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CAN SOCIAL CAPITAL HELP INDIAN SMALLHOLDER FARMERS? ANALYSIS OF ITS IMPACT ON RURAL DEVELOPMENT, AGRICULTURAL EFFICIENCY, PRODUCTION AND RISK

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ABSTRACT

Keywords:

Social Capital; Rural Development; Efficiency, Productivity and Risk; Smallholder Farmers; India

This research project intends to investigate empirically the potentials of Social Capital to act as a mechanism to improve the performance of India's smallholder agriculture. The study employs both a qualitative and quantitative research approach. The *qualitative* analysis provides useful information on smallholders' long-standing production constraints and livelihood strategies. Specific attention is given to gender issues, by analysing gender disparities in access and control over agricultural resources, markets and technologies. Social capital is analysed in the specific context of Indian rural society, with its multiple identities and complex social stratification. In this framework, our research findings indicate that all three dimensions of social capital i.e. collective production, information sharing and trust and mutuality, are significant in explaining farmers' production costs and productivity levels, representing a vital determinant of poor smallholder performance. The *quantitative* part of the analysis is then set out to provide a two-fold contribution to the state of knowledge on social capital: assess the effect of social capital on productive efficiency on one side and assess its impact on farmer's vulnerability and output risk on the other. The first line of investigation uses a stochastic frontier analysis to analyse the contribution of social capital to the productive efficiency of smallholder Indian farmers. To our knowledge, it is the first time that social capital is investigated into its separate functional parts from this analytical viewpoint, using a parametric approach. Results from this part of the research suggest that higher levels of technical efficiency are obtained when smallholder farmers use higher levels of social capital. Specifically, the aspects of social capital that greatly influence efficiency and productivity levels are information sharing and collective production. Following the research findings, efficiency ratings are also positively correlated with social capital levels. Moreover, the strengthening of social capital result to be particularly effective in improving productive efficiency of less educated and less experienced/younger farmers. By the second line of investigation, this research contributes to the academic literature offering the first study to analyse empirically the impact of social capital on production risk in a developing country's setting. The effects of social capital on the productivity and the riskiness of India's smallholder agriculture are explored using the Just-Pope (1978) production function. Our results suggest social capital to be the input with the highest contribution to productivity after labour. Another interesting result is that social capital can be risk increasing, even when its effect on risk improves farmer welfare. This is a very interesting research topic, given the magnitude of social, institutional, economic and technical constraints faced by this category of farmers who have trouble increasing conventional input use such as land, capital, labour, etc. In this context, social capital may enhance agricultural production where other conventional inputs are hard to improve. Returns to social capital in a rural community setting might hence be as important as returns to labour, physical or human capital. The study concludes discussing the

role of social capital for rural development policy-making. It highlights the importance of developing local institutions where farmers can design, manage, control and scale up new initiatives to build social capital; and it eventually suggests strategies for forging new participative policy actions inspired by effective bottom-up community models. The positive relation which is found between social capital and agricultural performance brings hope for a new agricultural economy, where farmers are secured a dignified standard of living, where social relationships are promoted in a sustainable manner and reinforced in a conscious relationship among people, their communities and the environment they live in.

RÉSUMEN

Este proyecto de investigación se propone estudiar empíricamente el potencial del Capital Social para que actúe como mecanismo de mejora del rendimiento entre los pequeños agricultores de la India. El estudio emplea un enfoque de investigación tanto cualitativa como cuantitativa. El análisis cualitativo tiene como objetivo proporcionar evidencia empírica de la relación entre el Capital Social, los costes de producción de los pequeños agricultores y sus restricciones de producción. Los resultados indican que las tres dimensiones del Capital Social, es decir, producción colectiva, intercambio de información y confianza y reciprocidad, son significativas en la explicación de los costes de producción y los niveles de productividad de los agricultores, lo que representa un importante determinante del rendimiento entre los pequeños agricultores pobres. La parte cuantitativa del análisis se establece con el fin de proporcionar una doble contribución al estado actual del conocimiento sobre el capital social: evaluar el efecto del capital social en la eficiencia productiva de un lado, y evaluar su impacto en la vulnerabilidad y el riesgo de producción de los agricultores por el otro. La primera línea de investigación utiliza un análisis de frontera estocástica para examinar la contribución del capital social en la eficiencia productiva de los pequeños agricultores de la India. Según nuestro conocimiento, es la primera vez que el capital social se investiga desde este punto de vista analítico en sus partes funcionales por separado, utilizando un enfoque paramétrico. Los resultados de esta parte de la investigación sugieren que niveles más altos de eficiencia técnica se obtienen cuando los pequeños agricultores utilizan mayores niveles de capital social. En concreto, los aspectos del capital social que influyen en gran medida los niveles de eficiencia y productividad son el intercambio de información y la producción colectiva. Siguiendo los resultados de la investigación, los índices de eficiencia también se correlacionan positivamente con los niveles de capital social. Además, el desarrollo del capital social resulta particularmente eficaz en la mejora de la eficiencia productiva de los menos educados y menos experimentados/jóvenes agricultores. En la segunda línea de investigación, el estudio contribuye a la literatura académica ofreciendo el primer estudio que analiza empíricamente el impacto del capital social sobre el riesgo de producción en el marco de un país en desarrollo. El efectos del capital social en la productividad y el riesgo de los pequeños agricultores se explora mediante la función de producción Just-Pope (1978). Nuestros resultados sugieren que el capital social es el input de mayor contribución a la producción después del trabajo. Otro resultado interesante es que el capital social puede incrementar el riesgo, incluso cuando su efecto sobre el riesgo mejora el bienestar de los agricultores. Se trata de un tema de investigación muy interesante, dada la magnitud de las limitaciones sociales, institucionales, económicas y técnicas que enfrenta esta categoría de agricultores que tienen problemas para aumentar el uso de inputs convencionales tales como tierra, capital, mano de obra, etc. En este contexto, el capital social puede mejorar la producción agrícola, donde otros inputs convencionales son difíciles de incrementar. Estos hallazgos podrían ser particularmente útiles en proveer a los responsables políticos con directrices claras para identificar y movilizar el capital social local con el fin de mejorar efectivamente la sostenibilidad de la agricultura en la India y su impacto en la pobreza.

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Dedication

This work is dedicated to my father, Stefano. He stood by my side and shared with me the subtler and most essential part of his life, which became mine too. His teachings and enlighten vision will always live in my heart.

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FIRST CHAPTER

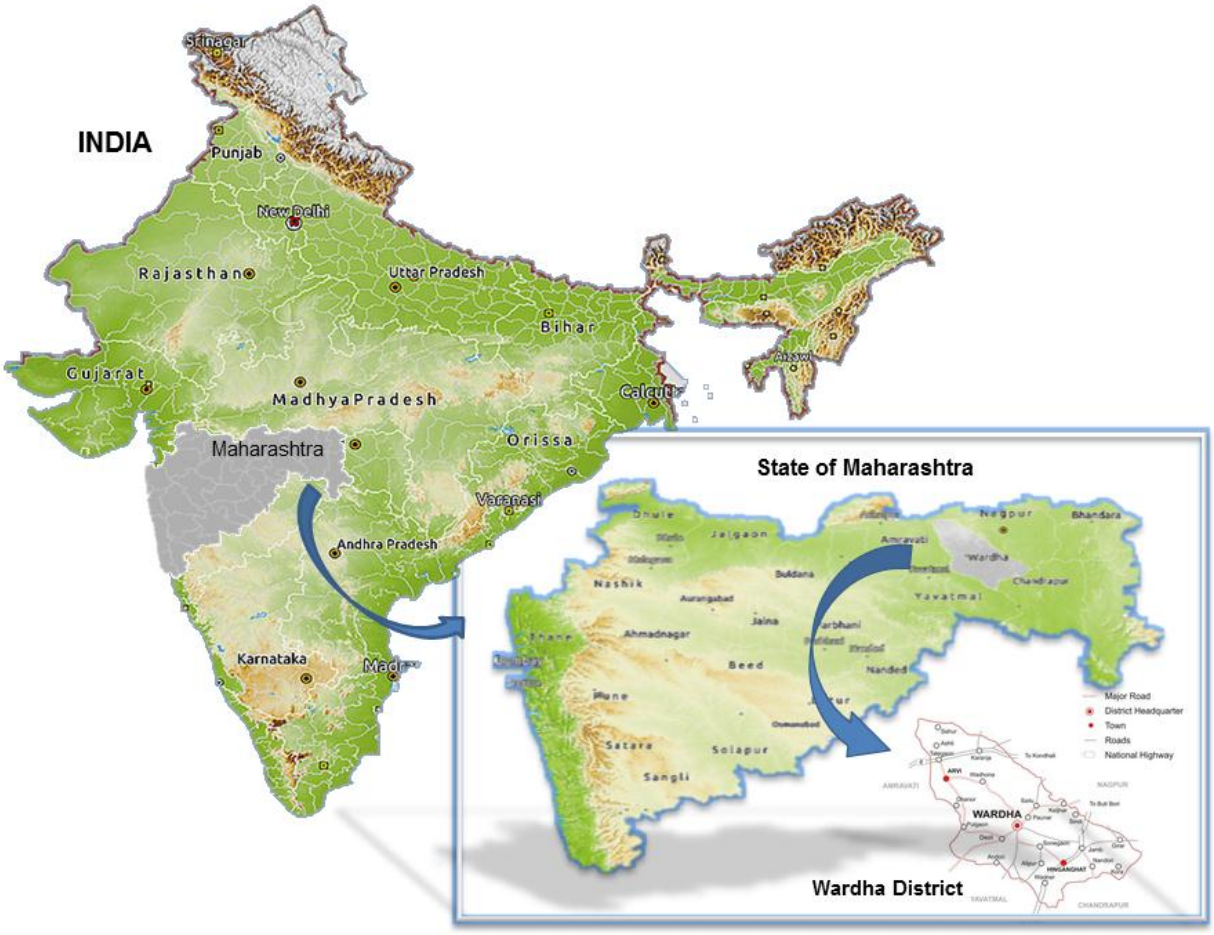
"I firmly believe that we shall not derive the full benefits of agriculture until we take to co-operative farming. Does it not stand to reason that it is far better for a hundred families in a village to cultivate their lands collectively and divide the income therefore than to divide the land anyhow into a hundred portions?"

Mahatma Gandhi[1]

1.1. Study Area

The empirical part this research was conducted in India, State of Maharashtra, Wardha District, from January to March 2012. The survey was performed at nine villages in the District (Zadgaon, Shivanphal, Kosurla, Nagazari, Madani, Malakapur, Jamani, Muradgaon and Karanji) involving more than 250 small and marginal cotton farms situated in similar social and agronomic conditions.

Figure 1.1 Location of the Study: Wardha District, Maharastra, India



[1] Harijan, February 15, 1942.

1.2. Problem statement

Agriculture is nowadays facing a major challenge. To feed the world's growing population, projected to exceed 9 billion in 2050 (UN, 2009), it will be necessary to double the actual agricultural production in the next three decades. And the challenge is not only to increase agricultural production but to do it sustainably if we are to protect the environment and the future generations. To be sustainable, agriculture will need to be intensified and its environmental impact made to reduce.

Most of the projected population growth will occur in developing countries, where smallholder farming dominates and average yields are low. An important element of food security and farm viability in these countries and the world at large is to increase the productivity of small farms. Moreover, the diminishing availability of agriculturally productive land and the need to minimize the further loss and degradation of natural environments call for efficiency gains in the use of resources as well as achieving effective rural community development to sustain these gains in the long-term.

The concept of sustainability is a challenging one in agriculture and different solutions have been proposed to achieve it at farm level in the developing world. These solutions might be technical, institutional, political, socio-economical or environmental. We propose a solution which lies in human beings, in their capacity to generate a subtle, yet strong type of capital, a "Social Capital" which can be employed to achieve higher results in agricultural production. Our hypothesis is that this solution can respond to the challenge of finding a "sustainable" answer to the urgent need of improving the productivity of smallholder agriculture.

We will test this hypothesis in the case of smallholder farmers in India, and specifically in the state of Maharashtra, where a state of widespread agrarian distress have been determined by several constraints of different nature: from poor soil fertility and erratic rains, to lack of labour and physical capital, restricted access to technical information, rural credit, inputs and marketing systems as well as weak institutions and inadequate physical infrastructure. These constraints affect particularly women farmers, given their restricted control over resources, and are manifested in the low productivity of smallholder agriculture, as well as recurrent crop failures and food insecurity.

Nevertheless, research evidence has demonstrates that, given access to resources, small and family farms can be more efficient than large farms (e.g., Heltberg 1998; Lipton 2009); and that investment in improving smallholder agriculture is the best way to create income at the grassroots level, generating demand for goods and services that create a broader base of jobs and incomes in rural areas. Identifying innovative rural development practices, institutions, partnerships and strategies to address smallholders' constraints is thus one of the main challenges to realize their full potential.

1.3. Prior research on cotton smallholder farming in India

When this doctoral research started, five years back, its main objective was to investigate sustainable solutions to improve developing countries' smallholder farmers' standard of living while increasing their level of productive efficiency. At that time, agricultural biotechnologies[2] were increasingly been regarded by developing countries' policymakers as a significant tool for developing their rural areas and eventually benefit resource-poor farmers. India was clearly one example where biotechnology was given a central role by governmental agencies to foster economic growth over the rural areas and attain the country's food security.

With this purpose in mind we started analysing the case of Indian smallholder cotton farmers, their issues and reality. Following the approval of the first GM crop (Bt cotton) in 2002, Indian governmental agencies started investing heavily on biotechnology for the uplifting of their rural areas and eventually benefiting resource-poor farmers. In this situation, a socio-economic impact study on the effects of biotechnology on cotton smallholder farmers was justified and desirable.

Hence a preliminary research was directed at exploring the suitability of this technology for the needs of the farmers and its appropriateness to smallholders' agronomic constraints (i.e. low-input use, robustness and capacity to resist abiotic stresses). Secondly, the research was directed to the possible negative impact the traits embodied in these varieties (mainly referring to pest and herbicide-resistant varieties) could produce on the labour market (results from this study are reported in Poli *et al*., 2013). Yet, from this preliminary research become apparent that for the benefits of this technological intervention to be realised, a range of technical obstacles needed to be overcome, as well as institutional and socio-economic contexts to be taken into account, even when the technology may be technically feasible.

As access to complementary resources affects technology adoption (Feder *et al*., 1985), understanding the constrictions farmers face in accessing those resources is crucial in determining adoption and benefit derived from the technology. When access to input markets is constrained by inefficient infrastructures and marketing system, seeds cannot get to the farmers in marginal and remote areas (Acharya, 2006). Moreover, when transgenic seeds are costly, lack of credit may disallow farmers from adopting this technology innovation (Qaim and de Janvry, 2003; Ameden *et al*., 2005; Giné and Klonner, 2006). In addition, there may be comprehension and learning constraints to deal with the new system (Stone, 2007), as the quality and source of information is proved to be a critical factor in influencing farmers' adoption and benefit from this technology (Tripp and Pal, 2000; Marra *et al*., 2001; Tripp, 2001; Stone, 2011). Eventually, on access to input and output markets, depends whether or not

[2] Biotechnology is a very broad term. In this study it will be used exclusively referring to the application of genetic engineering in agricultural biotechnology.

farmers will be able to access the new technology and benefit from increases in production (Shilpi and Umali-Deininger, 2008).

Moreover, the different timing of adoption can also impact on the distribution of the benefits of biotechnology interventions (Burton *et al*., 1999). If adoption of the improved varieties depends on particular resources and if large holders/better off farmers tend to have better access to these inputs than smallholders (because of their wealth or social-cultural reasons), then in that context, the technology will produce different timing of adoption, which, in turn will impact on the distribution of the benefits of the technology (Giné and Klonner, 2006; Severn-Walsh, 2006). As described in Lipton (2007) relative to the increased production derived from Bt cotton, the risk is that once local production rises (due to richer farmers being early-adopters), prices and income may result depressed. Thus the late-comers would lose from price falls when others adopted Bt varieties, but would also benefit less when they eventually adopt Bt seeds (Lipton, 2007). This process produces consequences over local inequalities. Evidence is provided by Morse *et al*. (2007) who show that adopting Bt cotton reduced inequality among growers but increased inequality for non-adopters (Morse *et al*., 2007).

Therefore, if differences in adoption depend on unequal access to complementary inputs, then this finding has important policy implications and indicates that assuring a more equitable adoption of new technologies in agriculture may not exclusively depend upon a shift in the research approach, but also on the establishment of measures that ensure better access for the smallholders to these complementary inputs.

The insights learned from this prior research showed how the desired changes we expect from the introduction of new agricultural technology applications are intertwined with the socio-cultural and economic dimension. Hence, a sustainable future for Indian agriculture with the presence of GM technology calls for many reforms, development strategies and institutional and policy interventions. By pointing at the constraints that limit access to biotechnology, significant voices have raised doubts about the developmental impacts of solely technical solutions to increase Indian farmers' productivity (FAO, 2004; Lipton, 2007; De Janvry and Saudolet, 2000 and 2002; Acharya, 2006; Qaim and DeJanvry, 2003).

The main challenge for this type of technology approach to rural development is that every variety which is introduced and promoted, although with a pro-poor purpose, will produce both winners and losers in the rural society. Moreover, the developmental impact of technically successful varieties can be heavily limited by non-technical constraints (such as difficulties in marketing the increased production). Hence this preliminary study observed how essential is for developing countries' policymaker to design this technology according to their specific socio-economic aims, promoting both farmers' participation and long-term interaction with the scientific establishment, which is indeed a challenging venture.

To date, very few participatory exercises with resource poor farmers have led to the implementation of bottom-up biotechnology research projects (FAO, 2004), which is partly due to the difficulties in involving farmers in research (given the time lag between project identification, the

development of the technology and its availability to farmers) and partly to the specific interests of the private sector involved in pursuing its own concerns in research and commercialisation of biotechnological traits.

Under these circumstances, and when there was still a choice for millions of smallholder farmers to grow GM or not-GM cotton, we analysed the socio-economic impacts of this type of solution – a technical approach through biotechnology – for the benefit of the smallholders and the improvement of their productivity levels. This background analysis resulted particularly valuable to understand the socio-economic impact of Bt cotton on production and its controversy in India. This understanding proved particularly useful to follow the debate surrounding India's second transgenic crop: Bt brinjal. Most probably, in fact, future politics and policy towards agricultural biotechnology in India will be conditioned by the success or failure of Bt cotton.

The reality of the present time in India is that non-Bt cotton seeds became unavailable in the market and planting Bt cotton is virtually the only option available to cotton farmers. However, the promise that Bt cotton would bring a sensible improvement to the livelihoods of the smallholder farmers is not indeed fulfilled. Specifically in our case study, which is the area of Vidardbha in the state of Maharashtra in central India, a state of profound agrarian distress characterize farmers' situation to the extent that in the last decade this area has become 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 options are available, are farmers still in a distress?

Given the limitations of a technological approach, 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 takes up this challenge of finding alternative methods of enhancing agricultural production in a situation where the effectiveness of technical answers is particularly limited by non-technical issues and where access to productive resources and other conventional inputs such as land, material capital and labour is particularly restricted.

We will explore how, in contrast to biotechnological innovations that usually require a top-down approach in which the government and/or the industry have a key role, bottom-up social innovations presents a number of advantages. The hypothesis we propose is to consider the potentials of the civil society to build a cost-free and context-specific capital which would make a difference in the productive performance of the farmers, making it especially useful as a development tool: Social Capital.

1.4. Justification for this study

Smallholder agriculture dominates the landscape of the developing world with more than 500 million small farms operating on the majority of the world's agricultural land and producing most of the world's food supply (FAO, 2014). Hence improving the livelihoods and the productivity of smallholder farmers represents one of the key challenges towards rural development and long-term sustainability of agriculture worldwide.

In India, smallholder farmers (intended as those operating on less than 5 acres of land) represent 85 per cent of the farming population (at Agricultural Census 2010-11) and, together with landless agricultural labourers, constitute the main share of India's rural poor. Many of them are female farmers; which continue to face a number of critical challenges to produce food in a sustainable and profitable manner.

Giving their central role for food security both locally and worldwide, increasing performance of small and marginal farmers has a key role in reducing hunger and poverty. However, the magnitude of social, institutional, economic and technical constraints faced by this category of farmers make it difficult to increase the use of conventional (and expensive) inputs such as land, capital or labour. In such situation, the context-specific and cost-free nature social capital presents a number of opportunities for improving the performance of the smallholders, as well as acting on their production constraints.

We test this hypothesis in the context of smallholder agriculture in Wardha District, Maharashtra, India. This area, where more than 87 per cent of the land holding are either marginal or small, have been experiencing in the last decade a situation where agriculture is on the decline and farmers are largely in distress. The riskiness in the production system and the vulnerability of farm households experienced in this area are common throughout India, which calls for the pressing need of finding alternative solutions to enhance agricultural production and improve the livelihoods of the rural population.

1.5. Research questions

This thesis aims to empirically examine the potentials of social capital to act as a mechanism to improve the performance of India's smallholder agriculture and become a powerful instrument for rural development. Hence, the objective of this study is to contribute to the existing body of research by investigating, qualitatively and quantitatively, the effect of social capital on smallholders' productive efficiency, production levels and output risk, as well as its impact on local rural development. In this research framework, this thesis formulates and tests two main hypotheses. The first is that by acting collectively farmers can substantially improve their production performance and reduce their vulnerability

in the production process. We assume that the positive role of social capital not only increases farm efficiency and productivity but also allow farmers to adopt higher-return technologies and farming practices. In order to verify this hypothesis, a number of research questions were addressed:

i. How is social capital built among the smallholder farmers?
ii. How can the smallholders (and especially its most disadvantaged categories such as women farmers) harness the power of collective action (in the form of collective production, sharing of technical information and mutual trust and reciprocity) in order to reduce input costs and overcome production constraints?
iii. To what extent can social capital, intended as the networks that enable farmers to cooperate and act collectively in production activities, increase efficiency and productivity ratings among the smallholders?
iv. What is the impact of farmers' social capital on the riskiness of India's smallholder agriculture?

The positive relation found between social capital and agricultural performance motivates our second line of investigation. Here our second hypothesis is that the potential hidden in social relations can be turned into an actual base for community development in the rural areas. Here we assume that it would be desirable for governments and communities to act in synergy to enhance each other's developmental efforts, creating long-lasting and mutually beneficial collaborative relationships. To explore this hypothesis three specific lines of enquiry are pursued:

i. How can social capital in Indian rural communities – where multiple identities and ethnicities co-exist - be nurtured, developed, and maintained in practice?
ii. Which are the aspects of social capital which own major potentials to produce collective benefits in the specific context of the Indian rural society? And which are the development outcomes we can expect?
iii. Which is the role of social capital in rural development policy-making? And how can policy-makers harness the potential of social capital to support community development in the rural areas?

These research questions are investigated through the review of social-capital oriented projects in India and especially in Maharashtra, their pitfalls and best operating practices. Here we will present the case of a successful rural development project which involved Maharashtrian smallholder farmers on building trust, collective action and achieve higher agricultural performances, called Sahaja Agricultural Project. Through its pioneering functioning we will suggest some practical elements through which social capital can be operationalized into development policy.

1.6. Research methods for the empirical work

Each of the three empirical chapters has a different, yet complementary, research approach which is described in more detail below. Following the first introductive chapter, Chapter II uses a qualitative approach to evaluate the potentials of social capital to improve the welfare of different categories of smallholders by acting on their business management constraints. A household survey, a rapid rural appraisal and, a stakeholder workshop were used for data collection. Both qualitative and quantitative data were collected regarding farm production, farmers' constraints in agricultural activities, farmers' social networks, and perceptions of mutual trust and reciprocity at the village and household level. Stakeholders related to farming, science, extension services, agricultural universities and NGOs were consulted to set priority areas and research objectives. A lot of effort was expended to ensure that data collected were valid and reliable.

Different techniques were then used to analyse the data collected, starting from factor analysis, multiple linear regression, descriptive statistical methods and qualitative socio-economic analysis. The empirical results are discussed along with their implication for rural development and farmer's livelihoods. A specific attention is given to gender issues, by analysing gender disparities in access and control over agricultural resources, markets and technologies. Results of this chapter show that returns to social capital in a real world with transaction costs might be as important as returns to labour, physical or human capital. And that collective action has the capacity to turn social capital into a broad-based beneficial resource for the entire community.

The following chapters use quantitative analysis to analytically define the relationships of social capital with farmers' yields and productive efficiency levels (Chapter III) and with farmers' production risk and risk management strategies (Chapter IV).

Chapter III analyses the contribution of social capital to the productive efficiency of smallholder Indian farmers, using a stochastic frontier analysis. To our knowledge, it is the first time that social capital is investigated from this analytical viewpoint, using a parametric approach. In this chapter we examine the technical efficiency of cotton production in smallholder farmers and identify the factors that explain differences in efficiency levels across sample farms. Social capital is examined into its separate functional parts, as well as in interaction with farmers' demographic characteristics such as education and age. For each variable, its contribution to farmer's productivity and efficiency levels it is examined. Regarding the social capital variables, we also calculate their correlation with the efficiency estimates to evaluate their effect on farmers' production performances.

Chapter IV sets out to examine first and second-moments of cotton production in smallholder Indian farms and identifies the factors that explain differences in these moments across different sample farms. Within this framework, the study pays special attention to the capacity of farmers to increase their productivity and manage output risk by building up social capital. The effects of social capital on the productivity and the riskiness of India's smallholder agriculture is analysed using the Just-Pope (1978)

production function. This study represents the first approach to analyse empirically the impact of social capital on production risk in a developing country's setting. The different methodological strategies employed in the study are detailed inside each of the empirical chapters, where the analytical methods are introduced and justified.

1.7. Outline of the thesis

The thesis is structured into four chapters. Each chapter addresses certain aspects of the study and it is designed in logical sequence towards answering the research questions.

As an introductory chapter, Chapter I provides a brief background on social capital and identifies the research problem. Here are explained the main aims and objectives of the thesis; research questions; scope and limitations of the study as well as its significance and justification.

Chapter II reviews the state of knowledge on social capital with the research problem in mind. It aims at ascertaining the extent of the research problem stated in chapter one as well as identifying and narrowing research questions. The chapter analyses the characteristics of social capital in the specific context of Indian rural society, with its multiple identities and complex social stratification. In this framework, it explores the potentials of collective action to turn social capital into a broad-based beneficial resource for the entire community. The analysis also aims at disaggregating and understanding the concept of social capital, identifying which are the aspects of social capital which own major potentials to produce collective benefits in the context of the Indian rural society.

This chapter also describes the socio-economic scenario of the study setting. A brief economic and social background of Maharashtra and specifically Wardha District is presented. The social, economic and pertinent cultural characteristics are discussed. The process of collecting research data and their administration are also presented in this chapter. Here the methodology of data collection and the preliminarily study which preceded it are explained and justified. Finally the chapter presents the techniques for analysing the data collected, both qualitative and quantitative. The chapter ends by discussing the role of social capital for rural development policy-making. It analyses how different aspects of social capital affect different development outcomes and it eventually suggests strategies for forging new participative policy actions inspired by effective bottom-up community models.

In Chapter III we examine the technical efficiency of cotton production in smallholder farmers and identify the factors that explain differences in efficiency levels across sample farms. Within this framework, our study assesses the capacity of farmers to increase their productive efficiency by building up social capital, an issue that is rarely taken into consideration in efficiency studies. Applying a stochastic frontier analysis we demonstrate the positive relation between social capital and smallholders' efficiency ratings. Results suggest that higher levels of technical efficiency are obtained when

smallholder farmers use higher levels of social capital. Specifically, the aspects of social capital that greatly influence efficiency and productivity levels are collective production and information sharing. Moreover, the strengthening of social capital results to be particularly effective in improving productive efficiency of less educated and less experienced/younger farmers.

Chapter IV sets out to examine first and second-moments of cotton production in smallholder Indian farms and identifies the factors that explain differences in these moments across different sample farms. Within this framework, the study pays special attention to the capacity of farmers to increase their productivity and manage output risk by building up social capital. Using the Just-Pope (1978) production function, we find social capital to be the input with the highest contribution to productivity after labour. Another interesting result is that social capital can be risk increasing, even when its effect on risk improves farmer welfare. Our analysis identifies that the risk-increasing and productivity-enhancing nature of social capital allow farmer to engage in riskier but more profitable activities and technologies.

Finally, Chapter V summarizes the thesis. Significant findings under each research question are identified and discussed. Here the process contribution of the thesis to the state of knowledge in social capital is explicated. The chapter provides recommendations for policy makers with guidelines to identify and mobilize local social capital in order to effectively improve the sustainability of Indian agriculture and its impact on poverty. The chapter ends with limitations and suggestions for further studies.

SECOND CHAPTER

SOCIAL CAPITAL IN INDIAN SMALLHOLDER AGRICULTURE: EMPIRICAL ANALYSIS OF ITS POTENTIALS FOR RURAL DEVELOPMENT[3]

This chapter is an empirical evaluation of the role of social capital as a rural development tool. It takes the case of India, with its multiple identities and complex social stratification, analysing the potentials of collective action to turn social capital into a broad-based beneficial resource for the entire community. The study employs several analytical techniques to assess the effect of different manifestations of social capital on farmers 'productive capacity: from principal component analysis to multiple linear regression, qualitative socio-economic analysis and descriptive statistical methods. The empirical results are discussed along with their implication for rural development and farmers' livelihoods. Specific attention is given to gender issues, by analysing gender disparities in access and control over agricultural resources, markets and technologies. Results suggest the positive role of social capital in improving farm productivity, reducing input costs and allowing farmers to overcome their main production constraints. This suggests that the returns to social capital in a rural community setting might be as important as returns to labour, physical or human capital. The chapter ends by discussing the role of social capital for rural development policy-making. It suggests several strategies for forging new participative policy actions inspired by effective bottom-up community models.

[3] Publication information: Poli, E., Gil M.J., and T. Serra, 2015. Social capital in Indian smallholder agriculture: empirical analysis of its potentials for rural development (*Under the first round review* at *the Journal of South Asian Development)*

2.1. Chapter overview

Smallholder agriculture is the largest provider of food and raw material at world level (HLPE, 2013). Smallholder agriculture is also the principal source of income and employment in the rural areas, where globally it is estimated that 85 per cent of farms are below 2 hectares (IFAD, 2015). The majority of these small-scale holdings are found in Asia and Sub-Saharan Africa, where smallholder agriculture is the basis for food security and rural livelihoods for millions of families (FAO, 2014).

In India, smallholder agriculture is the core contributor to agricultural production and therefore vital for achieving food and nutritional security goals of the country's growing population. During the last decade, however, smallholder farmers have faced several constraints of different nature: from poor soil fertility and erratic rains, to lack of labour and physical capital, restricted access to technical information, rural credit, inputs and marketing systems as well as weak institutions and inadequate physical infrastructure. These constraints affect particularly women farmers, given their restricted control over resources, and are manifested in the low productivity of smallholder agriculture, as well as recurrent crop failures and food insecurity.

Nevertheless, research evidence has demonstrates that, given access to resources, smallholder agriculture can be more efficient than large farms (Heltberg 1998 ; Lipton 2009); and that investments in improving smallholder agriculture is the best way to create income at the grassroots level, generating demand for goods and services that create a broader base of jobs and incomes in rural areas. Identifying innovative rural development practices, institutions, partnerships and strategies to address smallholders' constraints is thus one of the main challenges to realize their full potential.

At policy level, for this potential to be realized, agriculture should enter the agenda not only through a focus in productivity, but also with a broader target of sustainability and resilience. Governance needs to be designed to support the multifunctional roles of smallholder farming in development: on one side favouring the conditions to increase farmers 'productivity, and on the other engendering mechanisms of wider community development to be sustained in the long-term. To successfully achieve this result, ownership of processes, projects and programs is vital.

This research analyses empirically the case of a poor rural community setting, where sustainable economic development claims for promotion of productivity and output growth but where the chances of increasing the use of conventional (and expensive) inputs such as land, capital or labour are difficult, given farmers' economic restrictions. In such setting, we propose to consider the potentials of a context-specific type of capital whose cost-free nature presents a number of opportunities for improving the performance of the smallholders, making it especially useful as a development tool: Social Capital.

For the purpose of this study, we conducted a farm-level survey on 250 smallholder cotton farmers in Wardha District, Maharashtra, India. In this district, more than 87 per cent of the land holding are

either marginal or small, and in the last decade have been experiencing a situation of widespread agricultural decline and farmers' distress.

In this research framework, this chapter formulates and tests two main hypotheses. The first is that by acting collectively farmers can substantially improve their productivity level and reduce production cost as well as production constraints. Verification of this hypothesis requires answering the following research questions: (i) which are the long-standing constraints facing this category of farmers (ii) how is social capital built among the smallholders and (iii) how does social capital act on these constraints to improve farmers' livelihoods and productive capacity on a sustainable basis. We test this hypothesis using survey data, paying particular attention to gender differences.

The second hypothesis is that the potential hidden in social relations can be turned into an actual base for community development in the rural areas. To explore this hypothesis we analyse (i) the aspects of social capital which own major potentials to produce collective benefits in the Indian rural area ii) the challenges for policy making to actually implement community development projects focused on social capital building. These research questions are investigated by reviewing the case of social-capital oriented projects in India and especially in Maharashtra, their pitfalls and best operating practices. Here we will explore the case of a successful rural development project which involved Maharashtrian smallholder farmers on building trust, collective action and achieve higher agricultural performances, called Sahaja Agricultural Project. Through its pioneering functioning we will explore some practical strategies that can be used to operationalize social capital into development policy.

This chapter is organized as follows. In the next section, we present the state of knowledge on social capital with the research problem in mind. The third section focuses on methodological issues. Results and policy implications are derived in the fourth section. The chapter ends with the concluding remarks section.

2.2. Literature review on social capital and development in rural India

Social capital is a wide-ranging concept covering the resources derived from social relationships. It embraces the ability to develop and use various kinds of social networks and the resources that become available thereof. Social capital is used to characterize the voluntary action taken by a group to achieve common interests, as well as subjective aspects such as confidence in institutions and trust in people. Since the middle of the 1990s, social capital has captured a rapidly growing interest among academics and policy makers. This has yielded multiple definitions, interpretations and uses of the concept that have been applied at the individual, group, and organizational levels. Different social sciences emphasize different aspects of social capital.

The economic literature has largely considered social capital along the lines of Putnam (1993), i.e., mainly as an associational activity that facilitates cooperation and coordination among individuals (Narayan and Pritchett, 1999; Grootaert and Narayan, 1999; Grootaert *et al*., 2002). The idea of social capital has also been employed extensively in studies of democracy and governance, schooling and education, families and youth behaviour, community life, work and organizations, as well as in the general field of collective action (Woolcock, 1998 provides an extensive literature revision of its use in different fields).

Late research has moved towards a characterization of social capital as a multidimensional variable that not only reflects associational practices, but that also embraces information sharing, trust, reciprocity, etc. (Ha *et al*., 2008). Each of these aspects has been proved to exert beneficial effects on economic performance.

Trust reduces social and economic transaction costs by lowering the need for contracts, legal and regulatory frameworks (Luhmann, 1979; Knack and Keefer, 1997; Hardin, 1999; Pretty and Ward, 2001; Pargal *et al*., 2002; Sturgis *et al*., 2012) while acting as a control mechanism for embedded relationships (Uzzi, 1996). Trust also facilitates cooperation between individuals and encourages joint efforts (e.g., Gambetta, 1988). Reid and Salmen (2000) moreover find that trust is a key determinant of a successful agricultural extension. This implicit confidence on the people around us - will be the group, will be families, communities and even nations - is seen as impacting positively on development and economic growth (Fukuyama, 1995; Putnam, 1993). Accordingly, several authors have empirically demonstrated the relation between trust and good economic performances (Glaeser *et al*., 2000, Knack and Keefer, 1997; and La Porta *et al*., 1997).

The concept of trust is closely related to the concept of *reciprocity*. Putnam *et al*. (1993) define generalized reciprocity as an especially productive component of social capital. The information about others' trustworthiness is an essential premise to individual's decision of whether or not to interact and cooperate. *Information sharing* reduces transaction costs, mitigates imperfect market information (Fatchamps and Minten, 2002; Grootaert, 1998) and facilitates knowledge networking and sharing of novel different perspectives, fostering capacity building and innovation (Cross *et al*. 2003). This type of local knowledge which is shared by farmers within a social system or a group is moreover found to be more ecosystem-sensitive and context–dependent and therefore more suited to sustainable agriculture (Roling and Wagemaker, 2000).

Collective action (both through formal – cooperatives and farmer associations – and informal community connections) has also been found to exerts a positive impact on production performances, especially in the case of agricultural production in low-resources environments by: facilitating access to agricultural technical information (Hoang *et al*., 2006; BenYishay and Mobarak, 2013), improving irrigation management (Krishna and Uphoff, 1999; Uphoff and Wijayaratna, 2000), reducing transaction costs (Randela *et al*., 2008), and improving land management through better access to information and technologies (Pender and Gebremedhin, 2007).

In addition, social capital has been found to encourage technology adoption through a double mechanism. Firstly, social capital (in the form of farmers' networks and their collective action) acts as a conduit for information about new technologies facilitating learning diffusion both from external sources as well as from other farmers (Isham, 2002; Conley and Udry, 2010; Rijn *et al*., 2012[4]). Secondly, social capital facilitates poor farmers in adopting new technologies by reducing their restrictions on participation. On one side it allows adoption of innovations requiring indivisible investments (Monge et al., 2008); on the other, since group loans started to be accepted as a form of collateral by non-traditional micro-financing institutions, collective action also serves to facilitate access to credit to poor farmers (Knox *et al*., 1998). Besides, adopting a new technology requires taking on new risks. In this respect social networks can exert a risk-mitigating effect (Edillon, 2012) which in turn augments the likelihood of adopting new technologies.

As a result, social capital is usually found to be related to higher efficiency and productivity levels of small farms (Nyemeck *et al*., 2005; Jaime and Salazar, 2011). In this respect, Serra and Poli (2015) have found social capital to be the input with the highest contribution to productivity after land, with productivity improvement associated to an investment in social capital on the order of 12%. All these different perspectives corroborate the importance of social capital in improving the welfare of rural small-scale producers (Lyon, 2003; Darr, 2005; Milagrosa, and Slangen, 2006; Hellin *et al*., 2007).

While some analyses have considered these different dimensions of social capital separately, others have aggregated the different components into an additive social capital index (Ha *et al*., 2008; Grootaert, 1999; Grootaert and Narayan, 1999; Grootaert at al., 2002). Closely related to the need to define social capital is the debate on how to measure and quantify it. Fukuyama (1999) has suggested that one of the most common shortcomings of social capital is the absence of consensus on how to measure it. Social capital is difficult to measure because we are unsure of what we shall be measuring (Dasgupta, 2002). On one side this is a multivariate and multidimensional concept, covering a wide range of factors that can operate at the individual and geographic level. On the other, social capital is revealed as the property of individuals, groups or communities, whose factor inter-relationship/dependencies make it difficult to measure.

While the debate is still open on the definition of social capital and on its contribution to the production process, scholars have moved forward both in conceptual and empirical terms. The concept has been increasingly applied in rural studies (Castle, 2002) and has received growing attention in the rural development debate where it is seen as a factor potentially overcoming poverty, developing rural areas (Sobels *et al*., 2001; Sorensen, 2000; Uphoff, 2000; Uphoff and Wijayaratna, 2000; Grootaert and Van Bastelaer, 2002b), and helping rural households overcome the deficiency of other capitals and inputs, thus increasing their welfare (Annen, 2001; Fafchamps and Minten, 2002).

[4] Rijn *et al.*, (2012) show a significant relationship between an aggregate measure of social capital and agricultural innovations.

2.2.1. Conceptual Framework

A number of studies analyse the specific characteristics of social capital in the Indian society (Serra, 1999; Bhattacharyya, 2004; Gupta, 2005 and Krishna, 2007 among others). This body of literature agrees that the structure of Indian society is particularly complex and segmented, which makes the characteristics of social capital different from those in Western societies. It is argued that, differently from Putnam's analysis in the Italian context where the emphasis is upon a community of equals actively participating in public life for common purposes, in India and especially in its rural areas, social capital exists within and not between the segments of rural society (Serra, 1999; Bhattacharyya, 2004).

Moreover, it is believed that given the multiple social division in the Indian society (based on caste, class, culture, language, religion, etc), there may be high social capital within a certain group ("bonding" social capital) but also exclusions from other groups (showing a lack of "bridging" social capital)[5]. Bhattacharyya (2004) shows how cooperative behaviour in members of the same *panchayat* (belonging to different socio-cultural and religious groups) might arise from the need to address common interests, such as building a road or doing flood control works. However, this cooperation is indeed rare and emerges mainly in times of crisis. It is hence maintained that in the context of the Indian society it is difficult for collective action to bridge these segmentary boundaries and for social capital to turn into a broad-based beneficial resource for the entire community.

On the other hand, it is possible and desirable for this particular civil society, in which multiple identities and ethnicities co-exist, to foster social capital and a community spirit. Paradoxically, in Indian history, the complex stratification of its society and its pluralism has acted in favour of its unity. As Grootaert and Bastelaer (2002) confirm, even at the village level, socially and economically heterogeneous communities are not less likely to act collectively than more homogeneous populations. Inducing collective action among all the diverse groups is therefore the main challenge. It is not sufficient that a group of people – a particular type of farmer, a particular caste - have trust and networks among themselves. It is important that trust and networks go beyond the small groups. Connections need to be established and nurtured among different groups in order to "produce" a good effect on rural development (Dekker and Uslaner, 2002). These new cross-cutting ties are especially effective in opening up economic opportunities to those belonging to less powerful or excluded groups (Narayan, 1999) which is the case of the rural poor.

Despite the fact that these patterns of social stratification and social restriction continue to exist, the reality of modern India is changing very rapidly and its society today presents some major structural changes, not only economically, but also culturally (Heath and Jeffery, 2010). Factors like migration and entry of scheduled castes and other backward classes in public sector jobs, as well as the rapid increase in lower caste representation in state-level legislative assemblies have loosened the link between caste,

[5] See Warren *et al.*, (1999) for a discussion of bonding and bridging social capital

occupation and economic status. These changes contribute to the decline of old labour relations and social solidarities based on kinship and community and the upsurge of new social inter-relationships.

This "silent revolution" (as defined by Jaffrelot, 2003) occurring in both urban and rural areas, is changing the nature of the relationship between caste, class and cultural communities (Gupta, 2005). This structural transformation suggests that a key ingredient necessary for far-reaching social change is already in place. It is in the light of these changes that social capital in the rural areas and specifically in the agricultural sector needs to be reconsidered, especially when thinking of social capital in developmental terms. The main question is: how can this knowledge be translated into action for development purposes?

The reality of current development policy action in India is that the potential of social capital for policy-making is far from being fully realised. Here, an interesting analysis by Cecchi *et al*., (2009) puts social capital in a development perspective, analysing its role as a policy tool against poverty and inequality in the development strategies of a number of international agencies in rural India (such as the World Bank, ICRISAT, UNIDO and Asian Development Bank). Their discussion illustrates the actual limitations of these current approaches in effectively building social capital, showing a basic mismatch between the stated emphasis on social capital and the actual role that is assigned to it (Cecchi *et al*., 2009).

On the contrary, we observe that successful projects in promoting social capital building among the farming communities in rural India have a number of things in common. Whatever may be the promoting organization – governmental or non-governmental, self-help or grassroots, relatively successful projects managed to undertake effective community consultation and farmers' participation during the whole project life cycle[6], managed to build wide-ranging social networks that brought together villagers of different castes (Krishna, 2002) and succeeded to allow farmers to gain collective voice and empower themselves (Larson and Williams, 2012).

Governments and active communities can enhance each other's developmental efforts, creating long-lasting and mutually beneficial collaborative relationships. Lesson from successful experiences highlight the importance of developing local institutions where farmers can design, manage, control and scale up new initiatives to build social capital. In this process, the challenge to policy makers is to identify the conditions under which a "state-society synergy" in building social capital can take place (Evans, 1996). This route could be the turning point for unlocking the leveraging role of social capital as a policy tool in the fight against poverty and inequality.

[6] A number of interesting examples come from South India. One is a participatory irrigation management project in Andhra Pradesh reported in Oblitas and Peter (1999). The project was based on the establishment of local water users' associations and then the devolution of management responsibilities to them. Other relevant examples are shown in Krishna (2002) and Larson and Williams (2012).

2.3. Data and Methods

2.3.1. Study area

The study area considered in this research is Wardha District, Maharashtra, India (Figure 2.1). The District has a largely agrarian economy, which in the last decades has been affected by an increasing agricultural distress; where the shrinking of the gross area under cultivation has been sided by a sharp increase in fragmentation of land holdings as well as a sharp marginalization of the rural workforce (Barik, 2010)[7]. The rural population has responded to the increased economic difficulties by shifting production to more profitable but riskier cash crops such as cotton, sugarcane and soya. The area under food grain, in contrast, has declined considerably, engendering critical implications for food security of the local population (Rukmani and Manjula, 2009).

Figure 2.1 Map of India; highlights on the State of Maharashtra and the District of Wardha

[7] While nearly one-half of the holdings were either medium or large in 1970–71, the percentage of such holdings declined to less than 5 percent by 2010–11. In 2011, the agricultural holdings in the state of Maharashtra were categorized into 5 groups: 52.37% were marginal (less than 1 acre), 30.26% small (1 to 2 acres), and 13.51% semi-medium (2 to 4 acres) 3.58% medium (4 to 10 acres) and 0.26% large (more than 10 acres). Source**:** *World Agricultural Census, 2011; http://agcensus.nic.in cited as on 23-02-15.*

The riskiness in the production system and the vulnerability of farm households in this area, and especially of cotton farmers, is described in depth in Rukmani and Manjula (2009) and Gaurav and Mishra (2012). However, this region and Maharashtra as a whole, has also witnessed a positive phenomenon with the proliferation of many social capital manifestations, especially among the rural communities.

In Wardha District there are currently more than 1.500 farmers' groups, carrying out a number of activities, mainly organic farming, spice crops cultivation, sericulture, horticulture as well as milk production and pulse processing. The State government also recently got involved in encouraging the voluntary formation of groups of farmers to cultivate a particular crop or a group of crops, with the prospect of facilitating their tie-ups with banks, markets and retail chains [8]. This particular context allows us to look deeper inside the process of social capital intensification in the rural areas, to value its shortcomings and explore its potentials.

These two main conditions - agricultural distress and social capital intensification - can be found in different shapes and intensity all over India. Encountering them together in this research area makes this case study especially relevant for understanding the potential of social capital to foster agricultural viability and rural development.

2.3.2. Study design and measurement procedures

Our empirical analysis is based on a unique farm-level survey of smallholder farmers in Wardha District, Maharashtra, which was conducted from January to March 2012. The survey involved more than 250 small and marginal cotton farms, whose category represents the large majority of the area's farming population. A total of nine villages (Zadgaon, Shivanphal, Kosurla, Nagazari, Madani, Malakapur, Jamani, Muradgaon and Karanji) with similar social and agronomic conditions were chosen for field survey.

The research was preceded by an initial exploratory study inspired by the qualitative techniques of rapid rural appraisal (RRA) (Chambers, 1994), through which we gained the first insights into processes shaping of social capital formation and into different aspects of the agricultural production in the villages. The final household survey was then conducted to gather data on farm production, farmers' constraints in agricultural activities, farmers' social networks, and perceptions of mutual trust and reciprocity at the village and household level. Stakeholders related to farming, science, extension services, agricultural universities and NGOs were consulted to set priority areas and research objectives.

[8] A 2013 scheme envisaged the constitution of 1,000 additional farmers' groups of 10-15 members functioning like self-help groups in the villages of Wardha District.

Group discussions were held in the village centre and/or on farmers' fields. The data collection was undertaken using semi-structured interviews and field observations of practices. A lot of effort was expended to ensure that data collected were valid and reliable.

Both qualitative and quantitative data were collected. Quantitative data were collected on farms' input use, including land use, crop-specific inputs such as seeds, fertilizers, pesticides and labour. We further collected data on total output produced. Table 2.1 displays the main summary statistics of the research sample, along with a brief definition and units of measurement.

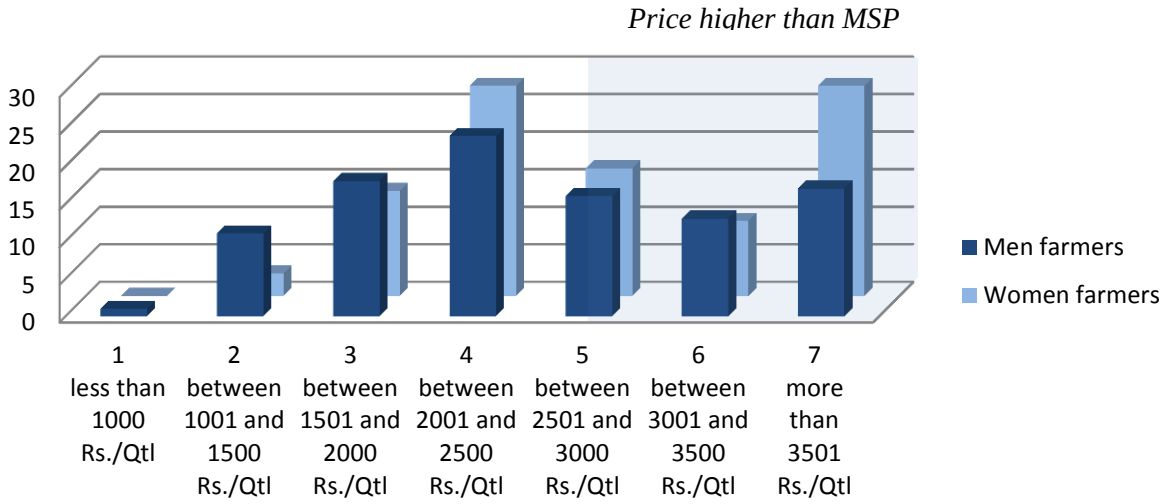
Table 2.1 Definition and summary statistics of the research sample

Variable	Description	Mean	Std	Min	Max
PRODUCTION	Cotton output (Qtl)	14.96	8.16	1.50	50.00
LAND	Cotton Land (Acres)	2.91	1.04	1.00	5.00
SEED	Seed cost (Rs.)	5,481.84	3,205.91	930.00	32,790.00
FERTILIZER	Fertilizer and manure cost (Rs.)	6,561.67	5,266.23	0.00	40,750.00
PESTICIDES	Pesticides cost (Rs.)	2,431.94	2,149.44	0.00	15,000.00
LABOUR	Labour cost (Rs.)	19,017.72	10,849.09	0.00	72,000.00
EDUCATION	Farmer's Education (years)	7.63	4.40	0.00	15.00
AGE	Age of the Farmer (years)	46.34	13.56	20.00	98.00

Our sample farms produce, on average, 15 quintals of cotton on 2.9 acres that are usually owned by sample farmers. Around 1.6 acres are irrigated, mainly through bore-dug wells. The average income obtained per quintal is slightly below 4,100 rupees.

Among production costs, labour cost is the most relevant, followed by fertilizers, seeds and pesticides. The low cost of pesticides relative to other costs is not surprising given the Bt cotton variety planted by our sample farms. The average per quintal net income is around 1,250 rupees. Farm income represents almost 80% of the income obtained by sample households. While sample farms rarely own farm machinery, the tenure of bullocks is more common (around 54% of sample farms). Around 60% of sample farms sell their products to ginning mills. The rest is sold to private agents and the Cotton Marketing Federation (18 and 12% of the sales, respectively). In terms of production costs, the mean cost per quintal is 2,610 Rs, being slightly higher for women farmers (2,633 Rs/Qtl) compared to men farmers (2,607 Rs/Qtl). The expenses reported by farmers relative to input cost, operational cost and labour cost are summed to obtain the total cost of production, which is expressed on a per quintal basis. These statistics of farmers' production costs are summarised in the histogram in Figure 2.2 which displays its frequency distribution.

Figure 2.2 Production costs histogram



Note: production costs higher than Minimum Support Price were highlighted in grey.

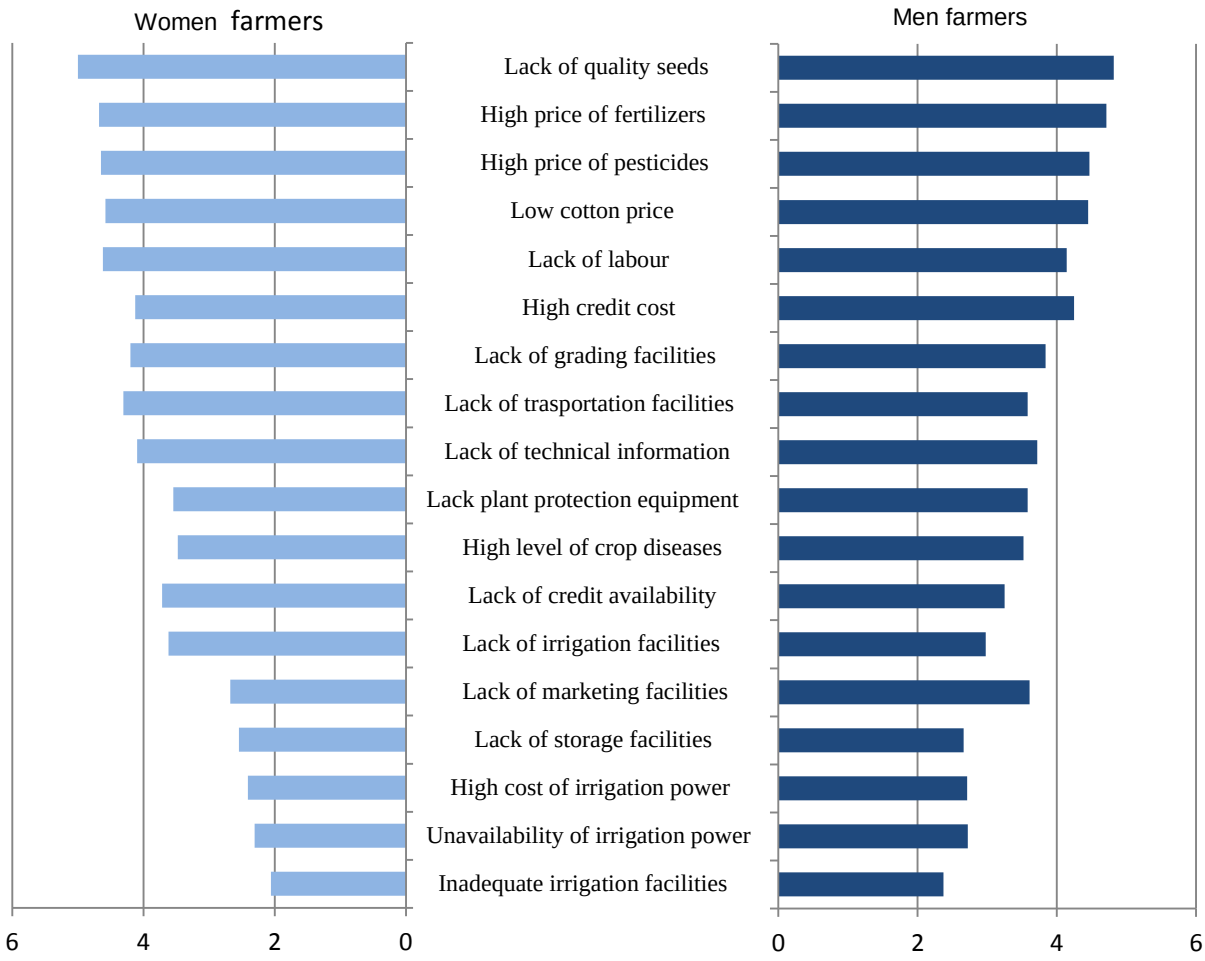
A number of insights regarding the risk faced by farmers are possible from the histogram above if one considers that the Minimum Support Price (MSP) for cotton set by the Government of India (price at which the Cotton Corporation of India intervenes the market by purchasing cotton, when the market prices 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 MSP, thus facing the risk of considerable economic losses in low price years.

Beside quantitative data, qualitative data were also collected to identify the main constraints confronting smallholders in cotton cultivation, as well as measuring the level of social capital and collective action in the farming community, as detailed in the next paragraph. Data from the household survey were analysed by means of descriptive statistical methods, principal component analysis, and multiple linear regression techniques. Qualitative and quantitative data were evaluated separately and ultimately combined to answer the research questions.

2.3.3. Identification of farmers' production constraints and their gender dimension

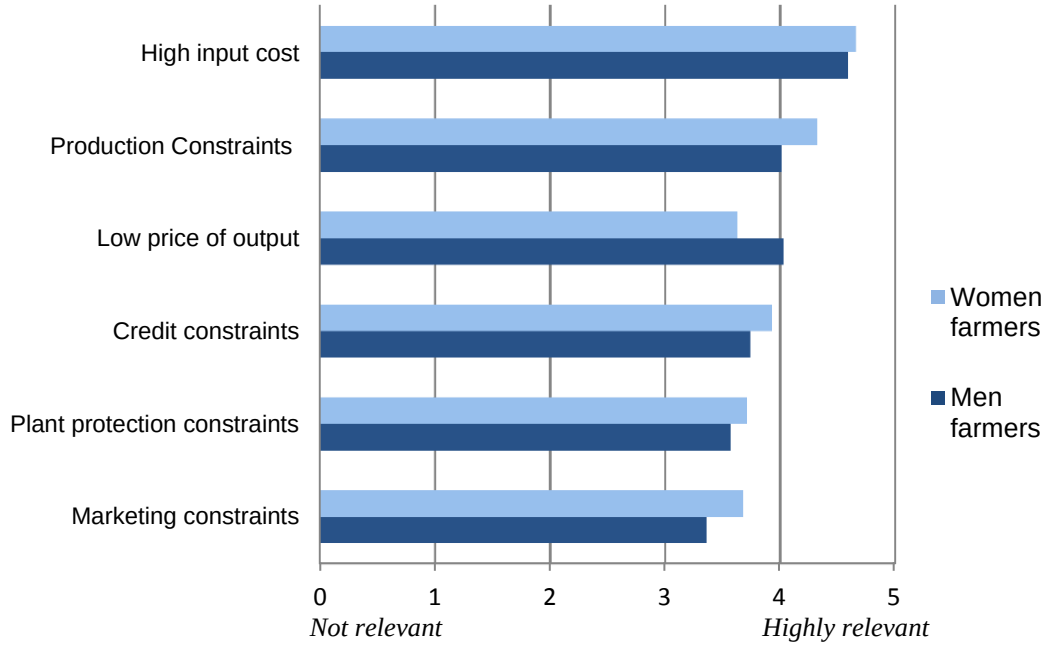
One of the objectives of the field research was to identify and measure the constraints farmers faced in farming as well as their needs and aspirations in improving their productive life. Given the profound differences in terms of roles, resources, rights, opportunities and responsibilities of women and men in the Indian rural society, sample farmers' perceived constraints were analysed by gender. Increasing score values denoted higher relevance of the constraint (with 0 being "not relevant" and 5 being "very relevant"). The diagram in Figure 2.3 is illustrative of the wide variety of issues and perceived constraints experienced by sample farmers, reported separately by gender lines.

Figure 2.3 Farmer-identified technological and socio-economic constraints in cotton cultivation



These constrains involve difficulties in marketing produce, obtaining technical and market information, access land, credit and rural insurance, etc. A rating scale from 0 to 5 was used to evaluate the relevance of a series of constraints in smallholder production and marketing, based on previous research and also on the knowledge and experience of faculty members from the College of Rural Services, Wardha. The constraints identified by sample farmers were then processed through a Principal Component Analysis (PCA) which yielded six such components: high input costs; production constraints; low output price; credit constraints; plant protection constraints and marketing constraints. Only the variables with a significant loading in each of the six components were retained for the analysis (a total of 20 variables). The sum of the score points for each of these variables was used to quantify the six variables representing farmers 'constraints in agriculture, as shown in Figure 2.4.

Figure 2.4 Farmer-identified technological and socio-economic constraints in cotton cultivation (by PCA).



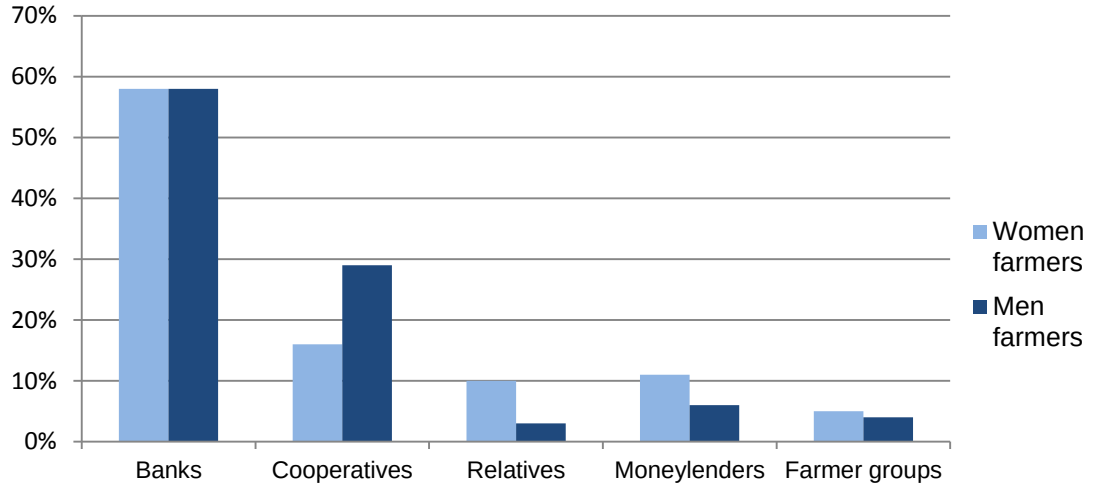
These results reflect the different opportunities and limitations women and men farmers face because of historic and cultural barriers - especially in terms of their needs for, and access to, inputs, services and programs. Result from both Figure 2.3 and Figure 2.4 reveal an important gender gap between women and men farmers' perceived production constraints in farming. As such, women farmers report significantly higher production constraints (i.e. lack of quality seeds, lack of labour during peak seasons, lack of technical information, lack of plant protection equipment, lack of timely availability of plant protection appliances) as well as higher credit and marketing constraints.

Gender differences are also observable from other indicators, such as farmers' literacy rate. In our sample, men study an average of 7.9 years while women farmers study only an average of 5.8 years. Difference in literacy rates are widespread in the area and also affect women farmers' access and control over extension and technology. When they are unable to read and understand instructions on fertilizers or seed packages, or if illiteracy impedes them from participating in extension courses, farmers are only able to access lower levels of information, technologies and techniques, which in turn, affect their productivity levels.

In the case of women, their daily workloads do not generally allow them to participate in extension training courses; in addition, as individual contacts with extension services - staffed predominantly by men – contravene traditional cultural norms, women farmers have little prospective to access technical information. Confirming this situation, survey women farmers reported higher constraints in accessing relevant farm information and technical training with respect to men.

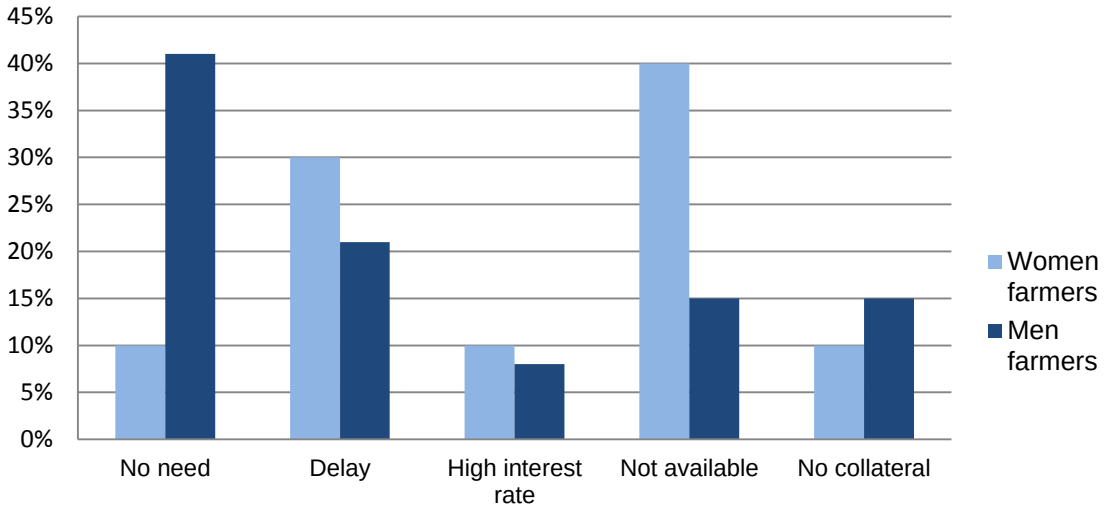
We also find differences in terms of access to credit and credit sources. Survey results show how 62% of women farmers use credit to finance their farming operations compared to the 57% of men farmers. Figure 2.5 details results on farmers' sources of agricultural credit. We can observe that while women and men appear to use the same rate of banks loans, women farmers use a much higher rate of informal credit provided by moneylenders and relatives.

Figure 2.5 Farmers' sources of agricultural credit



This difference is moreover explained when farmers not using credit to finance their seasonal operations are asked to detail their reasons. In this regard Figure 2.6 shows a notable difference between the situation of men and women farmers. While the large majority of men who do not use credit to finance their agricultural operation do not actually need this service, the majority of women farmers who do not use credit report problems of unavailability of financial services, delays in loan disbursement (speed of loan processing is a significant concern reported by survey farmers) and their high interest rate.

Figure 2.6 Farmers' reasons not to seek/obtain credit



Women farmers' ability to fulfil their overall credit needs is influenced by many factors as diverse as cultural norms and lack of well-defined property rights. While many microfinance programs are directed towards women, mainly due to their high rates of repayment, it is still difficult for women to access larger amounts of credit, which also affects the level of operation and investments they can afford.

However, addressing access to these factors (such as credit and technical information) depends on much more than just the provision of the service itself. And an augment in productivity of women farmers depends on much more than just the access to these services. The productivity of women farmers is also affected by their limited labour availability and the competing requirements for their labour between household responsibilities, farm work and social commitments. Hence, equity in access to resources and agricultural knowledge depends on farmers' participation as well as on realizing their different needs, roles, resources, rights and opportunities in the rural society.

Notwithstanding the gender gap in access to productive resources and opportunities, the vast majority of literature confirms that women are just as efficient farmers as men and would achieve the same yields if they had equal access to productive assets, inputs and services (Quisumbing, 1996). Closing the gender gap in agriculture would generate significant gains not only for the women farmers, but for the agricultural sector and the broader local economy. Moreover, when women control additional income, they spend more of it than men do on food, health, clothing and education for their children (FAO, 2001). This has positive implications for the immediate well-being and the long-run human capital formation of the society as a whole.

One of the solutions that proved successful in addressing the many challenges that affect the productivity of Indian women farmers is an active participation in farmer groups that are sensitive to the needs and challenges faced by female farmers (Paris *et al*., 2008 and Agarwal, 2010 provide examples of successful cases of agricultural production collectives involving women farmers in India, while Bantilan and Padmaja, 2008 provide insights on specific gender dimensions in build-up of social capital in the Indian setting). Through joint farming and agricultural associations, women farmers are able to acquire cheaper inputs while increasing their bargaining power with buyers. In addition, when buyers bring their markets closer to the farmers they also get the advantage of accessing their supplies in bulk. Although this benefits all farmers, women farmers tend to benefit more because unlike male farmers, they have fewer options and opportunities for selling their produce given their time, labour and social constraints.

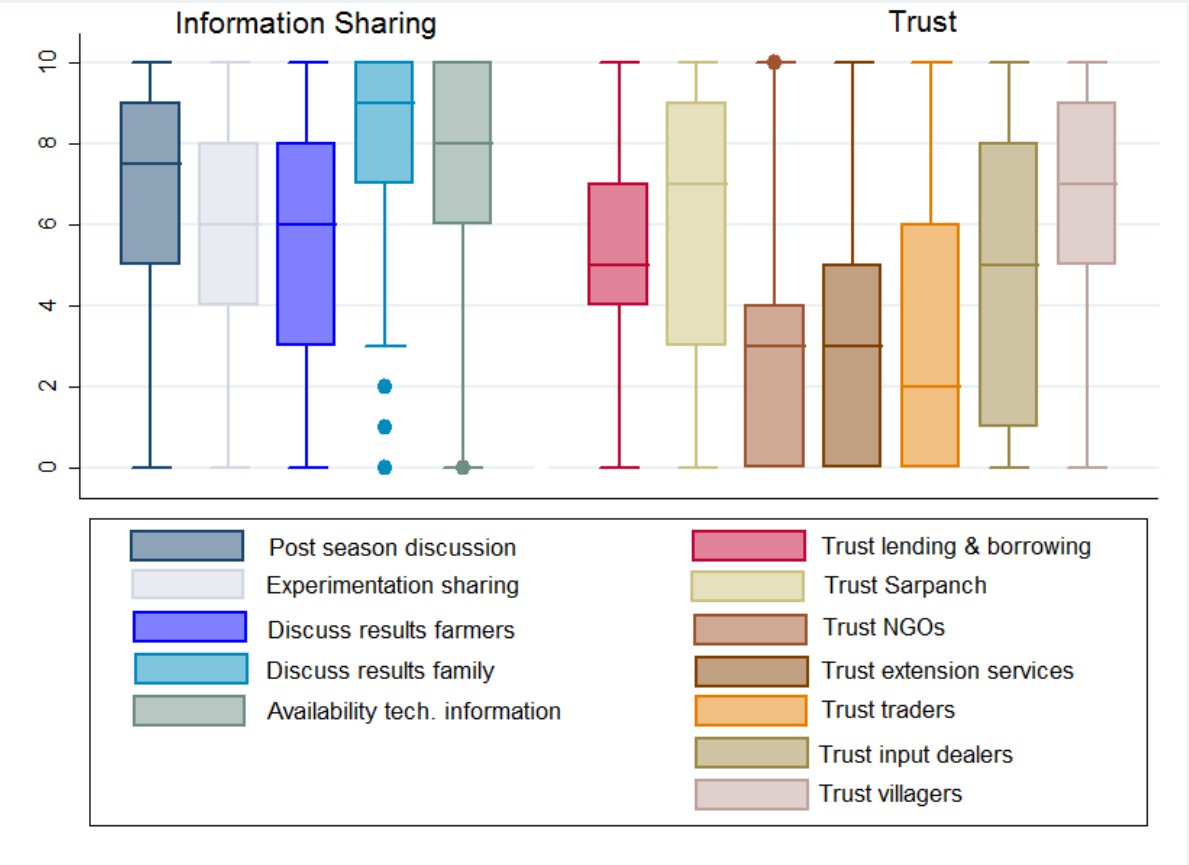
Summarising these results, from farm surveys emerge two main reasons for agricultural distress in the study area, which affect both women and men farmers: high production costs and production constraints.

2.3.4. Identification and measurement of social capital

Another important methodological concern in our analysis is the measurement of social capital. We designed the survey adapting the questions suggested in the World Bank's Social Capital Questionnaire (Krishna and Shrader, 1999) to our specific case study. For its strong context-specific nature, the measurement of social capital needs adjustments in relation to each local community (Krishna, 2001). This adaptation is especially needed in the context of multiple identities and complex social stratification which characterize the Indian rural society. Our social capital survey thus aimed at capturing the particular features of local social interactions among farmers as well as the larger picture of collective social interconnections among groups and individuals.

A specific part of our survey questionnaire was devoted to social capital (Appendix A), with a total of 25 questions, enquiring about farmers' social networks, collective action in production activities as well as perceptions of mutual trust and reciprocity at the village and household level. Relevant results in terms of information sharing and trust among survey farmers are reported in Figure 2.7. Particularly helpful was the support of the faculty from the College of Rural Services in Wardha which provided expert advice on the adaptation of the survey to the study area characteristics.

Figure 2.7 Survey results regarding Information Sharing and Trust



Note: responses were measured on a Likert scale from 0 to 10, with higher scores indicating higher levels of social capital

A principal component analysis (PCA) was then performed on the social capital variables measured on a Likert scale from 0 to 10, with increasing score values denoting higher levels of social capital. Only the variables with a significant loading in each of the social capital components were retained for the analysis (a total of 14 variables). PCA revealed three main underlying structures: collective production (CP) activities, information sharing (IS) and trust and mutuality (TM). The sum of the score points for each of these variables was used to quantify the three social capital components, whose results statistics are shown in Table 2.2.

Table 2.2 Key summary statistics for social capital variables

Variable (N=250)	**Description**	**Mean**	**Std**	**Min**	**Max**
CP	Collective Production (PCA factor)	10.29	8.67	1.00	50.00
IS	Information Sharing (PCA factor)	32. 76	10. 38	4.00	50.00
TM	Trust and Mutuality (PCA factor)	24.97	7.99	3.00	40.00
SOCIAL CAPITAL	*CP + IS + TM*	68.05	19.07	8.00	135.00

Given the low level of participation in formal farming organizations reported by sample farms, we considered the density of formal organizations to be an inappropriate indicator of cooperation and collective action among local farmers. Krishna, 2001 underlines how the large majority of organizations in Indian rural areas have been set up at the initiative of some government agency, which villagers joined mostly in order to gain some immediate economic benefits. We thus created proxies for social capital which do not depend on formal/informal group memberships[9] but derive from the quality of relationships among people within the farming community, showing their propensity for mutually beneficial collective action in production activities.

The component CP summarizes the information on farmers' degree of cooperation in production activities (collective input acquisition, share of labour force, collective soil and/or water conservation, etc.). CP statistics shows that around 80% of sample farms undertake some form of collective action in agricultural production involving one or more of the following: collective provision of labour, fertilizers and other inputs, collective soil and/or water conservation, or collective output sales.

IS represents the capacity of farmers to find, generate and share valuable technical information on cotton production. Statistics for IS show that 97% of the sampled population discuss their ex-ante farming decisions with other farmers and 91% with other family members; furthermore, 86% report sharing farming results with other farmers at the end of the season.

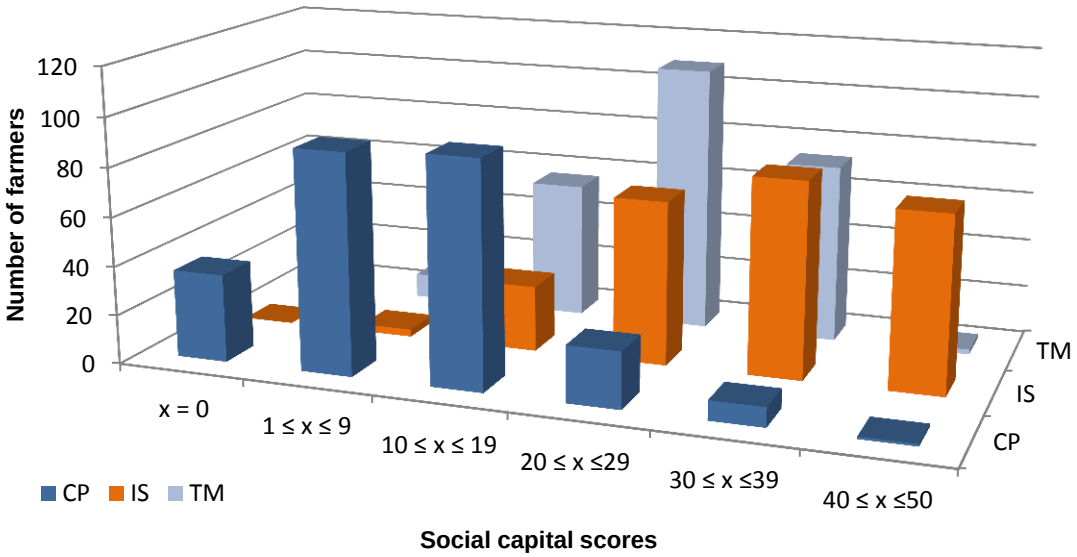
[9] The levels of social capital registered showed a positive, although very weak and not statistically significant correlation between group membership and social capital levels: 0.10 for CP; 0.02 for IS and 0.11 for TM.

TM, on the other hand, represents inter-caste collaboration, mutual support, cooperation and volunteership in the development of community activities. Concerning volunteership, 84% of the farmers report to be expected to volunteer or help in community activities in their community/neighbourhood and 73% confirm their readiness to contribute money or time to community schemes even if they would not directly benefit them. Results show considerable differences across components of social capital. CP presents the lowest frequency of incidence (with an average score of 20,58%) in respect to IS and TM (65,52 % and 61,45% respectively). The distribution of different social capital scores is shown in Table 2.3 and illustrated in Figure 2.8.

Table 2.3 Distribution of social capital scores by category

Social Capital scores	Number (percentage) of farms		
	CP	**IS**	**TM**
$1 \geq x$	36 (14.4%)	0 (0%)	0 (0%)
$1 \leq x \leq 9$	90 (36%)	3 (1.20%)	10 (4%)
$10 \leq x \leq 19$	92 (36%)	27 (10.84%)	56 (22.40%)
$20 \leq x \leq 29$	23 (9.2%)	67 (26.91%)	109 (43.60%)
$30 \leq x \leq 39$	8 (3.2%)	71 (28.51%)	73 (29.20%)
$40 \leq x \leq 50$	1 (0.40%)	1 (0.40%)	2 (4%)

Figure 2.8 Distribution of the three categories of Social Capital: CP, IS and TM



These findings indicate that although sample farmers hold high levels of trust, mutuality and information sharing, there is still ample scope to increase the extent to which farmers cooperate and pool resources in production activities. The following paragraph will evaluate the direct effect of social capital to reduce farmers' major hurdles: high input costs and production constraints.

2.4. Results and Discussion

2.4.1. Social capital and farmers' production costs

The major hurdle reported by sample farmers relates to high production costs. High production costs are moreover burdened with increasing interest rates, a situation which becomes especially critical when crops do not yield reasonable returns on investments. On this point social capital and collective action can hold a substantial role. 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. In this case, sharing of technical information among farmers and collective production activities could help two ways: reducing production costs on one side, and allowing a more intensive and efficient use of production inputs – which again reduces unit costs - on the other.

This is the case of certain farm investments which would be, not only too costly, but impossible to undertake other than collectively. This is the case of water leasing, which requires negotiating a passage for water channels and management of water flows, all of which are difficult to undertake through rental agreements (Agarwal, 2010). Given these hypothesis, we measured through Spearman Rank Order Correlation[10] the strength and direction of association that exists between social capital and production cost per quintal. Table 2.4 presents the obtained results.

Table 2.4 Correlations between production costs, education and the three components of social capital

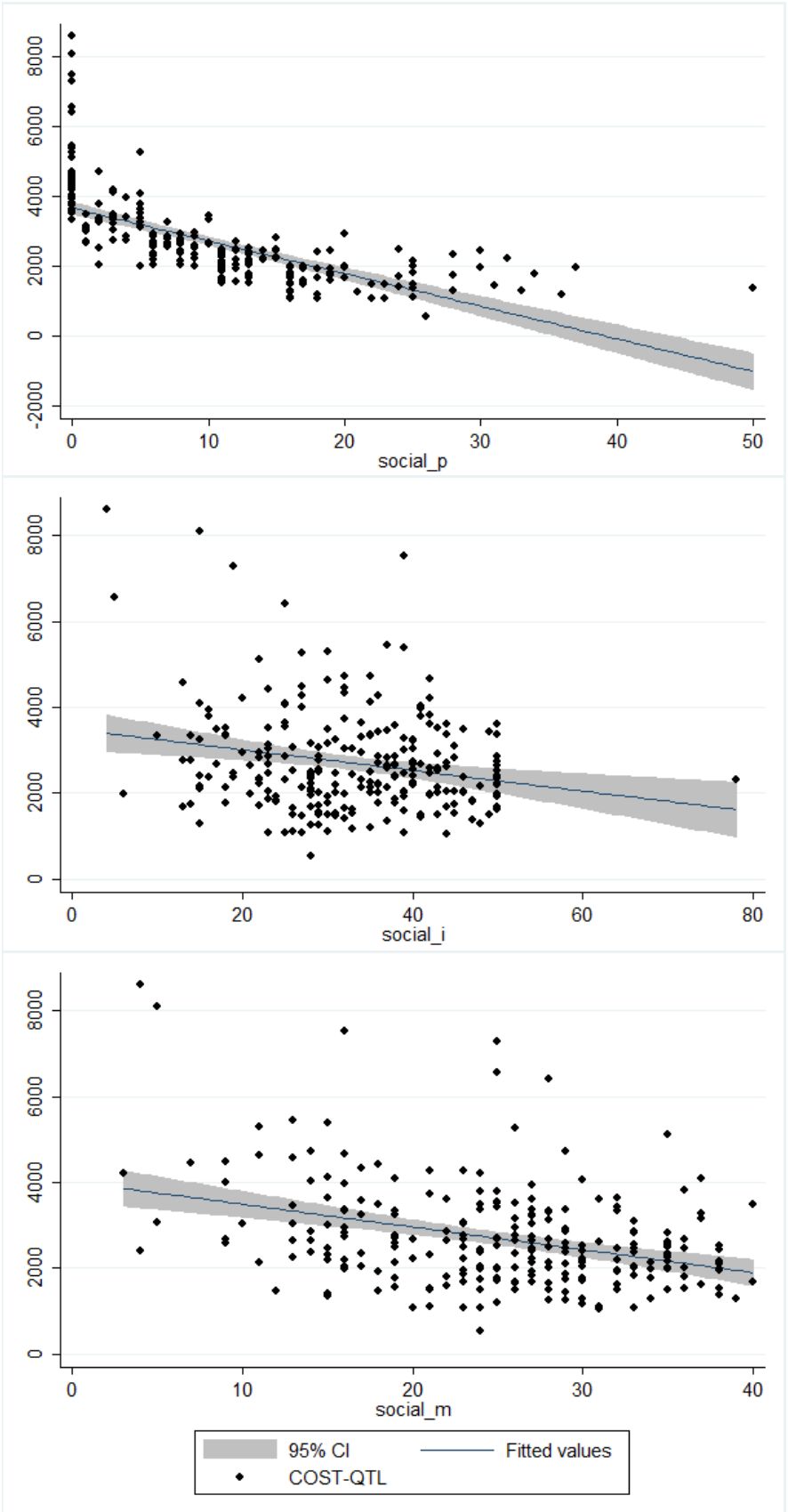
		CP	TM	IS	Education
Spearman's rho	**COST/QTL**				
	Correlation Coefficient	-0,852**	-0,277**	-0,145*	-0.221**
	Sig. (2-tailed)	0,000	0,000	0,022	0,000

Note: **. Correlation is significant at the 0.01 level (2-tailed) and * at the 0.05 level (2 tailed).

Our findings indicate that out of the three social capital variables, CP exerts the stronger impact (ρ = -.852). This is suggesting that cooperation in farming activities as well as in the procurement of productive inputs helps reducing farm production expenditures. Moreover, smallholder farmers also use social capital to overcome transaction costs through a reduction in information and search costs and through substitution for poor market institutions. Accordingly, TM and IS too present significant negative correlation with production costs ratings (respectively ρ = -.277 and ρ = -.145). The negative association between these variables can be further observed in the dispersion graph in Figure 2.9.

[10] 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. This correlation measure is not significantly affected by outliers (the presence of outliers in the production cost data mirrors the reality of a farmer suicide prone area, where a number of interviews report production costs higher than income).

Figure 2.9 Dispersion graphs describing the relationship between social capital and cost per quintal



The above association is validated by the results obtained with multiple regression analysis, confirming social capital to be a relevant predictor of cost per quintal (Table 2.5).

Table 2.5 Multiple linear regression model estimating the effect of social capital and education on farmers' production costs

	Production cost per quintal (Rs.)	
	Coef	**Std**
CP	-86.2967***	6.7233
IS	-11.5061**	5.2212
TM	-15.0087**	7.4150
Education	-27.5867**	12.4333
_cons	4546.138***	233.5333

*** and** indicate significance at the 1 and 5% respectively.
$F(4, 244) = 59{,}94$ $p < .0000$, $R^2 = .5001$.

Given that human capital serves as a complement to social capital in enhancing household welfare and farm productivity, the effect of education was considered beside social capital both in the correlation analysis (yielding $\rho = -.221$) and multiple linear regression model (Table 2.5). Our findings on both tests show the importance of education in reducing production costs and hence increasing farm viability. Our results are hence compatible with those of Narayan and Pritchett (1999) and Robinson *et al.* (2000) confirming the positive association between social capital and microeconomic performance.

2.4.2. Social capital and farmers' productivity

The second major hurdle to cotton production faced by sample farmers relates to the production constraints which limit their productivity and profitability. Production constraints in this analysis specifically refer to the lack of quality seeds, lack of labour during peak seasons, lack of technical information, lack of plant protection equipment and lack of timely availability of plant protection appliances. These types of constraints crucially hold back the productivity of the smallholders. Here we consider the role of social capital to act upon the constraints on smallholder productivity, by increasing farm production level. To be able to quantify this relation, a Spearman's Correlation is used to relate production yields reported by sample farms (computed as the quintal of cotton produced per acre) with their level of human and social capital.

Findings, reported in Table 2.6, show that education, TM and IS have a positive, although moderate, correlation with production yields (ρ = ,282; ρ = ,210 and ρ = ,207, respectively). These results point toward the importance of farmers' education and information sharing to provide valuable technical know-how to improve production levels. Moreover, through labour sharing, farmers are overcoming the problem of a lack of agricultural labour during peak seasons. This especially benefits marginal farmers. In general there would be less conflict/competition between farmers for obtaining extra labour during peak needs (Agarwal, 2010).

Similarly, the relatively strong, positive association between the level of CP and production yields (ρ = ,568) indicates that farmers gain in productivity by acting jointly rather than individually. Potential gains of group farming to bring greater productivity and social empowerment as compared to individual production units is proved in many empirical studies, showing how individual unorganized small-scale farmers 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).

Table 2.6 Correlations between production yields, education and the three components of social capital

		CP	TM	IS	Education
Spearman's rho	**QTL/ACRE**				
	Correlation Coefficient	0,568**	0,210**	0,207**	0,282**
	Sig. (2-tailed)	0,000	0,001	0,001	0,000

Note: **. Correlation is significant at the 0.01 level (2-tailed) and * at the 0.05 level (2 tailed).

To validate the above association, a multiple regression analysis (Table 2.7) was used to examine whether productivity levels are related to social capital scores. The results of the multiple regression prove social capital and education to be relevant predictors of farm productivity. To check the absence of a bi-causal relationship between social capital and farm welfare indicators, the exogeneity of social capital was verified by the Durbin-Wu-Hausman Test. Results confirm social capital to be exogenous (which is in line with Narayan and Prichett, 1997; Grootaert, 1999; Aker, 2005; and Yusuf, 2008). The positive association between the social capital and productivity levels can be further observed from the dispersion graph in Figure 2.10.

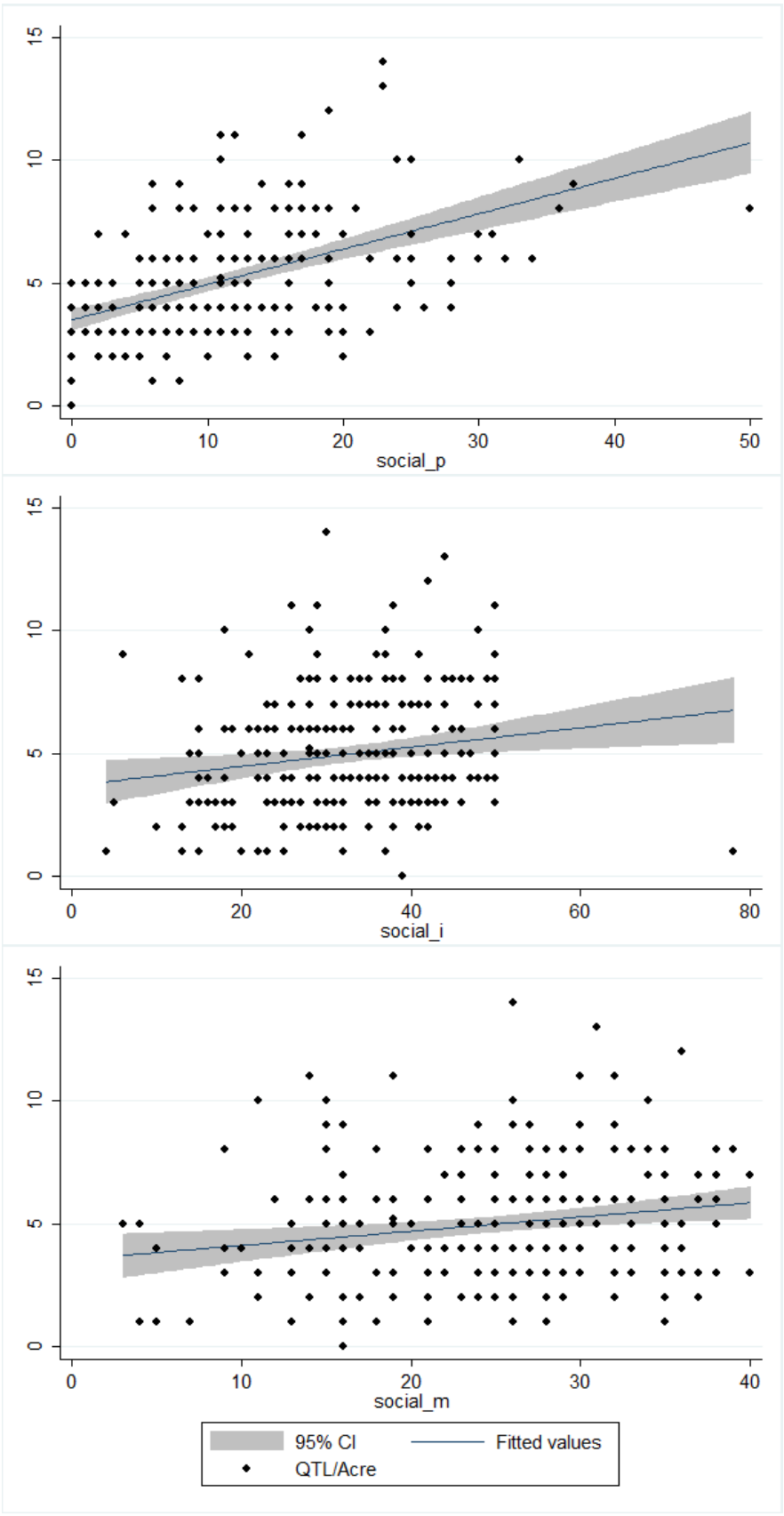
Table 2.7 Multiple linear regression model on social capital and education's effect on farmers 'productivity

	Yield per acre (Qtl)	
	Coef	**Std**
CP	.1383***	.0159
IS	.0235*	.0124
TM	-.0076	.0176
Education	.1255***	.0295
_cons	2.0153***	.5536

*** and * indicate significance at the 1 and 10%, respectively.

$F(4, 244) = 29{,}32$ $p < .0000$, $R^2 = .3246$.

Figure 2.10 Dispersion graphs describing the relationship between social capital and yield per acre



The interrelation between social capital and farm performance is also consistent with a number of different studies which have shown how participation in social networks (both formally – cooperatives and farmer associations – and informally) exerts a positive impact on the productive efficiency of small farms (Nyemeck *et al*., 2005; Jaime and Salazar, 2011; Serra and Poli, 2015) and on the welfare of rural small-scale producers (Lyon, 2003; Darr, 2005; Milagrosa, and Slangen, 2006; Hellin *et al*., 2007). Moreover, given the shortcomings of formal rural credit system (largely due to the twin issue of high transaction cost and poor repayment rates), a household which can rely on its networks to obtain credit to compensate for any temporary shortage of physical and financial capital, can reasonably reduce its vulnerability and risk. This suggests that the returns to social capital in a rural community setting might be as important as returns to labour, physical or human capital.

2.4.3. Social capital and rural development

We demonstrated how different aspects of social capital exert different impacts on farmers` production performances; similarly, it is important to understand how different aspects of social capital affect different development outcomes.

As a general line, social capital has been found to foster rural community wellbeing in environments where government or private sector substitutes for risk coping mechanisms are not available or prohibitively costly (Collier, 2002; Murgai *et al*., 2002). Social capital offers alternative adaptive strategies which are easier, cheaper and more accessible in comparison to formal, more technical and capital-intensive strategies, such as insurance, which remain unaffordable for most poor rural communities. In this regard, empirical investigations have emphasized the role of social capital in improving health in resource-poor settings (Story, 2013)[11], promoting food security (Misselhorn, 2009) and in facilitating community adaptation to climate change[12].

Social capital is evidently a resource that originates from the grassroots, but it actually needs connection with other levels of governance to be sustained and flourish. On one side policy makers and development planners can facilitate social capital built up by providing an adequate framework for its development. This involves sustaining mutually beneficial relations among the farming communities and between communities and external institutions. On the other, policy makers can increase the reach and the effectiveness of social capital by making contributions to the social resources available within communities in terms of human and economic capital. In turn, a stronger social capital will have the

[11] There is significant agreement that the health of individuals is highly related to the cohesiveness of the social environment (Lomas, 1998; *Waverijn et al*., 2014).

[12] Specifically, farmer experimentation, information sharing and farmer-to-farmer extension has been proven to helps farmers building local capacity to eliminate constraints in production and changing strategies in adaptation to climate change (Deressa *et al*., 2009; Tessema *et al*., 2013). In addition, social capital in the form of voluntary labor has been shown to facilitate collective adaptation practices such as sea dike maintenance (Adger, 2000) and adoption of soil conservation (Cramb, 2005; Bezabih *et al.*, 2013). Eventually, in case of environmental shocks, social capital exerts also a vital role by facilitating asset recovery (Mogues, 2006).

means to sustainably manage and equally distribute these resources through social networks and collective action (Grootaert & van Bastelaer, 2001).

Having emphasized the benefits of social capital for rural development, the question is how can social capital in the rural communities be nurtured, developed, and maintained in practice? We try to answer this question starting from our research findings. Let us take the case of trust. Our sample farmers reported to increase their trust on others as they experienced the benefits of cooperative behaviour. This cooperative behaviour may arise in the context of formal associations and/or from participation to common projects but also within less formal social networks that exist among fellow farmers. Higher trust, in turn, is expected to engender more cooperative behaviour, creating a virtuous circle between social connectedness and trust (Claibourn and Martin, 1997) . Our analysis here lends support to this virtuous circle model, by finding a significant positive correlation between TM and CP ($r = 0.36$, $P < 0.01$) and between TM and IS ($r = 0.25$, $P < 0.05$).

This confirms that generalised trust and reciprocity, collective action and information sharing reinforce each other leading to a high equilibrium of higher production performances. Thus, Putnam (l993, p. 177): "Stocks of social capital, such as trust, norms, and networks, tend to be self-reinforcing and cumulative. Virtuous circles result in social equilibria with high levels of cooperation, trust, reciprocity, civic engagement, and collective well-being." Engendering this process is thus the main challenge for policy making.

From our survey emerges another important point. We find a significant positive correlation between the level of inter-caste collaboration and farm productivity performances: cost per quintal ($r = -0.28$, $P < 0.01$) and quintal per acre ($r = 0.21$, $P < 0.05$). The relationship between heterogeneous social relationships and positive development outcomes has also been reported by other studies in the developing world (Narayan & Cassidy, 2001). Promoting diverse, heterogeneous network would be especially beneficial for disadvantaged households that have few assets and little access to resources. This may give marginal communities better access to resources and information, as well as more opportunities to voice their claims and negotiate support.

Inducing collective action among all the diverse groups is therefore another key challenge. It is not sufficient that a group of people – a particular type of farmers, a particular caste - have trust and networks. To "produce" a good effect on rural development, it is important that trust and networks go beyond the small group, establishing and nurturing connections among different groups (Dekker and Uslaner, 2002). These new cross-cutting ties are especially effective in opening up economic opportunities to those belonging to less powerful or excluded groups (Narayan, 1999) which is the case of the rural poor.

However, tailoring specific solutions to each local contexts and supporting the structure to make social capital prosper at the grassroots level is not an easy task. Much of the blame for the present inability to translate the concept into policy settings lies in the intrinsic characteristics of social capital. On one side, social capital is intangible, and thus difficult to measure. On the other side, it is unlikely for

there to be a "one-size-fits-all" prescription for strengthening social capital. These conditions make it difficult for policy makers to operationalize social capital and to evaluate the extent to which particular policies can actually succeed in promoting community cohesion and build social capital (Jeff, 2003).

These limitations indicate the need for policy to search for alternative ways of meeting these challenges. If it is clear that successful "local" and "rural" development strategies are best built on evidence and development needs, it is important to find out the actual needs that social capital building is supposed to fulfil, and accordingly adjust the projects' focus and objectives. A "learning-by-doing" approach can fruitfully be sided by an account of "what is actually working" in particular contexts. This would allow constructing an empirical framework with a new set of tools for understanding the conditions under which policy instruments are likely to either work well or poorly in a specific context[13]. Furthermore, literature suggests that, in the short term, it may be also useful to settle small-scale policy experimentation to gain experience and collect data regarding effective local projects and initiatives aimed at supporting and enhancing social capital (Productivity Commission 2003).

During our field research in Maharashtra, we encountered an interesting grassroots initiative with key focus on collective action in farming as well as high quality and productivity goals. The project is called "Sahaj Agricultural Project" and currently involves twenty thousand farmers all over India, while its progress is monitored by the ICAR[14] (Feeding Knowledge, 2015)[15]. Its model offers a good example of how a bottom-up rural development project can produce successful results both in terms of collective action in farming as well as in terms of high quality and productivity goals. Its networks carry on bottom-up solutions for sustainable development; solutions that respond to the local situation and the interests and values of the communities involved.

One of its unique features is that every farmer is considered as an integral part of the agricultural process through which the inherent connection with his/her fellow farmers and the surrounding natural elements is harnessed and channelized. Regardless of their socio-religious background, farmers share a common practice which is related to the Indian ancestral knowledge of yoga and meditation to enable them to establish a deeper connection with the energy flow in the natural environment they live in[16] as well as accessing higher levels of collective social consciousness like trust, sharing and mutual respect[17]. In some regions entire villages have adopted the practice wholesale as a means of improving their lives and community well-being, while the project is managing to bring people of different backgrounds to work together, providing a successful holistic and zero-cost alternative for approaching agriculture and its sustainability.

[13] Taking the case of the Indian coal mining sector, Pantoja (2000) offers an in-depth analysis of different attempts to build up and strengthen social capital at community level, reporting their successes and failures.
[14] ICAR Project number 13[40]\2015-cdn[Tech]
[15] The full program is now currently being practiced in over 17 states across the Indian nation, and in Maharashtra alone there are 830 SAP centers in operation, supporting a vast network of small rural farmers. Its executive plan can be found at the UN for Expo project, Feeding Knowledge (2015).
[16] This flow of life energy within the nature which farmers harness in agricultural production is known to Indians as the Chaitanya Lahari described by Adi Shankaracharya.
[17] The principles behind this method has shown improvement in managerial social responsible behaviour, the same improvement factors which also deliver the key components of trust and sharing to the farmers which enable them to engage across the entire social capital model: http://www.corporatejustice.org/IMG/pdf/Response_FinalReport.pdf

In this model we find a number of key elements that activate and nurture social capital: trust, information sharing, collective production and inter-caste, inter-group collaboration. In this case trust comes from shared believes and shared practices (farmers have in common a meditation practice which help them connecting to the energy flow of the natural environment) and then carry on their farming activities in cooperation. Moreover, trust comes from realizing the collective interconnection among farmers, which goes beyond status-religious-ethnic differences. Cooperation is also reinforced by realizing how collective achievements (might be increased production quality, reduction of chemicals or any type of desired collective action etc) create positive spill-overs on individual achievements and vice versa.

The success of this model shows that the choice of increasing social capital is not only individual, but also a collective choice, and that the process can be facilitated from outside but only when actual community needs and aspirations are conveyed through it. Examples of this kind could be a useful illustration for forging new strategies in social capital policy-making inspired by effective bottom-up community models. This would allow policies to explore new ways of harnessing the potential of social capital resources, while crossing the traditional boundaries between policy-makers and policy-receivers, enabling thus bottom-up solutions to emerge during a participative design process.

2.5. Concluding remarks

This chapter analyses the potential for social capital to make a positive change in the productive life of smallholder farmers in India. This hypothesis has been tested from different analytical perspectives and qualitative methods. The results obtained converge on the same conclusion, showing the positive role of social capital in improving the productivity of cotton farms, reducing their input costs and allowing farmers to overcome the long-term production constraints limiting the viability of smallholder agriculture.

Hence, this study sheds light on the relevance of social capital in the Indian rural sector, linking together the subject of social capital with agricultural sustainability, productivity levels and production costs. In doing so, this research takes up the challenge of finding alternative methods of enhancing smallholder agricultural productivity in a situation where access to productive resources and other conventional inputs such as land, material capital and labour is particularly limited and where other technically successful answers can be heavily bounded by non-technical issues.

Social capital is intended as the quality of relationships among people within the farming community, showing their propensity for mutually beneficial collective action in production activities. Collective farm activities can 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 type of cooperation between people in the same community is based not only on their active connections, but also on their reciprocal trust, mutual understanding, and shared values which make cooperative actions possible.

On one hand, we have seen the potential of social capital for improving farmers' productive life, on the other, this study has also highlighted the difficulties in translating the potential of social capital into an action tool for rural development policies. We have seen that measurement is a difficult task; we have also seen that social capital has different characteristics in different contexts, which is especially the case for the complex and highly stratified Indian society.

However, social capital building at the grassroots level needs the connections with other levels of governance to be sustained and to flourish. We have seen how policy makers and development planners can facilitate social capital build up by providing an adequate framework for its development. Here the challenge for policy is to identify the conditions under which different social groups can harness the positive aspects of bonding social capital while simultaneously fostering its bridging and linking dimensions. Policy can also add to the reach and the effectiveness of social capital by contributing to the resources available within networks in terms of human and economic capital. In this way governments and engaged communities can act in synergy to enhance each other's developmental efforts, creating long-lasting and mutually beneficial collaborative relationships.

In this process, it is important for policy makers to find out the actual needs and aspirations that social capital building is supposed to fulfil for each community, and adjust accordingly projects' focus and objectives. For this purpose we have highlighted the importance of developing local institutions where farmers can design, manage, control and scale up new initiatives to build social capital. Successful bottom-up projects can also serve as inspiration for policies. We have observed the practical example of the "Sahaj Agricultural Project", and how similar grassroots solutions can prove that a holistic approach to agriculture is not only desirable but indeed possible.

The positive relation which is found between social capital and agricultural performance brings hope for a new agricultural economy, where farmers are secured a dignified standard of living, where social relationships are promoted in a sustainable manner and reinforced in a conscious relationship among people, their communities and a higher level of governance. Furthermore, the effectiveness of collective action among farmers could be an interesting starting point for research into new mechanisms for increasing the efficiency and the prosperity of the local agricultural system as a whole. An alternative model, where farmers, processors, distributors and consumers do not compete with each other only for economic and monetary interests, but act in cooperation for purposes which are also social and ecological.

THIRD CHAPTER

THE IMPACT OF SOCIAL CAPITAL ON PRODUCTIVITY AND EFFICIENCY LEVELS[18]

This chapter analyses the contribution of social capital to the productive efficiency of smallholder Indian farmers, using a stochastic frontier analysis. Social capital is examined into its separate functional parts, as well as in interaction with farmers' demographic characteristics such as education and age. For each variable its contribution to farmer's productivity and efficiency levels it is examined. Results suggest that higher levels of technical efficiency are obtained when farmers use higher levels of social capital. Specifically, the aspects of social capital that greatly influence efficiency and productivity levels are information sharing and collective production. Given farms' restricted access to economic resources, conventional inputs and marketing channels, strengthening farmers' capacity to collabourate and work together represents a powerful tool for improving the efficiency of Indian agriculture and its impact on poverty.

[18] Publication information: Poli, E. , Serra, T., and A. Sharma, 2015. The role of social capital in improving technical efficiency of the agricultural sector in developing countries, the case of india. (*Under the first round review* at *the Journal of Development Research)*

3.1. Chapter overview

Indian smallholder agriculture is dominated by cotton production and is already operating at its land frontier with very little or no scope to increase the supply of land (Indian Ministry of Agriculture, 2012). Moreover, due to population pressure, a further expansion of the crop area is no longer possible. While being one of the world's largest producers of cotton, India remains one the least productive[19]. Thus, the most plausible solutions to increase cotton production lie in raising farm productivity by improving technical efficiency and/or through technological improvements. Efficiency gains will have a positive impact on the incomes of the largely resource poor farmers engaged in cotton production. The role of efficiency and productivity in improving the economic sustainability of smallholder agriculture is subject to a long debate in development economics (see e.g. Schultz, 1964; Ali and Byerlee, 1991; Battese, 1992 or Barrett, 1997).

This chapter analyses technical efficiency of cotton production in smallholder farmers and identifies the factors that explain differences in efficiency levels across sample farms. Within this framework, our study assesses the capacity of farmers to increase their productive efficiency by building up social capital, an issue that is rarely taken into consideration in efficiency studies. This type of capital would be relatively free of cost, compared to other conventional (and expensive) inputs such as land, physical capital or labour, which, given the economic restrictions faced by farmers, would be hard to improve.

We focus on cotton production in the region of Maharashtra, accounting for about 30% of the area under cotton in India. It is estimated that more than three million families who are spread over 22 thousand villages of Maharashtra, depend upon cotton cultivation. Most of these are small and marginal farmers owning land up to 5 acres (Maharashtra State Cooperative Marketing Federation, 2015[20]). For this category of farmers, production costs have increased manifold over the years, while the productivity of land has remained at the same level and the sale price of farm produce has not commensurately increased. Out of the main cotton producing areas of Maharashtra, the District of Wardha was chosen for field research.

The rest of the chapter is arranged as follows: the next section describes the situation of smallholder farmers in Maharashtra, with specific reference to Wardha District. This is followed by a literature review and a brief discussion of the methodological approach. The empirical application section describes the dataset used in the analysis and discusses the empirical results. We conclude with an outline of the main findings and potential policy implications.

[19] According to the Ministry of Textile's Report on Cotton Fibre (2012), cotton yield in India improved from 278 kg/ha during 2000-01 to around 524 kg/ha in 2008-09. However, cotton productivity is still low in India when compared with the world average yield of 767 kg/ha.
[20] Maharashtra State Cooperative Marketing Federation accessed from: www.mahacot.com

3.2. Literature review on productive efficiency and social capital

Technical efficiency is a component of economic efficiency and reflects the ability of a firm to maximize output from a given set of inputs (Koopmans, 1951). There is considerable literature on the technical efficiency of Indian agriculture, tackling several aspects which explain efficiency differences between farmers and regions (Kalirajan, 1981 and 1982; Kalirajan and Shand, 1985; Battese and Coelli, 1989; Battese and Tessema, 1993). Recent studies in the Indian context focus on field crops like rice (Reddy and Sen, 2004), paddy (Rao *et al*., 2003), wheat (Singh, 2007), maize (Anupama *et al*., 2005), cotton (Shanmugam, 2003), and edible oil (Reddy and Bantilan, 2012; Mrutyunjaya *et al*., 2005). Results generally concord in reporting significant technical inefficiency among Indian smallholder farmers (e.g., Kalirajan, 1981, 1982; Battese, 1992). Noteworthy exceptions include Bagi (1982) and Fuwa *et al*. (2007), which represent a minority of studies finding relatively high performance levels for the smallholders.

Efficiency differences across farms are usually explained by factors such as farming experience, access to credit and extension contacts (Kalirajan and Shand, 1985), land size and age of farmers (Coelli and Battese, 1996), land fragmentation (Raghbendra *et al*., 2005) or physical capital formation (Venkataramana and Reddy, 2012). Other studies have extended the range of variables potentially affecting efficiency by including components of human capital such as health (Atheendar *et al*., 2010) and education (Kalirajan and Shand, 1985).

Our study proposes to consider another factor which is rarely taken into consideration in applied research: the capacity of farmers to increase their productive efficiency by building up social capital. Social capital is a wide-ranging concept covering the resources derived from social relationships. It embraces the ability to develop and use various kinds of social networks and the resources that become available thereof. Social capital is used to characterize the voluntary action taken by a group to achieve common interests, as well as subjective aspects such as confidence in institutions and trust in people. Since the middle of the 1990s, social capital has captured a rapidly growing interest among academics and policy makers. This has yielded multiple definitions, interpretations and uses of the concept that have been applied at the individual, group, and organisational levels.

Different social sciences emphasize different aspects of social capital. The economic literature has largely considered social capital along the lines of Putnam (1993), i.e., mainly as an associational activity that facilitates cooperation and coordination among individuals (Narayan and Pritchett, 1999; Grootaert and Narayan, 1999; Grootaert *et al*., 2002). The idea of social capital has also been employed extensively in studies of democracy and governance, schooling and education, families and youth behaviour, community life, work and organisations, as well as in the general field of collective action (Woolcock, 1998 provides an extensive literature revision of its use in different fields). In spite of the methodological difficulties to measure social capital (Portes, 2000; Van Deth, 2003), the literature has

developed many definitions and indicators to measure its existence and impact (see work of Narayan and Pritchett, 1999 and Payne *et al*., 2011).

The concept has been increasingly applied in rural studies (Castle, 2002) and has received growing attention in the rural development debate where it is seen as a factor potentially overcoming poverty, developing rural areas (Sobels *et al*., 2001; Sorensen, 2000; Uphoff, 2000; Uphoff and Wijayaratna, 2000; Grootaert and van Bastelaer, 2002b), and helping rural households overcome the deficiency of other capitals and inputs, thus increasing their welfare (Annen, 2001; Fafchamps and Minten, 2002).

Social capital has been shown to manifest its influence on efficiency and productivity in a number of different ways. Different studies have shown how social networks (both formal – cooperatives and farmer associations – and informal) have an impact on different aspects of the production activity: facilitating access to agricultural technical information as well as to extension (Hoang *et al*., 2006), improving irrigation management (Krishna and Uphoff, 1999; Uphoff and Wijayaratna, 2000), reducing transaction costs (Randela *et al.*, 2008), or improving land management through better access to information and technologies (Pender and Gebremedhin, 2007). As a result, social capital is usually found to be related to higher technical efficiency levels of small farms (Nyemeck *et al*., 2005; Jaime and Salazar, 2011). In this respect, Serra and Poli (2015) have found social capital to be the input with the highest contribution to productivity after land, with productivity improvement associated to an investment in social capital on the order of 12%.

Contributing to this debate, many recent economic development analyses at the micro level have included social capital in household production functions (see Ha *et al*., 2004; Innes, 2010; Grootaert, 1999; Maluccio *et al*., 1999; Narayan and Pritchett, 1999; Uphoff and Wijayaratna, 2000; Ruben and Strien, 2001). Applying a stochastic frontier analysis we add to the literature by assessing the contribution of social capital to the productive efficiency of smallholder Indian farmers using a parametric approach. This subject has not yet been investigated from this analytical viewpoint. Another important contribution of our analysis is the breaking down of the concept of social capital into separate functional parts, showing their different impacts on efficiency and productivity. This information is meant to provide policy makers with clearer guidelines to identify and mobilize local social capital in the Indian rural sector thus contributing to the scant literature on the topic.

3.3. Methodological approach

The production economics literature has traditionally measured technical performance of a firm through the concept of efficiency. Given a set of inputs and a technology, technical efficiency measures

the capacity of economic units to reach the maximum attainable output (Koopmans, 1951). Technical efficiency has thus been identified as a necessary condition to attain economic sustainability. Different (deterministic as well as stochastic, parametric as well as non-parametric) techniques to measure technical efficiency are extensively described in the literature (see e.g. Coelli *et al*., 1998; or Kumbhakar and Lovell, 2000). In the following analysis, we apply a stochastic frontier approach to characterize smallholder cotton production in Maharashtra. The stochastic frontier approach assumes that maximum attainable production is delimited from above by a parametric production frontier that depends on known inputs, unknown parameters and a measurement error. In a cross-sectional context, the production frontier can be formulated as follows:

$$y_i = f(\mathrm{X_i};\beta)^* \exp(v_i)^* TE_i \qquad (1)$$

where y_i is the output of the *i*-th firm (*i*=1,..,*N*); $f(\mathrm{X_i};\beta)^* \exp(v_i)$ is the stochastic production frontier consisting of the deterministic production technology $f(\mathrm{X};\beta)$ and a stochastic producer-specific component $\exp(v_i)$, which captures the effect of random shocks and measurement errors on cotton production; being v_i a vector of random errors that is usually assumed to be iid $\mathrm{N}(0,\sigma_v^2)$. $\mathrm{X_{i=}}[\mathrm{x_{1i}},\ldots,\mathrm{x_{Ki}}]$ is a (1 x *K*) vector of production inputs and other factors that influence production; β is a vector of unknown parameters that have to be estimated; $TE_i = \exp(-u_i)$ represents technical efficiency, being u_i a vector of iid nonnegative random disturbances that measure the extent to which firms fall short of expected output. v_i and u_i are assumed to be independently distributed. Technical efficiency of a producer can be expressed as the ratio of output to maximum feasible output as:

$$TE_i = y_i / f(\mathrm{X_i};\beta)^* \exp(v_i) \qquad (2)$$

Following Battese and Coelli (1995), exogenous influences are incorporated in the model to explain differences in producer performance. Specifically, it is assumed that u_i has mean $\mu_i = \gamma Z_i$ and variance σ_u^2, where Z_i is a (Mx1) vector of farm and farmer-specific characteristics (gender, age, education, etc.) and social capital measurements. The inefficiency effects function is specified as:

$$\mu_i = g(\gamma Z_i) + \epsilon_i \qquad (3)$$

where $\epsilon_i \sim N(0,\sigma_\epsilon^2)$ is a random variable that follows a truncated normal distribution with $-\gamma Z_i$ as the truncation point.

Another important methodological issue in our analysis is the measurement of social capital. Our questionnaire aimed at collecting information to create a locally adapted measurement of social capital which would serve to examine its contributions to the production process. Towards this aim, social capital was identified and measured as a compound of three elements: Trust and Mutuality (TM), Information

Sharing (IS) and Collective Production (CP). The component CP represents farmers' degree of cooperation in production activities (collective input acquisition, share of labour force, collective soil and/or water conservation, etc.). IS represents the capacity of farmers to find and share valuable technical information and know-how on cotton production. TM, on the other hand, represents mutual support, cooperation and volunteership.

These three elements (CP, IS, TM), which are introduced as variables in our production efficiency analysis, are all relatively free of cost compared to other conventional (and expensive) inputs such as land, capital or labour. These proxies do not depend on the existence of a formal/informal group membership but derive from the quality of relationships among people within the farming community, showing their propensity for mutually beneficial collective action in production activities. This characteristic of social capital presents a number of opportunities for the smallholder poor farmers, given the restrictions they face in accessing the other type of capitals and inputs.

3.4. Empirical application and results discussion

Our empirical analysis is based on a farm-level survey that was conducted in Wardha District, Maharashtra, India with the participation of 250 smallholder Bt cotton farmers. The survey focuses on the small and marginal farms, representing the majority of the area's farming population. Data were collected on farms' input use, including land use, crop-specific inputs such as seeds, fertilizers and pesticides, and labour. We further collected data on total output produced (both in physical and monetary units).

As regards the social capital part of the questionnaire, a total of 25 questions were asked to measure social capital. A principal component analysis (PCA) was then performed on the social capital variables measured on a Likert scale from 0 to 10, with increasing score values denoting higher levels of social capital. PCA revealed three main underlying structures: collective production (CP) activities, information sharing (IS) and trust and mutuality (TM). Only the variables with a significant loading in each of the three components were retained for the analysis (a total of 14 variables). The sum of the score points for each of these variables was used to quantify the social capital variable. Overall, the average social capital score is 68, being 140 the maximum score. Table 3.1 presents the descriptive statistics of the variables used in the production efficiency analysis, along with a brief definition and units of measurement.

Table 3.1 Definition and summary statistics for the variables used in the model

Variable	Description	Mean	Std	Min	Max
Production	Cotton output (Qtl)	14.96	8.16	1.50	50.00
Production factors					
Land	Cotton Land (Acres)	2.91	1.04	1.00	5.00
Seed	Seed cost (Rs.)	5,481.84	3,205.91	930.00	32,790.00
Fertilizer	Fertilizer cost (Rs.)	6,561.67	5,266.23	0.00	40,750.00
Pesticides	Pesticides cost (Rs.)	2,431.94	2,149.44	0.00	15,000.00
Labour	Labour cost (Rs.)	19,017.72	10,849.09	0.00	72,000.00
Education	Farmer's Education (years)	7.63	4.40	0.00	15.00
CP	Collective Production (PCA factor)	10.29	8.67	1.00	50.00
IS	Information Sharing (PCA factor)	32. 76	10. 38	4.00	50.00
TM	Trust and Mutuality (PCA factor)	24.97	7.99	3.00	40.00
Social	*CP + IS + TM*	68.05	19.07	8.00	135.00
Age	Age of the Farmer (years)	46.34	13.56	20.00	98.00
Sex	Gender (0 = male, 1 = female)	0.11	0.32	0.00	1.00

Vector X_i is defined as a (1x9) vector including the logarithm of the following variables: land (x_1), seeds (x_2), fertilizer (x_3), pesticide (x_4), labour (x_5), education (x_6). The social capital variables[21] are also part of X_i as follows: CP (x_6), IS (x_7) and TM (x_8). A flexible translog specification is used to model the effects of $x_1 - x_5$ on output. Education is assumed to have a log-linear impact on the first moment of production. Social capital variables (x_6 to x_9) are also assumed to explain the first moment of production. The specification of the production frontier is presented below (equation 4). The inefficiency effects model is specified following previous research results that have found statistically significant impacts of farmers' and farms' socio-economic characteristics such as education (z_1), sex (z_2) and age (z_3).

We further hypothesize that farms developing higher levels of social capital show a higher technical efficiency than farms which tend to carry out farming activities mostly individually. z_4, z_5, and z_6 represent the social capital components (CP, IS and IM, respectively). The interaction of social capital with the rest of efficiency determinants is considered as well. By doing so, we contemplate, for example, the possibility that the influence of education on efficiency can be affected by the level of social capital. The inefficiency effects equation specification is also presented in (4).

[21] We tested our model for endogeneity by the Durbin-Wu-Hausman F-statistic, which confirmed the exogeneity of social capital.

$$y_i = \sum_{k=1}^{9} \beta_k x_{ki} + \tfrac{1}{2}\sum_{k=1}^{5}\sum_{l=1}^{5} \beta_{kl} x_{ki} x_{li} + (v_i - u_i)$$

$$\mu_i = \gamma_0 + \sum_{r=1}^{6} \gamma_r z_{ri} + \sum_{r=1}^{3} \gamma_{r7} z_{ri} (z_{4i} + z_{5i} + z_{6i}) \quad (4)$$

where β_k and β_{kl} [γ_r and γ_{r7}] are parameters shaping the first moment of production and efficiency, respectively. Symmetry in cross-effects is imposed as $\beta_{kl} = \beta_{kl}$.

Some of the explanatory variables were finally dropped from the equation for not being statistically significant. The variables included were tested for multicollinearity using Variance Inflation Factor (VIF). Resulting VIF has mean of 1.93 with values ranging between 1.07 and 3.92 which indicates the absence of multicollinearity among the explanatory variables. Parameter estimates from the single-stage estimation of the model by Battese and Coelli (1995) are presented in Table 3.2.

Table 3.2 Maximum likelihood estimates of stochastic frontier function and inefficiency effects model

Variables	**Coefficients**	**Standard Errors**
Stochastic Frontier Model		
Log Land	1.6219	1.3475
Log Seed	-1.0821 *	0.5171
Log Fertilizer	0.3953	0.5651
Log Pesticide	0.1611 **	0.0582
Log Labour	0.0065	0.6226
Log Land x Log Land	0.1652	0.2716
Log Seed x Log Seed	0.2455 ***	0.0594
Log Fertilizer x Log Fertilizer	0.0512	0.0459
Log Pesticide x Log Pesticide	0.0058 **	0.0020
Log Labour x Log Labour	0.0559 ***	0.0139
Log Land x Log Seed	-0.1870 *	0.1005
Log Land x Log Fertilizer	-0.0266	0.0745
Log Land x Log Pesticide	0.0122	0.0118
Log Land x Log Labour	0.0049	0.1128
Log Seed x Log Fertilizer	-0.0742	0.0463
Log Seed x Log Pesticide	-0.0024	0.0060
Log Seed x Log Labour	-0.0014	0.0490
Log Fertilizer x Log Pesticide	-0.0091*	0.0043
Log Fertilizer x Log Labour	0.0037	0.0522
Log Pesticide x Log Labour	-0.0060	0.0067
Log Education	0.0115 **	0.0038
Collective Production	0.0367 ***	0.0028
Information Sharing	-0.0005	0.0017
Trust and Mutuality	0.0024	0.0022
_constant	-0.4141	5.0618

Inefficiency Effects Model		
Log Education	-0.0909 **	0.0395
Log Collective Production	-0.0776 ***	0.0233
Log Information Sharing	-1.0248 ***	0.3189
Log Trust and Mutuality	-0.5657 **	0.2370
Log Social (CP + IS + TM) x Log Educ.	0.0082 **	0.0028
Log Social (CP + IS + TM) x Log Age	0.0019**	0.0007
femaleDum	-0.0447	0.1802
_constant	2.8164 ***	0.8268
	Ln (likelihood) = 46.2953	

***,** and * indicate that the parameter is significant at the 1, 5 and 10%, respectively.

Since, in the translog form, coefficients cannot be directly interpreted, we report the estimated values of the output elasticities calculated at the data means (Table 3.4). As expected, the estimated values of output elasticities for all conventional inputs are positive and significantly different from zero at the 1% level of significance. Output elasticities support the presence of increasing returns to scale.

Table 3.3 Elasticity estimates of stochastic frontier function

Input	**Elasticity**	**Standard Error**
Land	0.277 ***	0.1074
Seed	2.226 ***	0.2445
Fertilizer	0.583 ***	0.1039
Pesticide	0.097 ***	0.0249
Labour	1.083 ***	0.1087
Education	0.012 **	0.0038
Collective Production	0.037 ***	0.0028
Information Sharing	-0.00056	0.0017
Trust and Mutuality	0.0024	0.0022

***, Significant at 0.01 level; **, significant at 0.05 level.

By sorting inputs from highest to lowest output elasticity, seeds occupy the first position and are followed by labour, fertilizer, land and pesticides. Bt seeds have the highest output elasticity (2.22). Being Bt cotton seed a very expensive input whose use is restricted, its contribution to marginal productivity can be reasonably explained by the law of diminishing returns. The rest of conventional inputs have substantially less capacity than Bt seeds to increase farm output. The magnitude of pesticide elasticity, which is 0.097, indicates that cotton production is highly inelastic to changes to the amount of pesticides used. It should be considered that survey farmers were growing Bt cotton, which has in-built pest resistance against a number of cotton bollworm, considered one of the main pests attacking this crop in

India. Land shows an elasticity of 0.27, hence, it does not offer much scope for production improvement. Land use intensification is likely to lead to better results than an increase in the number of acres planted. The relatively high labour elasticity (1.083) is due to the sharp reduction in the workforce engaged in agriculture recently experienced in Wardha District. Rukmani and Manjula (2009) report a fall in the number of agricultural labourers in the District over the last decade, mainly regarding women labourers. Survey farmers also reported difficulties in securing agricultural labour, which becomes a pressing problem during the picking season. Being cotton a highly labour intensive crop, these circumstances explain the relatively high marginal productivity of this factor on cotton production.

The productivity of fertilizer (with an average of 0.58), is also relatively high. In the surveyed areas, the predominant soil type is of *kanhar*, which is characterized by a high cation-exchange capacity (CEC), which makes the soil highly responsive to fertilizer application and nutrient management. Moreover, fertilizers are often underused by farmers in the area. According to Rukmani and Manjula (2009), the quantum of fertiliser applied for cotton in Wardha District is lower than the recommended dosage and the method of application is not as per recommendations either. That explains the high marginal productivity of fertilizers.

Education shows a positive and statistically significant log-linear effect. This result is consistent with the hypothesis that, when being more educated, farmers are advantaged in responding readily to the use of improved technology (Weir and Knight, 2004; Asfaw and Admassie, 2004) as well as accessing the tools and the knowledge for improving farm management (Feder *et al*., 1987), which augment their productivity levels. As a result, farmer education can contribute to increase output, even without new technologies. In the specific case of cotton cultivation, a recent study showed how farmers' education increases the environmental and social sustainability of cotton farming mostly in terms of optimizing the use of highly toxic pesticides, generating positive effects not only on productivity, but also on people's health and on the environment (Mancini *et al*., 2008).

Regarding social capital effects on output, results show that CP has a positive and highly statistically significant effect on cotton output, while IS and TM do not exert significant effects. The effect of CP on productivity levels is in accordance with the results of a number of empirical studies that show that small-scale, dispersed and unorganized producers gain from collective action (Johnson and Berdegue, 2004). The type of cooperation reflected into CP can range from just joint acquisition or investment in inputs such as agricultural machinery, to land pooling and joint cultivation by small owners, or even joint land acquisition through purchase or lease. Acting collectively, farmers are in fact able to exploit new market opportunities arising from higher economies of scale and increased bargaining power in negotiating prices. 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).

Advantages are felt also at the time of selling the produce. When farmers need cash urgently, they tend to dispose of their produce as soon as the harvest is over, when prices are generally low. If farmers sell their produce collectively, they can afford different timing of sales on the open market, which in turns affects the price obtained for the produce. Moreover, given the imperfection of the cotton marketing system which often forces farmers to sell their cotton as ungraded, by managing collectively the grading, storing and transportation farmers improve their bargaining power vis-a-vis companies and market functionaries. Through labour-sharing, farmers are overcoming the problem of lack of agricultural labour during peak seasons. This especially benefits marginal farmers. In general, there would be less conflict/competition between farmers for obtaining extra labour during peak needs (Agarwal, 2010).

The impact of different aspects of social capital was also analysed in the inefficiency effects model, to identify the factors causing variations in technical efficiencies among sample farmers. Here the impact of CP, IS and TM, together with the interaction of social capital (intended as a sum of the aforementioned 3 aspects) with different farms' socio-economic characteristics such as education, and age is examined. The analysis reveals that all variables, except gender of the farmer, are significantly responsible for technical efficiency variation among the farmers.

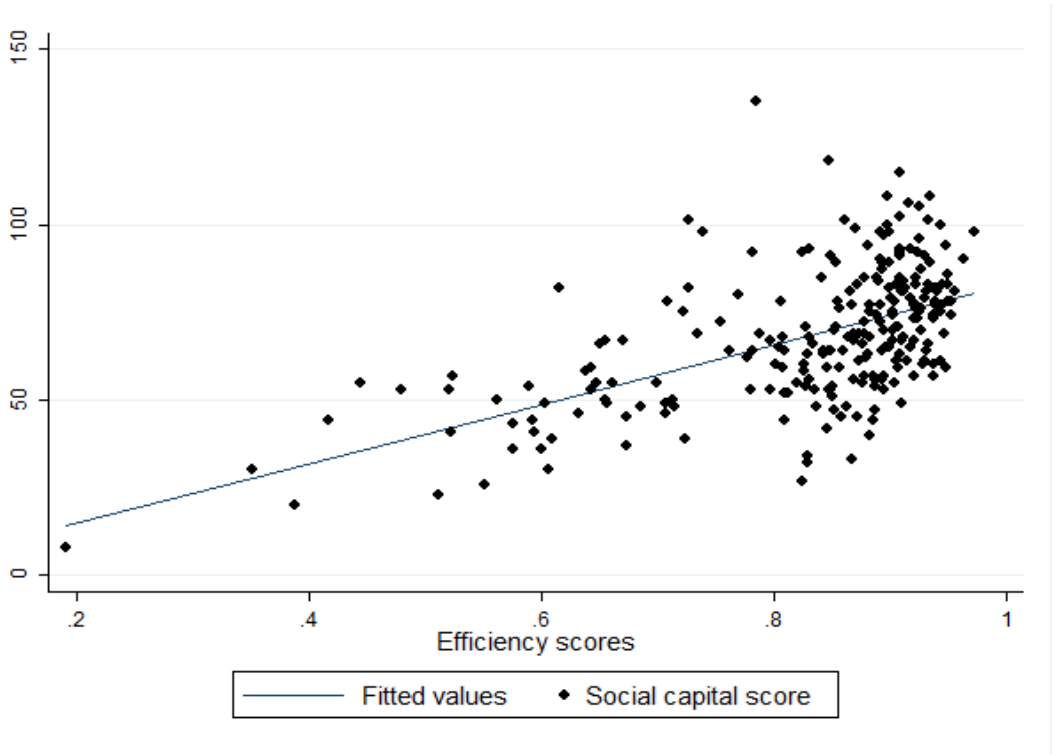
All three aspects of social capital have positive and significant effect on production efficiency. Higher levels of social capital thus seem to bring higher performance levels. This positive link (shown by the dispersion graph in figure 3.1) is confirmed by the positive and highly significant correlation existing between efficiency estimates and each of the social capital variables, as presented in Table 3.4.

Table 3.4 Correlation scores between efficiency estimates and social capital

	Efficiency estimates	
Social Capital	Correlation coefficient	P value
Social (CP + IS + TM)	0.5548***	0.0000
Collective Production	0.3640***	0.0000
Information Sharing	0.4585***	0.0000
Trust and Mutuality	0.3214***	0.0000

***, Significant at 0.01 level

Figure 3.1 Dispersion graph describing the relationship between social capital and efficiency ratings



Note: a linear tendency line was superposed to data points

Results show that the average efficiency score for the whole sample is on the order of 86% (Table 3.5); suggesting there is still scope to reduce input use, while keeping cotton production unaltered. The distribution of efficiency scores is shown in Figure 3.2, suggesting a bimodal distribution with most farms displaying efficiency scores between 0.6 and 0.8 and above 0.9.

Figure 3.2 Distribution of efficiency scores

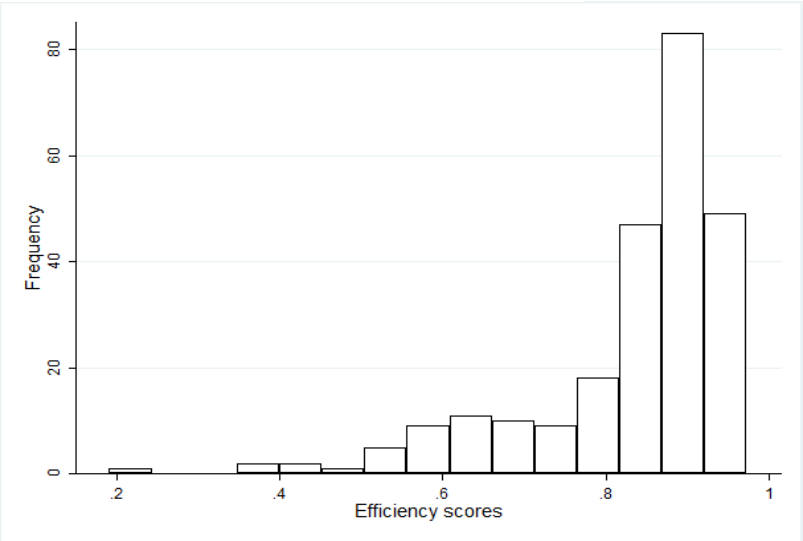


Table 3.5 Technical efficiency and inefficiency statistics

	Technical efficiency	**Inefficiency**
Mean	.8633498	.1565014
Standard Dev.	.1237161	.1607178
Min	.2563984	.0274199
Max	.9732897	.9959484

Analysing the impact of the three different aspects of social capital, results show the important role of CP in fostering not only farmers' productivity performance, but also their efficiency levels. Similar results are found for TM. The estimate of the TM coefficient is negative and statistically significant, indicating that higher community participation and reciprocal trust (as well as trust in local institutions) is augmenting farmers' efficiency levels. This result is in accordance with other relevant studies showing how trust plays an important role in facilitating cooperation and supporting a long-term relationship among individuals, reducing their transaction costs (Lyon, 2000; Ha, 2004). Although it benefits individuals, mutuality and trust have been found to produce benefits that are more collective than just individual, augmenting the efficiency of farmers' organisations (Uphoff and Wijayaratna, 2000). Moreover, given the shortcomings of formal rural credit systems in this area (largely due to the twin issue of high transaction cost and poor repayment rates), a household that can rely on its network to obtain credit from others to compensate for any temporary shortage of physical and financial capital, can reasonably augment its efficiency levels.

Similarly, IS has a positive and statistically significant effect upon the efficiency of sample farms. That is, the capacity of farmers to find, generate and share valuable technical information on cotton production is augmenting farmers' efficiency levels. As the literature confirms, information sharing between farmers facilitates the flow of information and compensates for imperfect market information, creating a net of mutual knowledge (Fatchamps and Minten, 2002; Grootaert, 1998b) which can hence act to increase farm efficiency. This suggests that in Indian rural areas, returns to social capital in the presence of transaction costs might be as important as returns to labour, physical or human capital.

Education of the farmer (measured as years of schooling) is found to significantly enhance farms' technical efficiency. This is compatible with findings by Coelli and Battese (1996) and Seyoum *et al.* (1998). The implication is that farmers with formal schooling tend to be more efficient in cotton production, presumably due to their enhanced ability to acquire technical knowledge, which makes them move close to the frontier output. Our results further show that interaction of education with social capital significantly increases technical inefficiency. As a result, social capital is found to mainly augment the efficiency levels of illiterate farmers. Similarly, the interaction of age with social capital is found to increase technical inefficiency, which provides evidence of social capital augmenting the efficiency levels of younger farmers. This has important implications for rural development strategies. If on one hand social capital helps compensating for less education, it also substitutes for farming experience, allowing less educated and less experienced/younger farmers acquire more productive efficiency.

3.5. Concluding remarks and policy recommendations

Based on a sample of small Maharashtrian farms in India, this chapter assesses the influence of social capital on production and productive efficiency levels using a stochastic frontier analysis. While the role of social capital as an input in the production process has been previously investigated, the literature on the impact of social capital on the efficiency with which agricultural holdings operate is very scarce.

We tackle this subject in a poor rural community setting, where sustainable economic development claims for promotion of productivity and output growth, and where increasing the use of conventional (and expensive) inputs such as land, capital or labour is difficult, given the economic restrictions faced by farmers. In this case, the relative cost-free nature of social capital presents a number of opportunities for the smallholder poor farmers.

Result show how group mobilisation, that contributes to build up social capital, improves the capacity of smallholder farmers to meet a whole range of agricultural needs including land leasing, procuring inputs, pooling resources, sharing information, marketing of produce and accessing production loans. Our empirical analysis shows the positive role of social capital in improving cotton farms efficiency and productivity. Specifically, results indicate that productivity levels of farms that are more intensive in social capital are higher than the productivity levels of social capital-poor farms. Efficiency ratings are also positively correlated with social capital levels. Moreover, the strengthening of social capital result to be particularly effective in improving productive efficiency of less educated and less experienced/younger farmers.

Among the different aspects of social capital, the one which we identify as "collective production" is especially active in increasing production levels of sample farms. This result suggests that farmers can improve their functioning by means of undertaking collective production activities such as collective input acquisition, collective soil and water conservation, share of labour force, etc. Other forms of social capital such as information sharing and trust and mutuality are also found to increase productive efficiency of sample farms, but not production levels, being thus less powerful in shaping production.

Conclusions derived from this research serve as recommendations on how smallholder farmers might use production inputs more efficiently and productively; and specifically, on how a relatively cost free input, such as social capital, could be used for improving the performance of smallholder agriculture. Furthermore, the context-specific nature of social capital makes it a powerful tool for rural development strategies. Political institutions can facilitate social capital built up by providing an adequate framework for its development. This will not only increase the quantity of output, but will also increase productive efficiency and in turn the economic viability of sample farms.

FOURTH CHAPTER

Relation between social capital and production risk[22]

This chapter examines the effects of social capital on the productivity and the riskiness of India's smallholder agriculture, using the Just-Pope (1978, 1979) production function. We identify and measure social capital as the networks that enable farmers to cooperate and act collectively in production activities. Results show the positive role of social capital in reducing production costs, as well as augmenting farmer's productivity. Specifically, social capital is found to be the input with the highest contribution to productivity after labour. This is especially relevant to agricultural households facing important economic and institutional restrictions that make it difficult to increase conventional (expensive) inputs. The risk effects of social capital on production represent another interesting conclusion of this study, showing that social capital can be risk increasing, even when its effect on risk improves farmer welfare. This risk increasing effect reflects an impact of social capital on the upside risk primarily, which responds to the probability of gaining something rather than losing. Hence, social capital, although augmenting output variability, is not vulnerability increasing. On the contrary, it offers chances to farmers to adopt higher-return inputs and technologies which can augment their productivity levels as well as offering an informal safety net which protects them against a range of adverse shocks. Our results, thus, suggest the need to explore a wider range of institutional arrangements for farming than single family cultivation, to offer scope for improving smallholder farmers' livelihoods as well as enhancing agricultural productivity.

[22] Publication information: Poli, E. and T., Serra, 2015. Social capital and farmers' production risk in developing countries, the case of India. (Under the *first round review* at *the Spanish Journal of Agricultural Research)*

4.1. Chapter overview

Most of the world's poor currently reside in rural areas. The rural poor are exposed to many risks while often lacking instruments to manage them adequately, and so are highly vulnerable. Understanding the sources and the characteristics of rural risk is thus one key pillar in an effective and sustainable rural poverty-reduction strategy.

The aim of this chapter is to better understand first and second-moments of cotton production in smallholder Indian farms and identify the factors that explain differences in these moments across different sample farms. Within this framework, our study pays special attention to the capacity of farmers to increase their productivity and manage output risk by building up social capital. This type of capital would be relatively free of cost, compared to other conventional (and expensive) inputs such as land, physical capital or labour, which, given the economic restrictions faced by farmers, would be hard to improve. The relationships between production risk and social capital have not yet been investigated in the Indian context. An understanding of these relationships, not only represents a significant contribution to academic research, but most importantly, can provide valuable information to design improved smallholder agriculture risk management programs.

We focus on cotton production in the region of Maharashtra, accounting for about 30% of the area under cotton in India. It is estimated that more than three million families who are spread over 22 thousand villages of Maharashtra, depend upon cotton cultivation. Most of these are small and marginal farmers owning land up to 5 acres (Maharashtra State Cooperative Marketing Federation, 2015[23]). For this category of farmers, production costs have increased manifold over the years, while the productivity of land has remained at the same level and the sale price of farm produce has not commensurately increased. Out of the main cotton producing areas of Maharashtra, the District of Wardha was chosen for field research.

This chapter is organized as follows. In the next section, we present a literature review. The third section focuses on the methodological approach. Results and policy implications are derived in the fourth section. The chapter ends with the concluding remarks section.

4.2. Literature Review on production risk and social capital

Risk is an essential part in decision-making processes and affects agricultural viability, particularly for smallholder farmers in developing countries. Hence, understanding farmers' risk sources and their influencing factors is essential to sustain and promote rural development. In a country like India, where crop production is mainly rain-fed and commonly subject to various natural calamities, the

[23] Maharashtra State Cooperative Marketing Federation accessed from: www.mahacot.com

instability of agricultural production has been subject of considerable academic debate. Different aspects of risk have been tackled in the literature: production and market risk (i.e. uncertainties associated with prices of inputs and outputs), financial risk (associated with the variability of interest rates and/or the availability of credit), institutional risk (i.e. government policies and regulations that can affect the returns from farming), environmental risk, etc. (Harwood *et al.*, 1999). We will focus on production risks, which can be identified as all events which make final production outcome uncertain when production decisions are taken (Antón, 2008).

In the Indian context, production risk has been tackled both at farm-level (Chand and Raju, 2008) and at aggregate level (Hazell, 1982; Mahendradev, 1987; Sharma *et al*., 2006; Kumar and Jain, 2013) and. Another set of studies have analyzed the evolution of instability in Indian agriculture over time, showing how post-Green Revolution agriculture, despite its progress in irrigation and technology, is still subject to large year-to-year fluctuations (Larson *et al*., 2004) [24]. Some studies have focused on the (ex-ante) risk-management strategies developed by households in risky environments, such as crop diversification (Bantilan, and Aupama, 2006), activity and labour diversification (Rose, 2001; Lamb, 2003; Ito and Kurosaki, 2009), income smoothing through safer investments (i.e. farmers choosing to plant low-risk, low-yield crops instead of investing in more profitable but riskier inputs) (Rosenzweig & Binswanger, 1993) and formal/informal insurance arrangements (Giné *et al*., 2010; Cole, 2013) [25].

Other focused on the risk-coping (ex-post) options available to farmers. This is the case of consumption smoothing - depleting savings and assets - (Morduch, 2004; Rosenzweig and Wolpin, 1993), shifting from own-farm cultivation to the labour market (Kochar, 1999; Rose, 2001)[26], seeking market credit (Jacoby and Skoufias, 1998) and interfamily/inter-caste lending (Townsend, 1994 ; Ligon *et al*., 2002; Munshi and Rosenzweig, 2009). Some other options involve community-based risk management arrangements, both traditional and semi-formal, such as rotating savings and credit associations called "*chit*" in India (Bhattamishra and Barrett, 2010), grain banks (Bhattamishra, 2007) and local microfinance institutions providing "micro-savings" and "micro-credit", a form of credit insurance otherwise unavailable to many poor farmers (Morduch, 2004).

A further branch of the literature has investigated risk preferences, with the aim of understanding how Indian farmers' degree of risk aversion shapes their decisions and outcomes (Binswanger, 1980; 1981 and more recently Kurosaki, 2001). Our study proposes to consider yet another factor which is rarely taken into consideration in applied research on production risk in the Indian context: the impact of social capital on variability of output and the productivity of smallholder farmers.

Social capital is a wide-ranging concept covering the resources derived from social relationships. It embraces the ability to develop and use various kinds of social networks and the resources that become

[24] These studies report a decrease in production instability for few crops, namely wheat, cereals, sugarcane and pulses. However, for the rest of the crops an increase in production instability is shown (Larson *et al*., 2004), especially for cash crops which present the highest variability of price and farm income (Chand and Raju, 2010).

[25] Taking the discussion one step further, Mobarak and Rosenzweig (2012; 2013; 2014) in a series of studies based on a field experiment in three states in India, explore the interaction between agricultural insurance, informal risk sharing, basis risk and risk-taking behavior.

[26] Examples are Rose (2001) which test ex post labor supply responses to weather risk for rural Indian farm households, and Ito and Kurosaki (2009) which examine the labor supply decisions of households in rural areas; in particular, whether households shift labor from farm to off-farm employment as a response to adverse shocks.

available thereof. Social capital is used to characterize the voluntary action taken by a group to achieve common interests, as well as subjective aspects such as confidence in institutions and trust in people. Since the middle of the 1990s, social capital has captured a rapidly growing interest among academics and policy makers. This has yielded multiple definitions, interpretations and uses of the concept that have been applied at the individual, group, and organizational levels. Different social sciences have emphasized different aspects of social capital.

The concept has been increasingly applied in rural studies (Castle, 2002) and has received growing attention in the rural development debate where it is seen as a factor potentially overcoming poverty, developing rural areas (Sobels *et al*., 2001; Sorensen, 2000; Uphoff, 2000; Uphoff and Wijayaratna, 2000; Grootaert and Van Bastelaer, 2002a), and helping rural households overcome the deficiency of other capitals and inputs, thus increasing their welfare (Annen, 2001; Fafchamps and Minten, 2002).

Social capital has been shown to manifest its influence both on production and on output risk in a number of different ways. As to production activities, different studies have shown how participation in social networks (both formal – cooperatives and farmer associations – and informal) exerts a positive impact on production by: facilitating access to agricultural technical information as well as to extension services (Hoang *et al*., 2006; BenYishay and Mobarak, 2013), improving irrigation management (Krishna and Uphoff, 1999; Uphoff and Wijayaratna, 2000), reducing transaction costs (Randela *et al.,* 2008), and improving land management through better access to information and technologies (Pender and Gebremedhin, 2007).

In addition, social capital has been found to encourage technology adoption. This has important implications given that input variability and the risk of crop failures is considered one of the main hindrances to technology adoption in low income agriculture (Ogada *et al*., 2010). In this regard, social capital has been found to encourage technology adoption through a double mechanism. Firstly, social capital (in the form of farmers' networks and their collective action) acts as a conduit for information about new technologies facilitating learning diffusion both from external sources as well as from other farmers (Isham, 2002; Conley and Udry, 2010; Rijn *et al*., 2012[27]). Secondly, social capital facilitates poor farmers in adopting new technologies by reducing their restrictions on participation. On one side it allows adoption of innovations requiring indivisible investments (Monge et al., 2008); on the other, since group loans started to be accepted as a form of collateral by non-traditional micro-financing institutions, collective action also serves to facilitate access to credit to poor farmers (Knox *et al*., 1998).

Besides, adopting a new technology requires taking on new risks. In this respect social networks can exert a risk-mitigating effect (Edillon, 2012) which in turn augments the likelihood of adopting new technologies. Moreover, given the shortcomings of formal rural credit system (largely due to the twin issue of high transaction cost and poor repayment rates), a household that can rely on its networks to obtain credit to compensate for any temporary shortage of physical and financial capital, can reasonably

[27] Rijn *et al.*, (2012) show a significant relationship between an aggregate measure of social capital and agricultural innovations.

augment its productivity levels. As a result, social capital is usually found to be related to higher productivity levels of small farms (Nyemeck *et al*., 2005; Jaime and Salazar, 2011).

An active social capital has also been proven to exert a positive impact on the production risk faced by farmers. A number of recent studies, such as Dercon (2005), Morduch and Sharma (2001) and Fafchamps and Gubert (2007) have found that social capital (intended as a system of mutual assistance among kinship networks and local communities) is still commonly used by smallholder farmers in developing nations to cope with the consequences of risk.

Informal social relationships can form efficient short term safety nets, mitigating the effects of different type of shocks related to agricultural production and allowing households to manage the distribution of risks over time (Mogues, 2006). Expressed as a flexible and informal system of credit transaction within networks, social capital plays an important role in risk-sharing (Fafchamps and Lund, 2003) and serves as an insurance against idiosyncratic shocks (Udry, 1990)[28]. Specifically, social networks are shown to function as an informal insurance mechanism against potential downfalls in consumption (Eswaran and Kotwal, 1990; Dercon and Krishnan, 2000; Fafchamps and Lund, 2003), which help households speed up disaster responses (Carter and Maluccio, 2003) while enabling consumption smoothing (Dercon and Krishnan, 2000).

In recent years, there has been a growing academic interest in the empirical analysis of the role of social capital in adaptation to climate change in developing countries. Studies such as Deressa *et al*., (2009) and Tessema *et al.,* (2013) show that farmer-to-farmer extension and informal institutions such as peer networks, positively influence adaptation to climate change through experience-sharing and channeling of informal financial sources that help households to invest in this adaptation. Social networks are also found to play an important role in asset recovery and growth after environmental shocks (Mogues, 2006). Carter and Maluccio (2003) find that trust has a mitigating effect on weather shock. In addition, social capital in the form of voluntary labour contribution has been shown to facilitate collective adaptation practices such as sea dike maintenance (Adger, 2000) and adoption of soil conservation (Cramb, 2005; Bezabih *et al*., 2013). In case of drought, informal networks have also proven to help households reduce risk by supporting each other, mainly via moral and financial support (Murendo *et al*., 2011).

These studies further suggest that households with more extensive networks and hence greater access to consumption credit, assistance in-kind, and capital markets (access to credit and other inputs) are better able to cope with risks ex-post[29]. Thus, social capital may be particularly important in environments where government or private sector substitutes for risk coping mechanisms are not available or accessible (Collier, 2002; Murgai *et al*., 2002).

[28] Besley (1995) reviews informal institutions that have emerged to provide credit in the context of missing formal markets for credit and insurance. A further literature models the types of informal arrangement that have evolved to cope with these market failures (Coate and Ravallion, 1993, Fafchamps and Lund, 2003, Udry, 1994).

[29] For a comprehensive review of the effects of community-based social capital on risk sharing across the developing world see Bhattamishra and Barrett (2010).

The increasing academic interest on the impact of social capital on farmers' risk has produced a number of interesting empirical analyses and theoretical models on informal risk-sharing mechanisms and on the sustainability of these arrangements (see Dercon, 2002 and Fafchamps and Gubert, 2007 for a more detailed review). Contributing to this debate, many recent economic development analyses at the micro level have included social capital in risk preference studies (see Nielsen *et al*., 2013), as well as in household production functions (see Ha *et al*., 2004; Innes, 2010; Grootaert, 1999; Maluccio *et al*., 1999; Narayan and Pritchett, 1999; Uphoff and Wijayaratna, 2000; Ruben and Strien, 2001).

We add to the literature by assessing the contribution of social capital to the mean and variance of cotton yield of a sample of smallholder farmers in Maharashtra. To the best of our knowledge, this study is the first to analyze the impact of social capital on production risk in the Indian setting. This allows shedding light on the relevance of social capital in the Indian rural sector from a different perspective, thus contributing to the scant literature on the topic.

4.3. Methodological approach

The estimation of the production risk faced by poor farmers has been of continuing interest in the development literature. This study focuses on how farmers' production decisions affect output levels and risk. Farmers make a variety of decisions that influence the risks they face. For example, irrigation can reduce yield losses in the event of drought, which can in turn reduce yield fluctuations. While fertilizer can increase yields, it can also augment yield variability. Similarly, while bt seeds can boost yields, they can also result in more variable yields when compared to locally adapted crop varieties (Gaurav and Mishra, 2012).

The notion that input use not only affects the output mean, but also output variability was formalized by Just and Pope (1978). Since the effect of production decisions on yield variability is essentially an empirical question, we use the Just-Pope framework to empirically determine how input choices, like fertilization, affect the mean and variance of crop yield. The insights of Just and Pope were further developed by Pope and Kramer (1979) resulting in the taxonomical classification of input choices as risk increasing, risk decreasing, or risk neutral. The Just-Pope function is given by:

$$y = f\,(x, \alpha) + g\,(x, \beta)\;\; \varepsilon \qquad (1)$$

where y_i represents cotton yield, $f\,(\cdot)$ is the function representing the first moment of production and $g\,(\cdot)$ is the function representing the relationship between input use and yield variability, x is the vector

of inputs, and α and β are vectors of parameters. The exogenous stochastic disturbance (or production shock) is represented by ε, which is assumed to be normally distributed with $E[\varepsilon] = 0$ and $var(\varepsilon) = \sigma_\varepsilon^2$. The Just-Pope form separates the mean effect and the variance effect of changes in input levels. The expected output is given by $E[y] = f(x_i, \alpha)$, while the variance of output is given by $r(y) = [g(x_i, \beta)]^2 \sigma_\varepsilon^2$.

The literature suggests two main approaches to estimate the mean and variance functions of the Just-Pope production function. They can be estimated using feasible generalized least squares or the maximum likelihood method. However, Saha *et al*., (1997) have shown that the estimators under the maximum likelihood method are consistent and more efficient than the feasible generalized least squares method. Hence, in our study maximum likelihood method has been used.

Another important methodological issue in our analysis is the measurement of social capital. Our questionnaire aimed at collecting information to create a locally adapted measurement of social capital which would serve to examine its contributions to the production process. We designed the survey by adapting the questions suggested in the work by Ha *et al.* (2004 and 2006) and the World Bank's Social Capital Questionnaire (Krishna and Shrader, 1999) to our specific case study. Ha *et al*. (2004) consider four components of social capital (Associational Activity, Information Sharing, Trust and Norms of Reciprocity). Faculty from the College of Rural Services in Wardha[30] provided expert advice on the adaptation of the survey to the study area characteristics.

After pilot testing this questionnaire in two villages, the survey was first tested in two villages, and subsequently undertaken in larger group of 250 farmers. We started by enquiring about group membership and then about the actual benefits farmers obtained from that membership. 24 % of the farmers resulted being members of a farmer group or self-help group. On a scale from 0 to 10, where 0 was no benefit and 10 full benefit, farmers reported average benefit levels of 3,38 from group participation. However, when enquired about specific benefits, farmers reported averages as low as 1,24 in terms of technical information, 0,38 in credit facilities, 0,17 in access to input/output markets, 0,06 access to land through collective leasing, 0,16 access to labour and 0,08 to irrigation facilities.

In Wardha's rural areas most production-related collective action, as well as exchange of technical information among farmers, occurred within informal mutual support networks. Through this empirical observation, we realized that measuring social capital based on group membership (to agricultural related groups and associations) did not reflect the actual picture and potentials of group mobilization in the area studied. Therefore, in our analysis, the component "Associational Activity" (as suggested in Ha *et al.*, 2004) was dropped as a proxy for social capital[31]. This opened an important methodological issue regarding how to effectively measure social capital in that specific setting.

[30] We especially thank A. Sharma (College of Rural Services in Wardha) who closely collaborated with the research team in the revision and adaptation of the survey to the research field.

[31] At the origins of the concept of social capital, Putnam (1993) ranked social capital in Italian regions by utilizing a set of measures including, most notably, density of membership in formal organizations. This proxy, although commonly used in the literature, merely measures one of the

The context-specific nature of social capital and the need for tailoring the measurement approach to the local context have been emphasized by Krishna (2001) in relation to the case of India's rural areas. Krishna (2001) shows how the density of formal organizations is a particularly inappropriate indicator to provide any reliable sign of voluntarism and cooperation among Indian farmers. He explains how the large majority of organizations in Indian rural areas have been set up at the initiative of some government agency, which villagers joined mostly in order to gain some immediate economic benefits.

To develop his measure of social capital, Krishna formulates a locally relevant scale which focuses primarily on informal networks. To create this scale, he questioned a sample of respondents about: their membership in labour-sharing groups; how they dealt with crop disease and natural disasters; the trust they would feel if they owned a farm with another family; the solidarity between their village leaders and community members; and the level of reciprocity exchanged in child rearing.

In the case of Wardha, our questionnaire aimed at creating a locally adapted measurement of social capital among the smallholder farmers, in order to study its contributions to the production process. A total of 25 questions were introduced in our survey to capture information on associational engagement, information sharing, trust and reciprocity and collective production activities. We adopted the definition of social capital proposed by Woolcock and Narayan (2000), which links it to the networks that enable people to act collectively. In our analysis we transpose this concept to the context of agricultural production, intending social capital as the networks that enable farmers to cooperate and act collectively in production activities. Social capital thus represents farmers' degree of cooperation in production activities. This is the case of collective input acquisition, share of labour force, collective soil and/or water conservation and joint marketing of produce.

Hence social capital is introduced as a variable in our production analysis; with the particular characteristic of being a relatively cost free input, compared to other conventional inputs such as land, capital or labour. Its proxy does not depend on the existence of a formal/informal group membership[32] but derives from the quality of relationships among people within the farming community, showing their propensity for mutually beneficial collective action in production activities. This characteristic of social capital presents a number of opportunities for the smallholder poor farmers, given the restrictions they face in accessing the other type of capitals and inputs.

many manifestations of social capital, which may result relevant for one culture and quite irrelevant if applied to different settings (De Ulzurrun 2002, Claridge, 2004).

[32] Our results showed a positive, although very weak and not statistically significant correlation between group membership and social capital level (0.10).

4.4. Empirical Application

Our empirical analysis is based on a farm-level survey that was conducted from January to March 2012, in the Wardha District, Maharashtra, India. The survey focuses on the small and marginal farms, representing the majority of the area's farming population. A total of nine villages in the District with similar social and agronomic conditions were chosen.

Data were collected on farms' input use, including land use (in acres), crop-specific inputs such as seeds, fertilizers and pesticides (in physical and monetary units), and labour (both in hours and monetary units). We further collected data on total output produced (both in physical and monetary units). Seven variables are defined to conduct our analysis. These include cotton production measured in quintals (y); cotton area in acres (x_1); seed costs in rupees (x_2); fertilizer costs in rupees (x_3), which comprise manure and fertilizers; pesticides (x_4) in rupees; and total labour costs[33] (x_5) in rupees. The social capital variable is represented by x_6 and measured in score points. Summary statistics for the variables used in the analysis along with a brief definition and units of measurement, is presented in Table 4.1.

Table 4.1 Definition and summary statistics of variables used in the model

Variable (N=250)	**Description**	**Mean**	**Std**	**Min**	**Max**
PRODUCTION	Cotton output (Qtl)	14.96	8.16	1.50	50.00
Production Factors					
LAND	Cotton Land (Acres)	2.91	1.04	1.00	5.00
SEED	Seed cost (Rs.)	5,481.84	3,205.91	930.00	32,790.00
FERTILIZER	Fertilizer cost (Rs.)	6,561.67	5,266.23	0.00	40,750.00
PESTICIDES	Pesticides cost (Rs.)	2,431.94	2,149.44	0.00	15,000.00
LABOUR	Labour cost (Rs.)	19,017.72	10,849.09	0.00	72,000.00
EDUCATION	Farmer's Education (years)	7.63	4.40	0.00	15.00
SOCIAL CAPITAL	Likert scale (0 to 10)	10.59	8.67	1.00	50.00
AGE	Age of the Farmer (years)	46.34	13.56	20.00	98.00
SEX	Gender (0 = male, 1 = female)	0.11	0.32	0.00	1.00

[33] Our sample farmers did not keep track of the hours worked on the field neither by them, nor by their family members.

Following Driscoll *et al.* (1992), the following quadratic form is assumed to represent the expected yield function:

$$f = \alpha_0 + \sum_{i=1}^{6} \alpha_i x_i + 0.5 \sum_{i=1}^{6} \sum_{j=1}^{6} \alpha_i x_i x_j + \varepsilon \quad (2)$$

(2)

While function $g(x_i, \beta)$ is expressed as follows[34]:

$$g(x_i, \beta) = (\beta_3 x_3 + \beta_4 x_4 + \beta_6 x_6) ** 0.5 \quad (3)$$

The qualitative part of the questionnaire collected information regarding farmer's level of information sharing, trust and mutuality within the farming community. These qualitative figures enrich our understanding of the social capital in the area studied. Regarding mutual trust and cooperation towards community activities, on a Likert scale from 0 to 10 where 0 is no trust and 10 full trust, farmers report average trust levels of 7,4 in other farmers in the same village, 5,7 in the village Sarpanch, 4,5 in input dealers, 3,5 in governmental extension services, 3,2 in traders, and 2,6 in local NGOs. Inter-caste collaboration is rated as 7,8, where 0 represents no collaboration and 10 full collaboration. Concerning volunteership, 84% of the farmers report to be expected to volunteer or help in community activities in their community/neighborhood and 73% confirm their readiness to contribute money or time to community schemes even if they would not directly benefit them. Regarding the subject of information sharing, 97% of the sampled population report discussing their ex-ante farming decisions with other farmers and 91% with other family members; furthermore, 86% report sharing farming results with other farmers at the end of the season.

Data was then collected on the networks that enable farmers to cooperate and act collectively in agricultural activities. Hence, social capital was calculated as a proxy for farmers' degree of cooperation in production activities. Specifically, the questionnaire asked farmers to detail the extent (on a Likert scale from 0 to 10) to which they performed collective input acquisition, share of labour force, collective soil and/or water conservation and joint marketing of produce. Increasing score values denoted higher levels of social capital. The sum of the score points for each of these variables was used to quantify the social capital variable. The results show that around 80% of sample farms undertake collective production activities involving one or more of the following: collective provision of labour, fertilizers and other inputs, collective soil and/or water conservation, or collective output sales. Overall, the average social capital score is 11, being 50 the maximum score. These results show that there is still ample scope to increase farmers' cooperation in production activities and hence their amount of social capital.

[34] Other functional forms were considered, but did not lead to convergence in the estimation process.

4.5. Result Discussion

A quadratic functional form is used to model the expected yield function, which is estimated together with the yield variance function using a maximum likelihood estimator. To provide a meaningful interpretation of the estimated input parameters, empirical results are presented in terms of elasticities. The elasticity estimates from the mean function are reported in Table 4.2.

Table 4.2 Parameter estimates for the mean production function

Parameter	Coefficient	Standard error	T-ratio
Mean Function			
Land	0.1845552**	0.00217363	39062.2249
Seed	0.11853761**	0.0012709	73389.4919
Fertilizer	0.16057677**	0.00062853	406476.334
Pesticide	0.03624743**	0.00033812	317056.54
Labour	0.45322159**	0.00134803	249409.834
Social Capital	0.37673786**	0.00025843	5641061.35

**, Significant at 0.01 level

As expected, we see that the estimated values of output elasticities for all inputs are positive and significantly different from zero at the 1% level of significance. Output elasticities support the presence of increasing returns to scale. By sorting inputs from highest to lowest output elasticity, labour occupies the first position and is followed by social capital, land, fertilizers, seeds and pesticides. Labour has the highest output elasticity (0.45).

The relatively high labour elasticity can be reasonably explained by the general lack of machinery in rural India, which makes production systems highly dependent on human labour. In the case of Wardha, this situation is accentuated by the sharp reduction in the workforce engaged in agriculture recently experienced in the District. Rukmani and Manjula (2009) report a fall in the number of agricultural labourers in the District over the last decade, mainly regarding women labourers. Survey farmers also reported difficulties in securing agricultural labour, which becomes a pressing problem during the picking season. Being cotton a highly labour intensive crop, these circumstances confirm the relatively high marginal productivity of this factor on cotton production.

Subsequent to labour, land shows the highest factor productivity among the conventional inputs. Still, with an elasticity of 0.18, this input does not offer much scope for production improvement relative to labour. Similarly, the elasticity of fertilizer (with an average of 0.16), is relatively low. A growing body of literature reports the low and declining crop response to fertilizer application in India, especially when balanced fertilization is not practiced. According to Rukmani and Manjula (2009), both fertilizers dosage and method of application in Wardha District are not as per recommendations, which negatively affect crop yield. Beyond the general lack of extension, an important reason why farmers are unable to follow

the recommendations given by scientists regarding the quantum and combination of fertilizers, is to do with fertilizers' quality and availability. Farmers tend to buy fertilizers on credit from private shop keepers, and are often forced to take whatever fertilizer they are supplied with. Further, shortage of chemical fertilizers during sowing seasons is a recurrent problem (Rukmani and Manjula, 2009). This situation may explain the low factor productivity of fertilizers in our sample.

Seeds show an elasticity of 0.11, which implies that a 1-percent increase in seed use, ceteris paribus, would lead to an increase of 0.11 percent in cotton production. The magnitude of pesticide elasticity, which is 0.03, indicates that cotton production is highly inelastic to changes to the amount of pesticides used. This could be explained by the fact that survey farmers were planting Bt cotton, which has in-built pest resistance against a number of cotton bollworm, considered one of the main pests attacking this crop in India.

Regarding social capital effects on cotton output, results show social capital to be the second most valuable input after labour, which is in accordance with the hypothesis that social capital can play a key role in the production process. Social capital presents an output elasticity of 0.45, which implies that, ceteris paribus, a one percent increase in social capital leads to a 0.45 percent increase in cotton output. The high positive and statistically significant effect of social capital on cotton production is in accordance with the results of a number of empirical studies that show that small-scale, dispersed and unorganized producers gain from collective action (Johnson and Berdegue, 2004). Our results are moreover in accordance with those of Narayan and Pritchett (1999) and Robinson *et al*. (2000) who find a positive association between social capital and microeconomic performance.

An interesting finding which corroborates this result is the correlation between social capital and input use (Table 4.3). Here we find that social capital allows using inputs more efficiently (i.e. use less amount of inputs for the same amount of output). The negative and highly significant correlation coefficient indicates that farmers employing more social capital are more likely to use less conventional input quantities, or pay less for these, *ceteris paribus* (recall that, with the exception of land, inputs are expressed in monetary units).

Table 4.3 Pearson's correlation coefficients between production inputs and social capital

	Social Capital	
Conventional inputs	Correlation coefficient	P value
Land/quintal	-0.3981**	0.0000
Seeds/quintal	-0.4466**	0.0000
Fertilizers/quintal	-0.3751**	0.0000
Pesticides/quintal	-0.3027**	0.0000
Labour/quintal	-0.5470**	0.0000

**, Significant at 0.01 level

These results suggest that our sample farms are using social capital to reduce input costs and/or to increase their productivity by using fewer conventional inputs to produce the same amount of output. Our results are thus compatible with the argument that Indian smallholder farmers use social capital as a means to save transaction and production costs by reducing information and search costs and by substituting for poor market institutions. A number of empirical studies show the potential gains of cooperation in farming and group approach to agricultural investment to bring greater productive efficiency than the traditional individual-oriented approaches (Agarwal, 2010). Our results thus suggest the need to explore a wider range of institutional arrangements for farming than single family cultivation, to offer scope for rural development as well as enhancing agricultural productivity.

The type of cooperation reflected into social capital can range from joint acquisition or investment in inputs such as agricultural machinery, to land pooling and joint cultivation by small owners, or even joint land acquisition through purchase or lease. Acting collectively, farmers are in fact able to exploit new market opportunities arising from higher economies of scale and increased bargaining power in negotiating prices. Joint investment by small farmers with contiguous plots can provide a solution to input underuse. Moreover, through labour sharing, farmers overcome the problem of a lack of agricultural labour during peak seasons. This especially benefits small farmers who are unable to compete for extra labour during intensive-work seasons (Agarwal, 2010).

Advantages are felt also at the time of selling the produce. When farmers need cash urgently, they tend to dispose of their produce as soon as the harvest is over, when prices are generally low. If farmers sell their produce collectively, they can afford different timing of sales on the open market, which in turns affects the price obtained for the produce. Moreover, given the imperfection of the cotton marketing system which often forces farmers to sell their cotton as ungraded, by managing collectively the grading, storing and transportation farmers improve their bargaining power vis-a-vis companies and market functionaries. Regarding the variance part of the production function, the elasticities can been found by looking directly at the parameter estimates from the variance function $g\ (x_i, \beta)$ in Table 4.4.

Table 4.4 Parameter estimates for the variance function

Parameter	Coefficient	Standard error	T-ratio
Variance Function			
Fertilizer	0.000669**	0.00062853	406476.334
Pesticide	0.000027229**	0.00033812	317056.54
Social Capital	0.349222**	0.00025843	5641061.35

**, Significant at 0.01 level

According to these parameters, fertilizers, pesticides and social capital all have a risk-increasing effect. That fertilizers are risk-increasing is in accordance with the expectation[35], and supports the

[35] This result is in accordance with the empirical findings of Just and Pope (1979); Rosegrant and Roumasset (1985); Roumasset *et al*.,(1987); Ramaswami (1992) and Di Falco *et al*., (2006).

hypothesis that, as many purchased inputs in general, fertilizers can be considered high return but also high risk: although being potentially high return, their elevate cost makes fertilizers also high risk, especially when farmers need to buy them on credit.

Pesticides are also found to have a risk-increasing role. The impact of pesticides on output risk has been extensively studied in the literature. Some papers have concluded that pesticides are risk-decreasing (Smith and Goodwin, 1996), while others found pesticides to be risk-increasing (Horowitz and Lichtenberg, 1994). Horowitz and Lichtenberg (1994) show that pesticides can increase output variability in a number of situations: if on one side they can reduce the risk of potential losses in bad years, they can also reduce the income earned in good years. More specifically, they prove that pesticides will increase output risk whenever pest populations increase with favorable crop growth conditions, which is the case for a number of cotton pests in India.

Social capital is by far the input with the highest effect on output variability, with an elasticity of 0.34. Here lies the main contribution of this paper. The risk-increasing effect of social capital has a number of implications which deserve further examination. We observed that social capital exerts two simultaneous effects on production: it increases productivity on one side and increases variability on the other[36]. Given these results, it is interesting to examine what type of risk social capital is increasing.

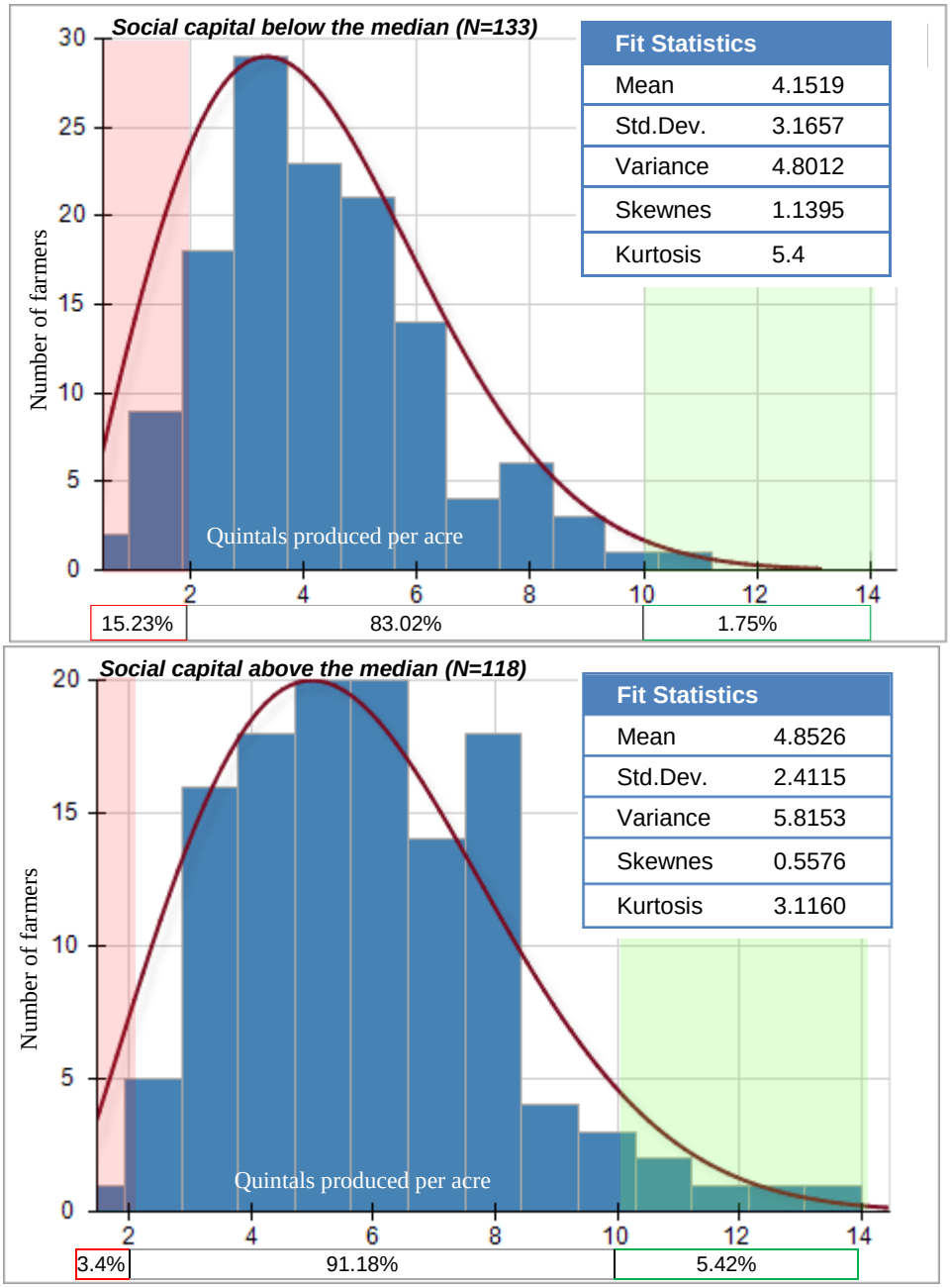
When we discuss about risk, especially in the development field, we generally refer to the possible "bad" or "negative" outcomes, i.e. outcomes conventionally located on the left-side tail of the probability distribution or "downside risk". This situation is frequent in agricultural production risk. Firstly, farm outcome tends to be more exposed to downside risk because of its dependence on values such as temperature and precipitations in a way that deviations from optimal weather have negative impacts on yields, whatever the direction of the deviation (Antón, 2008). Secondly, farmers (in particular resource-poor small farmers) generally lack adequate access to formal institutional opportunities of risk mitigation such as crop insurance, guaranteed contracts or market agreements through vertical integration (McConnell and Dillon, 1997).

The concept of risk is hence associated with as a risk that challenges farm survival, particularly if a series of adverse outcomes should occur simultaneously. However, the depiction of risk by the entire probability distribution of outcomes is somewhat different from this limited viewpoint. In the context of finance, for example, risk represents the chance that the return achieved on an investment will be different from that expected, and also takes into account the size of the difference. This includes the possibility of losing some or all of the original investment (i.e. outcomes conventionally located on the left-side tail of the probability distribution or "downside risk") or to achieve returns that exceed expectations (i.e. the possible outcomes which are located on the right-side tail of the distribution or "upside risk").

[36] There is a growing literature exploring the circumstances by which agricultural production techniques successful in increasing production as well as productivity, can also add to the risk simultaneously (Mishra, 2008). Relevant examples are Peterson and Ding (2005) which analyzes the different impacts of irrigation on risk across stages of production. Their study finds that the marginal effect of water on risk depends on how much water is applied. At low levels of application, the marginal unit of water substantially increases yield variability, while water reduces risk at the margin at larger application levels (Peterson and Ding, 2005). Another interesting example is provided in Hurley et al., (2004) which analyzes the different marginal risk-increasing/decreasing impacts of Bt seeds. Here the risk effect depends on the price paid for the technology and the expected value of loss (by way of protection from crop losses due to pest infestation).

This double meaning of the concept opens possibilities to value the "positive features of risk" in smallholder agriculture, hence the possibility to have risk which leads to higher income. We demonstrated how social capital, as an input in the production process, owns very peculiar characteristics. On one side it is free of cost and productivity increasing. On the other it incentivizes adoption of new technologies and favors access to credit for farm investments. All these activities undoubtedly involve taking risks. Our hypothesis is that social capital provides both a safety net and supportive propulsion for smallholders to engage into risker but higher profit activities. To test this hypothesis we measured productivity distribution (Qtls/acre) associated with social capital above/below the median (Figure 4.1).

Figure 4.1 Frequency distribution of farm's produce associated with social capital above/below the median



Note: the probability of obtaining particularly low (below 2 Qtl/Acre) or high outcomes (above 10Qtl/Acre) are highlighted in red and green respectively. Social capital presents a significant positive correlation with Qtl/acre ($\rho = 0.568$ Prob > |t| = 0.000).

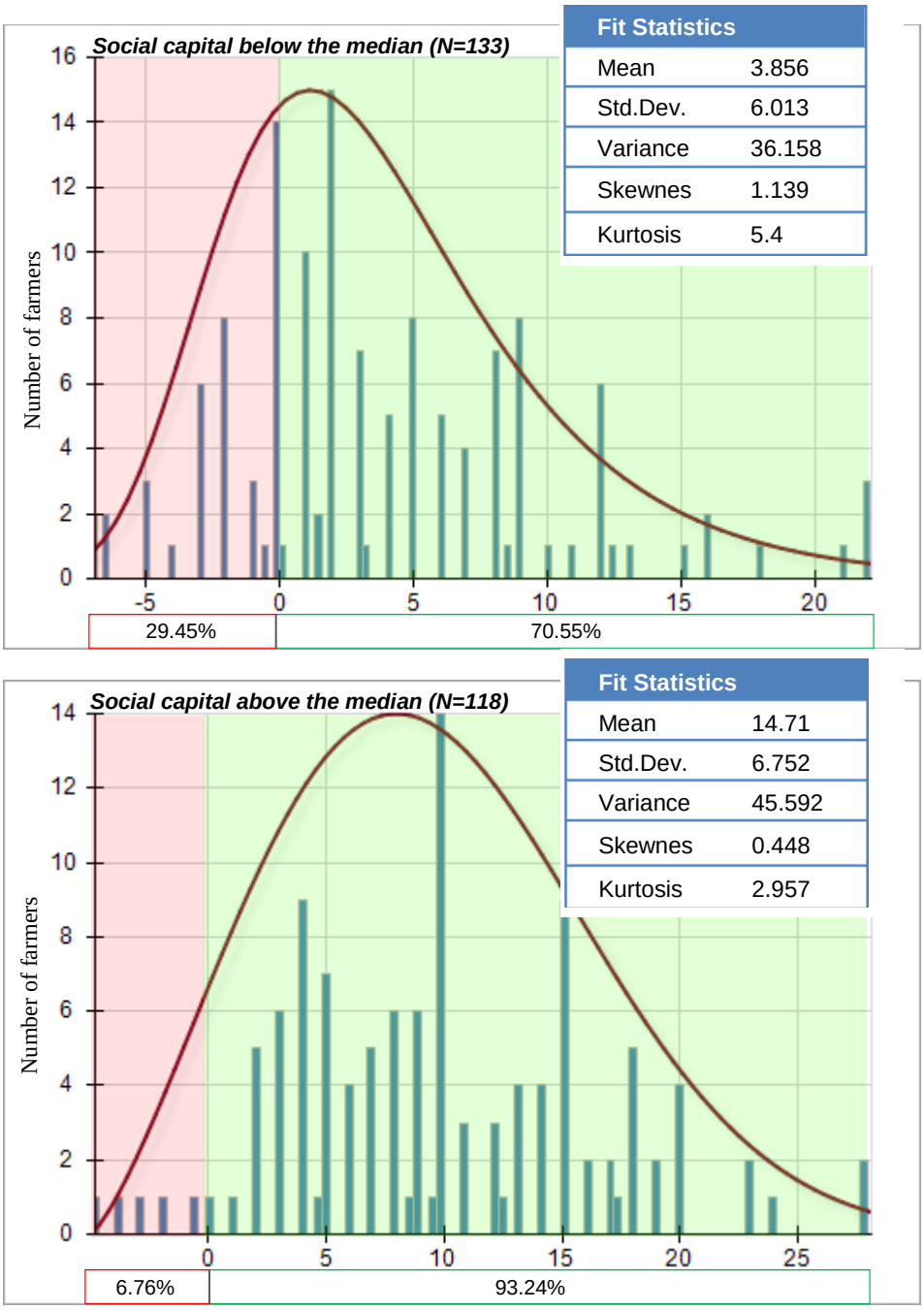
Figure 4.1 shows that the average outcome for farmers having social capital above the median is of 4.85 compared to 4.15 in the case of farmers with social capital below the median, which confirms the positive impact of social capital on productivity levels. In addition, the productivity distribution for farms with social capital above the median is wider and flatter. This implies greater ranges and hence higher variability of scores. However, we also notice that higher levels of social capital own the potentials for higher returns. We tested for two scenarios sets: first, high production outcomes i.e. yield higher than 10 quintals/acre; and second, low production outcomes i.e. yields lower than 2 quintals/acre. Our findings show that the probability of high production outcomes is more than twice higher for farms with social capital above the median (5.41%) than above the median (1.75%). The results are even stronger for the probability of having bad results i.e. less than 2 quintals per acre (3.42 versus 15.23).

Another approach to investigating the risk increasing nature of social capital is the relation of actual yield to expected yield by farmers' levels of social capital. In our survey we asked farmers to detail their yield expectations at planting time. The actual yield was then compared to the farmers' expected yield. Figure 4.2 shows the results of comparing actual average yield to the farmer's yield by social capital values. The large majority of the entries in Table 4.2 are positive. This reflects the fact that 2011 was a particularly good rainfall year for all the farms[37]. Notwithstanding this, we observe a striking difference between actual yield to expected yield for farmers with social capital above the below the median.

Our results show that the probability of obtaining lower yield than expected (a value which is associated with downside risk, i.e. distribution of yields tends biased towards the lower values) is much higher for farmers with social capital below the median than above (29.45 versus 6.76). On the other hand, the probability of obtaining higher results than expected is much higher (93.24% versus 70.55%) for farmers with higher social capital than the median. Based on the shape of the distribution we can deduce that a risk-increasing effect of social capital may reflect an impact of social capital on the upside risk primarily, which responds to the probability of gaining something rather than losing.

[37] The 2011 planting season's above-normal monsoon rains created favorable conditions for cotton cultivation and yield, which exceeded official initial forecast.

Figure 4.2 Evidence of risk: relationship of actual yield to expected yield by farmers' levels of social capital



Note: In each case the table reports the average across the sample of the farmer's actual yield minus the farmer's subjective expected yield. The probabilities of obtaining higher/lower yield than expected are highlighted in green/red. Social capital shows a highly significant positive correlation with the variable represented in this histogram ($\rho = 0.4861$ Prob > |t| = 0.000).

One may argue that, given this result, more risk-adverse farmers could be less willing to get involved in social capital activities, since the latter may imply risk in the sense that farmers' results rely partially on others. Although downside risk may be particularly important in the case of smallholder Indian farmers, their main concern is primarily with losses (downward fluctuations) than variability itself, which makes them not really "risk averse" but actually "loss averse" (Fafchamps, 2010).

Fafchamps (2010) suggest that inputs/activities that protect farmers from downside risk but preserve upside benefits can create incentives for smallholders to invest. In the case of our sample farms, social capital contributes to reducing farmers' downside risk by way of protecting farmers against a range of adverse shocks (such as weather shocks and pest attacks) through labour sharing and flexible credit transactions. Moreover, by managing grading, storing and transportation collectively, farmers considerably improve their bargaining power and their capacity to respond to market price fluctuations, which reduces the risk involved in falling of output prices.

One may interpret this result as a sign that farmers use their social capital to adopt risky but high-return technologies and farming practices. As farmers can get easier access to credit though their social networks, they may use it to finance high return technologies, or invest in productivity enhancing inputs such as fertilizers and high-yielding crop varieties. This would also explain the findings of its strong positive effect of social capital on efficiency levels as indicated by previous research (Serra and Poli, 2015).

Hence, social capital, although augmenting output variability, is not vulnerability increasing. On the contrary, it offers chances to farmers to adopt higher-return inputs and technologies which can augment their productivity levels as well as offering an informal safety net which mitigates the negative effects of production risk. Our results thus suggest the need to explore a wider range of institutional arrangements for farming than single family cultivation, to offer scope for improving smallholder farmers' livelihoods as well as enhancing agricultural productivity.

4.6. Concluding remarks and policy recommendations

This chapter analyses the effects of social capital on the productivity and the riskiness of India's smallholder agriculture. We identify and measure social capital as the networks that enable farmers to cooperate and act collectively in production activities. Hence social capital represents farmers' degree of cooperation in production activities; this is the case of collective input acquisition, share of labour force, collective soil and/or water conservation and joint marketing of produce.

It tackles this subject in a poor rural community setting, where sustainable economic development claims for promotion of productivity and output growth, and where increasing the use of conventional (and expensive) inputs such as land, capital or labour is difficult, given the economic restrictions faced by farmers. In such context, the relative cost-free nature of social capital presents a number of opportunities for the smallholder poor farmers.

Based on a sample of small Maharashtrian farms in India, this chapter assesses the influence of social capital on the mean and variance of cotton yield, using the Just and Pope (1978, 1979) production

function. While the role of social capital as an input in the production process has been previously investigated, the literature on the impact of social capital on the production risk with which agricultural holdings operate is very scarce.

Our empirical analysis shows the positive role of social capital in improving cotton farms productivity. Specifically, results suggest social capital to be the input with the highest contribution to productivity after labour. Farmers' cooperation in production activities are shown to improve the capacity of smallholder farmers to meet a whole range of agricultural needs including land leasing, procuring inputs, pooling resources, sharing information, marketing of produce and accessing production loans.

Another interesting result is that social capital may be used to reduce input costs, as well as augmenting farmer's productivity through the multiple positive externalities of collective production. The analysis shows a negative and highly significant correlation between farmers' production expenses and their level of social capital. Results suggest that our sample farms are using social capital to reduce input costs and/or to increase their productivity by using fewer inputs to produce the same amount of output. These results are also compatible with the argument that Indian smallholder farmers use social capital as a means to save production and transaction costs by reducing information and search costs and by substituting for poor market institutions.

The results of the risk analysis find social capital to be both productivity enhancing and risk increasing. The risk effects of social capital on production represent another interesting conclusion of our study, showing that social capital can be risk increasing, even when its effect on risk improves farmer welfare. Similar results were found by Hurley *et al.*, regarding the effects of Bt rice on production risk (Hurley *et al*., 2004).

We interpret this result as a sign that farmers use their social capital to adopt riskier but high-return technologies and farming practices. As farmers can get easier access to formal credit, inputs and technical information by acting collectively (see also Braverman *et al*. 1991), they may use these to finance high return technologies, or invest in productivity enhancing inputs such as fertilizers and high-yielding crop varieties. Hence, social capital, although augmenting output variability, is not vulnerability increasing. On the contrary, it offers chances to farmers to adopt higher-return inputs and technologies which can augment their productivity levels as well as offering an informal safety net which mitigate the negative effects of production risk.

CONCLUSIONS

"*Agriculture can be fruitful only through co-operation*"

"Mahatma" Gandhi[38].

This doctoral thesis analyses the potential for social capital to bring a positive change in the productive life of smallholder farmers in India. This hypothesis has been tested from different analytical perspectives, using both qualitative and quantitative analysis. The results obtained converge on the same conclusion, showing the positive role of social capital in improving cotton farms efficiency and productivity, reducing input costs and allowing farmers to adopt riskier but high-return technologies and farming practices.

In doing so, this research investigates the prospect for different categories of farmers to develop new collective forms of agricultural production, analysing their needs and constrictions over carrying out agricultural activities collectively or individually. Collective farm activities can 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 type of cooperation between people in the same community is based not only in active connection between people, but also on their reciprocal trust, mutual understanding, and shared values which make cooperative actions possible.

In our analysis we have been emphasizing the relative cost-free nature of social capital compared to other conventional inputs, and how this characteristic presents a number of opportunities for the smallholder poor farmers. However, social capital, and collective production in particular, has indeed a cost. This cost is not monetary, but involves the cost of creating the structure for social capital to work: creating linkages, bearing the opportunity cost of sharing information which could be kept to oneself, the cost of sharing inputs such as labour in some cases. It may take time to be created.

The experience of individually interviewing farmers on their mutual interaction and relations of reciprocal support gave me a hint of how difficult is to cooperate with others when it comes to trusting and sharing our own belongings. Some may find it natural if he/she sees the benefits that one can obtain from it, but for others it may just be not an option.

Our research findings show clearly how the benefits of smallholder collective action are far beyond the opportunity cost of farming individually. In the reality of rural India, where farmers have full

[38] Letter to Balvantsinha; July 24, 1947.

dependency on nature and agricultural outcome, if we choose to trust on others and cooperate we get much more than just an increase in productivity. We share a knowledge which can make other people's efforts in agriculture production more effective, we create a network that can adapt faster and easier to changes (may those be environmental, financial or market determined) and can support each other in time of need.

By acting collectively farmers can get easier access to technical information, inputs and formal credit, which they can use to finance high return technologies, or invest in productivity enhancing operations and assets. This kind of social capital moreover enhances smallholders' ability to manage irrigation and participate in agricultural research and extension activities. Many studies have confirmed the benefits of a strong social capital on the welfare of the entire rural society; and is moreover likely that the spirit of cooperation which is built in farming can expand to other sectors of the rural societies and engender new positive social and political changes.

These opportunities add to the long-awaited sustainability of the agricultural sector in the developing countries, creating the base for long-term, collective empowerment of the rural communities. This suggests that the returns to social capital in a rural community setting might be as important as returns to labour, physical or human capital. Moreover, given the bottom-up and context-specific nature of social capital, its potential goes beyond the agricultural sector, in the wider social, cultural and political contexts, making it a powerful tool for rural development strategies.

Policy makers and development planners can facilitate social capital built up by providing an adequate framework for its development and by sustaining mutually beneficial relations among the farming communities and between communities and external institutions. This will not only increase farm yields, but will also contribute positively to the economic viability of small farms, being an important step in the effort to reduce poverty and promote a better livelihood of this category of farmers.

However, a question can rise on how to turn the potential hidden in social relations into an actual base for community development projects in the rural areas. Programmes that actually put this in practice are not very common. I have been lucky enough to come across with one good example during my stay in India. It has been for me a great example of a bottom-up agricultural development project in which environmental sustainability, collective action in farming and high quality and productivity goals were promoted and successfully achieved. This project is called "Sahaj Agricultural Project", which is now working with twenty thousand farmers all over India and whose advances are currently monitored by the ICAR (Feeding Knowledge, 2015).

One unique feature of the project is that the local farmers are considered as an integral part of the agricultural process through which their inherent connection with nature and their fellow farmers is harnessed and channelized. Witnessing the working of a project of this magnitude showed me that a holistic approach to agriculture is desirable and indeed possible. And such ideas can become also guiding principles for proposing a fully new way of approaching agriculture, just the opposite of individual oriented, industrial agriculture.

This doctoral research takes up the challenge of finding alternative methods of enhancing smallholder agricultural production in a situation where technically successful answers can be heavily limited by non-technical issues and where access to productive resources and other conventional inputs such as land, material capital and labour is particularly limited. In doing so, this study has been the first to shed light on the relevance of social capital in the Indian rural sector, linking altogether the subject of social capital with agricultural sustainability, production efficiency, production levels and production risk. It demonstrated how a wider range of institutional arrangements for farming rather than single farm cultivation can be used to reduce farmers' vulnerability and how we can capitalize its potentials to strengthen farmers' position in the production process.

There is a need for similar studies to be replicated in other settings, countries and cultures so that these successful practices can be adapted as a means of improving smallholders' lives and communities. Furthermore, the effectiveness of collective action among farmers could be an interesting starting point for research into new mechanisms for increasing the efficiency and the prosperity of the local agricultural system as a whole. It is an alternative model, where farmers, processors, distributors, consumers do not act in competition against each other only for economic and monetary interests, but in cooperation for purposes which are also social and ecological. This thesis, in its wider perspective, brings hope for a new agricultural economy, where farmers are secured a dignified standard of living, where social relationships are sustainably promoted and reinforced in a conscious relation between people, their communities and the environment they live in.

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APPENDIX A - SOCIAL CAPITAL QUESTIONNAIRE

1. Are you a member of any of the following groups or associations?

Associations	*Nature of membership*				
	Man only	Women only	Mixed	Separated per caste	All caste represented
Farmers groups					
Self-help groups					

2. Since last February, how often have you participated in a farmer's / self-help group meeting?

0 = never										*10 = attended all meetings*
0	1	2	3	4	5	6	7	8	9	10

How often exactly?.....…….

3. How do you qualify your contribution to the group decision making?

0 = do not take part										*10 = relevant role*
0	1	2	3	4	5	6	7	8	9	10

4. Has the group's membership benefited you?

0 = no benefits										*10 = high benefits*
0	1	2	3	4	5	6	7	8	9	10

5. If membership improved your access to particular services, could you specify which ones?
   1. Access to better technical agricultural information ☐
   2. Access to credit ☐
   3. Access to agricultural Inputs ☐
   4. Access to land (though collective leasing) ☐
   5. Access to labour ☐
   6. Access to irrigation ☐
   7. Access to market facilities ☐

6. In case you DO NOT belong to any association, could you indicate the main reasons?
   1. I think that I would not gain from it ☐
   2. I am skeptical about their good functioning and benefits ☐
   3. It is difficult and/or expensive to enter the existing partnerships ☐
   4. I do not know of any associations ☐

7. Do you discuss or consult with other farmers before taking production decisions?

0 = no, never										*10 = yes, always*
0	1	2	3	4	5	6	7	8	9	10

8. Do you discuss about production decisions with the women of your family?

0 = no, never										*10 = yes, always*
0	1	2	3	4	5	6	7	8	9	10

9. If you need further information to take a decision on cotton production, do you know where to find that information?

0 = no, never										*10 = yes, always*
0	1	2	3	4	5	6	7	8	9	10

10. Are farmers in your village/group experimenting on new crops and cultivar methods and then sharing their knowledge with other farmers?

0 = never sharing										*10 = always sharing*
0	1	2	3	4	5	6	7	8	9	10

11. Once the season is over, is information on the outcome of cotton production shared among the farmers in your village?

0 = no sharing										*10 = full sharing*
0	1	2	3	4	5	6	7	8	9	10

12. What is your level of TRUST for:
    a. People in your village help you when you face a difficult time

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

    b. Seed / chemical dealers give trustworthy advices

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

    c. The traders to whom you sell your produce pay a fair price for your cotton produce

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

    d. Governmental extension services provide valuable technical information

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

    e. Local NGOs will benefit the village

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

    f. Local sarpanch represents the overall interest of the village

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

13. How much do people trust each other in matters of lending and borrowing in your village?

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

14. What is the general level of trust between the farmers in your village?

0 = no trust										*10 = absolute trust*
0	1	2	3	4	5	6	7	8	9	10

15. 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?

0 = will not contribute										*10 = surely contribute*
0	1	2	3	4	5	6	7	8	9	10

16. Do people in your community/neighborhood volunteer or help in community activities?

0 = disagree										*10 = strongly agree*
0	1	2	3	4	5	6	7	8	9	10

17. Do different caste/classes collaborate and work together in activities for the village's benefit?

0 = very unlikely										*10 = always collaborate*
0	1	2	3	4	5	6	7	8	9	10

18. How have you procured fertilizers during the last season?

0 = only individually										*10 =always collectively*
0	1	2	3	4	5	6	7	8	9	10

19. How have you procured other inputs this last season?

0 =only individually										*10 = always collectively*
0	1	2	3	4	5	6	7	8	9	10

20. Have you practiced soil and/or water conservation operations collectively?

0 = only individually										*10 = always collectively*
0	1	2	3	4	5	6	7	8	9	10

21. Have you shared labour force collectively with other farmers to overcome labour shortage?

0 = only individually										*10 = always collectively*
0	1	2	3	4	5	6	7	8	9	10

22. Have you organized the selling of cotton produce collectively with other farmers?

0 = only individually										*10 = always collectively*
0	1	2	3	4	5	6	7	8	9	10

23. Do you participate in a system of mutual farmer support to access credit sources?

0 = never										*10 =always*
0	1	2	3	4	5	6	7	8	9	10

24. Do you participate in a system of mutual farmer support in case of credit repayment problems?

0 = never										*10 =always*
0	1	2	3	4	5	6	7	8	9	10

25. Has cooperation with other farmers helped you reduce production risk?

0 = Very unlikely										*10 = Surely help*
0	1	2	3	4	5	6	7	8	9	10