

Chapter 6

Seed Potato Production and Returns

One of the basic pre-requisites of efficient and economic crop production is planting of genetically pure, physically good quality seeds in order to ensure uniform and vigorous plant growth ultimately contributing towards optimum production. A large number of improved varieties have been released of which the potential productivity is high but in the reality the average productivity is low. For instance the potato popularly grown in the high altitude has potential yield of over 25-30 mt ha⁻¹ but the average productivity stands around 11-15 mt ha⁻¹. It is because the crop is continuously grown by farmers. Thus, due to low adoption and low seed replacement rate, degeneration of genetic characters occurs in the farmers fields as a result potential productivity is never realized.

6.1 Production

The crop area and production generally depend on the availability of arable land and the resources to procure inputs by the individual farmers. In case of seed potato production, crop management and crop rotation is very essential to maintain the seed quality. In order to obtain quality produce the farmers has to follow proper planning of land utilization to avoid seed mixture

6.1.1 Area under potato cultivation

The land holding size among three categories of farmers in the study site ranges from 0.26 ha to 2.55 ha. The average land holding is 0.90 ha for contract farmers, 0.98 ha in case of ex-contract and 0.71 ha for non-contract farmers (Table 6.1).

Table 6.1: Land holding of three categories of farmers.

	Contract (25)	Ex-Contract (55)	Non Contract(60)
	-----ha-----		
Max	1.61	2.55	1.17
Min	0.40	0.40	0.26
Mean	0.90	0.98	0.71

Source: Survey, 2004.

Note: Number in bracket represent number of observations

Respondents reported that the average area under potato cultivation are 0.40 ha, 0.47 ha and 0.41 ha among the three categories of farmer Contract, Ex-Contract and Non- Contract respectively (Figure 6.1). While the area cultivated over the years remained consistent in case of ex-contract and non-contract; a steady increase in area cultivated by contract farmer was reported. This increase is motivating as seed volume produced through contract can increase subsequently.

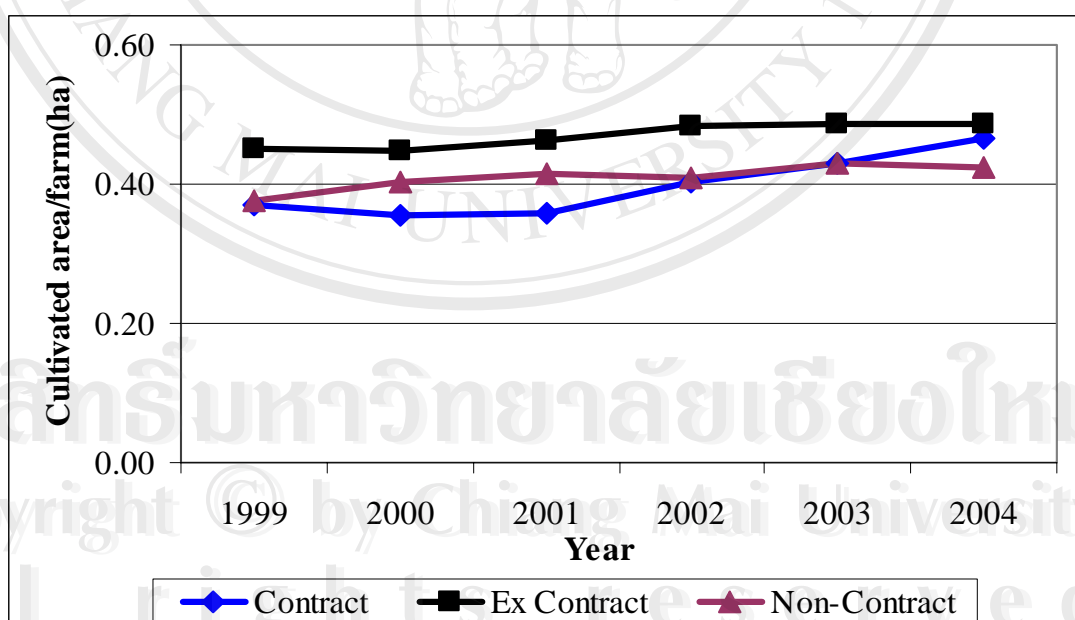


Figure 6.1: Trend in area cultivated with potato.

Source: Survey, 2004.

6.1.2 Seed rate

The use of optimum seed rate is essential to obtain the desired output. It is not only the use of quality seed and good agronomic practices but the seed rate greatly influences the yield of particular crop. In case of potato the recommended seed rate in Bhutan is 3 mt ha⁻¹. The average seed rate used by the contract, ex-contract and non-contract are 2.8 mt ha⁻¹, 2.9 mt ha⁻¹ and 2.6 mt ha⁻¹ respectively, and these seed rate are slightly below the recommended seed rate. (Figure 6.2). The seed rate used by all the categories have shown increasing trend over the years. For all categories there is scope to increase the seed rate and the production as well.

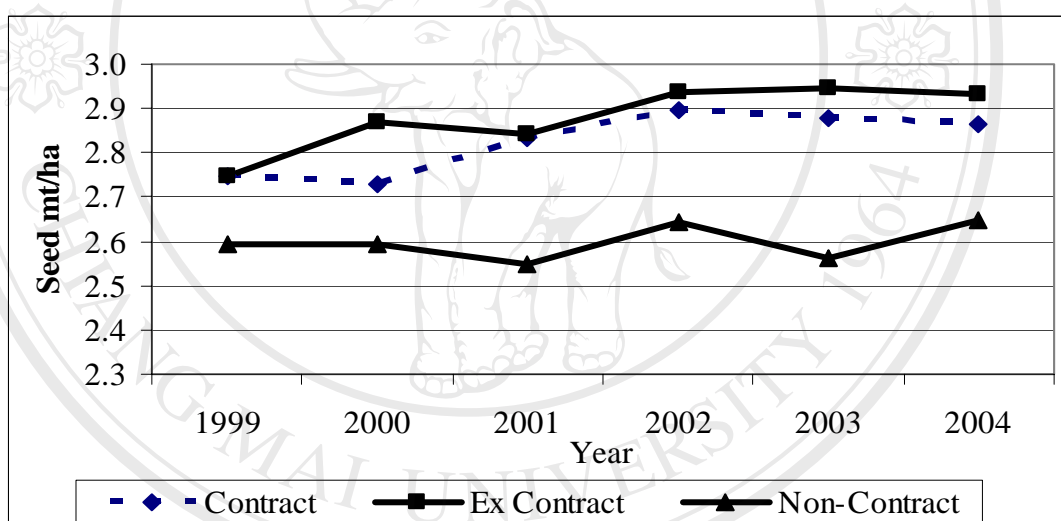


Figure 6.2: Seed rate used by different category of farmers over the years.

Source: Survey, 2004.

6.1.3 Varietal choice

The production and productivity of potato depend on the variety. Farmers will choose the variety depending on their preference. Some criteria include higher demand in market, good price, high yield, good taste, keeping quality (Figure 6.3). The respondent feels that Desiree fetches better price than Kufri Jyoti and Yusikaap, and has good taste too. Farmers prefer Kufri Jyoti for Indian market. Yusikaap is preferred due to its higher potential yield than other two varieties. Farmers reported

that white skinned variety (Kufri Jyoti and Yusikaap) is less susceptible to wild boar damage than the red potato (Desiree).

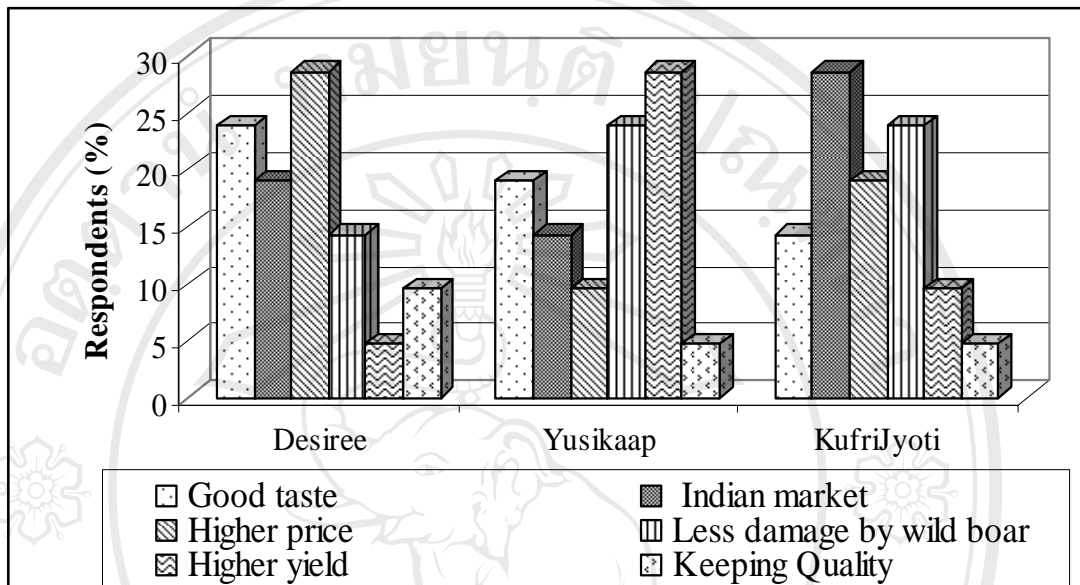


Figure 6.3: Varietal Selection.

Source: Survey, 2004.

6.1.4 Seed source

The respondents reported that 100% contract growers and 22% of ex-contract growers have used seed from DSC or CA. The 68% of contract and 100% of ex-contracted grower also have used their own seed source. The 100% non-contract farmer reported that they used own seed but the 35% of the non-contract farmers also reported that some of their seed source is from their neighbour.

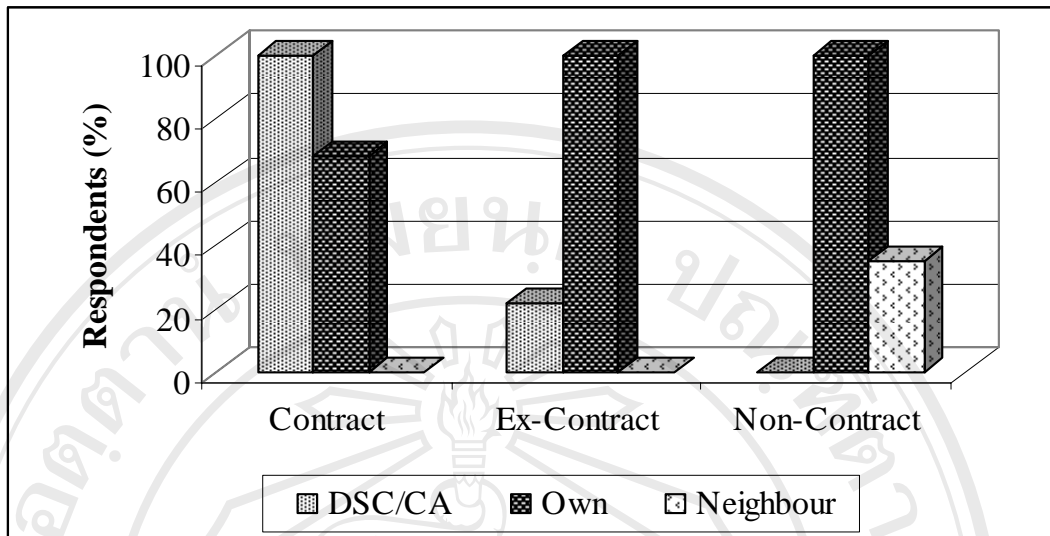


Figure 6.4: Seed Source.

Source: Survey, 2004.

6.2 Productivity

Achieving high productivity is difficult due to the small size of agricultural land holdings. The small size of holdings has another disadvantage, it hinders the ability of farmers to raise resources and market their produce. To increase productivity, the government will need to find ways to help farmers increase the scale of farming operations. Farmers' co-operatives and contract farming would be two successful options.

The impact of the seed production scheme are increases in productivity of potato per unit area, introduction of blight resistant varieties, expansion of area planted to potatoes, increase in household income and increased potato consumption. Per-capita consumption of potato in Bhutan is 21.1 kg/year (Hidalgo Oscar A. 2000). The cost of potato production is influenced by all factors that determine the productivity of land, the type of resources committed to the production process, and the alternative uses of these resources. In depth analysis tools, charts, and methods help to create best estimates and minimize expenses.

6.2.1 Yield increase by DSC seed

All the respondents considered using DSC seeds can lead to increased yield. However, the increase was reported to be variable. For instance, 56% of contract and 90% of non-contract farmer reported less than 15% increase by using DSC seed. 70% of Ex-contract farmers reported 15-20% yield increase by using DSC seeds. There were also 7% of ex-contract and 2% non-contract farmers suggesting 25-30% yield increase from the use of quality seed (Figure 6.5).

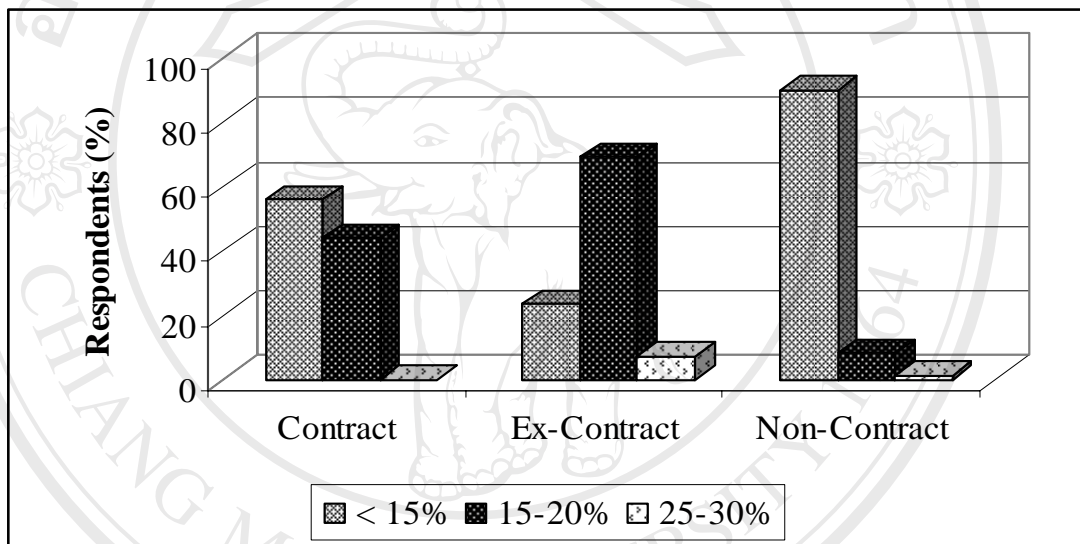


Figure 6.5: Yield increase by DSC Seed.

Source: Survey, 2004.

6.2.2 Yield increase by changing seed

The farmers feel that there is increase in yield by changing the seed but, the farmers cannot change the seed every year as the seed potato is quite expensive than other inputs in potato production.

The study reveals that by changing seed the farmers get around 25-30% more yield, but it solely depend upon the crop management. While all the ex-contract farmers reported less than 15% increase in yield by replacing the seed, 70% of

contract and non-contract farmers also reported less than 15% yield increase. About 28% of the contract and non-contract farmers reported 25-30% yield increase by merely replacing seed lot with quality seed tubers (Figure 6.6).

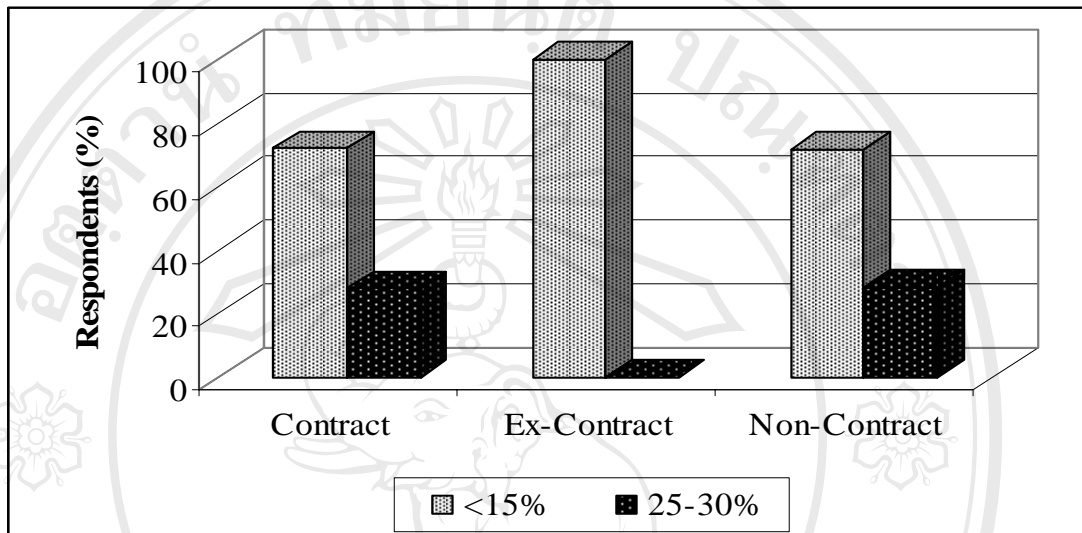


Figure 6.6: Percent yield increase by changing seed.

Source: Survey, 2004.

6.2.3 Yield assessment

The average potato yield within the category is shown in Table 6.2. The contract growers from Phobjikha harvested 14.9 mt ha^{-1} and the Bumthang contract growers harvested 14.6 mt ha^{-1} . The ex-contract of Phobjikha harvested 14.1 mt ha^{-1} whereas Bumthang harvested 14.2 mt ha^{-1} . The non-contract farmers from Phobjikha harvested 13.7 mt ha^{-1} and the Bumthang farmers harvested 13.6 mt ha^{-1} . However, the yield level of three categories of grower is higher than the national average yield of 11.5 mt ha^{-1} . In both the study sites, the mean difference within the category is very less and it is not significant (Table 6.2).

Table 6.2: Productivity of potato within the categories.

Category	Location	n	Min	Max	Mean	SD	Mean	
							Diff	Sig.
-----mt ha ⁻¹ -----								
Contract	Bumthang	12	13.5	15.0	14.6	0.49	-0.29	0.194
	Phobjikha	13	13.5	15.7	14.9	0.57		
Ex-Contract	Bumthang	25	13.5	15.0	14.2	0.51	0.11	0.381
	Phobjikha	30	13.5	15.0	14.1	0.44		
Non- Contract	Bumthang	20	13.1	14.6	13.6	0.30	-0.19	0.115
	Phobjikha	40	12.7	15.0	13.7	0.48		

Source: Survey, 2004.

The productivity among the categories of farmers is significant. It is revealed from the study that contract farmers have higher productivity than the ex-contract and non-contract farmers which is shown in Table 6.3. The average yield among the categories are 14.8 mt ha⁻¹ incase of contract growers, 14.1 mt ha⁻¹ in ex-contract and 13.6 mt ha⁻¹ in non-contract. The mean difference is highly significant as contract growers and ex-contract growers the difference is 0.691 mt. The difference between contract and non-contract it is 1.124 mt and between ex-contract and non-contract the difference is 0.432 mt.

Table 6.3: Productivity among the categories.

Category	n	Min	Max	Mean	SD	CV	Mean diff	
							Ex	Non
----- mt ha ⁻¹ ----- % -----mt-----								
Contract	25	13.5	15.7	14.8	0.54	36.6	0.691*	1.124*
Ex-Contract	55	13.5	15.0	14.1	0.47	33.3		0.432*
Non-Contract	60	12.7	15.0	13.6	0.43	31.7		

* The mean difference is significant at the .05 level.

6.3 Seed quality

Seed is the most vital input in crop production and quality seed is indispensable for high yield. Good quality “seed” means seeds possessing genetic purity, good germination, good vigour and freedom from diseases and pest. A large increase in production can be achieved by replacing farmers’ seeds with certified seeds on a regular basis. Besides the impact of added inputs like fertilizers, herbicides, irrigation and plant protection measures will be much higher when farmers use good quality certified seeds. The seed quality also can be improved by better management practices on the use of fertilizers, chemicals and weedicide.

Affect of seed change on seed quality:

Seed is a vital input in crop production. In any kind of agriculture, seeds and vegetative planting materials are the basic input. The quality of seed available to farmers determines to a large extent the amount of crops that will be harvested. Therefore it is essential for food production that seed of good quality is available at the right time for planting the crops.

The quality of seed differs as shown in the Table 6.4, when it is replaced at least once in three years and if it is replaced after three years. The seed quality is higher by 13% when the seed is replaced with in three years.

Table 6.4: Affect of seed change on seed quality.

	n	Min	Max	Mean	SD	CV	Mean difference
At least once in 3 years	83	35	80	59	8	14	13*
More than 3 years	57	30	70	46	11	24	

Source: Field survey 2004.

In potato production chemical plays important role by preventing the crops from diseases and enhancing the quality and the yield of the potato. The study revealed that the chemical used by three categories of farmers are not significant as some of the farmers have reported that they have not used the chemical at all.

Table 6.5: Chemical used by three categories of farmers.

Category	n	Min	Max	Mean	SD	CV	Mean difference	
							Ex-con	Non-con
		-----kg-----				%	-----kg-----	
Contract farmer	25	0.00	1.13	0.67	0.26	39.3	0.11	0.08
Ex-contract farmer	55	0.38	1.13	0.56	0.22	38.7		-0.03
Non-contract farmer	60	0.00	1.50	0.59	0.29	50.1		

Source: Field survey 2004.

The three categories of the sampled farmers are using the weedicide to control the weed pressure in their potato crops. The amount of weedicide applied by the categories of farmers ranges from 0.22 – 0.31 kg. The mean difference is significant which is shown in Table 6.6.

Table 6.6: Weedicide used by three categories of farmers.

Category	n	Min	Max	Mean	SD	CV	Mean difference	
							Ex-con	Non-con
		-----kg-----				%	-----kg-----	
Contract farmer	25	0.19	0.60	0.31	0.15	50.1	0.06*	0.09*
Ex-contract farmer	55	0.15	0.60	0.25	0.10	39.6		0.04*
Non-contract farmer	60	0.15	0.38	0.22	0.06	26.6		

Source: Field survey 2004.

The farmers are using the fertilizer (SSP) for the production of potato. From the study it is found that some farmers do not use SSP but instead of SSP they are using NPK complex. The mean difference of SSP among the categories is significant as shown below in Table 6.7.

Table 6.7: SSP used by three categories of farmers.

Category	n	Min	Max	Mean	SD	CV	Mean difference	
							Ex-con	Non-con
				-----kg-----		%	-----kg-----	
Contract farmer	25	0	1,125	495.0	535.5	108.2	-13.0	223.1*
Ex-contract farmer	55	0	1,125	508.0	423.4	83.4		236.1*
Non-contract farmer	60	0	1,125	271.9	401.7	147.8		

Source: Field survey 2004.

Seed quality influences industry profitability through its impact on crop yield. It would allow seed growers to produce and market with a premium being charged for better seed. Opportunities to export seed would also be enhanced. Overall, the potato industry would benefit by being able to manage crop establishment risk and increase crop yields.

The quality is more critical in crops in which vegetative materials are used as planting materials, as in cases of potato. Farmers are aware of importance of the quality seeds since ages as they used to select good ear-heads or panicles from the standing crops and preserve them as seeds. However, the ratio of farmers who follow such practice has always remained low. In fact it has become the innate characteristic of less developed agricultural countries. A small percentage of Bhutanese farmers use certified seeds of improved varieties annually. It is estimated that only about 5-7% farmers use certified seeds of improved varieties annually, which means the Seed Replacement Rate (SRR) in Bhutanese agriculture is around 6% for cereals. In case of potato it is around 10% (assessed by RNR RC- Khangma).

6.3.1 Quality seed produce

From the three categories of farmers, the contract farmer harvested more than 65% of quality seed tuber from their total produce. The ex-contract farmer harvested 59% quality seed and the non-contract farmer produce 38% quality seed tuber. The seed qualities produced are highly significant among the categories of the farmers as shown in (Table 6.8)

Table 6.8: Seed quality produced by three categories of farmers.

Category	n	Min	Max	Mean	SD	CV	Mean diff		
							Ex-cont	Non- cont	
		-----%-----							
Contract	25	63	73	65	2	2.92	6*	27*	
Ex-contract	55	54	63	59	2	3.29		21*	
Non-contract	60	28	43	38	4	9.22			

* The mean difference is significant at the .05 level

The Figure 6.7 shows the production of quality seed among the farmers for the period of six year (1999 - 2004). The graph clearly indicates that the contract farmers produce better quality than ex-contract and the non-contract farmers. If the quality has to be assured the production need to be carried out through contract farmers as they have better experience than the other two.

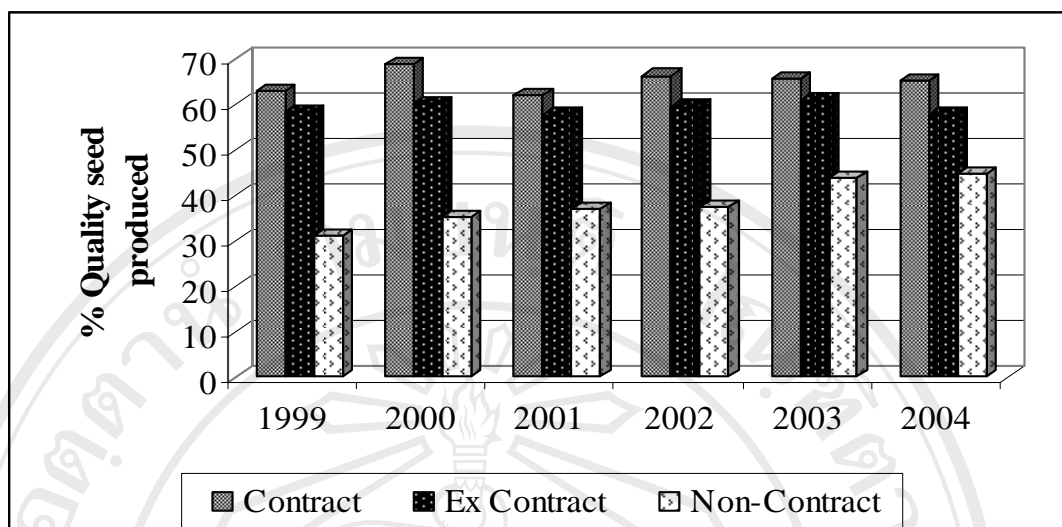


Figure 6.7: Percentage of quality seed produced.

Source: Survey, 2004.

6.3.2 Factors affecting seed quality

Multiple linear regression was run to find out the contributing factors for seed quality in potato production is defined as:

$$SQ = \beta_0 + \beta_1 \text{Contract} + \beta_2 \text{Seedrep} + \beta_3 \text{Chemi} + \beta_4 \text{Weedicide} + \beta_5 \text{SSP} + \varepsilon$$

Where:

SQ = Seed Quality produced in %

Contract = If Contract farmers =1, otherwise =0

Seedrep = If seed replaced at least once in three year = 1, other wise =0

Chemi = Amount of fungicide used

Weedicide = Amount of weedicide used

SSP = Amount of single super phosphate used

ε = Error term

Table 6.9: Coefficients of Regression analysis.

	Unstandardized		Standardized	t	Sig.
	Coefficients		Coefficients		
	B	Std. Error	Beta		
(Constant)	.4148	.023		17.964	.000
Contract	.1063	.021	.359	5.096	.000
Chemicals(gm)	.0003	.000	.121	1.711	.089
Weedicide(gm)	.0004	.001	.050	.654	.514
Seed change at least once in three year	.0976	.016	.423	5.947	.000
SSP(kg)	.0000	.000	-.008	-.109	.914
R-Square = 0.429	Adjusted R-Square = 0.408		F Value = 20.127		

Source: Analyzed by SPSS 13.0

The result of the least squares (Table 6.9) indicates that three selected variables have relationship with the seed quality improvement. Dummy of seed replaced at least once in three year (Seedrep) have contributed significantly in model by 42% to the seed quality and contract farmer by 35% at 0 .000 significance level. The uses of chemical also have contributed to the improvement of seed quality by 12% at 0.1 significance level.

Additionally, the average % of contract group seed quality was found higher by 10% than that of ex-contract and non-contract group. Although, it was earlier expected that weedicide and Single Super phosphate (SSP) could have affect on seed quality but it turned out to be insignificant.

Contract farmers

Contract farmers have significant role in seed quality improvement. The contract farmers have to follow all the necessary seed production guidelines as per the agreement. The basic seed is used to produce certified seed every year. The contract farmers have to do crop rotation (rotate the field once in every four year), strict

roughing practice to remove the off-types, regular field inspection with DSC staff, use recommended doses of fertilizers, weedicide and chemicals. Since the farmers have to arrange for the inputs like fertilizers, chemicals and the weedicide, it seems that farmers sometime do not follow the recommended use of inputs.

Seed replacement

In potato farmers in Bhutan use their own seeds ever since they started growing potato. The seed replacement rate of certified seed by Bhutanese farmers is 10% that is very low comparing to other neighboring countries. In potato it is a fact that yield potential of the seed potato can come down as much as by 40% with deterioration in seed quality due to diseases. The farmer knows very well that seed quality plays important role in potato production and if they change seed stock the yield can be increased. As most of the farmers are poor and the cost of seed potato is expensive, farmers normally do not change the seed annually. Although the farmers do not buy the seed frequently from DSC they still replace the seed stock from their neighbors or relatives.

The study revealed that farmers of all three categories recycle seed stock. Recycling of the seed ranges from 1 to 3 years and above. Among the contract farmers 44% of them change seed once in two years. In contrast, 82% of the ex-contract changes their seed once in three years and 82% of non-contract farmers change their seed after 3 years. The 5% of non-contract farmers have never changed their seed stock (Figure 6.8). It was stated that, as seed quality degeneration in high altitudes is slow, farmers mostly change their seed only once after three years. Generally when the farmers observe decreasing potato yield they change the seed stock, which they consider as the most appropriate strategy.

The availability of quality seeds is one of the major factor required to achieve higher production. The potential benefits that accrue to farmers from the use of quality seed include enhanced productivity, higher harvest index, improved tuber quality and higher profits. In general good quality seed tuber fetches good price in the

market but in case in Bhutan the absence of prefixed price in potato normally do not favour such statement.

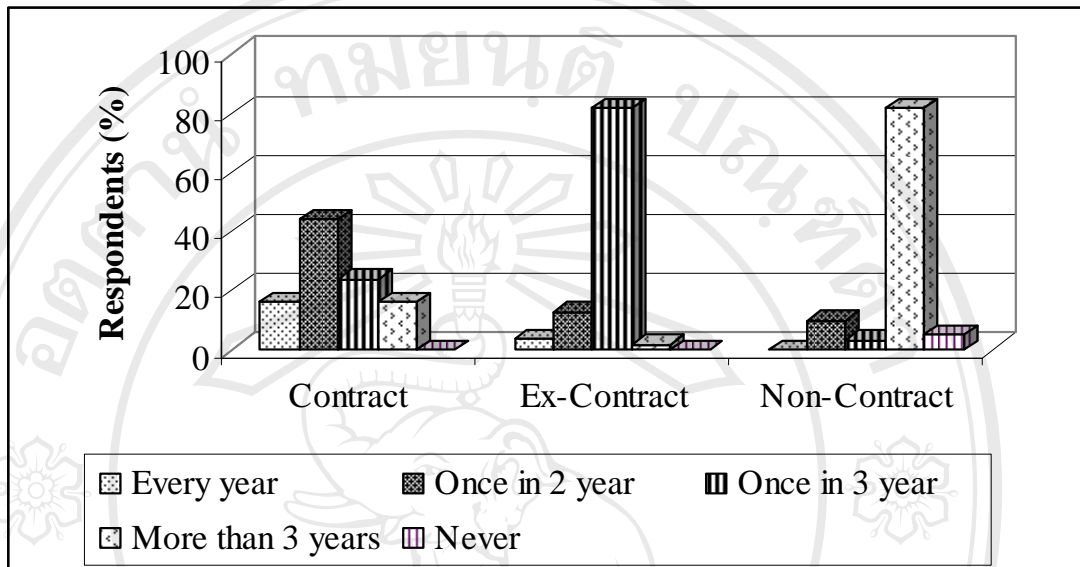


Figure 6.8: Seed Replacement.

Source: Survey, 2004.

Chemical

The use of chemical also contributes to the seed quality. Since, the potato crops are grown in summer, the high humidity and temperatures favours the proliferations of diseases. The chemical helps to protect the crop from the diseases thus leading to form good tuber quality.

Weedicide

As it was expected that weedicide would contribute to the seed quality but in the model it was found to be insignificant. The recommended dose of weedicide for one ha is 0.50kg but the farmers are using far less than it. From the study it was found that contract farmers are using 0.31kg, ex-contract farmers 0.25kg and non-contract farmers 0.22kg. The reason could be the weedicide is costly and farmers' could not afford to use recommended amount. The other reason could be it is not available in

time thus farmers cannot apply during the critical time. But, the use of weedicide for the quality seed production needs further investigation.

Single supper phosphate (SSP)

As it was expected that SSP would contribute to the seed quality but the model predicted that its contribution is insignificant. The possible reasons could be:

1. soil contain abundant phosphorus
2. farmers are not using proper combination of NPK complex.

Since, fertilizers are important inputs in production for increasing the yield, improving the quality of seed and as well as generating higher income to the farmers therefore, it is very much relevant that further research on fertilizers on seed quality improvement is carried out.

6.4 Economic returns

Seed is known as the biggest cost component in potato growing. The cost required to plant 1ha of potatoes is ten times the cost of planting a wheat crop and almost sixty times the cost of establishing a rice crop (Huda, 1990). Seed is expensive, even if it is not purchased, for farmers have the option of selling the tubers to the ware market or eating the tubers themselves (Monares, 1981).

The profitability of potato production was analysed based on the financial return. The economic analysis of potato production from three categories of farmers clearly indicates the advantage of contract farming (Table 6.10). Gross margin of contract farmer (Nu.¹ 55,983) is 19.5% higher than ex-contract and non-contract farmer, which have contributed by the better seed used, management practices and better price of seed tuber. In contrast, the direct cost is only 6% and 9% higher than ex-contract and non-contract farmers. Similarly return to land from contract farmers is also 67.7% higher than ex-contract and 63% higher than the non-contract farmers.

¹US\$ 1=44.50 Nu. (Dec.2004)

The higher returns can be contributed to higher tuber yield and seed price. There is no significant difference in cost of production among three categories of farmers.

The cost of seed production is Nu 3.49/kg in Bumthang and Nu 3.52/kg in Wangdiphodrang, shown in (Table 6.10).

Table 6.10: Economic returns from 1 ha of potato among three categories of farmers.

	Contract	Ex- contract	Non- contract	Mean difference		
	-----n-----			Con. vs Ex.	Con. vs. Non.	Ex. vs. Non.
	25	55	60			
	-----Nu/ha -----					
Total revenue	96,900	84,682	82,088	12,218.2*	14,812.5 *	25,94.3 *
Total cost	68,727	64,906	62,897	3,821.6*	5,830.9*	2,009.3*
Net income	28,173	19,776	19,191	8,396.6*	8,981.6*	585
Gross margin	55,983	46,831	45,666	9,152.0*	10,316.6*	1,164.6*
Returns to land	15,065	8,979	9,245	6,085.8*	5,820.7*	-265.2
Returns to Labour	206	182	186	23.20*	19.90*	-3.3
Returns to Family						
Labour	233	201	201	31.90*	31.60*	-0.31
COP (/kg)	4.65	4.60	4.60	0.044	0.046	0.002
Cost of seed production						
Bumthang	3.49					
Phobjikha	3.52					

Source: Survey, 2004.

Note :(The average farm (production size) size is 0.40 - 0.47 ha)

* The mean difference is significant at the .05 level

Across all the categories of farmers, labour takes up 45% of the expenditure incurred in potato production. As stated by the respondents, potato cultivation is a labour intensive activity. Seed is the next expensive input which covers 22% of the total cost (Figure 6.9).

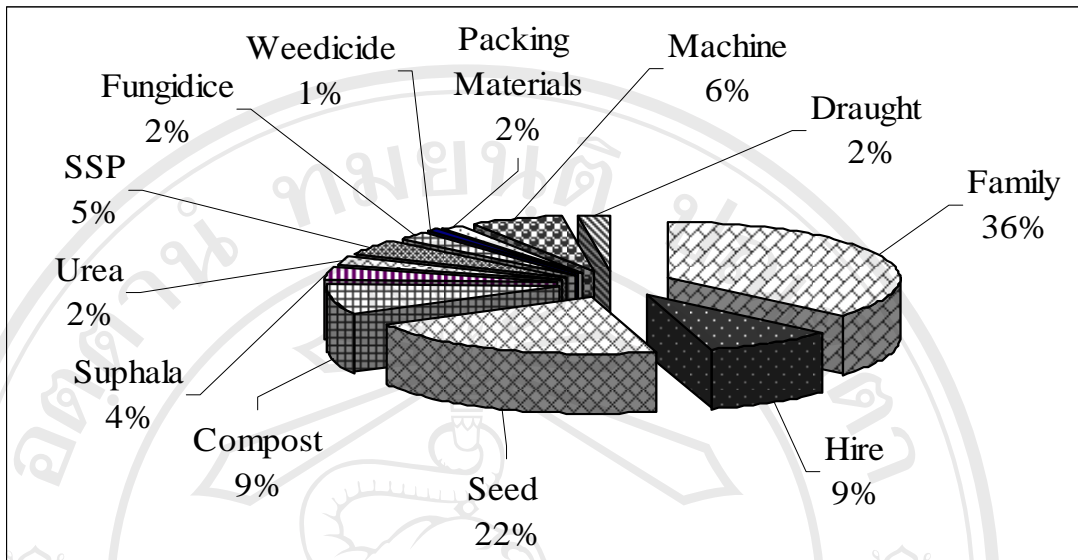


Figure 6.9: Proportion of expenditure incurred in producing 1 ha. Potato.

Source: Survey, 2004.

6.5 Performance assessment

Contract farming has proven to be a highly viable strategy and this stands to be true in case of enterprises like contract seed growers. It is apparent that the farmers have appreciated the various economic, technical and social advantages contract farming offers to them. However, in Bhutan the situation has been a little different than in the other countries besides the obvious advantages and the economic benefits being derived as contract seed growers. With the establishment of seed growing scheme in the form of *contract farmers* (seed growers), the scheme functioned quite smoothly with no major hindrances and almost all the farmers (potato growers) who were in the potato production activity and business participated actively. Many more joined after having understood the objectives of such a scheme resulting to some extent an increase in the number of farmers at the initial phase.

The Royal Government in the mid nineties introduced the *cash and carry* system in the seed business. The main aim of introducing *cash and carry* system was to make DSC a commercially viable enterprise in view of RGoB's policy of self

sufficiency through privatization strategy. In reality this scheme can be undeniably considered an opportunity for such government agencies like DSC to perform better and stand on its own feet.

Unfortunately, this system was not welcomed by the farmers thus this new initiative turned out to be a bottle neck in the over all performance of the DSC. In the process of implementation many farmers opted to drop from the scheme while some continued. The size of the group eventually decreased drastically from 359 to 25 (93 %). Under this situation, one can rightly state that cash and carry initiative has greatly hampered the potato seed industry in the country with most farmers opting to withdraw from the contract system. The crux of the matter has been that the farmers did not find contract system attractive without any form of appreciable incentive and felt they were on the losing end. This situation would not have arisen if there had been a good modality and a sound base in place to operate such an initiative of public interest. In true essence farmers were not prepared to readily accept this cash and carry system which means this was introduced a little too earlier without much ground work. The farmers on the other hand understood that it was targeted towards defaulting farmers as large proportion of farmers did not take interest in repaying the dues they had with DSC. Had the cash and carry system not been introduced, there would be more contract growers that would have catered to the increasing demand for quality seed potato both within and outside the country. However, from the DSC's point of view, the introduction of cash and carry system has reduced the burden of over due which the farmers had always sought excuses of not paying. The DSC also feels that farmers had been too dependent on the cash and carry system and so did not inculcate the habit of saving for the next plantation. The cash and carry system therefore was expected to instill some savings among the growers in any form but proved otherwise.

One notable reason for higher drop-outs of the farmers from the program has been the relatively lower price offered by DSC for the seed potato. This situation in fact paved the way for the farmers to sell their produce directly to other agencies which offered better price to them.

Various other factors which inflicted in one way or the other the earlier success of the contract system were for instance, the lack of insurance for seed crop failure (natural calamities, predator damage etc.), rejection of the produce by seed certifying agency which is the Bhutan Agriculture and Food Regulatory Authority (BAFRA) and the non-existence of legal bindings. At the same time DSC did not have any viable alternatives in their hand to face the situation should the size of the contract farmers group decrease so significantly due to unexpectedly high drop (exit) rate.

Under the above scenarios, DSC did make attempts to compensate for the cash and carry system through provision of seed potato at a subsidized rate to contract seed growers but farmers were still not willing to be a part of the contract citing lack of cash in hand to purchase seeds. Critics sometime comment that Bhutanese farmers are *spoilt* farmers.

Impact of providing seed on credit.

Positive Impact	Negative impact
<ul style="list-style-type: none"> • Increased farmer participation • Increased supply of quality seeds • Export earning for DSC • Easy monitoring & quality control • Higher price for the produce • Increased co-operation amongst growers • Increased income of growers • Improved socio-economic development 	<ul style="list-style-type: none"> • Government policy to encourage private sector will be defeated • Dependence on DSC by growers • Cash back-log for DSC • reduced investment in other activities • Growers default

In order to make contract seed production economically a more viable enterprise in the country and to assure quality produce, DSC should provide seeds on credit and deduct the cost when final purchase is made from the farmers. However, a strong legal contract agreement should be able to prevent growers from defaulting. In this way the corporation would not run into financial stress burdened by the problems of non recovery of the dues from the farmers. It is expected that such a strategy if in place would attract more participation and competitiveness amongst the farmers thus leading to both qualitative and quantitative improvements there by increasing income of the farmers and finally being able to contribute significantly in the overall socio-economic development and in particular in the field of potato production.

6.6 Prospect for DSC

The future prospects of DSC can be best understood by critically analyzing strength and weakness of DSC's present operating systems and alongside the threats that DSC has to encounter and the existing strengths for its success. The concept of SWOT analysis was employed to staffs in three DSC farms to examine the present operating system on seed potato production and distribution in Bhutan and to come up with recommendations for future actions.

Strengths

- Free technical backstopping from the Research Centers and the Department of Agriculture of the Ministry of Agriculture.
- Availability of seed production technologies and tissue culture laboratories.
- Availability of necessary infrastructures and skilled manpower.
- Government subsidy on transportation for agricultural input supply.
- Better supply coordination (specifically between DSC and the CSGs).
- Seed potato standards in place.(Seed Act of Bhutan, 2000)
- Linkage with regional (South Asian) and international seed agencies.
- Cooperatives Act of Bhutan, 2001 would facilitate group formation or primary cooperatives.

Considering the long association of DSC with seed sector, it has established itself as an institution supporting seed sector. It has built necessary infrastructures, network and skills in seed sector development. The existence of highly mechanized seed processing plants, and skilled manpower are the prime strength of DSC to support seed sector. The regional farms equipped with basic facilities and land also acts as strength for DSC. The well-established linkage with regional (South Asian) and international seed agencies can form a strong point, which is essential to take the seed sector forward. As a new corporate agency, there is strong support from the government in ensuring its success.

Weakness

- Low adoption rate of certified seed potato. (Seed replacement rate is only 10%)
- Low adoption of seed production technologies.
- Poor transportation network and high input cost.
- Weak professional and technical competency among the staffs.
- The contract arrangement do not have ethics of contract farming (Supply of inputs in credit)
- Payment of higher prices for quality seed would further deteriorate the financial status of DSC as the Corporation is already running at loss.
- Low price for the quality seed.
- Poor coordination among the key players (DSC, CAs, SPGG, DAOs and the farmers).
- Lack of market information on seed potato.
- Poor storage facilities for seed potatoes (optimum amount of light, temperature and humidity is crucial to ensure good seed quality).

Alongside, there exist certain weakness, which could hold back the development of DSC and consequently the seed sector. The study revealed that weak professional and technical competency among DSC's staff to handle wide range of crops can be a critical weakness. The poor linkage with research, extension and

Dzongkhag RNR programs is considered as a weakness of DSC. The management aspects in production and marketing seem one of the weaknesses of DSC.

Opportunities

- The diversity of the agro-ecology environments of the country offers excellent opportunity for production of seed potato.
- High domestic and export market potentials.
- Encourage private traders to involve in seed potato trade.
- Improve the certified seed potato production through trainings and technical information dissemination on newly developed production technologies.
- Initiate seed potato certification process through provision of production guidelines and putting in place adequate numbers of trained seed inspectors in the field.
- Introduce and promote affordable and technically sound storage system for seed potatoes.
- Improve linkage and coordination between key players like DSC, SPGG, CAs and the farmers.
- If inputs are given in credit, more growers will participate in the program which will help DSC to earn from export and subsidize the domestic produce (higher price for the quality seed).
- Government policy on foreign investment provides opportunity to DSC to explore the possibilities of entering in to mutual benefiting joint venture.

In view of the transforming DSC as corporate agency, there exist ample opportunities for making seed production a financially viable enterprise. For instance, the diversity of agro-ecological environments of the country offers excellent opportunity for seed production. At the same time, high domestic (Effective seed demand for potato is 816 mt annually) and export market potentials could greatly help financial self-sustainability of DSC. In view of the flexible and accommodative government policy on foreign investment provides the opportunity to DSC to explore

the possibilities of entering into mutually benefiting joint venture with international seed companies.

Threats

- Failure of the SPGG may have implication on the government policy on future promotion of farmers groups and cooperatives
- Presently a number of CSG are going out of the contract system which may lead to the unavailability of quality seed in the country.
- Increasing cost of production.
- The demand from buyers outside the country would drop if the quality of seed and its standards are not improved or maintained.
- Competition from the Indian seed potato producers in Himachal Pradesh (Kufri) and Punjab area.

However, increasing cost of production, low quality of seeds and a tarnished image of DSC, growers leaving the contract seed production, competition from the Indian seed potato producers, higher price demand by the growers, lack of professional experience in managing a seed corporation and DSC has to maintain its fixed cost are some of the critical threats, which could hamper the seed sector development.