Marketing Bhutanese Potato

Experiences, Challenges and Opportunities

W. Roder, K. Nidup and S. Wangdi, 2007

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LIST OF ABBREVIATIONS

AMS	Agriculture Marketing Section
AMC	Agriculture Machinery Centre
BAFRA	Bhutan Agriculture and Food Regulatory Authority
BNPP	Bhutan National Potato Program
BPDP	Bhutan Potato Development Program
CFC	Common Fund for Commodities
CIP	International Potato Centre
CCA	Commodity Chain Analysis
CoRRB	Council of Renewable Natural Resources Research for Bhutan
CSO	Central Statistical Office
DAO	Dzongkhag Agriculture Officer
DoA	Department of Agriculture
DSC	Druk Seed Corporation
FAO	Food and Agriculture Organization of the United Nations
FYM	Farm yard manure
FCB	Food Corporation of Bhutan
FYP	Five Year Plan
Gewog	Administrative sub-unit of district
MOA	Ministry of Agriculture
NPHC	National Post Harvest Centre
NPPC	National Plant Protection Centre
Nu	Ngultrum
PPD	Policy and Planning Division
RDP	Rural Development Project Bumthang
RNR	Renewable Natural Resources
RNRRC	Renewable Natural Resources Research Centre

1. INTRODUCTION

Potato production in Bhutan is largely for the export market. Potatoes produced in the hills of Bhutan at elevations ranging from 1500–3000 m reach the Indian market when prices are at their peak. Thanks to this situation Bhutanese potato producers are getting a relatively good price and potato production is economically beneficial in spite of the high production cost. Access to Indian markets became, however, only possible with road construction initiated in the 1960s. As soon as road access was realized, potato became immediately the most important cash crop for the higher regions of Bhutan with very fast adoption rates (Roder, 2004a).

Many attempts have been made to get a better understanding of the potato market, especially the export market, and to get some influence and control over the market prices. In addition, the Bhutan Potato Development Program (BPDP), CIP (International Potato Centre) and the CFC (Common Fund for Commodities) project in collaboration with other partners have carried out a range of activities with the main objectives to get a better understanding of the mechanisms, problems and potential of Bhutanese potato in domestic and Indian markets. This document provides a review of available information and summary of the information generated through recent activities.

Figure 1. Planting potato, Bumthang

2. METHODS, SOURCE OF INFORMATION

2.1. Review of documents

Information in reports and other documents relating to the marketing of Bhutanese potato, were reviewed. The most important sources for information generated prior to the 1980s were Roder (1982) and Scott (1983). Valuable sources covering the subsequent period were, recent reviews related to seed and seed potato (Chettri et al 2006; Roder, 2006) and unpublished documents and data files available with the Food Corporation of Bhutan (FCB).

2.2. Domestic market

Consumer survey Thimphu and Phuntsholing

Information was collected with formal questionnaires (Table 1). Respondents were randomly selected from consumers while returning from the weekly vegetable markets. The number of respondents was 50 for Thimphu (20 in October 2004 and 30 in March 2005) and 30 for Phuntsholing (21 in October 2004 and 9 in March 2005). Information recorded included quantities and prices of vegetables purchased on the day of the survey, ranking of vegetables (importance and preference) and vegetable cultivation.

Commodity chain analysis 2006

A commodity chain analysis was conducted in 2006 based on the Commodity Chain Analysis (CCA) methodology developed by the Food and Agriculture Organization (FAO). The investigations used functional, flow, technical and financial analysis. In this document only the information relating to production cost, consumption and marketing was used. For additional information consult Nidup et al (2007).

Table 1: Source of information

Source	Method of collecting	Period	Type of information
General			
References, reports	Review	1960-today	Experiences and observations Trade statistics, trends
Domestic market			
Consumer survey	Formal questionnaire	2004-5	Consumption, preferences
Commodity chain analysis	Questionnaires for producers, traders consumers	2006	Production cost, consumption, trade information
Export market			
Auction yard figures 2004 and 2005	Information available from dispatch challans (FCB)	2004-5	Main destination Main traders
Consultancy seed flow	Consultant visiting areas in West Bengal and Assam	2004	Contacts for further interactions Potential of Bhutan seed
Trader survey	Information collected from 18 traders buying Bhutan potato	2005	Experience with Bhutan potato
Visits to production areas in West Bengal and Assam	Interaction with farmers, researchers, potato business	2004-6	Field performance of Bhutan seed Assessment by producers
Trader workshop	Interaction with traders	2006	Feed back by traders on problems, constraints and opportunities

2.3. Export markets

Auction yard data

The auction yard in Phuntsholing maintains copies of dispatch notifications required by the buyers. Copies of these records were

used to document destinations and buyers over time. The information from these notifications has some limitations including: a) some destinations may only be transit points, b) about 3% of the notification copies were not readable, and c) sometimes the quantities given may not be accurate. In spite of these limitations the information generated does provide reliable indications on the major directions of the potato flow and the changes in the flow over the season.

Trader survey in West Bengal (2005)

The survey was carried out in 2005 with the objectives to: a) Device strategies to increase the demand for potato from Bhutan and to attract more buyers to the auction yards, b) Generate information which may be used to start separate auctioning of small size potato, c) Generate information for the planning of interventions which may lead to better target the needs of potato buyers with special requirements, especially seed and processing and d) Explore possibilities of conducting specific activities (advertising, inviting traders to Bhutan, ….) aimed at raising awareness on the potential of special quality potato (seed and processing) available from Bhutan with selected traders.

Traders visited in North West Bengal were selected from a list of major recipients of potato dispatched from the Phuntsholing auction yard during the 2004 marketing season (based on the dispatch notification). Attempts were made to visit all traders who had purchased more than 60 t in 2004. In addition some traders were selected out of those who have purchased more than 30 t. Information was collected from 18 traders from New Jalpaiguri and Cooch Behar districts through informal discussions complemented with a formal questionnaire. The information collected included: experience with potato business, importance of potato, potato seed, interest in buying small size potato from auction yard, special requirements for processing qualities etc.

Consultancy seed , visits

Initial information on the existing situation and potential for seed from Bhutan in West Bengal and Assam were generated through a consultancy by Dr. S K Bardhan Roy. Additional information was collected through visits to potato producers, seed merchants and traders (BPDP, 2006a BPDP, 2006b; Roder 2004b).

Trader workshop

A trader workshop was organised in Phuntsholing in November 2006. Participants (33) discussed mechanisms, advantages, disadvantages and potentials of the present marketing system (BPDP, 2006c).

2.4. Field studies

A range of field studies evaluating the performance of seed from Bhutan were carried out in selected target locations, mostly in Hooghly, Burdwan and Cooch Behar districts of West Bengal,

Figure 2. Evaluating varieties, Cooch Behar, 2006

with the objectives to evaluate variety, dormancy, and seed management effects and to demonstrate the potential of Bhutanese seed (Table 2, BPDP, 2005, 2006b).

Table 2. List of fields studies carried out 2004-2007

Type of activity	**Details**	**Location**	**Period**
Seed source effects	Seed from released varieties produced at 2700-3000 m Not replicated	Hooghly	2004/5
Variety effects	Demonstration plots by 3-20 farmers in each location	Hooghly, Burdwan, Jalpaiguri, Cocoh Bihar, Assam	2005/6
Seed source effects	Replicated study with 8 different sources, variety Desiree	Cooch Behar	2006/7
	Replicated study with source from North WB and Bhutan	Hooghly, Burdwan	2006/27
Effect of storing	Seed produced at high elevation were stored in Phuntsholing for 30 days, varieties *Kufri Jyoti*, *Khangma Kaap*, replicated	Hooghly Burdwan	2006/7
Effect of irrigation	Non-replicated, 4 irrigation treatments	Hooghly	2006/7

3. POTATO PRODUCTION AND USE

3.1. Early development

The expansion of potato cultivation followed the road construction with a lag period of only a few years (Roder 2004a). Chapchha and Khaling were the first major production areas initiating production in the early seventies. In Khaling, (Trashigang district; Figure 3) most house holds had adopted potato cultivation for export within less than 10 years after the village became accessible by road. In 1974, continuous potato cultivation was already perceived as a potential constraint to yield and quality. Similar developments were observed in the western part of the country, where Chapchha farmers quickly capitalized on the new opportunities offered by road access.

Figure 3. Potato fields Khaling (1800m), Trashigang district

3.2. Importance as a cash crop

The most important crops in Bhutan based on cultivation area, number of producers and food security are maize and rice. Both are mostly produced for home consumption. Important cash crops that emerged over the last 4 decades are potato, mandarin, cardamom and apple. Out of these potato and mandarin are by far the most important (Table 3). Cardamom and apple require very specific conditions and can thus only be produced by a limited number of house holds. Potato on the other hand is very adaptable and can be produced from the lowest elevations of about 300 m up to 4500m. Based on the number of house holds benefiting, it is again potato which is the most important cash crop. The importance of potato for income generation is also reflected in the strong association between the value of potato produced and the value of agriculture products sold (Table 3). For many regions, especially those above 2500 m, potato is likely to remain the single most important cash crop available.

Figure 4. Farmer with potato ready for auctioning

Table 3: The most important cash crops of Bhutanese farmers

Category	Potato	Citrus	Rice	Maize	Apple	Cardamom
Percent of house hold[1]	20	19	54	69	8	<5
Total production (1000 t[2]	63	45	69	77	6	<1
Value of commodity[2]						
Total production ($ million)	8.5	8.0	34.3	17.5	3.3	1.5
Sold ($ million) estimates author[3]	6.0	6.0	4	1.4	3.1	1.4
Exported ($ million)[4]	4.2	5.2	<0.5	<0.1	2.3	1.4
Correlation of commodity value (average per capita at gewog level)[2, 5]						
With total agriculture production	0,45***[6]	0.30***	0.29***	0.48***	0.16*	0.25**
With agriculture products sold	0.67***	0.25**	-	-	0.46***	0.28***
Potential contribution towards goals of Government						
Rural income generation	high	medium	medium	low	low	Low
Poverty alleviation	high	low	low	low	low	Low

[1]Adapted from RNR census 2000 PPD, 2000; [2]DoA 2004; [3]Estimates by authors; [4]FCB and BAFRA; [5]Average of all districts except Samdrupjongkhar, Sarpang, and Samtse ;
[6]Level of significance * <0.1, ** < 0.05, *** <0.01

Potato had a major impetus in the transformation of subsistence production systems to market oriented systems. Simultaneously, with access to imported rice, food production for self

consumption became less imperative. The dramatic changes brought by potato are illustrated based on data from Bumthang district (Table 4). The road to Bumthang opened in 1973 and the first potato were exported from this district in 1975. In 1987, only 15 years after the road was opened, 50% of all house holds in Bumthang district cultivated potato for the market (Table 4). The effect is similar in other parts of Bhutan were potato is produced as a cash crop. Considering its contribution to the individual house hold income, the adoption of this cash crop had no doubt the most important impact on the socio-economic conditions of rural house holds in the higher regions of the country.

Table 4. Changes in agriculture production system and marketing of products in Bumthang district over the last 3 decades.

Parameter	**Year**		
	1970	**1988**	**2000**
Dependence on buckwheat from grass fallow (%)	80[1]	40[1]	30[2]
House holds planting potato for sale (%)	0	46[1]	52[2]
Contribution of potato to farm products sold (%)	<5[1]	79[1]	54
Mineral fertilizer used (kg/house hold)[3]	0	253[4]	276[5]
Contribution of livestock products to farm products sold (%)	>50	15.7	46
Quantity of potato produced (t/house hold)	<0.1	2.87	3.38
Cash income from potato (US $/house hold)	0	140[4]	286[5]
Potato consumed per capita	<2	20	50

[1]Estimate by author based on information from Guenat 1991; [2]Estimate by author based on socio-economic survey Bumthang 2000 (Chophyll et al 2000); [3]Based on N and P inputs calculated as Urea and Single Super Phosphate; [4]Source Guenat 1991; [5]Source socio-economic survey Bumthang 2000 (Chophyll et al 2000)

The changes in Bumthang also show a gradual shift towards livestock, especially milk and other dairy products, with relative

importance of livestock products reaching levels similar to those prior to potato becoming a cash crop (Table 4) This trend is likely to continue. Potato and livestock production complement each other well, as potato should not be cultivated continuously on the same field.

3.3. Current practices

Production systems and production costs

Potato is almost exclusively produced under rainfed conditions by small holder farmers with landholding <4 ha. The respondents to the CCA had an average of 0.48 ha potato and yield of 14.3 t/ha.

Figure 5. Planting potato in mounds, widely used where potato as a cash crop started before 1975

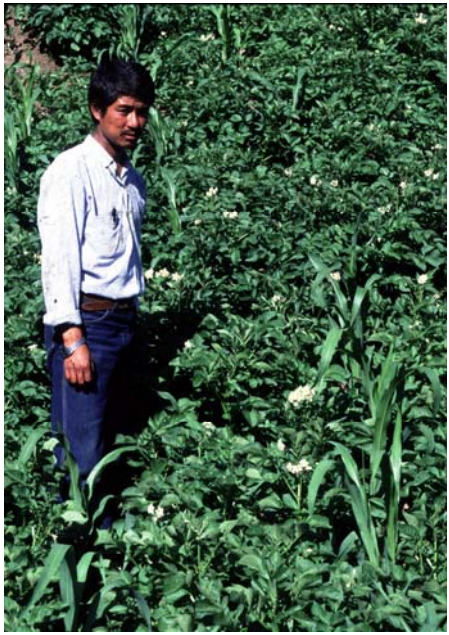

Figure 6. Potato intercropped with maize

The main potato production areas are concentrated in the altitude belt ranging from 1500 m to 3500m. The two most important production systems are:

- Potato in rotation with wheat, barley, buckwheat, vegetables or white clover-grass in the regions traditionally growing wheat, barley and buckwheat in the altitude range 2400-3500m. The upper altitude limit for growing potato is 4500m but cultivation above 3500m is mostly for home consumption.
- Potato-maize intercropping (Figure 6, Roder et al. 1992) in regions traditionally growing maize in the altitude range 1500-2500m.

Due to small landholdings and lack of other suitable crops many farmers do not follow a systematic crop rotation. Potato-maize is popularly practiced in the East, whereas potato-pea is common in the West. All production systems are highly labour intensive as most of the work except field preparation is done manually, resulting in high production costs (Table 5).

Table 5. Production cost

Component	**Production cost**	
	Total ($/ha)	**%**
Seed	483	36
FYM	190	12
Fertilizers	37	2
Labour[1]	711	48
Farm traction	44	2
Total	***1465***	***100***

[1]Land preparation 9%, FYM application 7%, planting 16%, earthing and weeding 11%, crop guarding 30%, harvesting 24%, fencing 3%;
Source: CCA 137 respondents

Small plots and sloping land limit the opportunities for mechanized production. The high labour requirement is further amplified by the requirements for guarding fields against wild animals. Depending on the terrain, farm size and the accessibility to resources, potato growers use tractors, power tillers and bullocks for land preparation (Table 6).

Table 6: Methods of land preparation

Method	%	Regions where practice is predominant
Tractor	10	Wangdue and Bumthang
Power tiller	22	Wangdue, Bumthang and Paro districts
Bullocks	64	Central and Eastern regions
Manual	4	Small farmers in all regions (especially East)

Source: CCA 2006, total respondents 149

Over the last few decades a substantial number of potato varieties were introduced to Bhutan. Currently the following four varieties are formally recommended by the Ministry of Agriculture: *Desiree, Kufri Jyoti, Yusi Kaap* and *Khangma Kaap.* Bhutanese farmers and consumers clearly prefer the red skin variety *Desiree,* which is accounting for about 90% of the potato produced. Some growers believe that white skinned varieties *(Kufri Jyoti* and *Yusi Kaap)* are less susceptible to wild boar damage when compared to the red potato.

Post-harvest

Generally, most cultivars are ready for harvest four to five months from planting. Crops at elevation below 1500m can usually be harvested before the onset of the monsoon. In the elevation range 1500-2500 maturity and harvest usually coincides with the onset of the monsoon rains making harvesting and

temporary storage difficult. Potato growers above 2500 m may harvest their crop during or after the monsoon. For potato growers at those elevations there is generally no time pressure for harvesting as fields may remain fallow after potato harvest.

Most ware potato are sold by the producers within 1-2 months after harvest. The most common method is to store the harvest in temporary sheds in or near the potato field (Figure 7).

Figure 7. Temporary store in the field

Potatoes are then graded and packed directly in those temporary sheds form where they are loaded onto trucks. Producers without road access to the field may use tractor, power tiller or horses to carry the potato to a road point. Trucks are the most common mode of transportation used to bring the potato to the auction yards.

Farmers generally grade their product at the time of packing. Grading into size classes has increased very fast after FCB announced separate auctioning for small size (seed) tubers in 2005 and recommended farmers to bring the larger grades

earlier in the season and the small size only towards the end of October. This practice resulted in better prices and farmers immediately responded by grading accordingly. During the 2006 survey, 78% of the respondents reported that they grade their potato before taking to the auction yards. The grading is mostly done by size, farmers however, often bring mechanically damaged (bruise, cut) and green potato to the auction. The National Post Harvest Centre (NPHC) together with the National Machinery Centre (AMC) has worked on the introduction of mechanical grading. A grader constructed by the centre (Figure 8) was not adopted because of mechanical problems (Tshering et al 2006).

Figure 8. Grader constructed by AMC and NPHC

In 2004 a grader was procured from India with support by the CIP/CFC project (Figure 9). During 2005 and 2006 this grader was evaluated by NPHC in major potato growing areas. Farmers participating in those evaluations generally expressed that the grader would be useful (90% participants in Chhapcha), but that the price was too high (74% in Chapcha, Tshering et al. 2006).

There are other problems due to the specific conditions prevailing, especially:

1. Ideally the grader should be used when packing the potato in the temporary field stores. In many situations these stores have no road access and no electricity.
2. Loading the potato into the grader is very time consuming. Because of the way the potato are stored, even lifting with a simple hand tool is generally not possible due to the uneven surface. Because of this, using a mechanical grader does not bring much reduction in the labour requirement.
3. The quantities produced by individual house holds are relatively small. The efforts in bringing a mechanical grader to the site may thus not be justified by the time saved in grading.

Figure 9. Grader imported from India

The most common packaging material used is the 50 kg and 100 kg jute bags. Efforts to introduce standard size 50 kg bags had limited success as the producers to not see any benefits from using smaller bags. Transportation is still largely based on the

number of bags irrespective of size. Over filling of bags to save on transportation cost is thus a common practice (Figure 12).

Figure 10. Loading from tractor onto a truck

Figure 11. Loading truck

Figure 12. Overfilled bags

Based on the CCA survey there is a substantial discrepancy in transportation cost (Table 7). Road condition is a major factor affecting cost, other factors include total distance (prices are higher for short distances (Chapchha, Zobel, Khaling) and the availability of goods in the opposite direction.

Table 7: Transportation charges to the auction yards

From	Distance (km)	Rate (Nu/Bag/km)
Locations supplying to Phuntsholing		
Choekhor, Bumthang	426	0.14
Ura, Bumthang	480	0.15
Chapchha, Chhukha	115	0.21
Naja, Paro	201	0.17
Phobji, W/Phodrang	281	0.17
Sephu, W/Phodrang	210	0.21
Locations supplying to Samdrup Jongkhar		
Drametse, Monggar	231	0.19
Zobel, P/Gatshel	85	0.23
Thrimshing, Trashigang	120	0.50
Khaling, Trashigang	126	0.35

Source: CCA, 2006

Processing

Negligible quantities of homemade potato chips are available in the local markets. There are about 10 household level chip processing units in the country. Limited quantities of processed potatoes like French fries are also served by the hotels, restaurants and bars.

3.4. Quantity produced

Data on annual potato production since 1965 shows a dramatic increase in the early seventies with an annual increase of over 10 %, followed by a period where the production was almost stagnant (Figure 13). The slump in production in the eighties resulted from declining profits due to the combined effects of stagnant yields, raising labour costs, problems with wild boars and fluctuations in market prices. The production picked up again towards the end of the nineties. In 2006 an estimated 10,725 house holds produced approximately 60'000 t of potato on an area of 3,831 ha (Nidup et al 2007). In some gewogs the area under potato has probably reached or even exceeded the maximum, with over 80% of the arable dry land planted annually with potato (Phoji, Gangtey, Khaling). In other regions, specially those which are newly becoming accessible through roads, substantial area expansion is possible. The expected expansion in area and increase in yields will lead to substantial increase in production in the next few years.

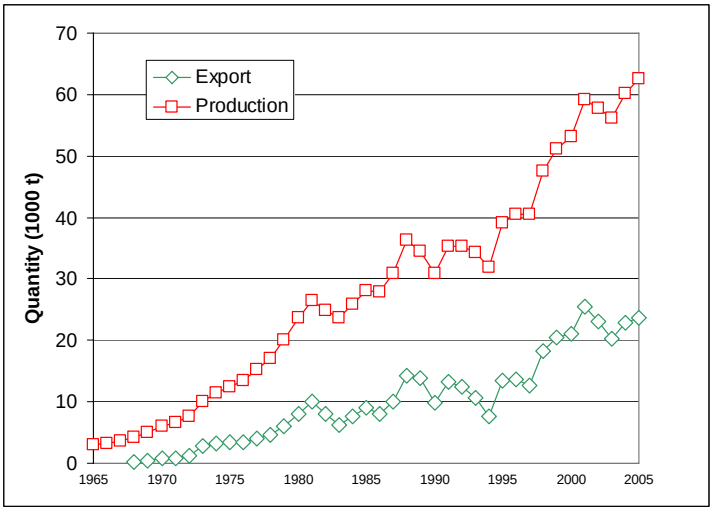

Figure 13: Potato production and export over the last 40 years (constructed based on quantities sold in auction yard, seed requirements and in-country consumption)

The respondents to the CCA sold an average of 72 % of their potato production (Table 8). If potato producers growing potato mostly for local markets and for home consumption are included the proportion sold will be in the range of 50-65%. A large proportion of the produce is required for seed.

Table 8: Flow analysis

Used for	% of production
Home consumption	5
Gift/Feed	2
Seed	15
Quantity sold[1]	72

[1]Break up: Local market 7%, urban market 16%, and auction yard 77%
Source: CCA 2006, 149 house holds

Figure 14. Trucks waiting for unloading in the FCB auction yard Phuntsholing, 2006.

4. MARKETING MECHANISMS

Up to the seventies marketing mechanisms were poor or non-existent. Agricultural goods were occasionally exchanged or used to pay taxes in kind. The introduction of potato as a cash crop in the seventies was strongly influenced by the purchase of potato through the Food Corporation of Bhutan (FCB) and through schools feeding comparatively large number of boarding students. In the seventies the urban population was very small <10% and markets for fresh products undeveloped. Families living in urban centres would partly depend on their own production or receive potato from relatives. With gradual change from subsistance farming to market oriented systems and the fast growth of the urban population, the in-country market for products such as potato has expanded very fast.

4.1. Weekend markets and regular vegetable retailers

A regular weekend vegetable market was introduced in Thimphu towards the end of 1960. Gradually, vegetable markets were established in all the district capitals and other emerging urban centre. Both, local produce and produce from India are sold at the larger weekend markets (Figure 15 and 16).

Figure 15. Thimphu weekend market

Figure 16. Phuntsholing vegetable market

In general, potato sold at these weekend and retail markets during the months of January - May are mainly imported from India, while those offered during the other months are locally produced. Based on CCA these outlets account for about 16% of the total volume sold. The sellers at these weekend markets are either traders, who buy from farmers, or farmers who are selling their own produce. Potato is always sold along with other vegetables and is the vegetable purchased in the largest quantities.

4.2. Auction yard system

The FCB supported potato marketing from 1973 onwards when it established a support price and started buying potato directly from the farmers (Figure 17).

Figure 17. FCB buying potato in Ura, 1976 (Source: National Geographic Journal).

The introduction of the auction yard system in 1980 provided a mechanism to optimise the interaction between potato growers and buyers.

Initially several make shift auction yards were operated but later reduced to ten strategic locations along the border with India at: Phuntsholing, Samdrup Jongkhar, Gelephu, Bhangtar, Sarpang, Mathanguri, Samtse and Sibsoo, Diafam, Nganglam. Out of the above only two are functional today, Phuntsholing in the West (bordering the Indian State of West Bengal) and Samdrup Jongkhar in the

East (bordering the Indian State of Assam). For potato marketing Phuntsholing is the more important outlet, receiving 70-80 % of the total quantity auctioned. Any producer can bring potato, vegetable, apple and mandarin to the auction yard and any trader who registers with the auction yard is allowed to participate in the auction bidding. Potato are auctioned from June to December every year.

Present auction yard functioning, regulations

Selected details of the auctioning process for potato include:

- FCB owns the auction facility and facilitates the auction system through management and provision of facilities like storage and truck parking (Figure 18).
- After arrival each grower is given a Lot Card, as an acknowledgment for the receipt of goods based on which auctioning is done. The goods are stacked in the auction yard.

Figure 18. Auction yard facilities Phuntsholing

- FCB acts as guarantor to the sellers for sales payment.
- At the time of auctioning randomly selected bags are slit open to allow buyers to assess quality (Figure 19).
- The lot is given to the highest bidder. Weighing of each bag is done after the bidding process. Producers who are not satisfied with the bid can retain their merchandise.

Figure 19. Checking quality (Phuntsholing auction yard)

Figure 20. Auctioning in progress (Phuntsholing auction yard)

- After billing is completed, goods are delivered to the bidders. FCB collects payments from the buyers against the bills. A 24 hours grace period is given to the potato buyers for clearance of the bill amount. Longer periods are allowed for selected bidders cleared for credit.
- FCB charges a service charge of 6% (3% each to growers and buyers). In addition Nu 2 (Ngultrum, 1 Nu is about 0.022 USD) is charged per bag to cover handling cost.

The system provides a mechanism to optimize the interaction between potato growers and buyers. Although the process does add to the cost (6% commission, about 1% for loading and unloading, 1-5% damage through loading and unloading and 1-8 days waiting by seller for payments), it is clearly appreciated by both (Table 9). Farmers also find the auction yards at the bordering towns of Phuntsholing and Samdrup Jongkhar convenient as they can buy their annual household essentials and their school going children requirements at cheaper price from the neighbouring Indian market.

Figure 21. Auction yard activities (Phuntsholing 2006)

Table 9. Why is auction yard appreciated?[1]

	What is appreciated
Potato producers selling products	• assured payment • weighing system • transparency • access to a pool of traders
Buyers	• handling facilities (packing, weighing) • opportunity to check quality • loan facilities given to registered traders

[1]Source: BPDP 2004

Traders participating in the auction yard

The traders participating in the auction yards are mostly Indian merchants who buy in bulk and sell the same in the major towns of northern West Bengal and as far south as Kolkatta. In recent year's potato were also purchased for further export to Nepal or for specific requirements of the processing industry.

The number of traders participating was considered a serious problem in the eighties. Observations made in 1986 read (BNPP, 1986, p. 20) "Our observations and interviews led us to the conclusion that at the auction more or less competition is between 6-7 Indian buyers. The number of bidders coming in for auction has never increased, mainly due to false information, like paying high taxation at the auction yard or that no new registration was being entertained for auction, were circulated by the old registered dealers". Over the last 3 years FCB and BPDP have made continuous efforts to increase the number of merchants participating in the auction yard to increase competition and optimise price. These activities included:

- visits to traders, processing plants, seed merchants and others
- workshop with traders
- trial planting of Bhutanese material used as seed
- introducing separate auctioning for small size tubers, combined with radio announcements to producers to bring large size tubers early and small size only from October onwards

These activities resulted in a substantial increase of buyers (Figure 22). The increased number of buyers, especially those interested in the use of potato as planting material may have contributed to the excellent prices realised in October and November in the last 2 years (2005-2006).
Potato traders not participating in the auction generally had some knowledge of the auction yard system and had visited Phuntsholing (Table 10). Many traders however, had the

impression that participation is limited to selected traders only (94% of respondents), that special documents were required (100%), and that traders need to be registered in Jaigaon (28%). This misconception may have prevented some from participating in the auction.

Table 10: What does the trader know about the auction yard?

Question	Respondents (%)
Have you visited Phuntsholing	100
Have you visited other parts of Bhutan	17
Participation is limited to selected traders	94
Credit facilities are available	83
Traders need to be registered in Jaigaon	28
Special documents are required	100
Storage facilities are available	94

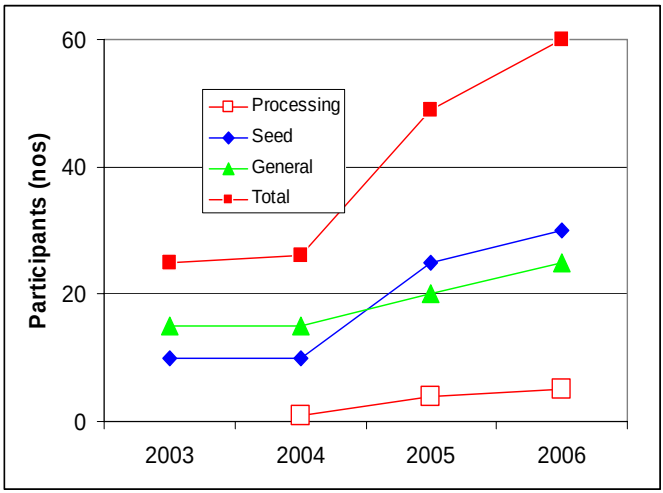

Figure 22. Traders participating in potato auction in Phuntsholing auction yard during 2003-2006 (Source: estimate authors)

Of the traders included in the 2005 survey 41% did not attend the auction. The lack of capital/credit system was mentioned as the most important reason for not attending (Table 11). In spite of this, most traders would be interested in visiting the auction yard and would prefer to purchase directly from the auction yard (Table 12). Graded potato packed in 50 kg jute bags was unanimously the preferred product traders would like to buy.

Table 11: Reasons for not attending auctions

Reasons	**Respondents (%)**
Proportion not attending	41
Reason for not attending auction	
Credit system/no capital	29
No manpower	12
Not aware of options	12
Less risk	6

Table 12. Response to questions on auction yard and trading partners

Question	**Respondents (% yes)**
Would you be interested to visit auction yard	94
Would you prefer to buy directly from auction yard	94
Prefer to buy from Indian trader	39
Prefer to buy from Bhutanese trader	33
Prefer jute bag	100
Prefer 50 kg bag	100
Prefer graded	100

5. DOMESTIC CONSUMPTION/MARKET

Up to the 1970s potato consumption in Bhutan was low. In the early seventies, when farmers started growing potato for export, they were generally reluctant to consume the tuber. Eating potato as a staple was socially and culturally unacceptable and many Bhutanese believed that potatoes caused problems of the lower abdomen, vomiting, constipation and diarrhoea Over the last 4 years the status of potato as a food or vegetable has changed tremendously. Today, unlike in the seventies, potato is widely eaten as a vegetable and sometimes even as a staple food.

Figure 23. School children eating potato dishes for lunch

5.1. Cultivation and purchase of potato

Today, potato has become the most frequently cultivated vegetable by rural and urban house holds (Figures 24 & 25, Table 13) and the item purchase in highest quantities in the vegetable markets (Table 13). Other important vegetables include chilli, radish, mustard green, turnip and pea.

Table 13. Vegetables cultivated/purchased by rural and urban households

Species	House holds cultivating	Total Production	Purchased in weekly market (kg/house hold)			
			Thimphu		Phuntsholing	
	(%)	(1000 t)	October	March	October	March
Potato	20	47	2.6	3.2	3.2	1.9
Chilli	15	4.5	2.3	1.0	1.5	1.2
Radish	17	5.6	0.9	0.4	0.5	0.2
Mustard green	8	2.3	0.9	1.8	1.4	0.4
Turnip	5	4.1	-[1]	-	-	-
Pea	(4)	0.6	1.2	0.6	0.5	-
Bean	6	1.9	0.7	<0.1	0.21	-
Garlic	5	<0.1	-	-	-	-
Onion	3	0.3	1.4	1.2	0.6	0.7
Cabbage	(2)	1.9	1.4	1.0	1.2	0.8
Olachoto	(7)		-	-	-	-
Cauliflower	(<1)	0.2	0.18	0.8	0.05	0.67
Broccoli	(<1)	<0.1	-	-	-	-
Carrot	(<1)	0.2	0.25	0.3	0.14	0.28
Tomato	(3)	0.2	1.5	1.2	1.0	1.2
Source[2]	***2 (2[a])***	***2***	***3***	***3***	***3***	***3***

[1]very minor <0.01 kg; [2]Source ***1*** = house hold survey 2005, ***2*** = DoA 2004, 2a values in () = estimates by authors ***3*** = Consumer survey 2005;

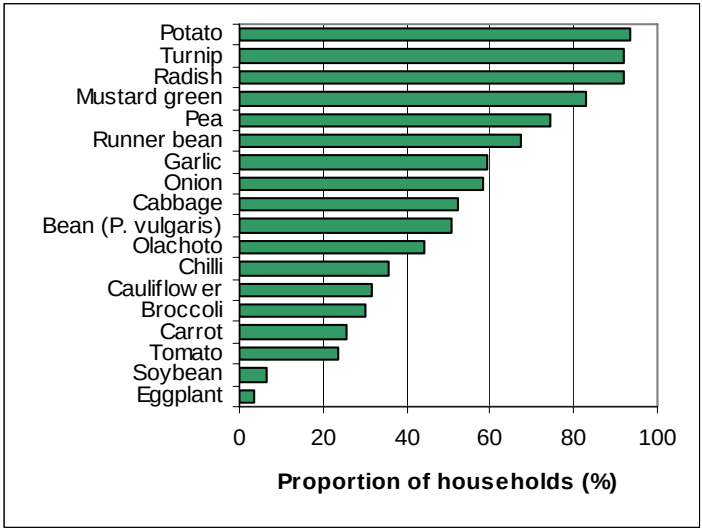

Figure 24. Frequency of vegetable species cultivated by rural house holds above 2300m (Source: house hold surveys)

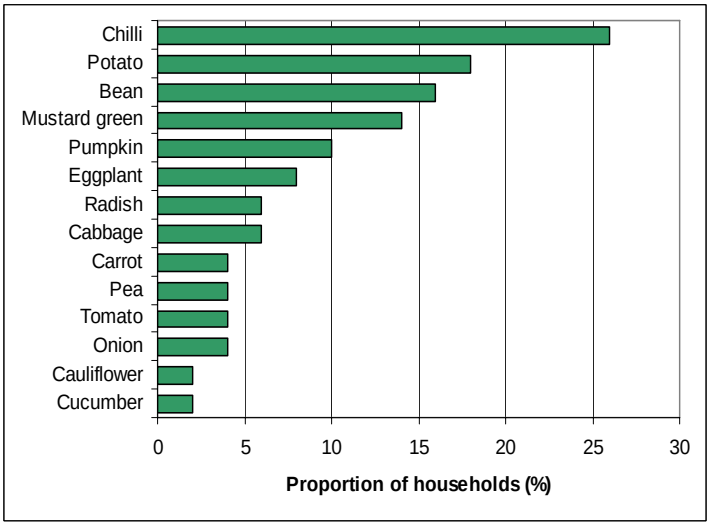

Figure 25. Frequency of vegetables cultivated by urban households in Thimphu (Source: average of respondents for March and October survey)

5.2. Level of consumption, preferences

No quantitative records are available on potato consumption prior to 1970 (Table 14). Roder (1982) reported an average consumption of <5 kg for the 1970s. Estimates from a survey carried out in 1983 (Scott 1983) clearly overestimated consumption, as the survey was limited to settlements with commercial potato producers along the national highway only. Although we may not get reliable estimates, what clearly emerges is a fast increasing level of potato consumption starting from the 1970s.

Table 14. Trend in country consumption

	1970[1]	**1985**[2]	**2005**[3]
Use in-country production urban population			
Population (1000 nos)	15	60	200
Consumption (Purchase & own production, kg/house hold)	10	30[4]	48[5]
Total purchased (1000 t)	150	1800	9600
Use in-country production rural population			
Population (1000 nos)	500	600	500
Consumed (kg/house hold)	5	20	35
Total consumed	2500	12000	17500
Total in-country	***3650***	***13800***	***27100***

[1]Based on Roder 1982, all from in-country production;
[2]Adapted from Scott (1983); [3]Based on BPDP consumer and producer surveys 2005 and 2006
[4] Out of 35 kg, 30% own production, 15% import
[5]Out of 60 kg, 5% own production, 20% import, adapted BPDP 2006

Over 50% of the respondents to the consumer survey (urban households) reported that they eat more potato today than 10 years ago. Preference for potato by children is reported as an important reason for increased potato consumption. It can

therefore be expected that the level of consumption may further increase. Potato is versatile and can be cooked in many different ways with meat and cheese and it is very compatible with chilli. Furthermore, potato can be easily stored.

Potato is especially important for the higher elevation where it is the only fresh vegetable available in the winter months beside radish and turnip. The impact of potato on the diet of rural households is, however not limited to direct potato consumption. With the opportunities of producing potato as a cash crop and the change from subsistence to market oriented production, households in the higher elevations replaced part of their traditional staple grains of buckwheat, millets, wheat and barley with imported rice, largely purchased with money received from selling potato.

Figure 26. Boiled potato offered as snack to visitor

The impact of potato on the diet of rural households is, however not limited to direct potato consumption. With the opportunities of producing potato as a cash crop and the change from subsistence to market oriented production, households in the higher elevations replaced part of their traditional staple grains of buckwheat, millets, wheat and barley with imported rice, largely purchased with money received from selling potato. The Bhutanese clearly prefer rice as a staple and the reduction in buckwheat consumption certainly had a negative effect on the diet of these communities.

5.3. Potato import

Some of the domestic consumption is covered through potato imported, especially for the months January to April when potato prices in India drop substantially below the prices in Bhutan . Quantities imported have increased fast over the last 3 years (Figure 27).

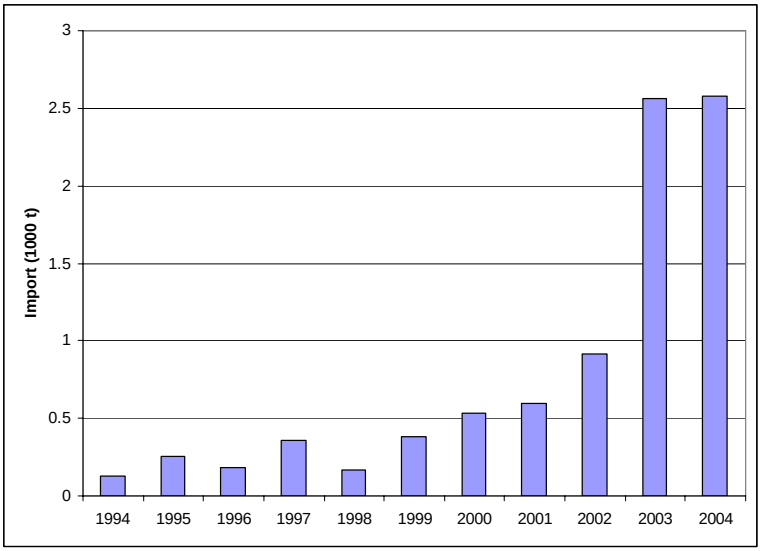

Figure 27. Quantities of potato imported (Source: Bhutan Trade Statistics, 2005)

The main reason for the fast increase in potato import is the fast growth of the urban population. The high number of Indian migrant workers employed in construction, road and hydro power projects also contributed to an increase in imports. Potatoes are also imported in the processed forms like potato chips and flakes but these quantities are comparatively small. The effect of the price fluctuation in the Indian market is also reflected in the trend of the average retail prices in Bhutan (Figure 28). The price drops in February and then starts rising gradually to reach a peak in October and November. This may partly reflect the relative high prices for Bhutanese potato compared to the Indian product.

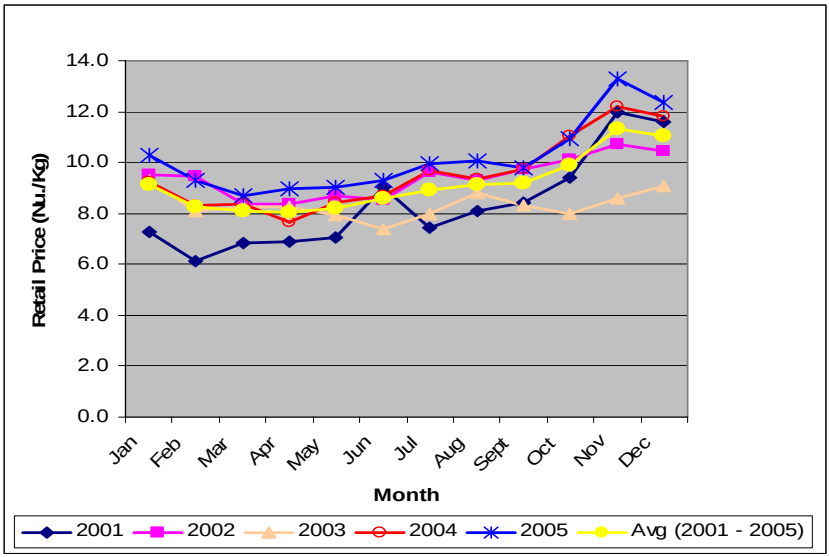

Figure 28: Monthly average retail price of potato, 2001-2005 (Source FCB)

6. EXPORT

6.1. From yak tails to potato

Traditional items exported to India in the past included yak tails, ponies, musk, wax, walnuts etc. (Table 15, Turner, 1800), mostly commodities with high value per unit weight or commodities which could walk to the market (ponies). When exploring opportunities for generating export earnings in the sixties and seventies, agriculture products were seen as the most likely commodities, as Bhutan was largely an agrarian society with no industries and no urban population. It was indeed agriculture commodities and timber which were among the most important commodities for almost 2 decades.

Table15. Bhutanese products exported to India through Rungpore in 1837

Product	Unit	Quantity	Value[2] (Rs)
Hill ponies	Nos	100	3500
Yak tails	maunds	4	160
Musk	Nos	50	100
Wax (bee)	maunds	30	1000
Walnuts	no.	50,000	125
Lac	maunds	10	100
Madder[3]	maunds	500	1500
Blankets	Nos	300	600

[1] approximately 40kg [2]Indian currency as valued in 1837; [3] a plant product used as dye
Source: Turner, 1800;

There are no published records, but it can be assumed that potato export to India started only after getting road access to the market in the 1960s. In the early years of potato trading, producers would take their products to the border towns of Phuntsholing, Gelephu and Samdup Jongkhar and sell to Indian merchants directly, or

merchants would come to the production areas and buy the potato. Sometimes the farmers would even sell the crop before harvest.

First Government sponsored interventions in potato export started in 1973 when FCB started buying potato from the farmers. Potato export increased very fast up to about 1981 (Figures 13 & 29) when potato generated 10% of the total export earnings and potato was the 4th most important export commodity after cement, timber and oranges.

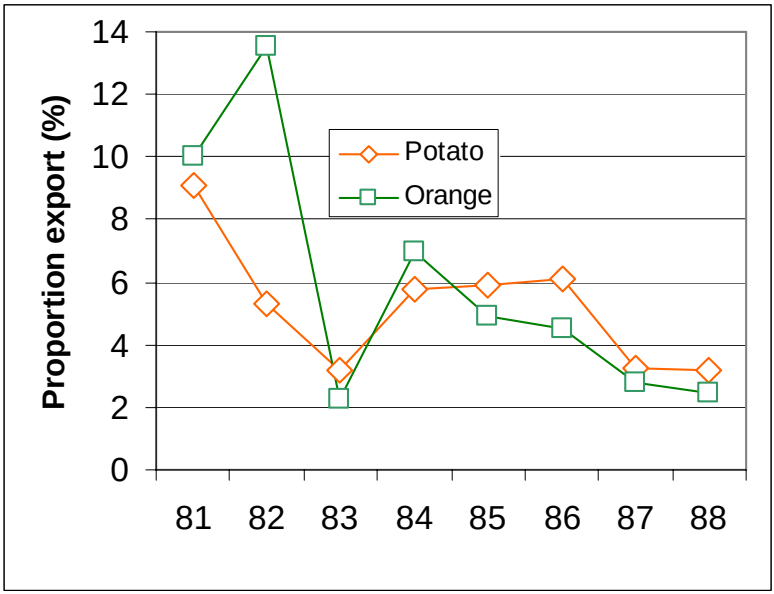

Figure 29. Contribution of potato and orange to the total value of exports (Source: CSO, 1990)

All through the 80s and 90s potato and orange competed for the position of the first ranking agriculture export commodity, with positions changing depending on production and market price of a particular year (Figure 29). With stagnant potato production and fast development of other export commodities, especially

electricity, dolomite, timber products potato gradually lost its prominence. In spite of this it was ranked 9th among the commodities exported to India in 1995 (CSO 1996). After a decade of stagnation, the production and export of potato started to increase again in 1994 (Figure 13). Similarly, the value of the potato sold has increased fast over the last 6 years (Figure 30) and crossed the 200 million Nu threshold for the first time in 2006 when the total value of potato auctioned was 227.49 million Nu in 2006. Due to increasing domestic consumption, the proportion exported however dropped below 40%

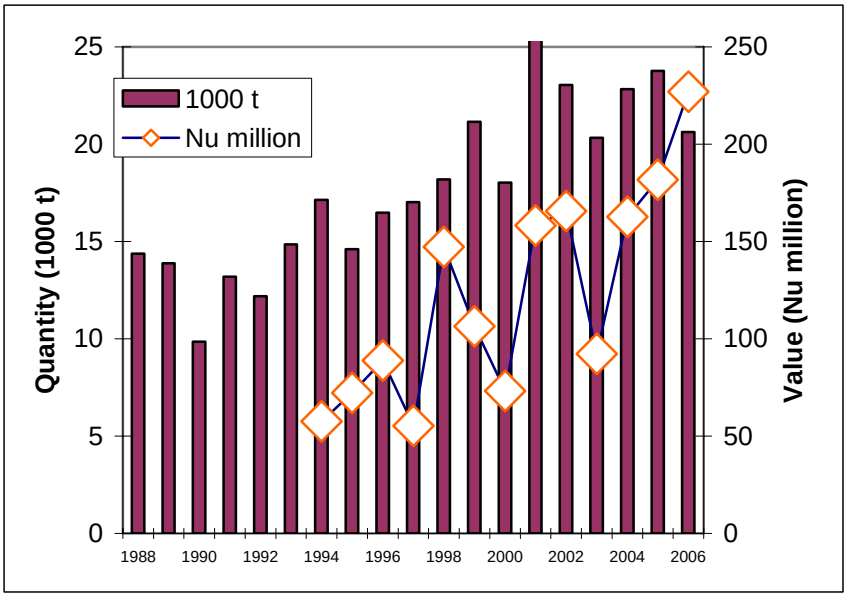

Figure 30. Quantities sold in the auction yards from 1988 to 2006
(Source: 1988-93 = CSO 1996, 1994-06 = FCB)

6.2. Flow and price dynamics

Most of the potato exported (99%) are sold through the auction yards. The potato quantity flow at the auction yards reaches its peak during the month of November (Figure 31). Bhutanese potato growers are very fortunate that their peak production also coincides with the peak prices in India. Potato cultivation in West Bengal and Assam is generally limited to the winter months with the first crops harvested in December and the bulk harvest in February. In addition to the need for fresh tuber by the consumer there is also considerable requirement for seed during October and November for planting in neighbouring Indian states of West Bengal and Assam (Roder 2006, Tshering and Domang, 2004).

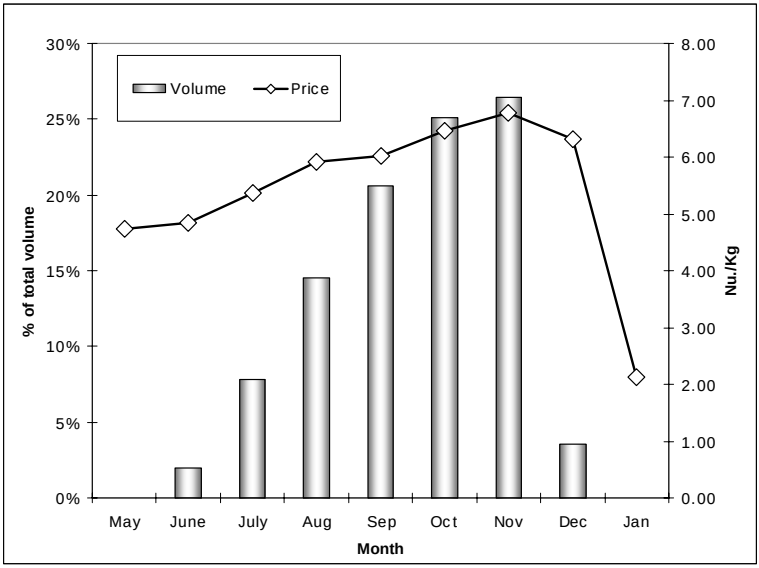

Figure 31: Monthly Average Auction Price -Volume Relationship for 2000 -2005 (Source FCB)

Potato prices in Bhutan are directly depended on prices in India. Over the last 3 decades there were 2-3 years when prices were barely sufficient to cover the transportation cost. With an

increasing proportion of the production sold in the domestic markets the fluctuations are becoming less painful. In years were prices are high as in 2006 the proportion exported is increased and the domestic requirement covered through early start of imports. If prices are low larger quantities are retained for sale in the country. In most years the highest prices have been realized in October or November (Figures 31 and 32).

The last few years especially in 2001, 2002, 2004, 2005 and 2006 prices have been very good (Figure 32).During the 2006 auctioning season the highest price was realized on 12th November for a lot of white tubers receiving Nu 21.15 per kg.

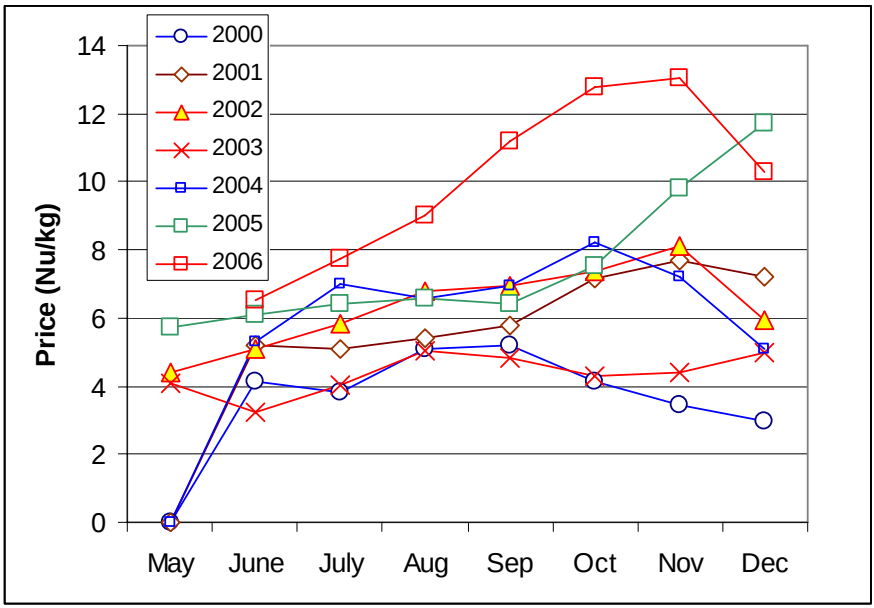

Figure 32. Average monthly auction prices in Phuntsholing for the years 2000-2006 (Source FCB)

Based on quantities sold in the auction yard the highest quantities of potato are produced in Wangduphodrong district (Phobjikha area) followed by Paro (mostly Naja), Bumthang and Chhukha

(Table 16). In 2006 these four districts accounted for 77% of the volume sold at the auction yard. Wangdiphodrang district (mostly Phobjikha area) accounted for 28 %.

Table 16: District wise quantities sold through the auctions yards (1998-2006, Source FCB)

District	Quantities sold (t/year)								
	1998	1999	2000	2001	2002	2003	2004	2005	2006
Bumthang	2189	2930	2516	3766	2660	1756	4002	3958	3495
Chhukha	2283	2712	2452	3051	2847	2794	3180	3567	3322
Dagana	0	0	0	0	0	0	0	1	0
Gasa	0	0	0	0	0	0	0	15	4
Haa	259	370	262	534	398	398	928	416	499
Lhuentse	0	0	0	0	0	0	0	0	3
Monggar	497	524	533	697	851	453	402	426	408
Paro	2960	4418	7236	6122	9875	4315	3415	4067	3376
Pema Gatshel	477	365	239	563	529	320	236	356	273
Punakha	216	0	0	0	0	0	4	13	12
Samdrup Jongkhar	59	17	6	59	24	7	8	7	3
Samtse	4	0	0	0	0	0	0	0	0
Sarpang	0	196	0	0	0	0	0	0	0
Thimphu	744	430	488	1109	647	571	534	406	511
Trashi Yangtse	612	579	432	547	517	269	361	309	282
Trashigang	3784	3929	2938	4332	3605	3021	2207	2518	2439
Trongsa	372	478	359	452	297	309	215	255	203
Tsirang	3	0	0	0	0	0	0	0	0
Wangdue Phodrang	3724	3509	567	4217	787	6123	7343	7451	5787
Zhemgang	9	3	0	4	0	0	0	0	3

The share sold in the east , (Samdrup Jongkhar auction yard) has declined over the past 8 years (Table 17, Figure 33). The same trend was observed in the quantities sold from Trashigang district. While the political problems in Assam would explain a decline in the volume traded at Samdrup Jongkhar, there is no explanation for the substantial decline in the production in Trashigang.

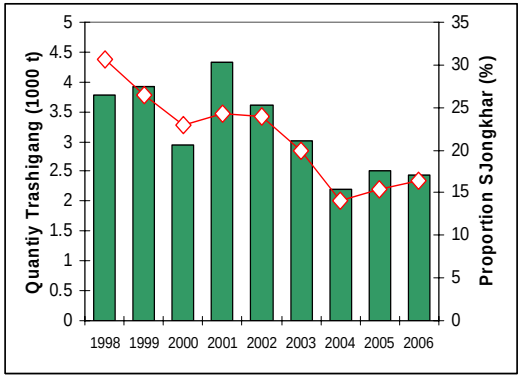

Figure 33. Quantities sold from Trashigang district (bar) and quantities sols in Samdup Jonkahr in % of total auction yard sale (line)

Table 17. Quantities sold at the individual auction yards

Year	Quantities (1000 t)			
	Phuntsholing	S/Jongkhar	Gelephu	Total
1996	11.78	4.61	0.10	16.48
1997	11.90	4.88	0.19	16.97
1998	12.52	5.58	0.10	18.19
1999	14.85	5.41	0.20	20.46
2000	13.74	4.15	0.14	18.03
2001	19.17	6.20	0.08	25.45
2002	17.52	5.52	-	23.04
2003	16.27	4.07	-	20.34
2004	19.63	3.21	-	22.83
2005	20.10	3.67	-	23.77
2006	17.23	3.39	-	20.62

Source: FCB

6.3. Destination and utilization of potato exported

Potato sold in the auction yards are mostly used in the regions along the Bhutanese borders (Tables 18-20, Figure 34) and the large centres such as Siliguri, Kolkatta and Guwahati. Based on the FCB dispatch records of 2004 and 2005 over 60% of the volume sold in Phuntsholing was send to destinations in the Jalpaiguri district (including Siliguri and Jaigaon, Table 18).

Table 18. Destination of potato sold in the auction yard in Phuntsoling[1]

Destination	Proportion (%)	
	2004	2005
Jalpaiguri district[1]	35	40
Siliguri	24	18
Nepal[2]	20	17
Kolkata	3	10
Jaigaon	5	4
Darjeeling district	4	4
Cooch Behar district	3	2
Assam	<0.1	<0.1

[1]Excluding Siliguri and Jaigaon; [2]Through Indian traders
Source: FCB dispatch documents (assuming 5% sold in-country)

The traders contacted during the 2005/6 survey (Table 20) have many years of experience in the potato business and they mostly trade in large quantities. The average quantity traded per company/trader was 1332 t/year (range 150-5500 t/year). Out of the total volume traded 38 % (range 5-67%) originated from Bhutan. About 18 % of the potato from Bhutan was reportedly sold for seed and 5 % for processing.

Table 19. Major destinations in Jalpaiguri district

Destination	Proportion (%) of total quantity send to district[1]	
	2004	2005
Dhupguri	16	21
Falakata	14	14
Birpara	7	10
Alipurduar	8	8
Banarhath	8	4
Jalpaiguri	5	7
Kalchini	7	4
Madarihat	5	4
Hasimara	4	3
Sisubari	4	3
Kamakhyaguri	4	2

[1]Excluding Siliguri and Jaigaon,
Source: FCB dispatch documents

The feed back from traders surveyed in Jalpaiguri and Cooch Behar supported the destinations established based on the dispatch documents. According to the traders feedback Bhutan potato were sold mostly locally (Table 21), but they also reported trading with more distant places, especially Assam and Nepal. The dispatch data from 2004 and 2005 both show a strong increase potato dispatch to Jalpaiguri (exluding Siliguri and Jaigon) during October and November (Figure 34). This peak is an indication that a high proportion of the potato sold during these two months is used as planting material.

Table 20. Details for individual traders visited

Place	Years trading potato	Other items traded	Potato quantity (t/year)	Proportion of potato (%)		
				Bhutan source	For processing	For seed
Jalpaiguri district						
Alipurdaur	15	Vegetable	2000	25		30
Banarhat	20	Fruit	275	36		20
Banarhat	30	Grocery	400	38		10
Banarhat	10	None	150	67		
Birpara	30	Transport	5500	45	35	35
Dhupguri	5	None	1050	5	20	20
Dhupguri	10	None	1200	33		40
Kalchini	7	Onion	250	60		25
Kalchini			175	57		10
Madarihat	25	None	950	53		5
Madarihat	21	None	2500	60		20
Siliguri[1]	20	Vegetables	?		15	
Sisubari	11	Onion	1000	50		10
Cooch Behar district						
Coochbehar	20	Onion	750	27	10	20
Coochbehar	7	Vegetable	175	43		
Falakata	34	Onion	2376	17	10	25
Falakata	20	Vegetable	3100	19		30
Falakata	10	Vegetable	800	41		30

[1]Regulated market
Source: Trader survey 2005 (BPDP/FCB)

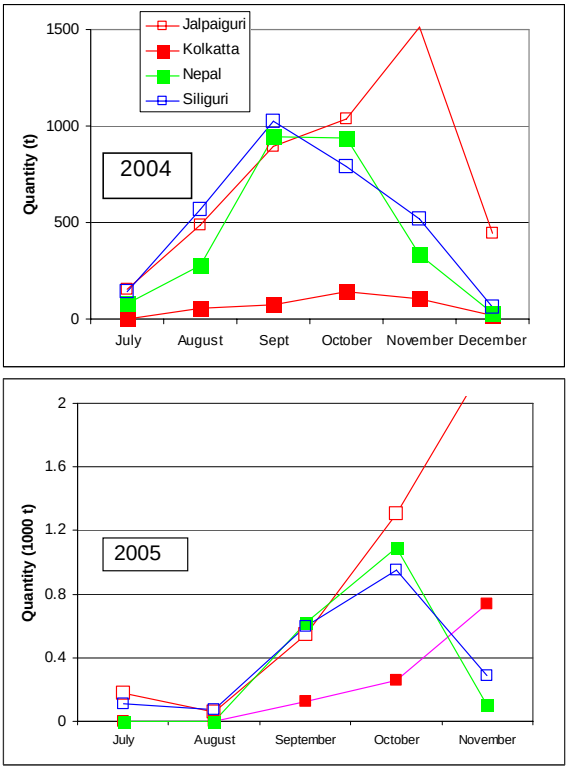

Figure 34: Destination of potato sold in Phuntsholing in 2004 and 2005 (based on FCB auction yard challans)

Table 21: Where are potatoes sold?

Where sold?	**Respondents (%)**
Locally	100
Assam	17
Nepal	17
Kolkatta	6
Kalimpong/Darjeeling	6
Sikkim	6

Source: Trader survey 2005 (BPDP/FCB)

The traders are well aware of the potential and the problems of Bhutanese potato used as planting material. Although most of them have never visited the production area they have a clear preference for lower altitudes as seed source and for higher elevation as ware potato (Table 22). Seed from lower lying production areas are preferred because of less problems with dormancy (for detailed discussion on this issue see chapters 6.5 & 6.6.).

Table 22. Preferred source

Preferred source	Altitude (m)	Respondents citing source	
		For seed	For ware
Chapcha[1]	2000-2600	19	4
Naja	2200-2600	13	5
Bumthang	2700-3300	6	11
Phobji	2900-3200	4	13

[1]Chapcha and Lobneykha combined
Source: Trader survey 2005 (BPDP/FCB)

Figure 35. Potato production in Lobneykha (Chapcha)

6.4. Effects of Indian potato market on price and flow

In order to understand the price dynamics of potato exported to India it is necessary to look at dynamics of potato production and marketing in India and especially in West Bengal.

Based on the total production, India is one of the five largest potato producers in the world (Tables 23 & 24), while Bhutan is one of the smallest. Bhutan has however a comparatively high production per capita and consequently a high proportion of the product exported. Bhutan may also have the highest per capita consumption in Asia but still substantially lower when compared to Europe (Table 23)

Table 23. Potato statistics for Bhutan, India and selected other countries

	Bhutan[1]	India	China	Bangladesh	Netherlands
Production ('000 t)	60	18'627	47'777	1'489	7'834
Production kg/person	100	16	36	11	476
Yield (t/ha)	12.7	17	14	11	43
Consumption (kg/person)	40	14	14	10	87

Source Bhutan adapted from CCA, others from Sruik and Wiersema 1999

Compared to Bhutan, potato production in India expanded earlier with gradual increases while the increase in Bhutan was less regular with two periods of fast growth from 1970-1980 and again after 1995 (Figure 36). In 1960 the area under potato in India was more than 20% of today's area while for Bhutan was

only about 7 % . In 1980 the area under potato for both Bhutan and India is about 50% of the area cultivated in 2005.

Table 24. The 8 most important potato producing countries in the world

Country	Area (000 ha)	Production (000 t)
China	3489	47777
Russian Federation	3389	38534
Poland	1390	24205
USA	556	21200
India	1116	18627
Germany	354	12530
Netherlands	183	7834
Iran	152	3182

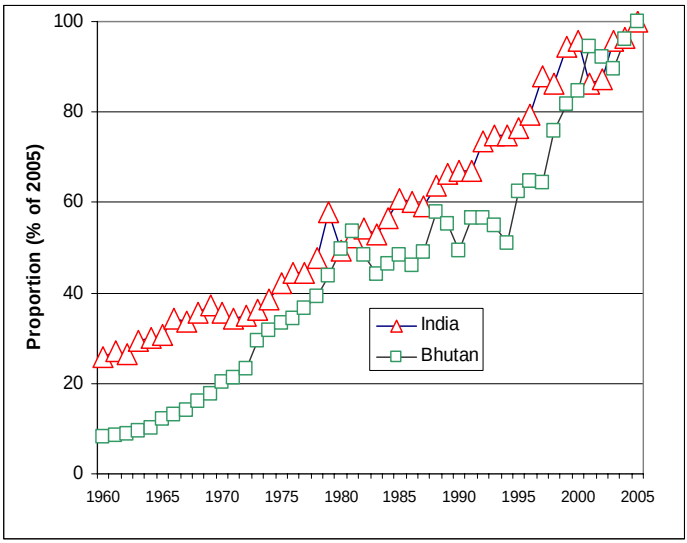

Figure 36. Area under potato in India and Bhutan in percent of the area planted in 2005 (Source

Two states Uttar Pradesh and West Bengal account for over 70% of all the potato produced in India (Table 25) . The most important potato producing areas in West Bengal are found in Hoolgly and Burdwan districts. A description of agriculture practices in Hooghly for the period 1850-1910 notes a high demand for potato and widespread cultivation in Hooghly and Burdwan districts (Kelly, 1981). In the period mentioned potato had already to a large extend replaced the traditional yam and colocasia species

Table 25. Potato production and cold storage capacity (CSC) in major states of India (1977 and 1997)

State	1977	1997	2002
	Production in 000 t		
Uttar Pradesh	2329	10702	9570
West Bengal	1657	8451	7822
Bihar	1341	1572	1432
Punjab	580	871	1414
Gujarat			802
Assam			621
Karnataka			489
Madhya Pradesh	196	644	472
Haryana	190	167	305
Meghalaya			144
Himachal Pradesh			143
Tripura			106
Arunachal Pradesh			33
Sikkim			26
India	7171	24897	24082

Source 1977 and 1997: Johl.and Dahiya, 2002
2002: Pandey and Kang, 2003

Today's dynamics of potato markets and prices in West Bengal and other parts of India are strongly influenced by the seasonality of the crop, the yields obtained, the availability of cold stores and the release of potato from the cold stores. The fast build up of the cold store capacity over the last 4 decades has had a tremendous impact on the potato availability, the potato quality and the potato production system (especially seed management). While the southern part of West Bengal already had large cold store facilities in the 1980s the Northern districts such as Jalpaiguri and Cooch Behar started building up their facilities more recently (Table 26).

Table 26. Trends in cold stores and potato production in West Bengal

Districts	**Nos of stores**	
	1980	**2004**
Calcutta	26	37
Howrah	9	6
Hooghly	67	126
Burdwan	55	85
Birdhum	11	15
Bankura	7	29
Midnapore	22	51
Murshidabad	0	10
24 Parganas		11
Jalpaiguri[1]	1	8
Cooch Behar[1]	0	5
Others	0	6
Darjeeling	0	1
Total West Bengal		

[1]Stores in 2006: Jalpaiguri =12, Cooch Behar = 11
Source 1980 = Chowdhury and Sen 1981; 2004 = www.agmarknet.nic.in; 2006 = personal communications potato traders

Based on the production cycle the lowest potato prices are generally seen in the month February to April and the highest prices in October November (Figure 37). The prices reported from India were generally lower compared to the auction yard prices from Phunsholing. The reported prices from India are for products stored in the cold store. Fresh harvested potato should receive substantial price premiums.

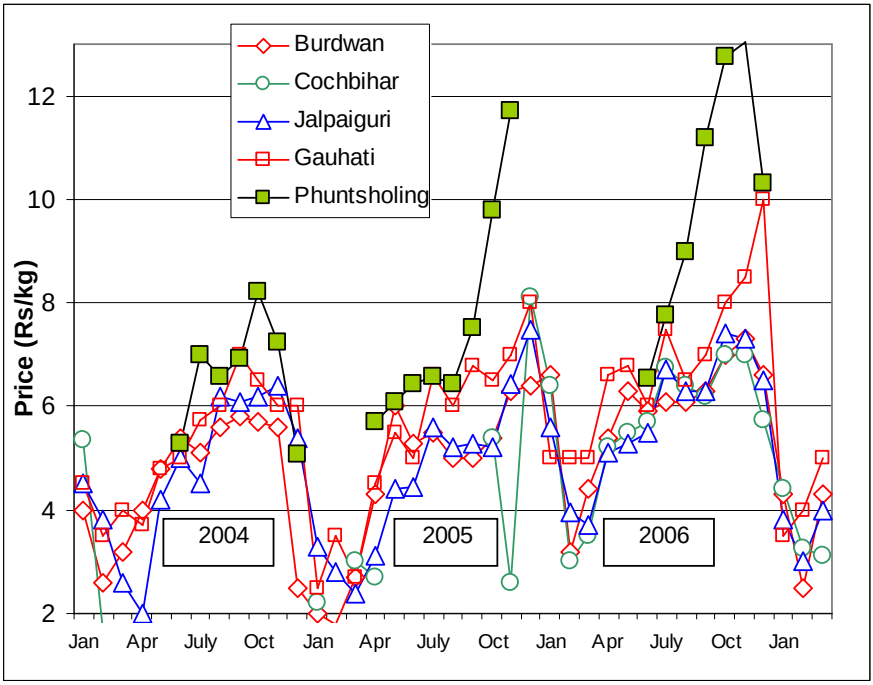

Figure 37. Average potato prices reported at the beginning of the each month for selected markets in West Bengal and Assam over the last 3 years (Source: www.agmarknet.nic.in)

Potato originating from Bhutan are usually sold side by side with Indian produce coming from cold stores. Many buyers prefer fresh potato over those stored in cold stores and are ready to pay higher prices. In addition there are specific demands for large size tubers to be used for French fries and for high dry matter/low

sugar content varieties to be used for chips as potato which had been stored at low temperatures (cold stores) are not suitable for processing.

By using the sprout suppressant CIPC (Chloro Isopropyl Carbamate) it is, however possible to store potato at higher temperatures (10-12^{o}C) for 3-4 months. CIPC was registered for use in India in 1998 and has become widely used to store potato earmarked for processing. This has reduced the demand for Bhutanese potato by the processing industry. Yet, even with this method there is a window in the period September-November when CIPC stored potato are no more suitable and fresh potato are required for chip making and other processing requirements.

6.5. Bhutanese potato used as planting material

Potato production areas in Bhutan at elevations above 2800 m have excellent environments for seed production with the following advantages:

- absence of vectors for virus transmission
- absence of important seed born disease, especially bacterial wilt
- excellent storage conditions.

Several projects and the DoA have made substantial efforts to capitalize on these favourable conditions to produce seed potato for export to India. The first documented export of seed potato took place in 1972 when 50 t were exported to West Bengal (Kuensel, 5. November, 1972). An other breakthrough was reported in 1981 when 50 t of seed were exported by the Department of Agriculture (Kuensel, 15. March, 1981, Figure 38). However, in spite of subsequent efforts, the seed export could not be further developed.

Yet, a large proportion of the potato sold in the two auction yards is used as planting material by potato growers in the northern districts of West Bengal (especially New Jalpaiguri and Cooch Behar) and parts of Assam. Potato growers from these areas have been using potato from Bhutan as a source of seed

since decades (BPDP, 2006b, Scott, 1983). In fact, potato seed from Bhutan has had a strong effect on the potato production practices in North Bengal. It was estimated that about 60-70 % of the area in the districts, Jalpaiguri and Cooch Behar are planted with material originating from Bhutan (Roy, 2004, presentation Technical Committee Meeting, Phunsholing). Potato growers in East Bhutan have since decades adapted their grading and marketing strategies to this opportunity (Scott, 1983). Already 25 years ago they sold large size tubers during the period July-September and small size tubers in October.

Bags of seed Potato variety Kufri Jyoti.

PIONEER STEPS IN
ARKETING OF SEED POTATO

practices to produce
varieties of potatoes
the farmers can get

Figure 38. Kuensel, 15. March, 1981

Figure 39. Preparing Desiree seed for planting in Dupguri (Jalpaiguri district)

The most common practice for Jalpaiguri and Cooch Behar potato farmers is to purchase seed from Bhutan (in the auction yard or through middle men) in October or early November and use that material to produce seed (2^{nd} generation) for planting in the following year. This is partly to reduce seed cost but also to overcome the dormancy problems. Seed harvested at higher

elevation is physiologically not ready for planting, especially for the earlier planting in October and early November. The dormancy problems result in lower number of eyes germinating and higher seed requirement. Some producers reported that the seed rate for Bhutanese planting material is 250-300kg/Bigha, compared to 160kg/Bigha for Punjab seed tubers. Before using Bhutan seed the potato producers in Cooch Behar and Falakata used to bring seed from Punjab and from potato growing areas in the southern parts of West Bengal, such as Burdwan (Table 27). Poor quality of seed from Burdwan, especially bacterial wilt problems and high cost of for seed from Punjab makes Bhutanese material attractive.

With the recent increase in potato cultivation in the northern parts of West Bengal it appears that the popularity of seed originating from Bhutan has increased too. Especially the practice of using 2nd generation Bhutanese seed. This may be partly linked to the availability of cold store facilities. Furthermore, potato growers in Cooch Behar and Jalpaiguri appreciate the Bhutanese potato varieties, especially Desiree (Figures 39 & 40). All the respondents interviewed in 2006 in Falakata and Cooch Behar were using seed from Bhutan. The reasons for using Bhutanese seed were mostly related to production, and pest tolerance/resistance (Table 28).

Table 27. Trends in seed used[1]

Seed source	**Respondents using particular seed (%)**	
	5 years ago	**Today**
Punjab	57	29
Burdwan	29	-
Manali	14	-
Bhutan	14	57
Bhutan 2nd generation	-	100

[1]Respondents from Cooch Behar and Falakata, 2006.

Table 28. Reasons for the preference of Bhutan seed

Reason	Proportion listing (%)
More production	71
Pest/disease resistance	43
Better storing	14

Figure 40. Seed ready for planting, Falakata (Jalpaiguri district, West Bengal)

Potato growers from the major potato growing areas in the southern part of West Bengal (Hooghly, Burdwan and Midnapore districts) are, however, not interested in the Bhutanese varieties, except for *Kufri Jyoti* (and may be *Khangma Kaap*). Compared to seed from Punjab (main source for Hooghly, Burdwan and Midnapore) Bhutan would have an advantage due to lower transportation cost and higher tolerance to disease. Seed dormancy related problems and variety will, however be a limitation.

6.6. Addressing challenges for planting material

Dormancy related problems are the single most important challenge to the use of potato from the hills as planting material in October, November and December. Other challenges include:

- Variety requirements: The varieties used in Bhutan are not released for use in India, with the exception of *Kufri Jyoti.* Although Desiree and *Yusi Kaap* are appreciated in Northern parts of West Bengal, they have no market in the southern parts and are also not the preferred varieties for Assam.
- Regulations: Seed movements within and between Indian states is subject to rules and formalities with specific documentation requirements. Formally exporting seed would thus be very difficult or impossible.
- Dependences trader-seed users: The established trade in seed are based on strong dependences (credit, marketing of produce, cold store facilities etc) between seed traders and seed users. This may limit the direct access of potato growers to planting material from Bhutan.

Starting from 2004 the BPDP supported by the CIP/CFC Bhutan, the regional office CIP SWCA, FCB and AMS has worked with seed traders, potato producers and researchers in West Bengal and Assam to address the major challenges and to find ways of increasing the demand for planting material from Bhutan (Table 2).

Studies addressing dormancy problems

In studies carried out during 1988 and 1989 seed from altitudes ranging from 1800 m to 3000 m were compared along with seed treatments to break dormancy (ARC 1990). Results were, however not conclusive and yields <10t/ha.

In the preliminary study (not replicated) carried out in Hooghly during 2004/5 the emergence of material from Bhutan was much slower compared to Punjab seed (Table 29). The seed

sources used for the Bhutanese material ranged from 2700-3000m.

Table 29. Emergence and yield of Bhutan seed in Hooghly (2004/2005)

Variety and seed source	Emergence (%)		Yield (t/ha)	
	Cut	Whole	Cut	Whole
Yusi Kaap (4 seed sources)	61	56	35.3	34.5
Desiree (3 seed sources)	88	63	30.3	29.0
Kufri Jyoti (source Bhutan)	92	63	37.5	42.5
Kufri Jyoti (source Punjab)	100	100	33.8	36.3

As expected the emergence was improved by cutting the tubers. Cutting strongly enhanced the speed of emergence. Some of the entries showed uniform emergence with good stem numbers for the cut treatment.

In the 2005/2006 demonstration plantings seed sources and variety effects were evaluated (Tables 30 and 31). The effect of seed source on emergence was observed for all varieties (Table 30) but was more pronounced for Desiree.

Table 30. Stem numbers observed during visit in January Cooch Behar (2005/06)

Varity	Stems (nos/plant)		T-test (P>F)[1]
	1st generation (new seed)	2nd or 3rd generation	
Desiree	1.27	2.06	0.03
Kufri Jyoti	1.42	1.50	0.01
Yusi Kaap	1.90	3.63	NS

[1]Based on 3 pairs for *Yusi Kaap* and two pairs for *Desiree* and *Kufri Jyoti*

Table 31: Average yields of demonstration plantings in Hooghly/Burdwan and Cooch Behar (2005/06)

Variety \,source	**Hooghly/Burdwan**			**Cooch Behar**		
	Sites	**Yield[1] (t/ha)**		**Sites**	**Yield[2] (t/ha)**	
		Average	**Range**		**Average**	**Range**
Bhutan source						
Kufri Jyoti	15	34.3	13.9-55	12	29.0	23.3-40
Yusi Kaap	11	34.1	25.0-43	9	30.7	21.7-40
Khangma Kaap	11	31.7	17.9- 49	13	32.7	20.0-40
Desiree	11	21.6	15.0-35	10	30.7	26.7-40
Other source						
K. Jyoti (Punjab)	3	34.2	26.3-39			
K. Jyoti 2nd generation	4	22.5	13.3-23			

[1]Statistical significant differences based on paired T-test were (PR>F <0.05): *K. Jyoti* (source Bhutan) vs *Desiree*, *Yusi Kaap* vs *Desiree* and *K Jyoti* 2nd generation, *Khangma Kaap* vs *Desiree*

Due to delayed maturity, crops from seed originating from Bhutan often appear to be more resistant to stress and late blight. In 2007 a heavy late blight epidemic in Hooghly and Burdwan however had devastating effects on the crops with delayed tuberisation and the performance of Bhutanese seed was consequently poor.

In an other experiment (Table 32) Desiree seed produced at elevations ranging from 2300-3100m was compared with 1st generation (one year multiplied in Cooch Behar) and 2nd generation (two year multiplied in Cooch Behar). There was not much effect by cutting the seed on stem numbers and no effect of cutting on yield. Seed source, however had a very strong effect on yield. Yield was best with 1st generation seed and lowest with 2nd generation seed. Yields from seed sources <3000 m, 2700 m and

2300 m were 52, 61 and 77% of the yield produced by the seed multiplied for one generation in Cooch Behar (Figure 41).

Table 32. Effect of altitude and seed source (Variety Desiree, Cooch Behar, 2006/07

Location	**Altitude**	**Stems (nos)[1]**	**Yield (t/ha)**
Seed source treatment			
Ura	3000	0.91	1.78
Shigneer	3100	0.92	1.63
Phobjikha	3000	0.98	1.59
Naja	2700	1.03	2.00
Shema	2700	1.11	1.94
Lower Chapcha	2300	1.04	2.48
1st generation		1.21	3.21
2nd generation		1.00	1.47
Cutting treatment			
Whole tubers		0.97	2.03
Cut tubers		1.08	1.99
Anova summary			
PR<F source		<0.01	<0.01
PR<F cutting		<0.01	NS
PR<F source*cutting		0.04	NS

[1]Number per planting unit

These experiences clearly showed that **physiological maturity is the single most important constraint** when using seed produced in the higher elevations. To address this problem it will be necessary to explore options for producing seed at elevation < 2000m. Other strategies that contribute towards reducing the dormancy problems include:

- Variety: Of the varieties used in Bhutan, the problem is most pronounced in *Desiree.* The least problems of

dormancy are with the variety *Khangma Kaap*. Dormancy is directly related to storability. *Khangma Kaap* has poor storage qualities.

- Cutting of seed: Cutting seed tubers is a common practice throughout West Bengal. The dormancy can be reduced substantially by cutting (Table 29).
- Storing at higher temperature: Bringing seed to lower elevations 40-60 days hastens the physiological maturity.
- Irrigation: low moisture after planting delays emergence with more pronounced effects for seed not physiologically ready for planting.

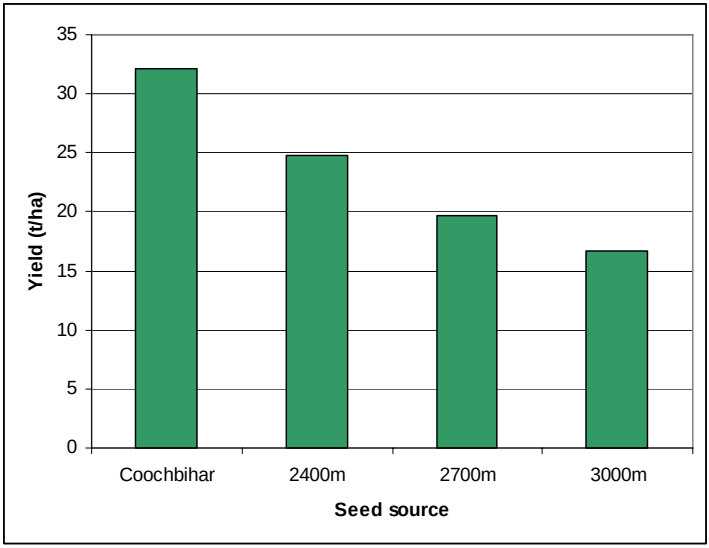

Figure 41. Effect of seed source on yield in Cooch Behar in 2007 (Variety *Desiree*)

7. FUTURE OPPORTUNITIES AND POTENTIALS

7.1. Domestic markets

The requirements for potato by the domestic markets will increase by about 7-10% annually. The factors contributing to this increase is population growth, fast growing urban population and overall increase of consumption levels.
The domestic market also requires small quantities of high quality speciality varieties for the tourist industry and for processing.

7.2. Export markets

Thanks to the different production cycle given by the climatic conditions potato from Bhutan will continue to enjoy an excellent market in India.
Potato for consumption: Given the large population with a fast growing middle class there will be strong demand for high quality fresh potato.

Potato used as planting material: The opportunities are mostly for selling informal seed in the northern parts of West Bengal and in Assam. If farmers multiply the seed for 1-2 generations (mostly because of dormancy problems) the seed requirement for 40-50000 ha will be less than 10'000 t/year. The quantities required would increase to <50'000 t if the dormancy problem could be solved and potato producers would change to replacing seed annually. Provided quality, variety and legal problems can be solved there would be additional opportunities in Southern parts of West Bengal, Assam and even Bangladesh.

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