Market Potential Assessment for Quality Seed for Four Crops in Madhya Pradesh

A Case Study Methodology Approach

Shajapur District

November – February 2008-2009

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Contents

List of Tables, Figures and Annexures

Tables

Figures

5.4a. Block total us of non-CS for each of the 4 blocks

5.4b. Block total us of CS for each of the 4 blocks

5.4c. Standardized block total us of CS for each of the 4 blocks

5.5a. Difference in the 4 CS factors for the blocks sampled

5.5b. Standardized difference in the 4 CS factors for the blocks sampled

5.6 Relationship between the two farm holder number proxies

6.1. Influence of village mean farm size on four village-specific CS use variables;

6.1a. farmer mean use of Soybean CS,

6.1b. farmer mean use of Wheat CS,

6.1c. farmer mean total CS use,

6.1d. and standardized total CS use,

1. Acknowledgement

I extend my sincere thanks to Mr. Ashish Mondal, Director, ASA, for providing me with an opportunity to undertake the project titled “Market Potential Assessment for Quality Seed for Four Crops in Madhya Pradesh”.

I am also very thankful to Mr. Raja Chakarborty and Mr. Yogesh Kumar for their valuable support constant guidance and constructive inputs. My work remains indebted to all those enterprising people I met during my field visit, ASA staff, who gave me their valuable time and especially the farmers, who took out their valuable time to interact and share their experiences with me and were helpful in the collection of data.

2. Objectives:

The objective of study can be classified as follows:

1. Establish the demand and supply of quality seed – i.e. both certified and truthfully labeled seed - of four major crops at small, medium and large farm size in three blocks of Shajapur.

2. To ascertain the factors limiting both demand and supply of quality seed for small, medium and large farm[i] size in three blocks of Shajapur.

2.1 Significance of Study:

Agriculture is the mainstay of the Indian economy. Agriculture and allied sectors contribute approximately 22 per cent of Gross Domestic Product, while about 65-70 per cent of the population is dependent on agriculture for their livelihood[1]. With the 1960s-70s Green Revolution, production progressed markedly and brought the nation from a situation of food scarcity and imports to that of food security and exportable surpluses. Agricultural growth has, however, not kept pace with population growth and has now stagnated, which adversely affects the nation's food security and economy[2]. The imperative of National food security and economic development demands a focused and resolute approach to raise productivity and production in agriculture.

Quality Seed is the sine qua non for high productivity in agriculture. It enhances the effect of inputs such as irrigation, pesticides and fertilizers; augmenting output yield by a magnitude of 25-30%[3]. Yet the farmers demand for quality seeds is sub-optimum, and the production, supply and use of quality seed is lower still. A strong positive correlation also exists between both Seed Replacement Rate (SRR) and Cultivar Replacement Rate (CRR) and productivity[2], elucidating the importance of regularly replacing used seed for new quality seed and replacing the seed variety for improved cultivars. However, the SSR and CRR remains below 2-10 % in much of India for the majority of crops, which is far below the desirable rates i.e. twenty five percent for self pollinated crops, thirty five percent for cross pollinated crops and hundred percent for hybrid varieties. Such replacement rates enable optimum crop productivity to be achieved[4]. The reasons responsible for this seed situation are elaborated in section 2.3. The minor use of quality seed, coupled with insubstantial technology, is reflected in the nation's agricultural performance, as exemplified by soybean, one of India's key crops that accounted for 7.85% of total agriculture production in 2003-04, yet is produced at one of the lowest mean yield per hectare area in the world[5]. This predicament needs to be redressed for the nation to increase its agricultural productivity. In consequence, seed production and extension has become a prime focus of the government's food production plans, under the annual National Seed Production policy[2].

The deficient use, production and replacement of quality seed is not, however, a uniform problem in India. Those states with a highly evolved agricultural sector have higher production, employment and SRR / CRR of quality seed than their less agrarianly developed counterparts. This can be illustrated by the contrast between Punjab, in which a yield of 4203 kilograms per ha of wheat from quality seed was produced in 2003-2004, and Madhya Pradesh, in which only 2165 kilograms per ha of wheat was produced from quality seed over this period[6]. This discrepancy between states

[i] The farm size categories small, medium and large, equate to areas of 0-1.9 ha, 2-3.9 ha and 4 - ha, respectively.

which calls for a state-specific focus to enhance the production and use of quality seed, which will drive a boon in agricultural productivity, the economy and the livelihoods of the nation.

2.2. Scope of Study:

The research will be done at the sub-district scale. The purpose of this is to clarify the market potential of 4 major crops for the district in which one of the largest seed producer companies in the state of Madhya Pradesh - the Samarth Kisan Producer Company (SKPC) – is centred. The 4 crops to be investigated are soybean, gram (chennay), wheat (gehoo) and coriander (dhaneya). The research will be further focused, making quality seeds the sole object of the study. SKPC is based in Shajapur district, in the north west of the state. Its long-term target is to spread its operations in the whole district, which is comprised of 8 blocks, although its primary focus is 3 blocks, thus necessitating sub-district-level research. Furthermore, it will establish a case study and a platform from which large-scale research can develop.

2.3. Causes of Sub-optimum use of Quality Seed

The use of quality seed, and thus agricultural productivity, is far below the optimum level. A multitude of interdependent factors are responsible, but can come under two different umbrellas: the gap between demand, production and supply of quality seed; and secondly, low demand for quality seed.

2.3i. Reasons for Gap between Demand and Production / Supply:

I. Demand Assessment system

i) Timing

At the district level planning assessments are not conducted early enough to provide an accurate assessment for the producers and suppliers to accordingly respond. District level planning is currently done just before sowing.

ii) Site-specific assessment

Assessment is conducted at too large a scale and not in all districts?

iii) Necessary varieties

Demand for varieties is not comprehensively assessed. For example, the demand for crops varieties that would be favourable in the event of environmental crises is not considered during demand assessment.

iv) Source of information

The demand data comes from the block, tehsil and district level by external assessors. Demand would be more accurately assessed if it were the effort of all the players in the seed industry, notably the producers, consumers and mediators, and relevant external sources, such as scientists and meteorologists.

As a result of the defective demand assessment system producer companies in MP are unaware of the extent of the demand and are thus not producing sufficient quantities to meet the state's demand.

II. Production constraints

i) Sub-optimum production/ recovery of certified seed

Low procurement price for certified seeds has the dual negative effect on prospect of reducing the quantity of certified seeds that farmers sell to distribution

companies and also discouraging the farmers to produce to their potential. Low procurement price is contiguous to low market prices, a largely sporadic variable.

ii) Climatic variables

Adverse climate curtails production

iii) Failure to for seeds to be certified

A low germination rate, stemming from production malpractices and pest problems, is the primary reason for produced seeds not attaining certified status. Inefficiency of certification inspectors is the subsidiary cause.

III. Stock Piling

i) Seed stock is insufficient to safe-guard against unexpected surplus in demand.

There is not a sufficient stock of parent seeds of all crops to supply to the farmers when there is a late surge in demand, such as following a water crisis and a subsequent need for more drought tolerant varieties.

IV. Supply

Late orders from farmers puts unnecessary pressure on the suppliers and often the suppliers cannot respond in time for punctual harvesting.

2.3ii. Reasons for Demand for Quality Seeds Being Below The Potential Demand:

1. Knowledge

i) Absence of awareness of seed varieties.

Farmers and extension workers are not always fully aware of the seed varieties available, especially new varieties and the regulatory framework promotes only a few varieties that are eligible for subsidies. This not only reduces the demand for seeds but also means the seed recommended and selected are not always the most suitable, resulting in sub-optimum yields. Extension programs and thus farmer awareness is particularly poor in rural areas.

ii) Absence of awareness of best farming practices

Certain pre and post harvest field management is required to ensure the certified seeds produce optimum yields, for instance, field preparation and rouging of off types, respectively. Seldom, farmers are ignorant of the necessary farming practices and the certified seeds have underperformed as a result.

2. Climate irregularities

i) Sporadic climate circumstances have resulted in crop failure.

As the cost of certified seed is more expensive than the traditional practice of using uncertified market seeds or old seeds, regular investment in certified seed is a risk for the farmer. The financial loss incurred as a result of i), ii) and 2 i), by farmers, discourages some from utilising certified seeds.

3. Affordability

i) Cost of seed.

The high cost of purchasing quality seeds discourages farmers from regularly replacing old seeds with new quality seed. This is exacerbated by the fact that the standard packaging size for certified seeds is too large, and thus unnecessarily exorbitant, for small farm holders.

Although the initial costs of quality seed is high, approximately 5-10 % of the total cost of cultivation per unit area, the loss of productivity using self-saved seed may be as high as 20-25% in

self-pollinated varieties and 40-50% in cross-pollinated crops[7]. Thus overall it is more cost-effective to use quality seed.

ii) Necessity of not reusing certified seeds requiring a high seed replacement rate.

Certified seeds are costly vis-à-vis to the alternatives of uncertified market seed, fake certified seeds or old seed. The necessity for certified seeds to be replaced after every harvest makes the use of such seeds costlier. As a result only the medium and large size farm holders have the capacity to enhance production via certified seeds and marginal and small size farmer holders, who constitute 61% of farmers in MP, can not afford to[1].

4. Availability

i) Only specific crop types and varieties are produced.

The private sector producer companies produce only the low volume or low area crop seeds which offer maximum profits, such as bajra and sunflower respectively. This has resulted in a dearth of high volume, low value crops, including urdbean, pigeon pea, lentil and kodo, despite the public sector primarily producing high yielding varieties of such crops.

ii) The range of varieties available is insufficient.

Private producer companies do not invest in the production of new crop types and varieties, except for the highly profitable hybrid seeds, and the public sector variety extension efforts are inadequate. More specialized varieties are needed that can be used in instances of environmental calamities.

The insufficient extension programme has a substantial adverse affect on the demand and production.

iii) Seeds not available to all parts of the state.

Deficient supply chain renders those in marginal farmers limited or no access to certified seeds. In a country where 90% of the land owners are marginal farmers this is an issue that that needs to be redressed[7].

5. Over production

i) Excess supply of most profitable crops.

Certain easily available, high yielding and well established crop varieties are over-produced, so the price producers receive for the seeds are diminished.

6. Market prices

i) Gap between grain and seed price

If the price difference between grain price and certified seed is high marginal farmers will be less inclined to use certified seed.

This shows that there is an awareness that multiple factors may contribute to the low use of quality seed and a gap between the supply / use and demand. These factors will vary based on the socio-economic and geographic characteristics of the region and thus these factors must be assessed on a district or sub-district scale in order to optimize the effectiveness of quality seed extension efforts. A vital aspect in the endeavour to close the supply / use and demand gap is to enhance the production of quality seed. For Producer Companies (PC) to do this they require assurance of demand for their product. Consequently, the fulfilment of the research objectives is the first step in the imperative to close this gap. Once the market potential is discerned, the production and use of quality seed will increase accordingly.

2.4. The Private Company and the NGO.

SKPC's vision is to improve livelihoods especially of poor, small and marginal farmers by upward integration of their institutions with agribusiness trade and industry. Their goal is harmonious with

ASA's[ii], particularly ASA's initiative to enhance the agricultural performance of farmers by developing cooperatives between small and marginal farmers to improve their backward and forward linkages, such as access to quality seed and good market value, respectively, under the auspices of Farmers' Producer Companies (FPC).

3. The State, the District and the Blocks – Secondary data

MP is the topmost pulses and oilseeds producing state in India f, bolstered by its productivity levels of gram and soybean. MP is also the highest maize producing state[8, 9]. Nevertheless, the use of quality seed and SRR is insubstantial. Table 1 illustrates the SRR for certain crop in MP, emphasizing it is far below the required 25%.

	Wheat	Maize	Gram	Soybean	Coriander
2005	15.06	6.41	1.85	15.68	-
2006	13.09	3.96	2.15	15.84	-

Table 3.1. SRR for major crops in MP. Derived from The National Seed Plan 2008[2].

The quantity of seeds required on the basis of seed replacement rates mentioned above and the area required for state-wise production of this quality seed is given in table 2.

Crop	Normal Area (000' ha)	Seed Rate* (kg/ha)	Seed Req. (000' ha)	SMR**	Area Requirement (000' ha)		
					100% SRR	25% SRR	35% SRR
Wheat	3802.2	100	380.22	20	190.11	47.528	66.539
Gram	2453.7	75	184.028	10	245.37	61.343	85.88
Soybean	4341.3	65	282.185	15	289.42	72.355	101.297

	Seed Requirement Per SRR (qtl)							
	1% SRR	**2% SRR**	**5% SRR**	**10% SRR**	**25% SRR**	**35% SRR**	**50% SRR**	**100% SRR**
Wheat	2555	5110	12776	2552	95055	133077	127760	255520
Gram	192	184	960	1920	46007	644098	9600	19200
Soybean	1149	2298	5744	11488	705463	987648	57440	114880

Table 3.2. Seed Requirements for the replacement of seed for the areas under production for major crops in MP, based on 2005 data. Derived from The National Seed Plan 2008[2] and SKPCS Business Plan[11]. NB conflict seed requirement data due to date difference (25 and 35% based on 2008 data vis-à-vis 2005). *Seed Rate – the quantity of seed needed per ha. **SMR - Seed Multiplication Ratio, the average amount of seeds one seed will yield.

Using this data it can be discerned that the total demand for quality seed of wheat, soybean and gram for the state, at a 25% SRR, is 211,608 tonnes. The quantity of all the quality seed that is produced and available for the state, including that coming in from other states, is needed to compare this, however, data was only available from the State Seed Corporation (SSC) of their supply. Information from all the companies whose purview extends to the state could not be obtained. It illuminates the difficulty in ascertaining the current supply to an area, and subsequently the gap. This indicates the necessity of a coordinated and comprehensive approach assessment approach.

There is a large gap between the demand and supply of quality seed in the state, particularly in Shajapur. The gap, formulated for 2003-2004, is illustrated in table 3.

[ii] Action for Social Advancement (ASA), is an NGO based in Bhopal, Madhya Pradesh of India has been working since 1996 for the environmental and livelihood issues. Its operation spreads across 3 states in India with more than 800 villages of the semi-arid region. It works mainly with the tribal and other socio-economically marginalized groups. See www.asaindia.org for more details.

Crop	Cropped Area (Ha)	Present Seed Requirement (qtls)	Present Seed Supply through Year 2003-04 (qtls)		Total Seed Requirement (qtls)	Gap between demand and supply with 10 % SRR (qtls)
		With 10 % SRR	Govt.	Private	With 15 % SRR	
Soybean	319400	25552	8614	10934	38328	6004
Maize	52000	1040	150	600	1560	750
Wheat	19200	1920	400	800	2880	720
Gram	143600	11488	3224	5425	17232	2839
Total seed requirement of all crop		40775		21885	60000	18890

Table 3.3. Seed demand and supply status of the district Shajapur**.** The National Seed Plan 2008[2]

The salient reason for the gap between demand and supply in Shajapur is that the district is predominately remote and poorly connected. For instance, only 23.7% of the 111 villages of the district have an all weather approach road, whereas the state average is 33%[10]. The major crops of the district are wheat, gram and coriander in Rabi and soybean in Kharif, hence the focus of the research is on these 4 crops. Consequent to the poor employment of quality seed in Shajapur, a government initiative, the Madhya Pradesh District Poverty Initiative Program (MPDPIP), has been established in the district.

Using the data from table 3, it can be discerned that the total demand for quality seed of wheat, soybean and gram for the district, at a 10% and 15% SRR, is 39,73.5 and 58,44 tonnes, respectively. These quantities are far above the 2100 tonnes that is currently produced and available for the whole district, revealing the extent of the gap between the demand and production / supply, and thus the large market potential, of the area[11]. Although the gap is huge but the seed replacement rate in the district is increasing as per trend of State SRR, which increased from 4.5 in 2002-03 to 8.5 in 2005-06[11]. In the villages where the MPDPIP, operational in the Shajapur district since 2001[12], has focused, the SRR has reached 30%. The resultant increase in productivity has been 40-50%[11], which exemplifies the benefit of using quality seed and the ability to substantially increase the use of such seed, and thus the market potential to be realized. Subsequent to the increasing SRR, the quality seed indent and PC requirement the need to enhance seed availability is also increasing. The rising demand needs to be assessed accurately and the quantity produced to be adjusted accordingly, to prevent the demand - production/ supply gap from widening.

SKPC's 3 target blocks are Agar, Badod and Susner, which are illustrated in figure 3.1[iii]. The gap between the demand and supply of quality seed in the district is greatest in these blocks, and thus the market potential is highest for these blocks, explaining the company's target area. The inaccessibility of the blocks again explains the gap differential – on average only 17.5 % of the 159 villages in the 4 blocks have an all weather approach road[13]. SKPC, the only seed producer company operating in these blocks, is aware that the area has a large captive market: the current SRR is below 1.5% per annum and SKPC'sbusiness plan estimated a 12% SRR to be achieved by 2009-10. To meet the SRR estimates of 12% per annum, a seed demand of over 6000 quintals of certified or labeled seeds of 3 major crops, namely soybean, wheat and chickpea, would be required[11].

[iii] All figures are displayed in the appendix

4. Methodology

4.1. Objective 1 Method.

To establish the market potential for quality seed of the four crops in four blocks in Shajapur district of Madhya Pradesh[iv], two factors must be ascertained:

1. The current quantity of quality seed that is being produced and supplied to the four blocks.

2. The current demand for these crops in the blocks and the potential for demand to increase if limiting factors were rectified.

1. The Current Quantity Produced and Supplied

Producer Companies are the sole agents responsible for the production of quality seed. Since SKPC[11] was the only company engaged in seed production in these four blocks semi-structured interview with the production manager of SKPC was done to determine, the quantity of quality seed produced for area. Traders and suppliers operating in the area and State Seed Corporation (SSC) and the State Agriculture Department Agriculture Development Officer (ADO) of Shajapur were also questioned via questionnaires and a semi-structured interview. The questionnaire and interview format is presented in figures 4.1a and 4.1b.

It is important to discern if a gap is extant between the quantity produced by SKPC and the quantity of that produce that is supplied to the farmers in the target area. A gap between production and supply would affect the amount of quality seed that needs to be produced to satisfy the demand, thus influencing the market potential. The principle cause for a gap between the amount produced for and the amount supplied to the area is that a proportion may be distributed outside the target area of the four blocks. The existence and extent of such a gap and the reasons were determined through the information collected through questionnaires of traders and suppliers, in conjunction with semi-structured interviews with the district and sub–district level representatives of a distribution company, such as the Madhya Pradesh State Cooperative Marketing Federation (MARKFED) and the state Agriculture Department.

2. The Current and Potential Demand

The farmers' requirement for quality seed was determined by two factors: their capacity to use quality seed and secondly, their awareness of the benefits of quality seed and new cultivars. These two factors are influenced by certain antecedents, notably land size, land type, remoteness, and affiliation with the dominant production, promotion agents and MDPIP. All these aspects were considered and incorporated into the methodology, as illustrated in figure 4.1c

The demand comes from the farmers in the region. The primary mode to assess the demand was done through representative sample of all the farmers in the study area, not just those currently producing the four particular crops, but also those with an interest and capacity to initiate growing them. The sample size of 150 was chosen, 50 farmers form each block. For the scale and scope of the study this was a sufficient sample size. It equates to 0.3% of the total number of rural households, 65,564, in all the three blocks[14].

[iv] Henceforth the use of the term ''quality seed'' in this document pertains solely to the 4 crop types upon which the market analysis is focused.

To ensure the sample was representative of the demand, the information was obtained from an equal number of farmers from each of the 3 standard categories of land size and land types. Thus, 17 small, medium and large farm holders from each block were interviewed through questionnaire. The farmers were grouped into further 2 categories according to their land type, thus approximately 8 of the 17 farmers from each size category had one of the land types: rain fed or irrigated. In addition to selecting farmers for interview in the above ways, the selection ensured an equal number of farmers from each block were SKPC or MPDPIP affiliated and non SKPC or MPDPIP associated. Representatively distinguishing the farmers in the above modes allowed a comprehensive comparative analysis of the market potential for certified seeds in the region and enabled the socio-economic groups where the market potential is greatest to be ascertained.

Data pertaining to the actual number of farm holders in each block was unavailable; however, the number of rural households was considered a reliable proxy for two reasons. Firstly, the rural population depends on farming and secondly, the landless population for these blocks is negligible[15]. Therefore, it was considered that for each rural household there is one land holder or head farmer responsible or involved in the process of determining which crops to produce, making it a suitable the surrogate. The variance of the total number of rural households between the 4 blocks was 5.2%, thus the sample was proportionately representative for all blocks, despite having a uniform sample size for each block.

The questionnaires ascertained a number of relevant factors, notably the farmers' current SRR and CRR; the farmers' main sources of information concerning quality seed; and the quantity of quality seed they would like to employ.

4.2. Objective 2 Method

The questionnaire and semi-structured interview were used with the same informants to get insights pertaining to the limiting factors, and thus data collection to fulfil both objectives was conducted in conjunction.

To summarize, the research data was be derived from questioning a variety of agents in the quality seed sector. The following people were interviewed to get better insight:

1. Representatives from Samarth Kisan Producer Company (SKPC)

2. Representatives from the Agriculture Department of Madhya Pradesh.
   - i) Deputy Director of Agriculture (DDA)
   - ii) Agriculture Development Officer (ADO) – District and Block level officer

3. State Seed Corporation of Madhya Pradesh

4. Representative from the a local marketing centre, such as the Madhya Pradesh State Cooperative Marketing Federation (MARKFED) and other fundamental quality seed promoters, such as extension workers.

5. Representatives from Madhya Pradesh Development Poverty Initiative project (MPDPIP)
   - i) Director of MPDPIP
   - ii) District project Manager of DPDPIP

6. Dealers, Vendors, traders and distributors - Including those operating on small, medium and large scale, respectively.

5. Data Analysis

Information garnered from SKPC, SSC, the Agricultural Department, MARKFED, and MPDPIP representatives, as well as local seed traders and suppliers, provided interesting insights for the study. In addition to SKPC, 4 other companies dealing with CS - although significantly smaller in scale and scope of operations - were found to be operant in the study area, and were thus included in the research. The details of each of the informants are presented in table 5.1. All these sources provided some information of relevance, however, the information that they were able to provide largely pertained to the district or block level and, regarding the demand for CS, was very vague. This unveiled a void in the demand awareness of the key players in the quality seed chain, the extent of which was discerned primarily from the farmer interviews.

As planned in the methodology, the farmer level data collection method was representative of each category of farmer. This was insured by firstly distinguishing an equal number of villages from each block that were SKPC or MPDPIP associated and non SKPC or MPDPIP associated. The villages thus defined were then selected randomly, eliminating any element of bias. As a result of this random selection, the farm holders in the villages sampled were also representative of the proximity and accessibility to important facilities; namely the market, producer companies, extension workers, highways and tarmac or 'pukka' roads. Sampling sites of varying proximity from certain services enabled the influence of distance from important facilities on market potential to be assessed.

Where possible, interviews were conducted in a focus group format. The group sizes ranged from ten to thirty and the random nature in which farmers were gathered and congregated ensured the number of farmers interviewed from each land size category was proportional to the farm size nuances of the village. As a result, the number of farmers interviewed from each land size category was not equal, as originally proposed. This amendment to the data collection method meant the data represented the farm size characteristics of each village, and, by extension, each block, enhancing the validity of the sample method.

Information pertaining to the two principle factors underlying the market potential – the quantity produced and supplied, and secondly, the current and potential demand – was obtained from all the agents assessed. Consequently, the key findings will be presented categorically, rather than agent specifically.

5.1. Assumptions

To make the research analysis transparent and ensure the validation of conclusion following assumptions were made:

1. *The village sample represents the village.*

2. *The mean of the village samples represents the block.*

3. *Lack of cash and information curtails further capacity.*

These 2 factors were generally given equal importance by the farmers who expressed them as limitations. It was assumed that each limiting factor represents 50%, or ½ of the farmers not using

CS, of the reasons for not adopting CS, when only these limiting factors, cash and information, apply. Thus, with one of the factors removed, ½ of the farmers not using CS would now have the capacity. As a result, if previously lack of finances and information were the sole factors limiting CS use, and the farmers showed an interest in the technology, then complete or 'perfect' extension services would lead to an increase in CS consumption among half the farmers in the area. The actual increase in CS consumption per village will depend on the percent of farmers not yet using CS and assumption *4*.

4. Farmers that start to adopt CS subsequent to improved extension services will be assumed to use the same amount and have the same SRR as the mean CS use of a farmer in the village.

5. The village samples are taken to be representative of the block by using the mean results of the villages sampled from each block and considering the number of villages in each block.

6. Every household has a farm holding. Thus the number of households in a block is approximate to the number of farm holdings in that block.

5.2. Objective 1 Data Analysis

One important factor the primary research revealed that impinged on the type of information obtained was that truthfully labelled seed was neither produced nor supplied in the three blocks. As a result, CS is the only type of quality seed in the area.

5.2.1. The Current Quantity Produced and Supplied

The research ascertained that SKPC were not the only suppliers of CS in the three blocks, although they are the only PC. There are four other private companies, though in comparison to SKPC they represent a fraction of the quantity of CS supplied in the area. In addition, two government institutions were involved with the provision of CS to the area. Table 5.2.1.1 presents the crops and the localities that were covered by these providers, illustrating that the government distributors and SKPC were the dominant sources of CS and collectively they accounted for 98%, of CS supplied to the region.

Name of Producer Company or Dealer	**Blocks Served within study area**	**Crop specific quantity CS supplied (qtl)**				**Total CS Supplied (qtl)**
		Soybean	*Wheat*	*Gram*	*Coriander*	
SKPC	Agar, Susner, Barod	1,150	2,500	250	50	3,900
Dev Nanayan Agro Seeds	Agar	0	10	0	0	10
Shyam Babuagamwal	Agar, Susner, Barod	50	36	0	0	86
RL Gupta	Agar, Susner, Barod	30	50	0	0	80
Dinwshy Aaya	Agar	10	11	12	0	30
MPDPIP	Agar	598.2	139	0	0	1,679
	Susner	110.8	9.2	0	0	
	Barod	750.4	71.4	0	0	
	Total	1459.4	219.6	0	0	
Agriculture Department	Agar, Susner, Barod	1,200	1,200	20	0	4,020
Total CS Supplied to to Agar block (qtl)		-	**-**	**-**	**-**	-
Total CS Supplied to Barod block (qtl)		**-**	**-**	**-**	**-**	-
Total CS Supplied to Susner block (qtl)		**-**	**-**	**-**	**-**	-
Total CS Supplied to 3 blocks (qtl)		**3,939.4**	**3,807**	**282**	**50**	**8,078.4 - 9,805***

Table 5.2.1.1. The Current Quantity of CS Supplied within the 3 blocks for 2008-2009. *There were two values for the total CS supplied to the 3 blocks. The lower value is the sum of the crop specific totals and the higher is the sum of the last column.

The proportion of both the population and the villages the dominant sources of CS in the region furnish with CS in each block is asymmetric. This is presented in table 5.2.2. Agar block, which is the most developed in terms of road infrastructure, services, and is where the district offices of each of the three CS suppliers are located, is the best supplied of the three blocks. This suggests proximity to facilities exerts an influence on CS supply. This inference is supported by the fact that all of the three dominant suppliers concentrate their activities in Agar block and two of the four other suppliers only operate here. Secondly, the data depicts that only a minor percent of each block is served with CS. For example SKPC, the only major supplier in which the number of villages it served per block was available, accounts for 34% of CS in the area, but its supply of CS to its most extensively covered block, Agar is only 12.6% and a mere 3.7% to its least covered block, Susner. The data is diagnostic of one of two conditions: either that the demand for CS is marginal or that the gap between demand and supply is notable. The clarification of this predicament is the focus of 5.2.2.

There is a possibility the research did not reveal all the private suppliers whose purview included the three blocks. For example, local seed suppliers, officially dealing solely in non-CS, may unlawfully supply quality seed. To supply CS a license is required and consequently, if suppliers are dealing CS without a license they would not disclose this malpractice. Accordingly, consultation with such agents was refused and thus the total CS quantity supplied to the area may in fact be greater than the research discerned if other agents deal with CS. This unknown value, however, is unlikely to be significant, but is noteworthy none the less.

5.2.2. The Current and Potential Demand

Augmenting information collected from the multiple sources was essential to understanding the current demand of CS. Although two bodies conduct demand assessment in the area - SKPC and the Agriculture Department - this study revealed their indent evaluations were incomplete and inaccurate. This was an alarming finding of the research, as it highlights severe problems in the demand assessment protocol at both government and private levels and thus entails investigation. The farmer level aspect of this research was fundamental in manifesting the weakness of the current demand assessment and furthermore, indicated the causal factors. This will be expounded in section 6.

One foci of the SSC is CS demand assessment. Representatives of SSC, table 5.1, were able to provide thorough explanations of the assessment procedure, but were unable to provide current demand data. In each instance, the representatives reported this information could be found at the block level of the institution, though consultation with two block level officers, Rural Agriculture Extension Officers (RAUs), contradicted this. The absence of the data indicates cracks in the government's demand assessment process. The information was unavailable because of RAU malpractice: demand statistics are discarded once the CS for that season has been supplied to the block offices. As a result, the statistics were only available for one month at the start of the season and there was no means to gage temporal changes in demand and sets a narrow window in which the quality of the block level demand assessment quality may be verified.

The primary step to increasing agricultural productivity through enhancing the adoption of CS is to accurately assess the current demand. Only then can the correct amount be produced and supplied. The farmer level, and even the RAU level, interviews painted a picture of stark contrast to the gleaming portrayal provided by the SSC, MPDPIP and Agriculture Department directors. The SSC demand assessment protocol stipulates the modus of operandi extends to every village within the block. The two RAUs interviewed declared they did not achieve this and in a mean season the indent would be sought from approximately 400-500 farm holders, amounting to just 2.6 - 3.2 % of

the farm holders in the block[v]. They stated they did not have the time to go to every village and often assessed the demand according to their own judgment. Indeed, only 3 out of the 12 villages sampled were RAU associated and of those villages only one had substantial contact with an RAU, supporting the indication that indent is assessed from the office as opposed to the field. The RAUs interviewed related that their approach to demand assessment was common among the RAUs. SKPC's demand assessment method is comparatively commendable. Service Providers (SPs), inter alia, are responsible for consulting with farmers to ascertain their specific demand of CS in advance of each season. Their role is thus analogous to that of an RAU. 58 SPs are employed by SKPC on a commission basis, encouraging them to fulfil their job requirements, with one covering a maximum of 3 villages. This compares favourably to the state assessment mode, in which there is no incentive for the RAUs to assess demand accurately and 3 RAUs are employed per block, equalling, in the case of Agar, 45 villages per officer. It must also be noted that SKPC only assess the demand for the villages in which they have shareholders, which is 24% of the rural population of the 3 blocks (table 2, p). These significant differences between the SPs mode and that of the RAUs are reflected in the discrepancy of the demand awareness and requirement fulfilment for farmers served by SKPC and those served by the Agriculture Department. A notable finding of this study exemplifies this: 100% of the SKPC associated farmers interviewed reported their current CS requirements were fully met, in contrast to farmers supplied by RAUs whose requirements, on average, were only 30-40% met[vi]. It was found that in 80% of the villages, farmers compensated for the inadequacy of the RAUs by sourcing CS from additional sources, such as village level societies, for example MARKFED, and local traders. The other villages were unaware of or unable to procure from these agents, and thus the RAUs inactivity rendered them incapable of realizing the benefits of CS. Within the 13 villages investigated there was one case, Awar of Agar block, where the RAU service satisfied a paltry 5% of the demand and the farmers, ignorant of other CS sources, resorted to farm-saved and local seed, despite having a CS demand of 100% for their two primary crops. These findings highlight there is a gap between demand and supply, stemming from the demand unawareness of the suppliers.

The correlation between SKPC's comprehensive demand assessment method and their demand completion, in contrast to the Agriculture Department's deficient assessment and fulfilment, emphasises the necessity of thorough demand assessment to ensure farmers' demand for CS is sated.

With no block level demand data available from the Agriculture Department, and SKPC's indent information relating to less than a 3rd of the 3 blocks, i.e. only for their shareholders, the current demand for the study area was chiefly ascertained from the farmer interviews.

The resulting detailed village data is presented in table 5.2.2.1 and the derived current and potential CS use is shown in table 5.2.2.2. The demand was discerned by multiplying the area sown per crop by the Seed Rate of that crop, divided by the SRR. Normally the SRR is given as a percentage representing the mean annual replacement level of a specific area, such as a district or state. In this study, in order to express the use and potential use of CS as an annual rate it was necessary to define the SRR as the number of years until farmers replaced the CS. The calculation methods are expounded fully in the note section of table 5.2.2.2.

[v] Using the farmer proxy of the number of farms per block.

[vi] These two statistics, derived from the farmers, was substantiated by the SKPC representatives and one of the RAUs, respectively, who iterated the extent of the gap between demand and supply that their corpus assessed and provided.

Table 5.2.2.3 displays the current use of CS, the current demand and the two potential demand proxies of the village samples and, by extrapolation, the blocks[vii]. From the data in the table many important inferences can be drawn. These will be evaluated in two sections; firstly, the village-level and secondly, the block-level.

Village-Level Analysis

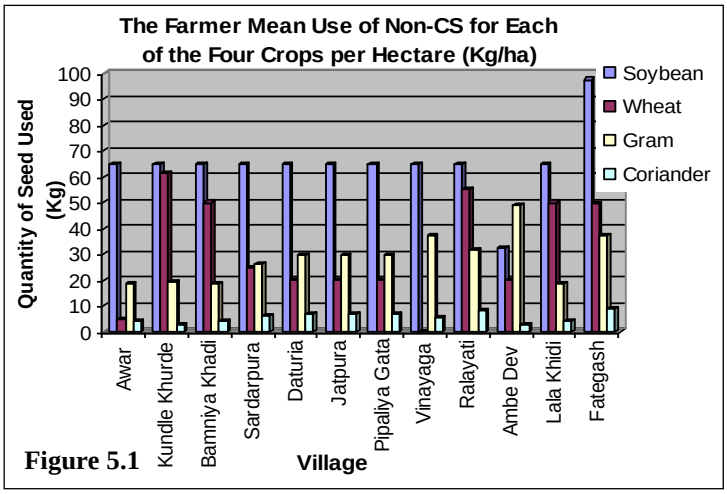


Figure 5.1

The most salient feature of the results is the asymmetry in the quantity of non-CS employed for the production of the 4 crop types investigated. This is illustrated in figure 5.1. From this graph it is clear the most used seed for the agricultural land in all the villages is soybean.

Wheat and, to an extent, gram are also used in substantial quantities in most of the villages, in contrast to coriander, which is produced in minor quantities in all villages. The use of and demand for CS would be expected to correlate with this pattern, though this is not the case, as illustrated in figure 5.2.

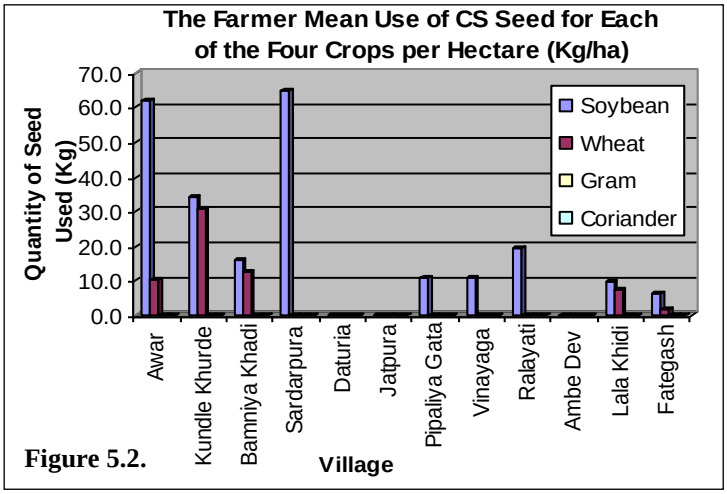


Figure 5.2.

The graph emphasizes the key characteristics of CS use. Firstly, for all the villages except one the use of certified soybean seed is by far the most popular and is used in 9 of the 12 villages sampled. Secondly, wheat is the next most popular crop for CS, but the quantity used is substantially less than would be expected if the use of CS followed a similar pattern to the use of non-CS seed and is only adopted in 5 of the samples. Finally, no CS is employed for the production of either gram or coriander. This is noteworthy, as although very little non-certified coriander seed was used in the study area, gram is used in significant quantities, especially in Ambe Dev. Thus the use of, and corollary demand for, CS cannot be predicted based on the use of non-CS in the area.

There is also extensive discrepancy in the 4 CS factors between the villages sampled. This is clearly portrayed in figure 5.3a by the parabolic pattern and reflects the differences in various aspects that characterize the villages. The effect of the number of farms per village on the 4 CS factors can be eradicated by standardising the values, which is illustrated in figure 5.3b[viii].

[vii] Details concerning calculation of these factors and necessary comments are given at the head of the table.
[viii] The improved farmer derived farm number proxy (see section 5.3

A comparison of the pattern of the two graphs manifests that the number of farms per village imparts a significant affect on the 4 CS factors at the village level. For example, when the variance

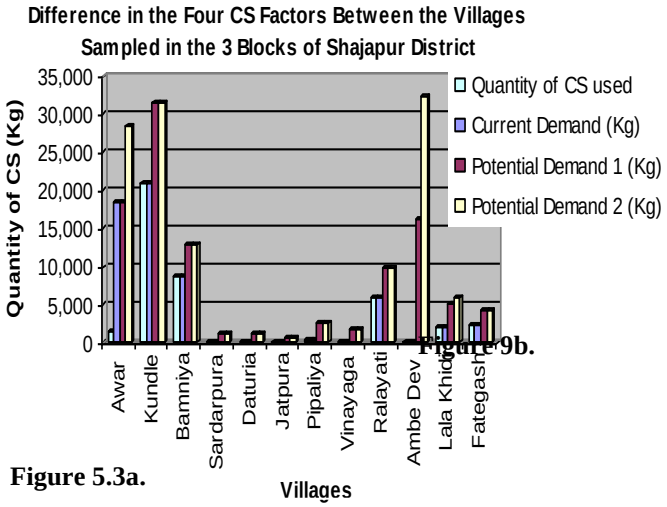
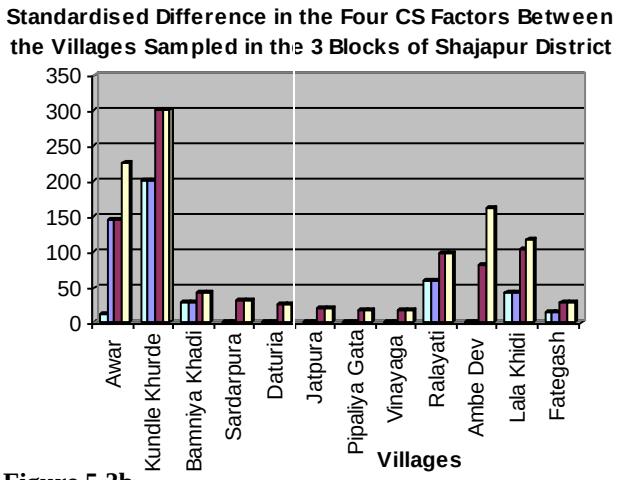


Figure 5.3a.

Figure 5.3b.



in the number of farms per village is accounted the relative difference in the 4 CS factors between Kundle Khurde and Ambe Dev, increases markedly. Exceptions to this are extant, such as in Bamniya Khadi, which has a relatively much reduced current demand in 5.3b, in contrast to Vinayaga, in which the current demand sees a relative increase when farm number is accounted for. The general similarity between the two graphs denotes that characteristics other than the number of farms within the village are responsible for the discrepancies in the use of and demand for CS. An analysis of these characteristics is the foci of section 6.

In addition to discrepancies in the 4 factors between the villages there is strong variance within the villages. For example, in 7/12 of the village samples the current use of CS is significantly lower than the current demand and in all the samples the potential demand[ix] is greater than the current demand. These differences reveal the gap between the current demand and supply and the potential for the use of CS to be greatly enhanced. The cognizance of this was the primary objective of the Study, the extent and significance of which will be emphasised in section 5.4.

Block-Level Analysis

The block level data is summarized in table 5.4. Differences in the quantity of non-CS seed and CS seed used for the four crops and the four CS factors between the villages also exist at the block level. The quantity of non-CS seed and CS used for each of the four crops follows the same pattern at the block level as it does at the village level, with soybean being the dominant seed. Although the pattern is similar for each block, the seed quantities used are quite disparate for one of the blocks, Agar. Figures 5.4a and 5.4b emphasises this. For non-CS,

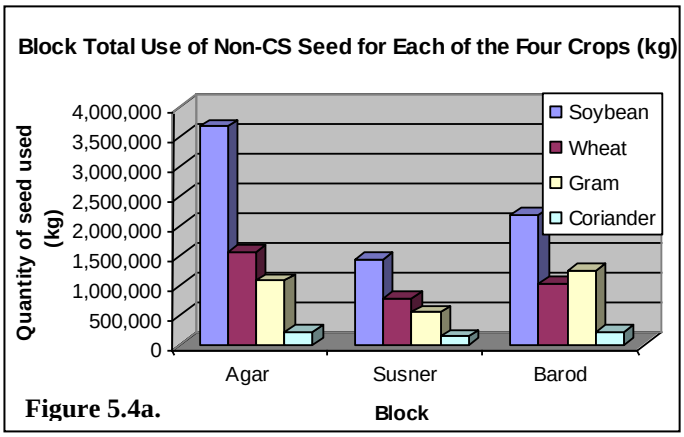


Figure 5.4a.

[ix] Two potential demand proxies were formulated for this study. Refer to points 2 and 3 of figure 6 for explanation of these proxies.

figure 5.4a, the quantity of seed used in Agar is similar to Susner and Barod for wheat, gram and coriander, but, with regards to soybean exceeds these blocks considerably, by 60% and 40%, respectively. These are insightful statistics, as the rural population difference between the three blocks is 0.89%, which shows that factors other than population are attributable to one block exceeding the others in the use of seed. One factor that is disparate for all the blocks is the number of farm holdings in each block. When the data is standardized for this factor[x], figure 5.5c, the dominance of one block diminishes slightly. This reveals the number of farms per block bears an influence on the block scale results, in accordance with the village-level observation, and thus is a factor that must be considered in the analysis of sample data at every level.

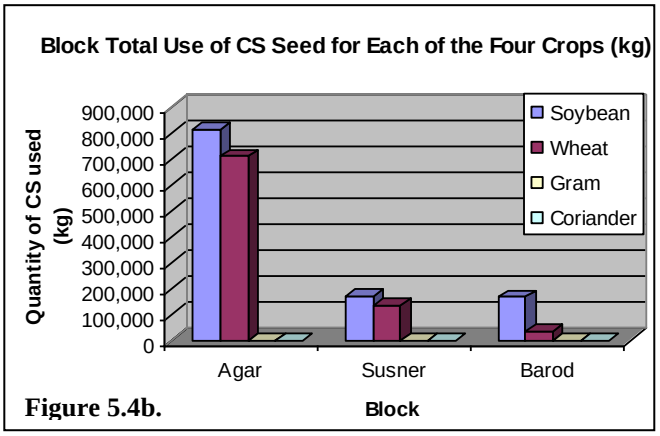


Figure 5.4b.

Another aspect of the crop specific non-CS use characteristics that is clarified in the block level graph 10a is that the use of gram seed is greatest in Barod block and constitutes its second most important crop. This reflects the scarcity of water in the Barod area, relative to the other blocks, and thus the less water dependent gram is cultivated in favor of wheat.

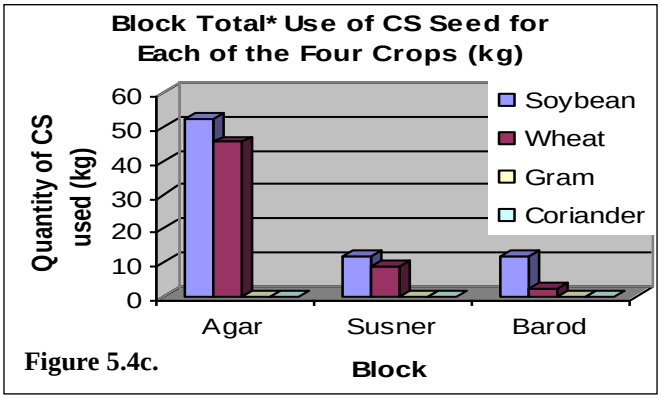


Figure 5.4c.

The difference in quantity of CS used for soybean in Agar compared to Susner and Barod is even greater for CS vis-à-vis non-CS, 79% and 80%, respectively. An almost identical inter-block difference in the use of soybean CS also exists for wheat, though for gram and coriander the use is uniformly nil. The differences in the quantities involved between the use of non-CS and CS shows that the use of CS is marginal in comparison to non-CS.

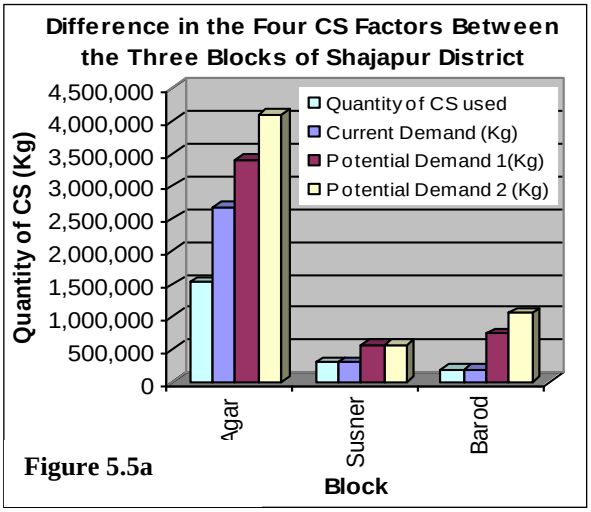


Figure 5.5a

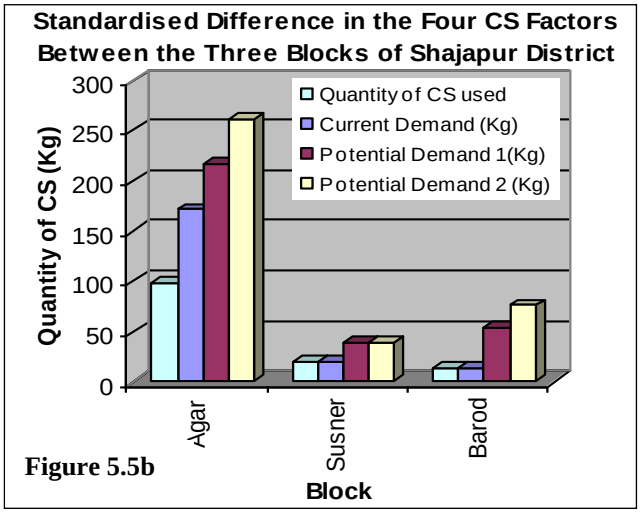


Figure 5.5b

[x] Refer to point 2 in table 3 for calculation and assumption details and table 4.

The large difference in the quantities of CS used for the four crop types between the blocks translates to a sizable difference in the total quantity of CS used. Figure 5.5a illustrates this and shows that the ancillary CS factor quantities are also greatest for Agar block by a notable margin. This is also the case when the number of farm holdings per block is accounted for, in the standardized total, 5.5b, although the relative dominance of Agar diminishes slightly, in accordance with the influence of farm number of crop-specific quantities of seed used. The formidable difference of CS characteristics for Agar vis-à-vis Susner and Barod are a consequence of a fundamental factor: extension services. Other factors play a part also, the analysis of which is the subject of section 6.

5.3. Validity of the Results

A comparison between the current supply and current and potential demand provides important insights pertaining to the low use of CS and potential to enhance it. From the interviews with the PCs and auxiliary seed distributors the total amount of CS supplied to the 3 blocks is between 8,078.4 - 9,805 qtl[xi] (table 5.2.1.1). The uncertainty results from the sum of the total supplied for each crop and the sum supplied for all crops, the former and latter quantity, respectively, not being equal. Another figure of the seed supplied has been derived from the farmer interviews. The current CS use is a surrogate of the current supply, the total of which for the 3 blocks is 20,321.96 qtls. This is presented in table 5.4 as well as the block specific totals. The discrepancy between the PC and distributor derived total and the farmer interview derived total is 12,243.56 – 10,516 qtls. The difference may be caused by one or a combination of a myriad of factors. The PC and distributor derived total may be too low because there are other sources of CS in the area. For instance, local traders may illegally deal with CS and other suppliers may operate in the area that the study failed to identify.

Alternatively, or conjunctively, the farmer derived figure may be too high. This could reflect inaccuracies in the sample extrapolation method. The most likely source of inaccuracy would be the number of farm holders figure. It was not possible to obtain a figure for the number of farms per village or block from any source other than the farmers at the villages sampled. It is not possible to adequately assess how accurate the information given was and they certainly lacked precision as farmers were only able to provide approximations. Although not exact, the approximations are likely to be correct as the farm holders would be knowledgeable of the agrarian characteristics of their village. Any inaccuracies collected at the farmer level would be multiplied through extrapolation to the village level and thence block level. Therefore, a slight inaccuracy in the figure for the number of farms / farm holders in the village would manifest as a significant inaccuracy and compromise the veracity and validity of the results and subsequent inferences.

The importance of validating the accuracy of the results behooves their assessment. The only way to do this is to compare the farmer derived block level number of farms with the figure derived from a census derived proxy[xii]. The discrepancy between the two proxies, presented in table 5, is vast; however a pattern is apparent – there is a correlation between the rural population of the block and the number of farms in the block. This pattern arose with the former proxy not including the population as one of its calculation parameters. The fact that the census derived proxy has this correlation suggests that the number of farm holders in each block is proportional to the population

[xi] Figures pertaining to the quantities of seed supplied and the current use, demand and potential demand apply to the 2008-2009 Kharif and Rabi season since all the data collected, from all the multiple sources, pertains to this period.

[xii] The census does have village level data, however the names of the villages differ to the names we obtained, the difference between the vernacular and official perhaps, which renders comparison of the number of farm proxies impossible at the village level.

Block	Rural Population of Block	No. of Villages in the Block	No. of Farm Holders in the Block1	No. of Farm Holders in block2
Agar	28,000	136	79560 / 15661*	4,746
Susner	26,000	140	14,700	4,407
Barod	25,000	111	13,875	4,237
Total	79,000	387	108135 / 44236*	13,390

Table 5.5. The two proxies for the number of farm holders / number of farms and related factors. [1]Farmer interview proxy. [2]Alternative census derived proxy. (= rural population of block / average number of persons per household, 5.9[14]). This proxy is dependent on assumption 6. This is an unsatisfactory assumption as it assumes every household in the entire rural population are agriculturalists. *Improved number of farm holders figure.

and indicates that the farmer derived proxy is accurate in relative terms. The comparison of the proxies reveals nothing, however, of the farmer proxy's accuracy in absolute terms, although proxy one is likely to be much more accurate than the latter. The emphasis of the correlation by the comparison clarifies a previous suspicion; the no of farm holders in Agar is too high in comparison to the other blocks. The error would have been a result of the two villages sampled having a mean number of farms that was higher than the number of farms in most villages and thus greater than the block mean. This shows the weakness of sampling only two (although three if you include the various villages sample) villages in a block. The strength of the correlation, when the anomalous Agar value is excluded, is determined by the correlation coefficient, R^2. The R^2 value of 1, figure 5.1 manifests the two proxies are extremely strongly correlated and confirms the farmer derived Agar value is erroneous. The importance of this confirmation is fundamental to one aspect of the research results.

The data in the 'standardized total' column of table 5.3 and table 5.4 was calculated by dividing the block totals for each of the CS factors by the number of farm holders in the block. As a consequence of using the erroneously high number of farms figure for Agar the standardized total results for Agar were very low. The standardized total and subsequent inferences drawn thus needed revision. The standardized total and the standardized current CS use were the only calculations that used the number of farms per block proxy, and thus are the only one affected by the inaccuracy.

Based on the strength of the relationship between the two proxies, the census derived number of farms in Agar can be used to give an accurate value for the number of farms in Agar block. This assumes the number of farms will follow the pattern observed in Susner and Barod, a sound assumption as the factors that influence the number of farms will be the same for these blocks. The number of farms in Agar using the relationship between the two proxies is 15,661. As justified previously, the approximate number of farms per village given by the farmers is likely to be accurate, so with the anomalous result rectified and the trend between the results of the blocks verified by strong correlation with an independent proxy, the results can be considered reliable.

Only the revised results and inferences have been presented in this paper.

5.4. Summary and Significance of the Results

The village and block-level analysis indicated the existence of a substantial difference between the use of CS and the demand and potential demand. The extent of the difference will now be expounded fully at the study region, or sub-district, scale. Table 5.6 shows the essential findings of this research at the study region scale.

		Soybean	*Wheat*	*Gram*	*Coriander*	*Total*
Total of the Three Blocks	**Current CS use (Kg)**	1,157,599	874,598	0	0	2,032,196
	Total CS Supplied to 3 blocks (qtl)*	393,940	380,700	28,200	5,000	980,500
	Current use and supply figure difference	763,659	493,898	-28,200	-5,000	1,051,696
	Current Demand (Kg)	2,510,340	1,389,766	0	0	3,900,105
	Current Gap (Kg)	1,352,741	515,168	0	0	1,867,909
	Potential Demand 1 (Kg)	2,639,737	1,603,340	180,375	0	4,423,451
	Potential Demand 1 Gap (Kg)	1,482,138	728,742	180,375	0	2,391,255
	Potential Demand 2 (Kg)	3,733,189	1,603,340	360,750	0	5,697,278
	Potential Demand 2 Gap (Kg)	2,575,590	728,742	360,750	0	3,665,082

Table 5.6. Total quantities of the 4 CS factors of the three blocks and associated gap calculations. *The total as ascertained from the seed PC, Government body, dealer and trader interviews. All other data presented in this table is derived from the farmer-level interviews. **There were two values for the total CS supplied to the 3 blocks (refer to * table 1). This total is the larger value.

The total current CS use differs from the total quantity supplied to the three blocks by the sources of CS determined to be operant in the area. The difference is shown in table 5.6 and is diagnostic of one of two, or a combination of two, factors: that the figure for the current CS use derived from the primary data is too high; or that there are other sources of CS within the area that were not uncovered in the research. The current CS use was ascertained directly from the farmers and the sample extrapolation to the block level is likely to be sound as no uncertain variable parameters were involved in its calculation (refer to * table 5.3, p). It is thus more likely that the primary cause for the difference is that CS is supplied to the area from sources other than those ascertained. The current CS use figure will thus be assumed to be accurate and is employed in the CS supply gap and potential calculations.

The current difference between the CS used in the 3 blocks and that demanded is momentous. For soybean CS the gap is in excess of 1.35lakh quintals (qtl) [xiii] and for wheat the gap is over 5lakh kilograms (kg). There is no demand at present for the other crops, gram and coriander, investigated. The existence of a gap between the current demand and supply / use of CS was previously known, but with no clarity. Indeed, one of the questions asked to all agents interviewed was to estimate the gap and it was as low as nil in some cases[xiv] and as high as 60-70% the present supplied in one case[xv]. This study has revealed the extent of the gap - which is almost 400% greater than the quantity ascertained to be supplied to the area and 192% greater than the current use – showing that there is great potential for PCs to enhance production of CS. With the verification that there is an existing and significant gap between the current demand and supply PCs have the assurance there is a ready market for CS and do not have to risk over production and corollary diminished fiscal returns.

The extent of the gap will come as a revelation to SKPC. They are contemplating accessing markets beyond their current purview, the 3 blocks investigated, based on the understanding that there is an insufficient market / demand for CS in these 3 blocks. This understanding originates from a demand assessment which is only conducted in the villages the PC currently supplies, i.e. 24% of the villages in the block; and a conception that the majority of agriculturists lack the capacity, be it financial, physical or motivational. This research concludes contrary to this and emphasises a large CS market exists within the three blocks.

[xiii] 1 quintal = 100 kilograms.
[xiv] SSC and MARKFED representatives.
[xv] RAU officer.

The momentous market potential shown to presently exist has the potential to increase further still, as the potential demand 1 and 2[xvi] totals and difference between the current supply / use portray, which are 21.9% and 196.2%, respectively. These proxies proclaim that if the required action is adopted the ability for farmers to cultivate with CS, PCs to enhance production and both parties to reap the rewards, will be vast. For these potentials to be realized farm holders in every village need to be fully informed of CS and new varieties, especially their required POPs[xvii], availability and benefits. The inadequacies of the current extension services, of which demand assessment is a vital part, was discussed in 5.2.2 and the extent of the potential demand exacts a radical enhancement of these services.

6. Analysis of Factors influencing CS characteristics

The data analysis revealed marked differences in the use of and current and potential demand for CS, both at the village and block level. There is a need to fathom the causal factors of the discrepancy as it will identify the factors limiting CS use and enable the CS extension approach to be better focused and more effective. In addition, an awareness of the factors responsible for facilitating CS use, and corollary demand, will assist in site location for emerging or expanding PCs. A thorough analysis of the factors influencing CS characteristics is beyond the scope of this paper, but the data collected will be used for an elementary examination to support extension refinement and further research.

The influence of four factors on CS characteristics will be investigated: farm size, land quality, accessibility and quality of extension services. The farm size of the sampled farmers in each village varied and so was normalized by calculating the village-mean farm size.[xviii] To analyze the other factors the associated qualitative information from the village samples were ranked.[xix] The four factors are presented in table 7 for each village. Statistical analysis manifested which of the factors influenced the use of or demand for CS within each village.

Relationship Between Two Variables		Pearsons Correlation Coefficient r	Pearsons R^2 value	Pearsons P value (5% confidence interval)
x	**y**			
Mean farm size (ha)	**Farmer Mean Soya CS use per ha (Kg/ha)**	-0.71	0.51	0.050
	Farmer Mean Wheat CS use per ha (Kg/ha)	-0.46	0.21	0.460
	Farmer Mean Total CS use per ha (Kg/ha)	-0.75	0.57	0.034
	Standardised Total CS use per ha (Kg/ha)	-0.16	0.03	0.080
	Potential Demand 1 per ha (Kg/ha)	-0.24	0.05	0.004
	Potential Demand 2 per ha (Kg/ha)	-0.29	0.08	0.005
Land Quality / Water Availability	**Farmer Mean Total CS use per ha (Kg/ha)**	0.48	0.23	0.002
	Standardised Total CS use per ha (Kg/ha)	0.50	0.25	0.06
	Potential Demand 1 per ha (Kg/ha)	0.39	0.15	0.03
	Potential Demand 2 per ha (Kg/ha)	0.27	0.07	0.004
Accessibility	**Farmer Mean Total CS use per ha (Kg/ha)**	0.68	0.47	0.005
	Standardised Total CS use per ha (Kg/ha)	0.31	0.10	0.005
	Potential Demand 1 per ha (Kg/ha)	0.24	0.06	0.004
	Potential Demand 2 per ha (Kg/ha)	0.15	0.02	0.004

[xvi] Refer to points 2 and 3 of figure 6 and assumptions 3 and 4 for details of the proxies.
[xvii] Package of Practices. For the optimum yields from CS certain cultivation procedures, both pre and post sowing, are required. For a comprehensive outline of these requirements see p72-3 of Seed Management[3].
[xviii] Refer to note *, table 7 for ranking explanation.
[xix] Refer to a, b and c of table 7 for relevant details about each of the ranked factors.

Quality of extension services provided	**Farmer Mean Total CS use per ha (Kg/ha)**	0.16	0.09	0.030
	Standardised Total CS use per ha (Kg/ha)	0.60	0.02	0.06
	Potential Demand 1 per ha (Kg/ha)	0.45	0.00	0.004
	Potential Demand 2 per ha (Kg/ha)	0.23	0.04	0.005

Table 6.1. Statistical Analysis of Influence of Four Factors on the Inter-Village CS Use and Potential.

Of the four factors, the mean farm size has the greatest influence on CS use. The low correlation coefficient R^2 values shown in figures 6.1a, b, c and d depict that the CS use is not strongly dependent on the mean farm size, although the Pearson's product moment correlation coefficient shows a strong negative association exists between farm size and both the farmer mean use of soybean CS and the farmer mean total CS use, r = -0.71 and -0.75, respectively. The relationship denotes that, generally, the larger the farm size the lower the quantity of CS adopted. This is contrary to the a priori prediction of the research, which was based on the understanding that farm size is positively related to the farmer's wealth, and thus larger farm holders would have more capacity to employ CS, and corollary would use CS in greater quantities relative to smaller size farm holders. Instead, the negative correlation suggests that farm size acts as a constraint on the use of CS per hectare, indicating that the larger the farm holder the less intensively or extensively they are able to cultivate their land with CS. Table 6.1 displays these statistics and also the p value, to show the significance of the relationships. For instance, for both the farmer mean use of soybean CS and the farmer mean total CS use, p is less than or equal to 0.05, signifying the relationships are statistically significant and thus, with 95% confidence, not a product of chance.

The relationship between the mean farm size and use of wheat CS is weak compared to soybean, r = -0.46 and -0.71, respectively. There is no discernable reason for this and the probable cause of anomalous results is not the cause. Seven of the twelve villages use no CS for wheat, which in effect means fewer than half the points in the data set contribute to determining the relationship in the statistical calculations. However, removing the anomalous data points from the calculations has negligible effect on the strength of the correlation – the p value adjusted by 0.05 to -0.41. The mean farm size has the least influence on the standardized total CS use out of all the CS parameters (r= -0.16), showing that for the majority of the farmers in the villages farm size does not affect their CS use, a consequence of CS adoption by only a minority of farmers. The farmer's potential demand per hectare for CS is also not significantly influenced by farm size, although farm size still acts as a limiting factor (r= -2.4 / -2.9).

The influence of the remaining three factors on CS use and demand will be only be presented for the total farmer mean and the standardized total value, as these are the most meaningful parameters. The former indicates the CS cultivation practices of the CS farmers within each village; the latter reflects the formers relativity with other farmers at both the intra and inter-village level.

For the other three factors CS use and demand is positively related. The strongest influence is imposed by the accessibility of the villages, for example, the r value for the farmer mean total CS use per hectare is = 0.68. Although this factor strongly influences the current use of CS, its affect on the potential use is minor (r=0.24 / 0.15). The current use is enhanced by adequate accessibility as it facilitates the mobility of extension services and CS to the village. The potential demand of a village, however, is not significantly influenced by accessibility as the capacity of the farmers to adopt CS is the primary determinant of their potential. Indeed, the difference between the quantity of CS used and potential demand for CS between the villages is greatest for the least accessible villages, as exemplified by Ambe Dev, which has very poor accessibility, table 6.7, though high potential demand despite not currently employing any CS, as emphasised in figures 9a and 9b.

The quality of land and extension services has a similar, though slightly diminished, influence on the CS parameters as the accessibility. The influence of these two factors is roughly comparable, for example the correlation between land and the total farmer mean CS use and standardized total CS use is r=0.48 and r=0.5, respectively, which is analogous to the association between extension service quality and the standardized total and potential CS use with r values of 0.6 and 0.45, respectively. The p-value for these correlations, sub 0.05, delineate they are statistically significant. The existence of a significant positive relationship in the data is, as with accessibility, is no surprise. The availability of water is the primary limiting factor for pastoral agriculturists in Shajapur. This factor, coupled with the fact it is easily ascertained, is thus a good proxy for land quality. High land quality would facilitate CS use and demand as the farmer would be less reliant on inputs to raise the land quality, such as fertilizers, increasing the likelihood of having the capacity to invest in other inputs, such as CS. The availability of water is also diagnostic of water security, which may significantly influence CS use. With high water security, such as land with 100% irrigation and thus a high probability of year-round water access, farmers would be more likely to invest in CS. Conversely, with low water security, investing in CS may be considered too much of a financial risk, as poor rains may spoil the crop, causing the farmer to incur a financial loss compared to if he used cheaper seeds or saved seeds. The use of CS is positively influenced by the quality of the extension service provided as it not only gives farmers the choice to adopt CS, but also clarifies the benefits of doing so. Consequently, a village with no or an inactive SP would render farmers unaware of the boon of CS and subsequently the use of the technology would be low.

Individually, the four factors do not sufficiently explain the inter-village variance between the CS characteristics, although collectively they may. Multivariate statistical analysis clarifies this. The multiple regression value is 0.68 and the adjusted R^2 value, the most important multivariate regression statistic, is 0.29 (table 6.8a). The r-value depicts the combined influence of the three factors on CS use is fairly strong, as strong as the influence of accessibility, but the low adjusted R^2 value expresses additional factor(s) also strongly influence the CS use. Multivariate regression analysis on the combined influence of the mean farm size, quality of land, accessibility and extension service on CS use (table 6.8b), emphasises one of these additional factors is the mean farm size, but also elucidates that additional factors are also influential. The r-value is very strong and positive, r=0.8 and the adjusted R^2 value is reasonably high, 0.54. The sub 0.05 ‘significance F’ value, table 9b, shows the relationship is statistically significant and thus the use of CS is strongly associated with, and has a sizable dependency (54%) on, the four factors.

To summarize this section, the use of, and potential demand for, CS in an area is positively influenced by the quality of accessibility, land and extension services in that area. The mean farm size of the village, in contrast, has a strongly negative effect on CS use and conjunctively, the four factors very strongly and significantly influence CS use. Additional, a range of factors, also impart a substantial influence. It must be noted that the influence of each of these factors is not uniform for the CS characteristics. For instance, out of the four factors, accessibility has the second strongest correlation with the total use of CS and yet has the weakest correlation of all the factors with the potential demand, r = 0.68 and 0.15, respectively. The strength of the influence of mean farm size on the CS characteristics shows parallel disconformities.

7. Conclusion

This benchmark case study was conducted to make an agricultural socio-economic appraisal of small, medium and large category of farm holders to understand their existing practices, awareness and capacity pertaining to CS. This was appropriate by the presumption, prominent to the majority in the CS sector, of a gap between demand and supply of CS, which, although understood to be extant, its extent is unknown. This ignorance results in unfulfilment. For PCs the uncertainty causes caution. Unaware of the gap they produce CS in conservative quantities to safeguard against overproduction and incurring subsequent fiscal forfeit at the expense, ironically, of not fulfilling their market potential. For suppliers, dealers and distributors, it results in less trade of the profitable product, and its stimulating effect on the economy, than would be possible. For farmers it results in their demand and potential to utilize CS to be unfulfilled and the benefits unrealized. The cognizance and quantification of the gap is thus of primordial importance and was the primary purpose of this paper.

The current quantity of CS use and demand at the village, block and sub-district scale was ascertained from multiple agents. This enabled data comprehensiveness, clarification and validation and permitted the causes attributable to the discerned. The main findings will be summarized henceforth.

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Appendix

Glossary of terms:

Quality seed: Seeds that have been officially registered as either certified seed or truthfully labeled seed.

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