

Ph.D. Thesis Proposal

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Can Social Capital help Indian small-holder farmers?
Analysis of the impact on agricultural efficiency, production and risk

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by
Elena Poli¹

Under the Supervision of

Thesis director: Dr. Teresa Serra
Tutor (UPC): Professor José M. Gil

¹ Elena Poli

PhD student at CREDA-UPC-IRTA
Parc Mediterrani de la Tecnologia
Edifici ESAB. C/ Esteve Terrades, 8
E-08860 Castelldefels [Barcelona]
Tel. +34 93-552- 1208
e-mail: elena.poli@upc.edu

Abstract

This research project intends to investigate the potentials of Social Capital to act as a mechanism to improve production in India's small-holder agriculture. Given the magnitude of institutional and technical constraints faced by this category of farmers, which dominate the Indian agricultural sector, this doctoral research will assess whether the strengthening of Social Capital can serve as an alternative way of enhancing agricultural production where other conventional inputs such as land, material capital and labour are hard to improve.

The analysis will take two main routes: on one side a qualitative study will evaluate the potentials of Social Capital to improve the welfare of different categories of small-holders by acting on their main production constraints; on the other, a quantitative study will assess the effect of Social Capital on productive efficiency, production levels and output risk.

This study contributes to a very limited local and international literature linking Social Capital with agricultural efficiency and production behaviour. No studies have yet investigated this subject in the Indian context. This research thus hopes to provide recommendations to developmental institutions and developing countries' policymakers to (re)design rural development projects and policies to respond to collective targets and actual successful strategies.

I. Background Research and Research Hypothesis

Driven by previous work experience and Master specialization, this PhD project was initially started with a focus on the potentials of using agricultural biotechnologies as a development tool, and specifically on the impact of GMOs cultivation on small-holder farmers in India. On this subject, an academic article was written and presented at the “I Congreso de Investigación en Agricultura para el Desarrollo”, Madrid 17-18 October 2011.

This topic had a high relevance in a moment when biotechnology was portrayed as a development tool for rural areas in virtually all countries throughout the developing world. Also in the case of India, after the approval of the first GM crop (Bt cotton) in 2002, state governmental agencies started investing heavily on biotechnology for the uplifting of their rural areas and eventually the benefit of resource-poor farmers.

In this situation, a socio-economic impact study on the effects of biotechnology on cotton small-holder farmers was justified and desirable. This is how the research was directed to exploring, on one side, the *suitability of the technology* for the needs of the farmers (i.e. low-input use, robustness and capacity to resist abiotic stresses) and on the other, to issues of *access to complementary resources* (for example land rights, access to credit and input/output markets) needed for adoption. As both these factors affect adoption and eventually the benefits farmers can get out of these technologies, we considered them in our analysis to be necessary preamble for using biotechnology as a development tool.

This background analysis resulted particularly valuable to understand the socio-economic impact of Bt cotton on production and its controversy in India. And this understanding will prove useful to follow the debate surrounding India's second transgenic crop: Bt brinjal. Most probably, in fact, politics and policy towards agricultural biotechnology in India for the future will be conditioned by the success or failure of Bt cotton.

So, under these circumstances, and when there was still a choice for millions of small-holder farmers to grow GM or not-GM cotton, this was a motivating topic of research. However, the reality of the present time in India is that this choice is no longer available. By the time we run the field research, non-Bt cotton seeds were becoming unavailable in the market, leaving the farmers with the only option of planting Bt cotton. However, the promise that Bt cotton would bring a sensible improvement to the livelihoods of the small-holder farmers was not certainly fulfilled.

In our case study, which is the area of Vidarbha (specifically Wardha District) in the state of Maharashtra in central India, a state of profound agrarian distress characterized farmers' situation to

the extent that this area became internationally known for the tragedy of farmers' suicides (Mitra, 2007; Mishra, 2008 ; Das, 2011). Therefore, the question rose as why after a decade of adoption of bt cotton technology to a point that no other option is available, are farmers still in a distress? Given the limitations of technology, is there any other factor which could be put into play to help farmers reduce production risk and raise their production and efficiency levels? This is how this doctoral research took a new direction, which is finding alternative ways of enhancing agricultural production where other conventional inputs such as land, material capital and labour are hard to improve. The hypothesis we propose is to consider the potentials of group farming and Social Capital.

The analysis will take two main routes: on one side a qualitative study will evaluate the potentials of Social Capital to improve the welfare of different categories of small-holders by acting on their production constraints; on the other, a quantitative study will assess the effect of Social Capital on both productive efficiency and to tackle the problem of output volatility by reducing production risk.

This study will contribute to a very limited local and international literature linking Social Capital with agricultural production efficiency, production levels and production risk. No studies have yet investigated this subject in the Indian context. This research thus aims to provide valuable recommendations to developmental institutions and developing countries' policymakers to (re)design rural development projects and policies to respond to collective targets and actual successful strategies.

II. Activity Report and Obtained Results

2.1. Field Research

The data collection stage was prepared in conjunction with a wide-ranging reading of the relevant academic literature on social capital and production risk faced by small-holder farmers and in a developing country setting. In order to start the field research stage, a number of contacts were taken

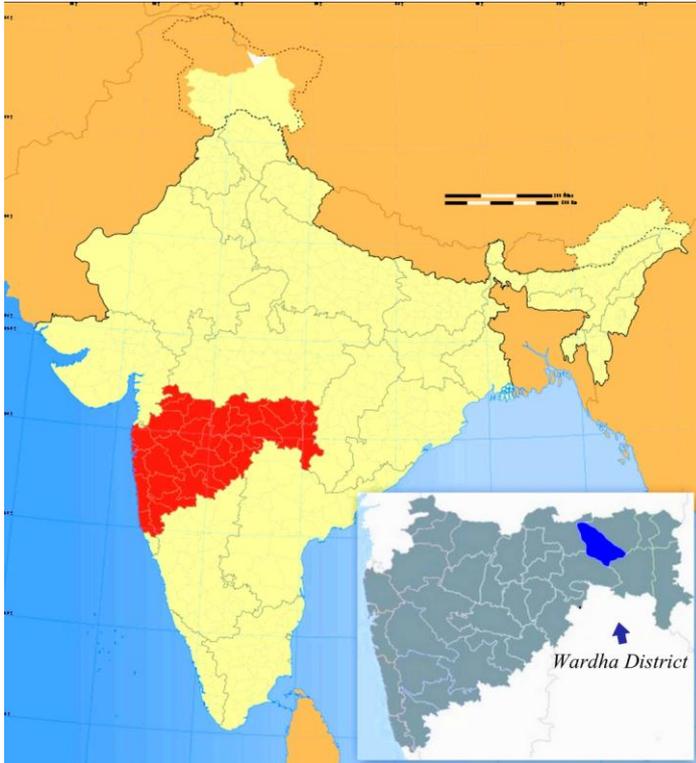


Figure 2.1 Map of India, the State of Maharashtra and the District of Wardha.

in order to select a suitable research partner institution. Eventually, the agreement came with the *Tata Institute of Social Sciences*, Mumbai, which is considered to be one of India's leading institutes in carrying out researches on small-holder agriculture and rural development. Faculty from this institution assisted during the whole process of survey design and data collection.

Data collection was initiated at the beginning of January 2012, and in three-months' time, semi-structured surveys were administered to more than 250 small-holder Bt cotton farmers in Wardha District, Maharashtra, India². Given that this District has been experiencing a substantial distress of the agricultural sector over the last decade, its study aims at providing direct insights to understand the production risk faced by small-holder farmers and the potential influence of Social Capital to reduce this distress and enhance production levels and efficiency. Productive efficiency is a necessary condition for a farm's economic viability. Its assessment is thus of high relevance. Eight villages in Wardha District (Zadgaon, Shivanphal, Kosurla, Nagazari, Madani, Malakapur, Jamani, Muradgaon and Karanji) with similar social and agronomic conditions (in terms of distance from water sources, distance from main cities and to input/output market) were chosen for the purpose of farmers' interviews.

² A copy of the questionnaire utilized is reported in ANNEX I

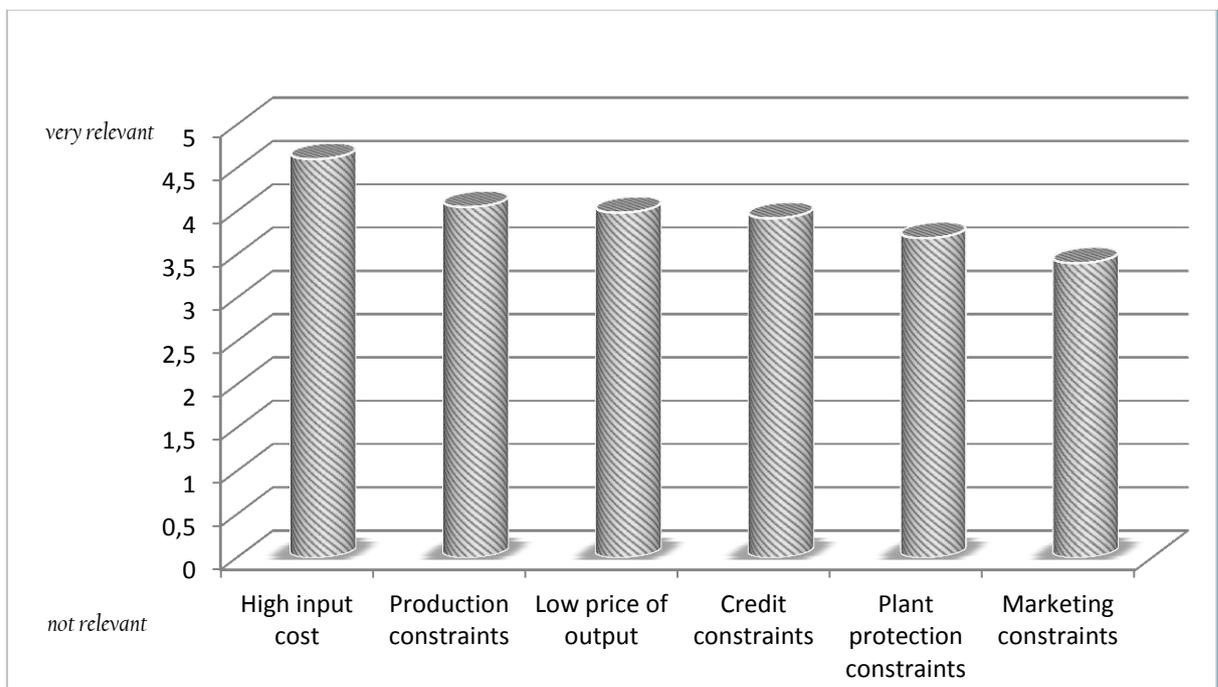
Both qualitative and quantitative data were collected to accomplish the main objective of the research: evaluate the potentials of Social Capital to improve the welfare of Indian small-holder farmers by assessing its effects on productive efficiency, production levels and output risk.

As detailed in the following work plan, to achieve these objectives, we planned to conduct two main types of analysis. First, a qualitative study to identify the influence of social capital on the main production constraints faced by sample farmers. Second, a quantitative analysis to identify the impacts of social capital on the level of production and its variability, as well as the productive efficiency of sample farms.

2.2. Qualitative study: the interaction between farmers' production constraints and social capital

This section presents a summary of the main findings of the qualitative research analysis. The field study allowed us to identify the main constraints in cotton cultivation faced by the small-holder farmers interviewed. A rating scale from 0 to 5 was used to evaluate the relevance of a series of possible production constraints (with 0 being “not relevant” and 5 being “very relevant”) that were identified based on previous research and also on the knowledge and experience of faculty from the College of Rural Services, Wardha, who provided meaningful advice during the process of designing our survey. Responses were analyzed by applying the Principal Component Analysis and results are presented in figure 2.2. Details of the component extractions can be found in ANNEX II.

Figure 2.2. Constraints confronting small-holders in cotton cultivation



Analyzing the data we collected, it emerged that the two main reasons for agricultural distress in this area are the *high production costs*, followed by a compound of *production constraints* (including lack of pure and quality cotton seeds, lack of technical information and lack of agricultural labor during peak seasons) as detailed in ANNEX I.

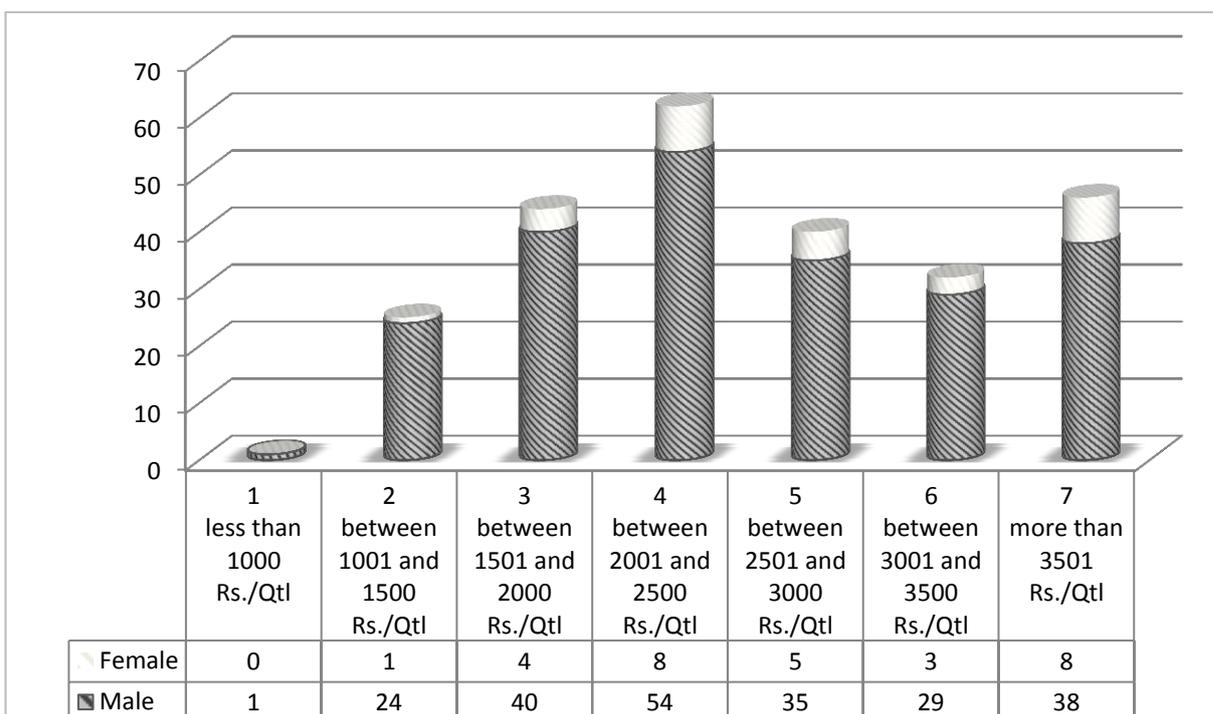
As one of the objectives of this research is to assess the potential of Social Capital to improve the welfare of small-holder farmers by acting on the constraints faced in cotton cultivation, the following paragraphs will evaluate the impact of Social Capital on the two main constraints reported by farmers, i.e., “High input cost” and “Production constraints”.

2.3. Impact of Social Capital on “High production cost” faced by farmers

Considering that the main constraint reported by farmers is the high production cost, the analysis will be directed to assess if/how the strengthening of Social Capital can help farmers to reduce this constraint. This analysis will be carried out by means of measuring correlation between the input cost and social capital variables. To be able to quantify and analyze the levels of input cost faced by farmers, we use data from the quantitative part of the questionnaire. For this purpose, expenses reported by farmers relative to input cost, operational cost and labor cost are summed to obtain the Total Cost of Production, which is expressed on a per quintal basis (hereinafter referred to as cost per quintal or “Cost-Qtl”).

For graphic representation (see figure 2.3), we divided the Cost-Qtl into 7 subgroups, where farmers were allocated depending on their level of production cost. In this scale, number 0 identified the subgroup producing at the least cost and number 7 the one producing at the highest cost.

Figure 2.3 Production costs histogram



A number of insights regarding the risk faced by farmers are possible from the histogram above if one considers that the Minimum Support Price for Cotton set by the Government of India (price at which the Cotton Corporation of India intervenes the market by purchasing cotton, when the market prices are not remunerative enough) ranges between Rs 2.500 and Rs 3.000 per quintal. The histogram shows that nearly 40% of the farmers interviewed produce at costs which are higher than the average Minimum Support Price, thus facing the risk of considerable economic losses in low price years.

Given that farmers are price takers and have access to rather homogeneous extension services, the production cost diversity in this specific setting may be mainly attributed to the lack of own equipment/animals which forces farmers to pay high rental costs, or to productive inefficiency related to lack/misguidance of proper technical information which leads farmers to bear unnecessary costs.

Table 2.1. Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
COST-QTL	,140	250	0,000	,730	250	0,000

Note: a. Lilliefors Significance correction

Since the production cost per quintal variable showed a violation of normality, one of the necessary assumptions for conducting the Pearson's product-moment correlation, we instead applied a Spearman Rank Order Correlation to non-parametrically measure the strength and direction of association that exists between the production cost per quintal and social capital. This correlation measure is not significantly affected by outliers (the presence of outliers in the cost of production data mirrors the reality of a farmers' suicide prone area, where a number of interviews report production costs higher than income).

There is currently considerable academic debate and controversy over the definition and the methods of measuring social capital. Despite the criticism often posed to social capital research concerning the heterogeneity of the concept and the methodological difficulties to measure it (for instance, see Portes, 2000; Van Deth, 2003), various definitions have proliferated in the scientific literature during recent years. We propose the definition of social capital as a multifaceted index by adopting the method suggested in Van Ha et al. (2004). These authors consider four components of social capital—associational activity, social relations (information sharing), trust, and norms of reciprocity—and examine the contributions of these components to the production process.

The part of the questionnaire devoted to social capital was originally designed based upon the work of Van Ha et al. (2004, 2006) and the Social Capital Questionnaire (Krishna and Shrader, 1999) recommended by the World Bank. However, during the field work, the questions were gradually transformed to suit the specific framework in which farmers were interviewed. Faculty from the Tata Institute of Social Sciences provided, again, very useful advice on the adaptation of the survey to the area characteristics. From this adaptation, and as will be seen below, we now add to the literature an original approach of measuring the capacity of farmers to work together building what we call “Collective Production Social Capital”. The need for this adaptation surged since in the context of our interviews, it appeared that general questions of trust and reciprocity did not obtain valid results. Farmers, in fact, tended to overestimate their trust on other fellow farmers, biasing the results of the interviews.

We thus opted to address this problem by asking more specific questions regarding trust and general cooperation in production activities. Farmers were therefore asked to specify to what extent (on a scale from 1 to 10) they share technical information, practice soil and/or water conservation operations collectively and to what extent they jointly buy inputs and sell their produce. Moreover, farmers were questioned regarding the extent to which they solve common problems, such as credit unavailability and labor shortage through systems of mutual support. This type of questions were formulated to both farmers belonging and not belonging to farmers groups, which made the effects of collective farming visible in contexts where no formal grouping was established.

In order to quantitatively measure Social Capital, the questions related to Social Capital in the survey were analyzed with Principal Component Analysis, which aims at identifying statistically the underlying dimension of the sets of questions, by locating clusters that are related to each other. Out of this analysis, three social capital categories emerged: “*collective production*” “*information sharing*” and “*trust and mutuality*” (see ANNEX III for analytical details). In the following lines, a brief description of these categories is provided.

The component “Collective Production” (CollPrPCA) reduces the relevant information contained in the original data set regarding the level of farmers’ cooperation in production activities into a single variable. Specifically, the component reduces the dimensionality of the following 5 questions in the questionnaire:

1. Have you organized the selling of cotton produce collectively with other farmers?
2. Have you shared labor force collectively with other farmers to overcome labor shortage?
3. Have you practiced soil and/or water conservation operations collectively?
4. Have you procured fertilizers collectively in the last season?
5. Have you procured other inputs (other than fertilizers) collectively this last season?

The component “Information Sharing” (**InfoPCA**) reduces in one variable the different dimensions of data concerning the capacity of farmers to find, generate and share valuable technical information on cotton cultivation. Specifically, the component is associated to the following 5 questions:

1. Are farmers in your village/group experimenting on new crops and cultivar methods and then sharing their knowledge with other farmers?
2. Once the season is over, would information on the outcome of cotton production (and the problems faced) be shared among the farmers in your village?
3. Do you discuss or consult with other farmers before taking production decision?
4. Do you discuss about production decisions with the women of your family?
5. If you need further information to make a decision for your cotton cultivation, do you know where to find that information?

The “Mutuality” (**MutuPCA**) component reduces the number of variables related to mutual support, cooperation and volunteership between farmers. Specifically, the component reduces the dimensionality of the following 4 questions:

1. If some community scheme does not directly benefit you but has benefits for others in the village, would you contribute time or money to this scheme?
2. In your community/neighborhood, is it generally expected that people will volunteer or help in community activities?
3. Do different caste/classes collaborate and work together in activities for the village’s benefit?
4. Has cooperation with other farmers helped you to reduce your production risk?

The three categories of Social Capital encountered were then correlated with the levels of production cost faced by the farmers. The results of the Spearman Correlation (Table 2.2) indicate a strong, negative association between the level of Collective Production Social Capital and the production cost per quintal ($\rho = -.852$) which is statistically significant at the 0.01 level. Mutuality Social Capital has a moderate negative, but statistically significant correlation with costs per quintal ($\rho = -.277$). A relatively weak correlation is registered between Information Sharing Social Capital and costs per quintal ($\rho = -.145$) although still statistically significant at the 0.05 level.

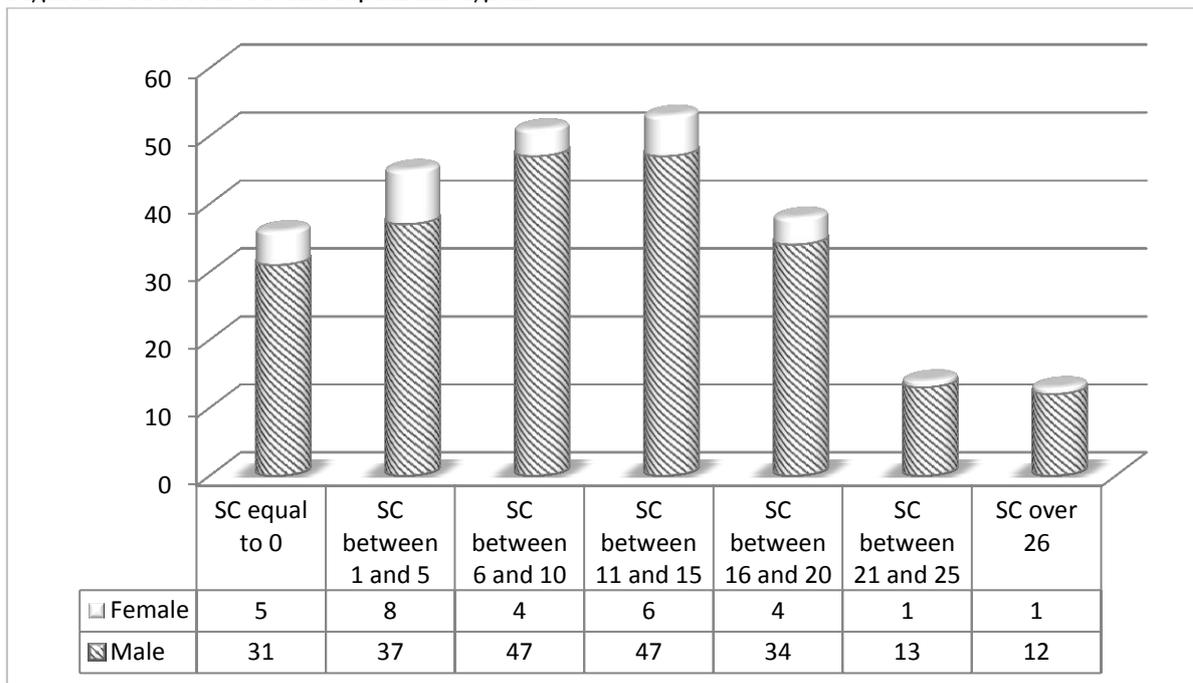
Table 2.2. Correlations between production cost and the components of social capital

		CollPrPCA	MutuPCA	InfoPCA
Spearman's rho	COST-QTL			
	Correlation Coefficient	-,852**	-,277**	-,145*
	Sig. (2-tailed)	,000	,000	,022
	N	250	250	248

Note: ** indicates significance at the 0.01 level (2-tailed) and * indicates significance at the 0.05 level (2-tailed).

In the following lines, we will focus the attention on the part of Social Capital which, based on correlation analysis, has a stronger impact on the production cost faced by the small-holder agriculture, i.e., Collective Production. Figure 2.4 provides the distribution of this variable measured as the sum of the values of the variables integrating the Productive Social Capital aggregate obtained through PCA. As noted above, Productive Social Capital consisted of 5 questions, each ranging from 0 to 10. Hence, their sum ranges from 0 to 50. Given that there were very few observations reporting a number higher than 25, values from 26 to 50 were grouped into a single category. The overall values obtained were allocated into 7 groups, which were then related with the production cost per quintal.

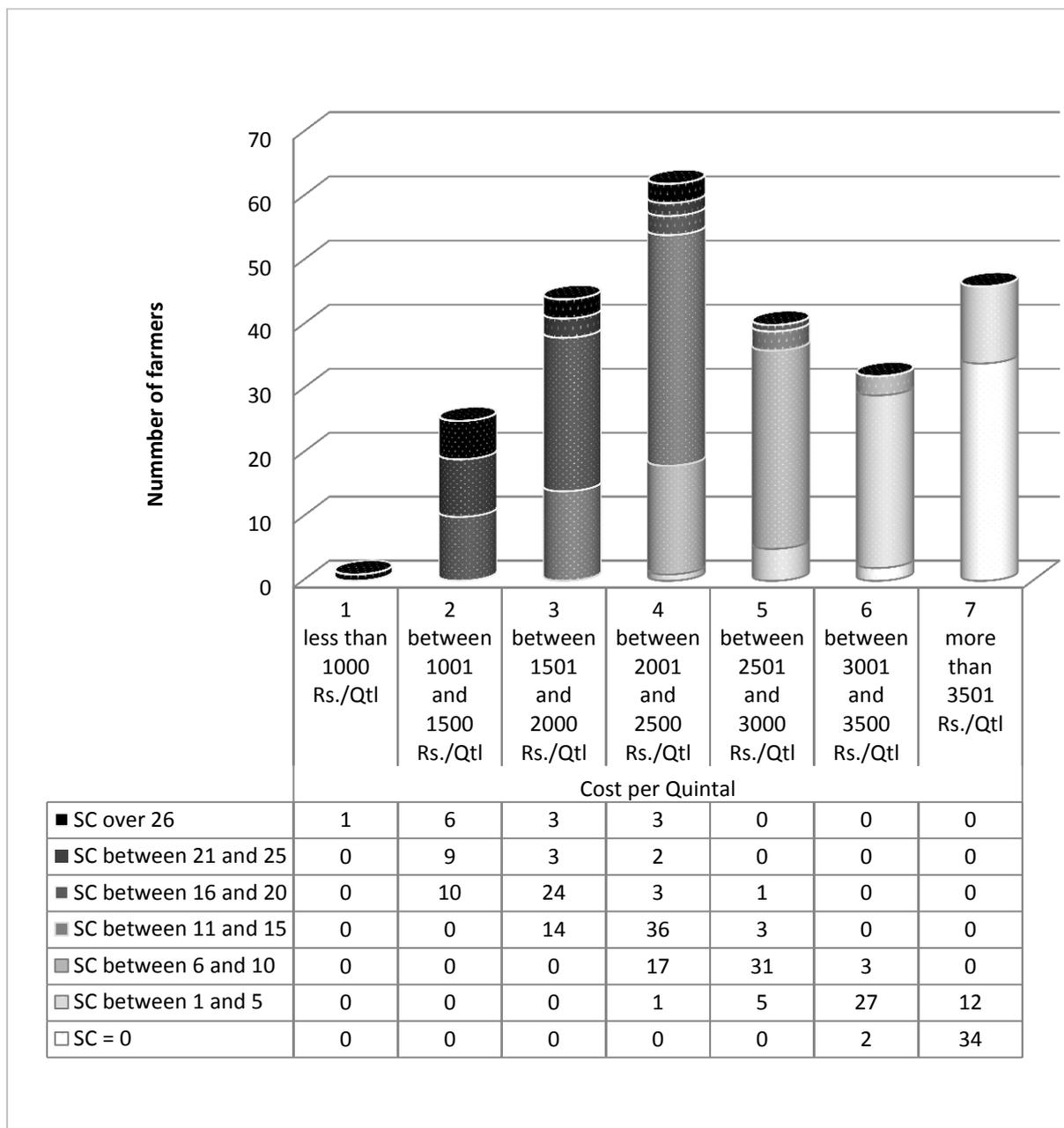
Figure 2.4 Productive social capital histogram



As indicated in Table 2.2, “Cost per Quintal” and “Collective Production Social Capital” are negatively correlated. To provide further insight into this relationship, Figure 2.5 relates different “Cost of Production” categories with different levels of Productive Social Capital. The graphic clearly shows that lower levels of Social Capital are associated with higher levels of production costs and vice versa. This suggests that social capital may reduce production costs, especially labour, inputs like fertilizers and pesticides, and soil/water conservation. This is evident if one considers the case of certain farm investments which would be, not only too costly, but impossible to undertake other than collectively.

For example, it would not be economically viable for farmers operating on few hectares, to invest in tube wells or machinery such as tractors, or keep more than a pair of bullocks. An active rental market can help with tractors and bullocks, but water leasing requires other prerequisites, such as negotiating a passage for water channels and managing water flows, all of which are more difficult (if at all possible) to undertake through rental arrangements (Agarwal, 2010). Here joint investment by small farmers with contiguous plots could provide a solution. Further, Social Capital is usually associated with a more intensive and efficient use of production inputs that usually results in a reduction in the unit costs of production.

Figure 2.5. Graphical representation of the correlation between Cost per quintal and Collective Production Social Capital



2.4. Impact of Social Capital on “Production Constraints” faced by farmers

Considering that the second main constriction to cotton production reported by farmers is “production constraints”, the analysis will be directed to assess if/how the strengthening of Social Capital can help farmers increase their production levels. To be able to quantify this relation, production yields reported by sample farmers (computed as the cotton production per acre, hereinafter referred to also as “Qtl/Acre”) will be correlated with the level of Social Capital in its three different aspects. Figure 2.8 reports the results of these correlations.

Table 2.3. Correlations between production yields and the components of social capital

		CollPrPCA	MutuPCA	InfoPCA
Spearman's rho	QTL/Acre			
	Correlation Coefficient	,568**	,210**	,207**
	Sig. (2-tailed)	,000	,001	,001
	N	250	250	248

Note: **. Correlation is significant at the 0.01 level (2-tailed).

The results of the Spearman Correlation coefficient (Table 2.3) indicate a relatively strong, positive association between the level of Collective Production Social Capital and the production yields ($\rho = ,568$). Moreover, both Mutuality and Information Sharing Social Capital maintain a moderate positive correlation ($\rho = ,210$ and $\rho = ,207$, respectively) with production yields. These positive correlations can be explained considering that Information sharing will provide valuable technical know-how to improve production levels, while mutual support will facilitate access to inputs and labor in time of need, enabling higher production performances.

These results suggest that farmers gain in productivity in acting jointly rather than individually. The potential gains of group farming to bring greater productivity and social empowerment as compared to individual production units is proved in a number of empirical studies, showing how small-scale, dispersed and unorganized producers are unlikely to exploit market opportunities as they cannot attain the necessary economies of scale and lack bargaining power in negotiating prices (Johnson and Berdegue, 2004).

Collective farm activity could range from just joint investment in inputs such as agricultural machinery, to land pooling and joint cultivation by small owners, or even joint land acquisition by purchase or lease. This is particularly so for women farmers, given the constraints they face in operating individually, such as their lack of control over land and major assets, limitations in extension and credit access, social restrictions on mobility and interactions in the marketplace for input procurement and product sale (Shah et al., 2007; Rao, 2006; Agarwal, 2003; Singh et al., 1999).

Indian small-holder farmers also use Social Capital to overcome transaction costs through a reduction in information and search costs and through substitution for poor market institutions. Moreover, through labor sharing, farmers are overcoming the problem of a lack of agricultural labor during peak seasons. This especially benefits marginal farmers. In general there would be less conflict/competition between farmers for obtaining extra labor during peak needs (Agarwal, 2010).

This suggests that the returns to social capital in a real world with transaction costs might be as important as returns to labor, physical or human capital. Social capital may not only have an impact on farmers' yields and productive efficiency levels but also on the production risk they face; this motivates the second investigation line, which involves the use of a quantitative analysis to analytically define these relationships.

III. Future Work Plan

Besides a qualitative study, the analysis aims to develop two lines of quantitative study, aiming to quantify the impact of Social Capital on production levels and volatility and on farmers' production efficiency.

3.1. Quantitative study to determine the impact of Social Capital on mean and variance of output

In order to estimate econometrically the production risk faced by small-holder farmers, we are going to employ the Just and Pope's (1978) production function. This functional representation will allow the analysis to determine whether the inputs used by small-holder farmers have either a negative or a positive effect on agricultural yields and their variance.

The choice of the Just and Pope (1978) model is justified by the improvements it makes on the classical stochastic production function to analyse risk. While the classical stochastic production function is represented as $y = g(x) + v$, with y representing outputs; x the inputs being used; and v a random variable with mean zero and unit variance, Just and Pope (1978) propose to specify production as the sum of two components, one relating to the mean output level and one relating to the variability of output: $g(x, v) = f(x) + [h(x)]^{1/2} v$, where $h(x) > 0$. Function $f(x)$ represents the mean production function, and $h(x)$ is the variance of output, where $E(y) = f(x)$ and $\text{Var}(y) = h(x)$. Given $\partial \text{Var}(y) / \partial x = \partial h(x) / \partial x$, it follows that $\partial h(x) / \partial x > 0$ identifies inputs x that are risk increasing and $\partial h(x) / \partial x < 0$ identifies inputs that are risk decreasing.

As shown by Just and Pope (1978), the model can be estimated by either the three-stage feasible generalized least squares or full information maximum likelihood techniques. Since the data analysis is still ongoing, we have not yet defined the functional forms of the Just and Pope production function. We are currently evaluating different functional forms to achieve the best fit (mainly Cobb-Douglas, quadratic and translog).

A few recent empirical studies of economic development at the micro level, such as Grootaert (1999), Maluccio, Haddad and May (1999), Narayan and Pritchett (1999), and Ruben and Strien (2001), have used social capital as a factor in household production functions. Our contribution to the literature will be to add Social Capital as an input in the Just and Pope production function and to estimate its impact on production risk faced by small-holder farmers.

This doctoral study will contribute to this stream of research by analyzing the impact of Social Capital on mean and variance of output in small-holder agriculture. To our knowledge, no academic study has tackled this issue so far in the Indian context. The contribution of this research would thus be highly relevant in the literature on rural development. The relevance of this study appears since

small-scale household-level units, which dominate the Indian agricultural sector, face several constraints such as lack of financial capital, advanced technical knowledge, and market information. The study will hence examine alternative ways of enhancing agricultural production where other conventional inputs such as land, material capital and labour are hard to improve.

3.2. Quantitative study to determine the impact of Social Capital on production efficiency of small-holder cotton farmers

There have been several attempts by the Government of India to improve the productivity of small farms, particularly for cotton, including the development of high yielding cotton varieties, subsidization of farm inputs and provision of credit. However, despite the importance of this subject, only few studies have assessed econometrically the technical efficiency of small-holder cotton producers in India (some of the few examples are: Mal *et al.*, 2011; Kambhampati *et al.*, 2006; Coelli and Battese, 1996). To add to this literature gap, no academic study has yet investigated the relationship between Social Capital and technical efficiency in small-holder agriculture in India.

The literature suggests several alternative approaches to measuring productive efficiency. For our study we will apply a stochastic frontier approach, which unlike the other parametric frontier measures makes allowance for stochastic errors arising from statistical noise or measurement errors. The stochastic frontier model decomposes the error term into a two-sided random error that captures the random effects outside the control of the farmer and the one-sided efficiency component. The model was first proposed by Aigner *et al.* (1977) and Meeusen and van den Broeck (1977). Maximum likelihood methods will be used to derive the parameter estimates of the model.

The academic literature is already supporting the evidence that Social Capital plays a role as a production factor on a par with other conventional production inputs such as land, capital and labor (Krishna and Uphoff, 1999; Maluccio *et al.*, 2000; Isham, 2000) and that it can help rural households and individuals to overcome the deficiency of other agricultural inputs (Annen, 2001; Van Ha *et al.*, 2006).

We contribute to this stream of research by analysing the influence of social capital on efficiency in production behaviour of Indian small-holder farmers engaged in cotton production. The conclusions derived from this research will serve as recommendations on how small-holder farmers might use production inputs more efficiently; and specifically, on how a relatively cost free input, such as Social Capital, could be used for improving the performance of small-holder agriculture.

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