HOW SEEDS BECAME “BIG-BUSINESS” AND A CAUSE FOR SUICIDE AT THE SAME TIME

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Summary

“The Indian government, academics and farmers all agree: Indian agriculture is in crisis” (Lerche, 2011: 104). The number of farmer suicide in India is really high; although the exact numbers differ per source, it can be argued that such a high suicide number is some kind of indicator for a crisis on the Indian agrarian land. The cultivation of cotton is a very important part of the Indian agrarian landscape. About 5.8 million Indian farmers produce cotton and together they cultivate 22% of the world’s cotton production (WWF-India, 2012). This study examines the relation between seed security and the sustainability of cotton-farmer’s livelihoods in India. My hypothesis is that centralization of power in the cotton seed industry undermines the seed security of Indian smallholder cotton-farmers, whereby a situation is created in which these farmer’s livelihoods become less sustainable. The following research question is central in this study; “How does a decline in seed security lead to less sustainable livelihoods for Indian smallholder cotton-farmers?” Here, a sustainable livelihood is defined as follows. “A livelihood is held to comprise the capabilities, assets, and activities required for securing a means of living. A livelihood is considered sustainable when it can cope with and recover from stresses and shocks; maintain or enhance its capabilities and assets in the present and through time, without degrading the natural resource base” (Macini et al, 2007: 99).

When India became independent in 1947, the new leaders were strong advocates of the modernization paradigm. Technology, integration in larger market systems, capital investment and scientific research were, within the modernization paradigm, seen as key solutions to the worldwide demand for increased yields. In 1969, the Green Revolution officially started. Key elements in this project were varietal improvement (hybridization of seeds), the introduction of (an increased use) of agro-chemicals and an expansion of the irrigated area. Through modernization, the Indian rural space gradually changed from ecologically adapted (and diversified) forms of peasant farming to industrial specialized monocultures. By doing so, classical givens like autonomy and self-sufficiency shifted to the background and new dependency relations between farmers and suppliers of external inputs arose. In India peasant farmers started showing features of entrepreneurial agriculture and many farmers changed into commercial smallholders.

In conjunction with the modernization and industrialization of agriculture, changes in the world’s political economy opened the way for western transnational companies to increase their power. The breakdown of the Bretton Woods system contributed to this by unravelling interstate market hierarchies and the creation of “single world market for money and credit supply” (Harvey, 1989: 161). In 1986, the Uruguay round was set up. In this round the WTO was founded and the Agreement on Trade-Related aspects of Intellectual Property Rights (TRIPS) was legally approved. The TRIPS system is a patent-like system that prevents ‘intellectual ideas’ from being stolen. At the same time, upcoming neoliberal policies opened the way for transnational companies to increase their power and restructure production and consumption on a global scale. A very important example of the restructuring of global patterns is the Structural Adjustment Program, which was imposed on indebted countries when they asked for financial “help”. The structural adjustment program objectives for India were twofold. First, the payment crisis had to be balanced. Second, “a broad set of policy reforms aimed at liberalizing the Indian economy and opening it up to more competition both from within and abroad” (The World Bank Group, 2012) was implemented. India had moved from a regime in which private investment was not allowed in major economic sectors to one whose openness to foreign investment compares favourably with that of most Asian countries (The World Bank Group, 2012). From this moment on, Indian farmers had to compete more and more with commodities produced elsewhere.
Seeds did not use to give the incentive to buy, because once a seed is bought, it can be reproduced independent of the market, thus no profit can be made by the selling companies. Therefore, seed reproduction used to be merely resistant to the ‘capitalist logic’, however, this fundamentally changed with the industrialization of agriculture, hybridization of seeds, and the increasing power of a few multinational corporations. Structural changes in the seed industry have much to do with the last mentioned “obstacle of reproduction”: the seed industry found two ways to counteract this obstacle. First is the legal way, which is about legal interventions to protect seeds from being reproduced, the TRIPS system is the most important system in this case. Second is the biological way in which the seeds are genetically “changed” (by hybridization or later genetically modification) to erect the generative nature of seeds. A certain kind of modification results in a Terminator Seed, which is completely infertile and is thus incapable of self-reproduction (Howard, 2009). Hereby, the incentive to buy seeds every year was born. In the last few decades, the commercial seed industry has changed dramatically. The industry today is dominated by a small number of transnational corporations, while it used to be a competitive sector of agribusiness composed of small and family owned firms. Corporations merged with large competitors and acquired the smaller seed companies, in order to strengthen their own competitive position. It could be said that only a few business corporations worldwide dominate the complete agricultural system by “owning” the seeds. Power became increasingly hierarchically ordered.

Currently, the relation between the organization of agricultural production and the interests of farmers is under pressure. Worldwide, agriculture is subjected to an economic squeeze that is worsened by the big and very powerful transnational corporations (Van der Ploeg, 2009). Prices that farmers receive are kept down or are reduced, due to the global changing interrelation between production and consumption, while at the other hand their costs rise. The squeeze on agriculture is very visible in the situation of India’s cotton small farmers, but it is a worldwide phenomenon in which the economic margins in agriculture are decreasing.

The increased influence and hierarchical control of corporations on cotton seeds, or the “corporisation” (Nemes, 2010: 25) of the cotton seed sector in India has influenced the livelihoods of farmers. Most of India’s smallholders are directly dependent on money that is earned by producing and selling cotton. Traditionally cotton was cultivated in crop rotation, and merely all inputs including seeds were reproduced at the farm independent of markets. During colonialism new cotton species were introduced that fitted better with the demand for cotton at that time. Nevertheless, farmers could still reproduce their cottonseeds to grow cotton year after year. There was no need for and no force to acquire external inputs. During the Green Revolution, the so-called high yielding hybrids were introduced on a large scale and relationships between men and nature changed dramatically. Hybrids force farmers to buy new seeds every year and although the hybrid seeds did give a higher yield, they also increased the need for external inputs like synthetic fertilizers and pesticides.

The bollworm is one of the major pests for cotton in India. Bt cotton is a type of cotton that is genetically modified to produce a toxin (the Bt toxin) from which some pests die. Especially the bollworm is sensible to this toxin. The commercial seed industry claims that with the introduction of Bt cotton, the use of pesticides and insecticides would decrease, since the plant creates its own toxin. However, contrary to expectations and promises, with the arrival of Bt cotton, the amount of pesticide sprays did not decrease (Nemes, 2010; WWF-India, 2012; Tirado, 2010), partly due to agricultural deskilling (Stone, 2007). For India, after its introduction in 2002, Bt cotton is the moment the most important genetically modified variety of cotton. “From 2003 to 2005 the market share held by Bt hybrids climbed from 1% to 20% to 62%. This was more than innovation diffusion and more than a ‘tipping point’: it was a stampede” (Stone, 2007: 68).
Nemes (2010: 9) introduced the concept of seed security as an important aspect of a farmer’s livelihood concerning agricultural choice and freedom. Seed security is about having a stable physical, social and economic access to sufficient quantity and quality seeds that meet the farmers’ preferences. The concept entails two main dimensions; seed access and seed availability. First, access to seeds is influenced by a farmer’s human and financial capital. Knowledge and skills are important determinants of human capital. Stone (2007) introduces the idea of agricultural deskilling in which he explains that both knowledge and skills are not really being developed by farmers. He ascribes this to the complex situation farmers are current in, caused by the very rapid modernization. Indian cotton small farmers are dependent on external sources for information about their seeds and agricultural methods and follow their neighbours in making choices. This makes them vulnerable for and subject to hierarchical control of business corporations with regard to marketing and distribution of information or even disinformation. Second, financial capital is about the economic means of farmers to access appropriate seeds. In literature it is confirmed time after time that (Indian) small farmers are increasingly in debt. This can be ascribed to the increased dependency on external inputs like seeds, pesticides and fertilizers. In addition, due to the frequency of payment defaulting, and the absence of a correct financial system, small farmers often do not have access to formal financial institutions with favourable interests. They are dependent on informal moneylenders who charge high interest rates; this only increases the costs for these farmers and deepens the squeeze on agriculture. Besides access, availability of seeds is another dimension of seed security. Here, a paradox can be seen that on the one hand more (Bt) seed varieties are available since the introduction of hybrid and genetically modified seeds. However, on the other hand, local and non-Bt seeds varieties are gradually disappearing whereby the availability of seeds is influence as well.

The technological treadmill, introduced by Willard Cochrane in 1958, explains why farmers continue to participate and are trapped in this process of debt and reliance on external knowledge. He explains the technological treadmill on the basis of relative inelasticity of (commoditized) agricultural outputs. Inelasticity is an economic principle that explains; when supply exceeds the demand, prices will fall and thus reduce the price that farmers receive for their crop. For the first/early adopters of new technologies by increasing production, for example during the green revolution, financial benefits might grow initially. However, for the majority of farmers, the result is that due to growing supply, the prices lower, and to compensate the lower price per output, yields must increase for maintaining the same revenue. In order to survive, farmers have to produce more and more. They cannot stop farming; because once they stop they “fall of” the treadmill and are financially ruined.

The conclusion of this study is that the seed security of Indian cotton farmers indeed has indeed declined and that this is partly caused by the oligopolisation of the commercial seed industry. However, it continues to be important to place processes like these in the broader context of agrarian change and developments. Secondly, it is concluded that the decline in seed security has led to less sustainable livelihoods in several ways. First, the decline of seed security, which goes together with the process of agricultural deskilling, the increased indebtedness and the grown dependency on world markets made Indian cotton-farmers less able to cope with stesses and shocks like pests, droughts and fluctuating prices on the global markets. Second, for maintaining and enhancing capabilities and assets in the present and through time, the same factors play a role. Concepts like the technological treadmill and the squeeze on agriculture do not offer very good prospects for developments “through time”. Finally, for a livelihood to be sustainable, it has to maintain its natural resource base. Here the most important aspect is the availability dimension of seed security; the disappearance of local cotton seeds whereby the local natural resource base is eroded. In India, hence all aspects of a sustainable livelihood are threatened by the decrease in seed security for smallholder cotton farmers.
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Chapter 1  Introduction

The cultivation of cotton is a very important part of the Indian agrarian landscape. About 5.8 million Indian farmers produce cotton and together they cultivate 22% of the world’s cotton production (WWF-India, 2012). Since a few years, high rates of suicide among Indian cotton farmers call the attention of journalists, scientists and activists. Although exact numbers differ, there is no doubt that the current rate of suicides is some kind of indicator for problems afflicting the Indian rural space. Factors such as rising costs of inputs, indebtedness and increasing power of the commercial seed industry are being put forward as possible explanations for the tragedy that takes place in India. Since most Indian cotton-farmers are fully dependent on the cotton yield for their income, securing a means of living is closely intertwined with having a “good” yield. Seeds are at the very foundation of the cotton plant, therefore being secure of “good” seeds can be considered very important for a farmer’s livelihood.

The attempt of this study is to sketch a fuller picture of the relation between seed security and the sustainability of cotton-farmer’s livelihoods in India. All information is gathered through an extensive study of available literature. My hypothesis is that centralization of power in the cotton seed industry has undermined seed security of Indian smallholder cotton-farmers, whereby a situation is created in which these farmer’s livelihoods become less sustainable. The following research question has been formulated; “How does a decline in seed security lead to less sustainable livelihoods for Indian smallholder cotton-farmers?”

Sustainable livelihoods and seed security are two important/crucial concepts. Seed security is defined as farmers or farmer groups having a stable physical, social and economic access to sufficient quantity and quality seeds, which meet their preferences of variety choice. The concept of seed security entails two main dimensions; the first is seed access, which stands for the means to access appropriate seeds. The second dimension is about seed availability; the availability of sufficient quantities of seeds of appropriate quality, at all times. A sustainable livelihood is defined as follows. “A livelihood is held to comprise the capabilities, assets, and activities required for securing a means of living. A livelihood is considered sustainable when it can cope with and recover from stresses and shocks; maintain or enhance its capabilities and assets in the present and through time, without degrading the natural resource base” (Macini et al, 2007: 99).

Two types of stresses and shocks that threaten the livelihoods of smallholder Indian cotton-farmers can be distinguished; first and very importantly there are ecological stresses like pests and droughts that decrease the volume of the yearly cotton yield. Second, there are stresses and shocks caused at a higher level; those created by a changing political economy of the seed sector and dependency on global markets. Both will be discussed extensively further on in the text. The sustainability of livelihoods does not only depend on the ability to cope with these stresses, it also depends on enhancing capabilities and assets in the present and through time. So, it must be possible for a farmer to earn a substantial income and enhance other capabilities like for example knowledge and ecological skills. The above mentioned increasing indebtedness of Indian cotton farmers questions this aspect of sustainability. Lastly, it is important that the natural resource base does not degrade. For cotton seeds in India it is thus important that local seeds remain available and the land is not degraded or polluted.
To understand how seed security of Indian cotton farmers can or actually is undermined by commercial seed companies, it is important to look at the changing political economy of seeds and in particular to the reproduction of seed. Chapter 3 will elaborate on the question “Which factors led to the oligopolisation of the cotton seed industry?” Central here is how during the last 40 years, the science of biotechnology became more and more advanced and influential, not the least in the field of agricultural seeds. Cotton seeds changed from being “just seeds” to being biotechnological commodities. Where traditionally almost all cotton seeds were reproduced at the farm, this changed with the advent of commercial seeds industries. A transition could be seen where internal reproduction of seeds was replaced by corporate reproduction of seeds and farmers became dependent on the market for their agricultural inputs. Local seeds are gradually disappearing while genetically modified seeds gain more and more ground.

The introduction of hybrids and genetically modified cotton seeds by the bigger seed companies like Monsanto, changed the interaction between Indian cotton farmers and their natural resource base dramatically. To examine this change, chapter 4 will elaborate on the question “What has been and is the impact of corporate reproduction of cotton seeds on farmer’s livelihoods in India?” Here, a livelihood analysis will be conducted based on the analytical concept of seed security. The squeeze on agriculture and the technological treadmill are used as explanatory concepts. Together these concepts give a good overview of the situation in which these farmers find themselves now.

In chapter 5 the information gathered will be critically assessed, and discussed in view of the main research question. Finally, some overall conclusions will be drawn in chapter 6.
Chapter 2  A changing agricultural regime

Seeds are at the basis of all agricultural production. Power over seeds can thus be seen as power over agriculture as a whole. Commercial seed industries have changed a lot over the last 40 years. Consolidations and acquisitions caused that now the whole cotton seed industry is in the hands of a few corporations, which is called an oligopoly. This chapter will elaborate on the question “Which factors led to the oligopolisation of the cotton seed industry?”, thus how agriculture changed from a local production and consumption base, to a global base dominated by western companies.

Important here is not only how commercial seed companies acquired so much power, important also is how they effectuate this power. To describe this, the chapter is subdivided in three main parts. First, it will be explained how the introduction of modernization and productivism changed agriculture into an industrial practice. Second, it will be discussed how changing markets and institutions created options for transnational corporations to gain power globally. Last, on the basis of intellectual property rights on seeds, it will be explained how transnational companies gained global control over the source of agriculture; seeds.

2.1 The modernization and industrialization process

India’s agricultural development policies of the 1950’s, 1960’s and 1970’s, coincide with an international context of ongoing rural and urban change. At that point, the changing and intensifying influence of globalization is of significance to every country in the world. Globalization manifested itself in the occurrence of a globalized food system, pushing developing countries towards more export oriented policies for agriculture (Halfacree, 2006). “There is no point in discussing whether this is true or not. The crux of the matter is that such a model has been made true, albeit to different degrees and with contrasting outcomes during the 1950 en 1990 period when big modernization projects dominated worldwide agriculture” (Van der Ploeg, 2009: 17)

When in August 1947 India became an independent nation, it was a hungry nation. The people in India were malnourished and starving due to a lack of (good) food. When the British rulers left, the approach of the new Indian government could be describe as a productivist one (Ganguly, 2014). Productivism portrays agriculture as a production maximizer which is strongly food production oriented (Halfacree, 2006), which suited well in the ideas of the Indian government of that time. Creating food security was one of the main goals. The Indian rural was perceived as not only traditional but also backward. From that time, the image of the Indian rural changed and modern agriculture became the new focus. In the following quote, Saha (2013: 203) explains the meaning of the modernization paradigm in agriculture: “Experts identify a modern agricultural production system as a highly mechanized countryside, where farmers are integrated with a larger economic system beyond their immediate locality and are largely profit driven. Such systems exhibit the widespread use of inputs like hybrid seeds, chemical fertilizers, and pesticides, which are systematically studied and improved by techno-scientific experts at research laboratories and markets. According to this normative framework, therefore, Indian farmers and scientists only witnessed and, more importantly, participated in a modern agricultural production system with the advent of the Green Revolution in the mid-1960s, which heralded the beginning of modern agriculture in India”.

Thus, within the modernization paradigm, technology, integrating in larger market systems, capital investment and scientific research were seen as solutions to the problem India faced. In that way it can be concluded that the modernization paradigm preaches an industrialization of agriculture in order to make it “successful”.
A meeting by the Rockefeller Foundation about the world hunger problem in 1969 was the start for a mobilization of (mostly western) agricultural development organizations, with the goal to modernize agriculture and increase food production. This project, which encouraged industrialization of agriculture on a western model, was later called the Green Revolution. Key elements were varietal improvement, the introduction of (an increased use) of agro-chemicals, both fertilizers and pesticides, and an expansion of the irrigated area. In India, the Green Revolution was implemented fast (Sebby, 2010). Agrarian conditions changed rapidly, both for the good and bad, in India and worldwide. The Green revolution has been credited for increasing yields in many of the places where the technologies were adapted, and thereby decreasing hunger. But, it is argued by many (Lerche, 2010; Sebby, 2010; Saha, 2013) that the benefits of the green revolution were highly unequal. Lerche (2011) states that there is a small class of rich capitalist farmers at the top, who benefited from the green revolution, while poor and marginal smallholder farmers, at the bottom, were unable to invest in agriculture and thus did not benefit.

Through modernization, in this case manifested in the Green revolution, labour intensive and ecologically adapted forms of (peasant) farming were gradually replaced or supplemented by industrial specialized monocultures. Crops and livestock were no longer produced on the same farms; artificial inputs could replace the complementary function of plants (food for livestock) and livestock (source of manure to fertilize crops and power equipment) (Friedmann, 2009). It is for these reasons that industrial agriculture involves disconnectedness between farming, nature and locality; natural growth factors are replaced by artificial growth factors as new technologies and external inputs (Van der Ploeg, 2010). This also was the case in India, since these new high yielding varieties required more, mostly imported, inputs then the traditional varieties. Classical givens like autonomy, self-sufficiency and the demographic cycle contained within the family were slowly shifted to the background (Van der Ploeg, 2009). The new patterns of global specialization in the 1950’s, 1960’s and 1970’s, encouraged the process of agricultural commoditization since enterprise became more and more integrated within markets both on the input and output sides. “In capitalist agriculture all the resources, including the labour force, are commodified: the heart of the process of production is based on capital – labour relations” (Van der Ploeg, 2014). Farmers had to take loans in order to expand or adapt to the new technologies. Indebtedness of farmers increases exponentially when industrialized farming is implemented; thereby increasing farmer’s dependencies upon financial markets as well (Van der Ploeg, 2010). This kind of dependency was new, as farming used to be built on ecological capital instead of industrial and financial capital (Friedmann, 2009). Costs for input increased and the margin per unit of end product decreased since these new industrialized and ‘modern’ farms started following the market.

In Figure 1, Van der Ploeg (2014) elaborates on the different stages of progression, “demanded” by modernization. Modernization and the implementation of industrialization in agriculture cause that farmer strategies change from peasant modes of farming to more entrepreneurial modes of farming. India’s smallholder cotton farmers show some features of entrepreneurial agriculture; they are commercial smallholders. Although the farms of smallholders are small in size (less than 2 hectares), they depend on a single market (the global cotton market). Also, most cotton farms lost their multifunctionality and are producing cotton in a monoculture setting, using hybrid seeds.
As shown in figure 1, there are a lot of stages a farmer can be “in”. However, a better understanding of the gradual shift from peasant modes of farming to entrepreneurial ways of farming is shown in Table 1. The table shows the differences between the ideal typical peasant (more traditional ways of farming) and the ideal typical entrepreneur. Typical peasant farms are grounded on natural and social resources that are controlled by the peasant him or herself and they are relatively autonomous from the (global) markets. The modernization paradigm pushes farmers from being peasant, to being a more entrepreneurial farmer. The most important change here is given in the second row of table 1; the shift from distancing from markets on the input side and differentiating on the output side, to a high degree of commoditization and high market dependency. For Indian cotton farmers, especially the externalization of the input of seed is very important. Van der Ploeg (2010: 100) argues that as a consequence of this commoditization and markets dependency “agriculture is becoming far more sensitive to economic trends and fluctuations than it ever has been before. It’s very foundations have started to follow ‘the logic of the market’”.

**Table 1:** From a peasant mode of farming to an entrepreneurial mode.

<table>
<thead>
<tr>
<th>Peasant mode</th>
<th>Entrepreneurial mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building upon and internalizing nature; co-production and co-evolution are central</td>
<td>Disconnecting from nature: ‘artificial modes of farming’</td>
</tr>
<tr>
<td>Distancing from markets on the input side; differentiation on the output side (low degree of commoditization)</td>
<td>High market dependency; high degree of commoditization</td>
</tr>
<tr>
<td>Centrality of craft and skill oriented technologies</td>
<td>Centrality of entrepreneurship and mechanical technologies</td>
</tr>
<tr>
<td>Ongoing intensification based on quantity and quality of labour</td>
<td>Scale enlargement as the dominant trajectory; intensity is a function of technology</td>
</tr>
<tr>
<td>Multifunctional</td>
<td>Specialized</td>
</tr>
</tbody>
</table>

*Source: Van der Ploeg, 2009: 114*
2.2 Institutional changes

Thus, since agricultural inputs and outputs became commoditized and traded on world markets, it is important to understand the market and institutions that regulate this. "Agricultural production became increasingly embedded in and dependent upon and consequently (re-) structured by a complex whole of interacting market-agencies that, to a considerable degree, prescribe and control the agricultural process of production. This control, on both the input of the farm as the output of the farm, increasingly intertwines with state control exerted through different regulatory schemes associated with agricultural policy" (Van der Ploeg, 2006: 260).

Notable is that in conjunction with the modernization and industrialization of agriculture, changes in the political economy of agriculture opened the way for western transnational companies to increase their power. McMichael (1992) ascribes this to the breakdown of the Bretton Woods system. The Bretton Woods system was characterized by regulation of capital accumulations and stable institutions, stable currency exchanges were supported by the International Monetary Fund and World Bank (McMichael, 1992). During the late 1960’s, metropolitan wage demands allowed for a global decentralization of capital. This, in combination with growing competition from rival transnational corporations, caused that the deficit of the United States grew. In 1972, de US government declared the dollar nonconvertible, which means that the US dollar rate of exchange was fixed and could not be exchanged for gold or other currencies. "This released internationalizing forces. The stable interstate hierarchy (within the North and between the North and South) unravelled, and international capital markets-based initially in Eurodollar markets in the 1960s and universalised in the 1970s via the prosperity of the oil-producing states-came into their own, forming, for the first time, "a single world market for money and credit supply" (Harvey 1989:161). So, the absence of a ruling system for international trade allowed for a dramatic restructuring of the world economy. The absence of a stable system to structure geopolitical relations, allowed nation-states and transnational corporations to negotiate their own competitive position in the world economy. Upcoming transnational companies, and their growing power, restructured production and consumption on a global scale (McMichael, 1992). Economic power translated into political power as well; large transnational companies are very successful in lobbying for policies in their advantage, thereby creating an even more uneven playing field (Howard, 2009).

The 1980’s were further characterized by neoliberal policies. These policies included specific goals for food and agriculture. Friedmann (2009) describes the United states in this period as the ‘undisputed new hegemon’ who had the power and wealth to protect its domestic policies. The post-war economic strategy of the United States was explicitly oriented towards re-establishing free trade in agriculture. The GATT (General Agreements on Tariffs and Trade), which were established after the second world war, were negotiated in the Uruguay round from 1986 till 1994. “The Uruguay Round of the GATT began in 1986 against a background of debt-enforced “adjustment” in the South and dangerous trade conflicts over agriculture in the North” (Friedmann, 2009: 10). With these ‘debt-enforced adjustments’ Friedmann (2009) refers to the Structural Adjustment Policies, worldwide these policies were imposed on indebted countries. The structural adjustment program for India started in 1991, when India faced an “unprecedented balance of payment crisis” (The World Bank Group, 2012). From 1980 until 1991 India’s domestic public debt increased steadily, while at the same time its external debt more than tripled. The structural adjustment program objectives for India were twofold. First, the payment crisis had to be balanced. Second, “a broad set of policy reforms aimed at liberalizing the Indian economy and opening it up to more competition both from within and abroad” (The World Bank Group, 2012) was implemented.
Most structural reforms were implemented during 1991 – 1993, after which they were complemented by additional reforms like liberalizing investment, further deregulating trade policy, improving tax administration, and strengthening the financial sector. These neoliberal policy changes from 1991 onwards caused that the Indian government moved away from their Green Revolution supporting systems, which used to provide for state-subsidized hybrid seeds, irrigation and low-interest credit (Lerche, 2011). By 1995, India had moved from a regime in which private investment was not allowed in major economic sectors to one whose openness to foreign investment compares favourably with that of most Asian countries (The World Bank Group, 2012). Friedmann (2009) argues that the structural adjustment policies forced debtors to adopt policies that worsened their conditions. Liberalization of their markets caused a more intense competition from commodities produced in the global North, “which continued to benefit from both production and trade subsidies” (Friedmann, 2009: 9). Since the green revolution India was already changing its domestic agriculture to a more export oriented agriculture, but since the structural adjustments India was under double pressure to open its markets to (subsidized) products from the north and increase its export earnings.

In 1986 the members of the GATT no longer found it a well working system for the new globalized world. The previously mentioned Uruguay round was set up, to find a solution. The Uruguay round was the biggest negotiating round ever, with trade as the main subject. The final ‘act’ of the Uruguay round, and thereby the establishment of the World Trade Organization, was signed in 1994. Six main points were discussed and legally set out. One of them is the Agreement on Trade-Related aspects of Intellectual Property Rights (the TRIPS system). The TRIPS system requires all WTO members to provide ‘copyright rights’, so intellectual ideas cannot be ‘stolen’. It is a patent-like system. Agriculture is thereby linked to a broader, and sometimes strategic, field of intellectual property. McMichael (1992) states that the policies that are (at that time still) discussed in the Uruguay round will institutionalize an international trading system that views agricultural products as commodities, ignores the use-value of agricultural products and helps to further concentrate capital and consolidate power in the North. “In other words, agricultural liberalization (especially opening Northern markets to Southern exports) is partly a lever for securing agreement on property rights in services and technology-especially the rights of TNCs in Southern markets. This linking of institutional liberalism to corporate power expresses the dualism of the GATT agenda. The formal goal is liberalization via state responsibility for securing standard economic and environmental conditions to unify the global marketplace for efficient producers. However, curbing "restraint of trade" would, in practice, facilitate global accumulation strategies by TNCs, and a further centralization of metropolitan power” (McMichael, 1992: 355).

Van der Ploeg (2010) agrees with McMichael (1992) and Friedmann (2009) that one of the reasons for the current crisis in agriculture is the restructuring of markets in the ‘neoliberal project’. He (2010) argues that although only 15% (approximately) of the world’s total production in agriculture becomes part of the world market by crossing borders, the other 85% (which is traded local/regional/national) is now set to price levels that govern world markets. The interconnectedness of all global agricultural production reflects itself in that local or regional centred markets are increasingly characterized by - and restructured in the global markets. This global market also allows for enormous flows of commodities between different parts of the globe.

The possibility for global trade, together with the extensive commoditization of all the main resources (e.g. land, water, seeds), has induced a completely new feature into the world agricultural and food market: “the complete exchangeability of large agricultural systems” (Van der Ploeg, 2010: 101). With the exchangeability of agricultural systems he means that agricultural products can be produced on several places around the world.
The world market now determines which place is the most optimal, and whether the local people consume the product or not, the product must be produced in that certain place. It is not at all traded at the local markets, but solely on the global market. According to Van der Ploeg (2010) this does not only show in price fluctuations, but also in globalizing insecurity.

The exposure of Indian farmers to competition from the North caused that prices were falling from 1997. Dramatic price fallings were seen for products such as edible oil, plantation crops, and above all; cotton. “At the same time, the environmental stress of modern agriculture has been felt by way of land degradation and falling water tables, adding to the difficulties of many farmers. Government of India data shows that real per capita farm incomes did not grow from 1997 to 2002, and in some states they fell” (Lerche, 2011: 107)

2.3 The rise of a global seed empire

With the industrialization of agriculture, driven by the modernization paradigm, and the liberalization of policies, the seed industry changed a lot. Agriculture has always been a sector of the economy that was merely resistant to ‘the capitalist logic’ which had to do with the fact that there were no commodities in agriculture which could be traded in order to make money. Agricultural production acquires land, which will always be a local asset and can never turn global. Besides, production needs time and the outcome (yield) will always be unpredictable (Howard, 2009). On top of that, most importantly, seeds do not give the incentive to buy because once a seed is bought, it can be reproduced outside the market and thus no profit can be made by the selling companies. However, two ways to counteract these barriers have been found. Now, a global seed industry has emerged and the seed industry is one where a lot of money is made. To understand these structural changes in the corporate seed industry and thus in the agricultural system, two subjects are useful; first, the natural barriers to accumulation, and second, the consolidation of the transnational seed companies.

- 2.3.1. Barriers to accumulation

Structural changes in the seed industry have much to do with the previously mentioned “obstacle” of seed reproduction, and how the industry found two ways to counteract this obstacle (Howard, 2009).

2.3.1.1. Overcoming barriers to accumulation legally

The “obstacle” of seeds reproducing themselves can be counteracted in a legal way. Inventions have always been protected in several ways; secrecy, trademarks, international conventions or regulation by public authority. So, legal strategies involved patent-like protections to certain seeds, but these strategies still allowed farmers to save seeds (Howard, 2009). In 1980, the US Supreme Court decided that living organisms (or parts of living organisms like genes) became patentable subject matter. At this moment, intellectual property rights are ‘protected’ under the Trade-Related Intellectual Property Rights System (TRIPS) within the World Trade Organization. This implies that WTO members have to protect innovative products by awarding utility patent or through sui generis systems (Semal, 2007).

With this development, the “patent-like” protections changed into full patent protections. Full patents prohibit farmers to save seeds; violators may even receive prison sentence. However, this legal strategy is very expensive and constrained to a limited length of time (approximately 17 to 20 years). Also, patents are found ineffective in the global south due to a lack of government enforcement. It is for this reasons that technologies are developed to further enhance the biological strategy (Howard, 2009).
2.3.1.2. Overcoming barriers to accumulation by hybridization and genetic modification

The biological obstacle and the way to overcome it, is very well illustrated in the following quote; “The regenerative nature of seed seemed to erect a significant obstacle to capital’s penetration into the seed business because farmers as consumers did not have to purchase new products (seeds) every year, instead reproducing seeds from their own harvest. The hybridization of seeds, regarded as one of the most significant scientific achievements in the twentieth century, overcame biological barriers to the commodification of seeds, by “uncoupling seed as ‘seed’ from seed as ‘grain’ and thereby facilitating the transformation of seed from a use-value to an exchange value” (Kloppenburg, 1988: 93).

Hybridization is a natural process, although it can be controlled by man. It is the process where two plants cross pollinate. Although the new seed remains part of the same family, it can differ from its “parents” because of dominant and recessive genes. This way, plants can be reproduced in such a way that it is likely to produce a seed that is still part of the same family, but with the optimal characteristics. The DNA has not changed, but the optimal characteristics have been triggered to show. Therefore, the seed does not per definition reproduces itself in the desired way again. Developing a hybrid crop can be an example of the biological strategy, as subsequent generations do not exhibit the same characteristics as parents, thus eliminating incentives to replant saved seeds (Howard, 2009).

In contrast to hybridization, genetic modification is a complete man-made process where the genetic code of the organisms is changed. Once the change is made, it will remain there forever and any descendants from the organism will carry the modification in their DNA. A very specific kind of modification results in a Terminator Seed which is a seed that is completely infertile and is thus incapable of self-reproducing (Howard, 2009). When seeds do not reproduce, the incentive to buy them every year is born. Other modifications create plants that are resistant to specific herbicides, so seed companies can supplement the selling of seeds by selling these specific herbicides. As explained in sub-paragraph 2.3.1.1, these modified seeds are owned by corporations and ‘protected’ under the TRIPS system. Thereby it has been made illegal to save these modified seeds, because the intellectual property in the genes of the seed belongs to the corporation who has patented it.

- 2.3.2 Consolidation of transnational seed companies

With agricultural products becoming commodities, agricultural industries tended to consolidate. “Liberalized markets have become an arena in which agribusiness groups are striving for hegemony” (Van der Ploeg, 2010: 101). In the last few decades, the commercial seed industry has changed dramatically. The industry today is dominated by a small number of transnational corporations, while it used to be a competitive sector of agribusiness composed of small and family owned firms. Figure 2 shows the world’s biggest seed companies and the share they have in the global seed market. Corporations merged with large competitors and acquired the smaller seed companies, in order to strengthen their own competitive position. In other words, the seed industry started with a large number of small competing firms and eventually became dominated by a small number a large firms.

The current seed industry could be described as an oligopoly (Van der Ploeg, 2010). Howards points to a possible danger of oligopoly “An important consequence is that when concentration reaches a certain threshold, the largest firms are able to ensure stable profits by ceasing to compete on the basis of price” (2009: 1270). This is possible, because a corporation of this size knows the other (smaller) firms have to follow the price in order to stay competitive.
When a firm controls 40% of the market, it can no longer be seen as a competitive market (Howard, 2009). This way, for large commercial seed companies, it is very easy to effectuate their power.

Consolidation in the commercial seed industry is nothing new. However where it occurred in the past for key commodity crops, the counteracting of obstacles to accumulation allowed the process to expand horizontally into all seed crops. This together with the emergence of full patent-protected transgenic seeds in the nineties triggered even greater consolidation in commodity seeds like cotton. Since then, in the nineties, the sale of cotton seeds became dominated globally by three transnational corporations, namely Monsanto, DuPont and Syngenta.

**Figure 2:** The world’s top 10 seed companies in 2007

![World’s Top 10 Seed Companies](image)

Source: ETC Group, 2008: 11

Previously explained international trade agreements facilitated the expansion of transnational corporations globally. The World Trade Organization’s TRIPS system together with high research development can be seen as high barriers to enter the industry for small firms. “Although the Global South is the locus of the majority of the world’s agricultural biodiversity, the seed industry is dominated by firms from North America and Europe that utilize intellectual property protections to exploit this wealth” (Howard, 2009: 1271). Empires have been constructed that increasingly control the global agricultural supply chain. Van der Ploeg (2010) argues that these transnational corporations have monopolistic power. For farmers it has become difficult to sell their agricultural product outside of the circuits that they control.

The Figure 3 supplements Figure 2 by showing the structure of the current commercial seed industry. It shows that all of the largest firms contributed to consolidation, and that Monsanto has been the most active in this process. It also shows that all the big companies, (partial) own many other firms; they dominate the market. Most of the power in the seed industry belongs to Monsanto, Syngenta and DuPont, there are only very few seed companies who act independent and separate from these ‘Seed Giants’. The largest firms are increasingly networked through agreements to cross-license transgenic seed traits (Howard, 2009).
Besides horizontal integration, strategies increasingly try to extend vertically (through multiple stages) and globally (into new markets). Vertical integration is about owning “both the biotechnology research & development companies that hold the patent protections for key traits, as well as the seed companies that sell the actual delivery vehicle for these technologies” (Howard, 2009: 1271).

**Figure 3:** The structure of the seed industry

Cross-licensing agreements are thus another strategy used by the largest corporations to secure their power. Cross-licensing is not always about ownership, it is about agreements between two (or more) independent firms. Monsanto has a central position in this network; it is the only firm that has agreements with each of the other big firms. The ETC Group (2008) express themselves very critically about this phenomena of cross-licensing. “The Gene Giants are forging unprecedented alliances that render competitive markets a thing of the past. By agreeing to cross-license proprietary germplasm and technologies, consolidate R&D efforts and terminate costly IP litigation, the world’s largest agrochemical and seed firms are reinforcing top-tier market power for mutual benefit. The trend isn’t new, but the tech cartel deals are getting bigger and bolder” (ETC Group, 2008: 13). Thus, even within the ‘big six’ agreements are made and competition is as much as possible bypassed, to keep control and power.
Chapter 3  Cotton production in India

For India, cotton is the most significant agricultural commodity. With the advent of liberalized seed policies, as explained in the previous chapter, the entrance and consolidation of multinational seed companies can be seen as a logical result. The “corporatisation” (Nemes, 2010: 25) of the cotton seed sector in India significantly influenced the livelihoods of its smallholder cotton farmers. This chapter focuses in contrary to the first chapter, on the level of livelihoods; “What has been and is the impact of corporate reproduction of cotton seeds for farmer’s livelihoods in India?” First some basic characteristics of cotton production in India will be described. In order to interpret this information better, the concept of seed security will be introduced, which looks at accessibility and availability of seeds. Both human- and financial capital of smallholder farmers are hereby appointed. Finally, the question why farmers keep participating in the process of industrializing their farm will be explained on the basis of the explanatory concept of technological treadmills.

3.1 Producing cotton

Cotton is a crop that can only be produced in warm climates. The raw material of the crop is used in the textile industry for the production of mostly clothes and shoes. Worldwide, there are about 500 wild species of the cotton crop; 4 of them are mostly used for the commercial production of cotton; G. hirsutum, G. barbadense, G. arboreum and G. herbaceum. The first two mentioned account for approximately 95% of the world cotton production (WWF-India, 2012).

In India, 5.8 million farmers produce cotton, 86% of all these farmers are smallholders who cultivate less than 2 hectares. Most of these farmers are directly dependent on the money that is brought in by producing cotton. “The cotton crop represents by far the largest income for these households, and in nearly all cases is crucial for the farmer’s family’s survival” (Tirado, 2010: 2). About 65% of all Indian cotton is produced on a rain-fed basis. This means that most farmers do not have (access to) irrigation systems to ensure themselves of water supply. These farmers are dependent on the monsoon for their water supply, which makes them vulnerable to stresses and shocks from droughts, and still causes a lot of crop loses. In India, the cotton crop can be planted from March to September, it can be harvested between October and February. About 70% of the cotton is harvested by hand (WWF-India, 2012).

Figure 5: Cotton acreage and production per region

![Cotton acreage and production per region chart](source: WWF-India, 2012: 12)
Cotton is produced in 3 zones: the Northern zone, comprising the states of Punjab, Rajasthan and Haryana. The Central zone consists of Maharashtra, Madya Pradesh and Gujarat and the Southern zone consists of the states Andhra Pradesh, Karntaka and Tamil Nadu.

Figure 6: Map of India’s cotton regions

The three states Gujarat, Maharashtra and Andhra Pradesh produce by far the most. Together they are accountable for 76% of India’s total cotton production. India is the second largest producer of cotton in the world, after China. The agricultural cotton production area in India represents approximately 30% of the global cotton production area (WWF-India, 2012), and accounts for 20% of the world’s production. Cotton is an important agricultural commodity. It is traded in over 150 countries.

- 3.1.1 Cotton, a cash crop

Being part of a country where the modernization paradigm has the upper hand in structuring policies, farmers started to see market integration as a key strategy to cope with external and uncontrollable changes (Finnis, 2006). Or, as Sonja Brodt (via Finnis, 2006: 367) argues; “there are local desires to access goods and services that people perceive as making their lives more developed or more “modern”. Producing cash crops often is part of this strategy; a (mostly non-food) crop that is grown to sale in return for profit. Therefore, cash crops differ from subsistence crops; which are crops that the farmer and his/her family uses for themselves or their livestock.
Cotton is a typical example of a cash crop; the farmer does not use its product, it is solely produced for the market. In Andhra Pradesh, now one of the main cotton producing areas, the area where non-food crops were produced doubled between the 1960’s and 2000.

“I used to grow crops that I could feed my family with, but now, with only cotton and this drought, I will get very little cash and will struggle to feed my family”
Katakuri Rajayya, Bt cotton farmer from Bijigiri village in Karimnagar (Andhra Pradesh)
(Tirado, 2010: 14)

Farmers who produce cash crops depend on the fluctuating market prices for the income of their family. The highly variable market rates contribute to the debt cycles that smallholder farmers experience on a year-to-year base (Finnis, 2006). Intercropping strategies that were common before the industrialization of agriculture, changed over the last decades into strategies of monocropping. Cash crops that used to be only a small part of what the farmer produced, turned into the main source of income for many farmers (Taylor, 2011).

Taylor (2011) points out that during the neoliberal period, government subsidies for helping farmers to access the costly inputs for production reduced. “Whereas the original Green Revolution model was predicated upon irrigated agriculture on medium and large farms, with heavy subsidization of inputs by the state – including seeds, fertilizers, pesticides and electricity – the increasing extension of Green Revolution technologies to marginal rainfed land has occurred in the context of dramatic price fluctuations alongside unpredictable climatic shifts” (Taylor, 2010: 495). Solely producing cash crops makes smallholder farmers vulnerable. In the case of crop failure, for example due to drought, pest attacks or poor seed quality, farmers who took a loan to pay for their seeds and other inputs lose everything (Nemes, 2010). Smallholder farmers thus experience an increased insecurity for providing their household with subsistence needs.

- 3.1.2 Industrialized cotton production

“Traditionally, cotton was cultivated in crop rotation, seeds were pre-treated with cow dung and urine, fertilization was done using organic manures like farmyard manure and green manure, and Neem oil was used as a natural pesticide” (Nemes, 2010: 18). Two of the previously mentioned cotton types (G. arboreum and G. herbaceum) are indigenous to Asia. These types of cotton have been used for thousands years, allowing the crop to become more (local) pest resistant and tolerant to dry and wet periods. During colonialism in the 17th and 18th century, new cotton species were introduced. Fibers like cotton differ in the length of the fiber itself, which is called the staple. The new British textile mills required long staple cotton which meant that “the quality in cotton fiber is dictated by the limits of the spinning machine” (Khadi et al, 2010).

So, since the 17th century, the cotton market became oriented towards producing long staple crops, in order for the spinning machine’s to work. Nevertheless, farmers could still reproduce their seeds to grow cotton year after year. There was no need for external inputs. “Although yields were no high, the crops did not need much attention yet harvest was still assured”(Nemes, 2010: 18).

Throughout history, regional farming styles coordinated agriculture in a way that was attuned to the necessary and available eco-systems. Markets, most of them regional but sometimes international, did not function as a structuring principle, but instead as a simple outflow of products (Van der Ploeg, 2006). Seeds and plants have traditionally always been the domain of regionally based family collections. The fact that a seed reproduces itself, as previously explained, seemed to be a real obstacle for creating a business around it.
Farmers did not have to buy their seeds every year, since they could use a small amount of seeds from their own previous harvest (Kim, 2006). During the second half of the twentieth century, the once organic relationship between ecosystems and regional farming styles became increasingly unravelled (Van der Ploeg, 2006: 260). Markets enlarged and new expressions of agriculture arose.

- **3.1.3 From hybrids to GMO’s**

The introduction of hybrids by the bigger seed companies like Monsanto, changed these kind of relationships between men and nature dramatically. As previously explained in chapter 1, hybrids do not per definition reproduce in the desired way; subsequent generations of the crop do not exhibit the same characteristics as the parent. Thus the incentive to save seeds is eliminated (Howard, 2009). In a short period of time, (coinciding with) the Green Revolution, India became the “pioneer country for the commercialization of hybrid cotton seeds” (Nemes, 2010: 19). Although the hybrid seeds did give a higher yield, they also increased the need for external inputs like synthetic fertilizers and pesticides.

With the introduction of new cotton species (the long staple ones and the hybrids), new pests arrived. “This gave an excellent argument for biotech companies to introduce Bt genes into Indian hybrids” (Nemes, 2010: 20). An important limiting factor to cotton production is damage due to pest attacks, especially bollworms (Bennet et al, 2006). Bt cotton is a genetically modified type of cotton. The abbreviation Bt stands for Bacillus Thuringiensis, which is a bacteria that is naturally found in the soils and produces a certain toxin. Commercial seed companies “took” those genes responsible for the production of the toxin and inserted them in the cotton crop, after which the Bt cotton produces the Bt toxins itself. Some pests die when they take this toxin, thus Bt cotton produces an insecticide that makes the crop resistant to attack by certain insects, and in particular the bollworm. In other words, the toxin protects the cotton crop from the larva of Lepidoptera (bollworm) and other related insects.

In March 2002, the interministerial Genetic Engineering Approval Committee (GEAC) of the Government of India approved the commercial distribution and cultivation of several varieties of genetically modified cotton developed jointly by the Indian seed company, Mahyco, and the transnational agrichemical company Monsanto, which holds the license for this technology (Yamacuchi, 2004: 267). For India, Bollgard is the most implemented variety of Bt cotton. It is first researched en developed by Mahyco (partly owned by Monsanto) and Monsanto, after which it was authorized by the Indian government (Yamaguchi, 2007). Monsanto owns the licenses of at least two third of Bt cotton sold in the world. Only three commercial seeds were legal at that time (Stone, 2007). Bt cotton was portrayed as a very promising technology, which could reduce the main problems in cotton production in India. The Indian government was very optimistic regarding the Bt technology (Yamacuchi, 2004). Biotechnological companies thus tried to sell a seed that helped farmers to cope with stresses from pests, specifically bollworms, whereby more sustainable livelihoods could be created;

“India will have to pay about 4m dollars to Monsanto to get the gene transfer knowhow, which will be India’s first import of technology for genetic engineering to create improved plant species. Incorporation of the Bt genes into major varieties of cotton will help cut down by half the use of insecticides and save cotton worth 5–10bn rupees [approximately 100m to 200m US dollars] annually, the DBT said in a report” (Yamacuchi, 2004: 274).
Since 2002 several varieties of Bt cotton have been used on a commercial basis (Yamaguchi, 2007: 88). In 2002, an area of about 29,000 hectares was used for planting Bt cotton, in 2003 the area expanded to 86,000 hectares and in 2004 to 530,000 hectares. For 2005 the estimate is that the Bt cotton area was over 1 million hectares (Bennet et al, 2006: 59-60).

Figure 7: (Bt) Cotton production in India

Figure 7 shows that the area under Bt cotton steeply increased in the period 2005-2006. This has to do with the fact that the Indian government set maximum retail prices for Bt cotton; less than half the amount that was charged by the seed companies before (Nemes, 2010). Stone (2007) collected data in Warangal (part of the Andhra Pradesh region) and point out that something “remarkable” happened; “From 2003 to 2005 the market share held by Bt hybrids climbed from 1% to 20% to 62%. This was more than innovation diffusion and more than a ‘tipping point’: it was a stampede” (Stone, 2007: 68). In 2009, about 5.6 million Indian farmers had (partly) adopted the Bt cotton, in conjunction with 80% of the country’s cotton area (Nemes, 2010:1). This is extra striking because the Bt seed cost Rs. 1600 per acre-pack, while other hybrids only cost Rs. 400 per acre-pack (Stone, 2007). Monsanto claimed Bt cotton to be the fastest adopted agricultural technology in history and Indian farmers being the fastest adopters in the world (Stone, 2007: 68). Now, the Indian cotton seed sector is the biggest seed market in the world, with sales accounting for about 250 million dollar (Nemes, 2010).

However, contrary to expectations, with the arrival of Bt cotton, the amount of pesticide sprays did not decrease (Nemes, 2010; WWF-India, 2012; Tirado, 2010). As will be explained later on, due to the complex and new situation farmers experience (by dint of the rapid modernization), they do not have extensive knowledge about the requirements for Bt cotton. Regarding pesticides, farmers create their own schedule’s or follow their (neighbors) spraying schemes (Nemes, 2010), and often they spray (too) much. “This indiscriminate use of pesticides, however, had adverse effects on the natural predators and parasites of bollworms”(WWF-India, 2012: 20). Namely, with the use of pesticides (in this case mostly insecticides) populations of natural predators are reduced as well. Besides, natural selection leads to populations of insects who are more and more resistant to the sprays.

In India, K.R. Kranthi, acting director of CICR in Nagpur, said that the rapid adoption of GM cotton by farmers in India —“has coincided with the rise of hitherto unknown insect pests, increased pesticide applications by farmers, and declining cotton productivity over the past three years”(The Telegraph, 2010). In addition, apart van ecological aspects, Tirado (2010) points to the fact that shop vendors who sell Bt cotton promote a higher use of pesticides, simply because they earn money by selling.
3.1.4 The Indian seed sector

In India seeds are offered in two ways, via public or private companies. Public hybrids are developed by state controlled agencies like universities or research centres, whereas private hybrids are developed by commercial seed companies by their own research centres. Since the end of the 1990’s (from 1999 to 2004) the area where public hybrids cotton seeds are produced declined from 13960 acres to 6175 acres. At the same time, the area where private hybrid cotton seeds were produced increased from 4000 acres to 20000 acres. A decreased role of public produced seeds, is not only valid for India, but can be seen as a worldwide trend (Nemes, 2010). Nemes (2010) refers to this process as the ‘corporation’ of the cotton seed sector, which is according to her an unstoppable process.

The Indian public seed sector consists of the state Farm Corporation, the National Seed Corporation and 13 state seed corporations. The state seed corporations of Maharashtra, Gujarat, Andhra Pradesh and Karnataka are the four most important ones. These corporations market and multiply (hybrid) varieties that are researched and developed by public sector institutions. Practically all Indian research institutes are financed by agricultural universities or by the Indian Council for Agricultural research (ICAR). During the 1970’s and 1980’s these corporations played a big role in the multiplying and marketing of location-specific hybrids. But, when in 1988 the New Seed Policy was implemented, which allowed companies to enter the seed business, the role of the public seed sector started changing. “By the late 1990s, public bred hybrids were beginning to lose ground to private hybrids and since few years public bred hybrids have almost totally disappeared from the market” (Nemes, 2010: 26).

The public sector was disadvantaged by something else; “the Seed Act of 1966 and the Seeds Control Order of 1983 laid down the rules on variety release, seed certification and seed testing, which is obligatory for all public bred varieties and hybrids (but only voluntary for private ones)” (Nemes, 2010: 26). For the public seed sector this means that the release of new hybrids is only possible after 3-year evaluation trials, while for the private seed sector this is not mandatory. Since the certification is a really time consuming process, most private seed companies skip it. Therefore, private companies are able to release hybrid a lot sooner than public companies, which contributed to their takeover of power in the Indian seed sector.

The private sector in India knows a few leading seed corporations. For 2008 these were Nuziveedu Seeds, who sold 5 million acre packets of Bt cotton seeds, followed by Rasi (4 million), Mahyco (3 million) and Tulsi Seeds (2.5 million). Just below the top are companies like Ankur Seeds (0.5-1 million), Emergent Genetics (0.5-1 million) and Vibha Agrotech (0.5-1 million). At the first glance, this does not look like the monopoly in the global seed market as explained in the previous chapter. However, when we look closely we see that for example Mahyco is the Indian subsidiary of Monsanto, Emergent Genetics India is fully owned by Monsanto and Nuziveedu Seeds is partly owned by Monsanto. Concentration in the private seed industry can thus very clearly be seen in India.

3.1.5 The squeeze on agriculture

Currently, the relation between the organization of agricultural production and the interests of farmers is under pressure. Worldwide, agriculture is subjected to an economic squeeze that is worsened by the big and very powerful transnational corporations (Van der Ploeg, 2009). “Whatever its location in time and space, agriculture always articulates with nature, society and the prospects and interests of those directly involved in farming” (Van der Ploeg, 2009: 10). Van der Ploeg (2010) argues that if “a more or less chronic disarticulation” emerges, it can be called an agrarian crisis.
Figure 8: The squeeze on agriculture

Prices that farmers receive are kept down or are reduced, due to the global changing interrelation between production and consumption, while at the other hand their costs rise. The left side of figure 5 shows the “economic logic” of the modernization and/or productivist paradigm; it shows an increased margin between costs and revenues due to increasing the scale of farming, the opening up of new markets, and above all an increase in technical efficiency. However, the right sight of the figure shows a cause of the modernization paradigm we are currently experiencing. As mentioned before, since the 1980’s farmer’s revenues started to stagnate, while at the same time farmers started using external inputs whereby costs for input increased. The increase of costs is related to the industrialization of agriculture and thus with the dependence on external inputs, like machinery, seeds and fertilizers. The squeeze on agriculture is a worldwide phenomenon in which the economic margins in agriculture are decreasing. Figure 5 is a graphic that shows the most important purport of the price squeeze in agriculture.

3.2 Seed security

Van der Ploeg (2014) focuses on the concept of food sovereignty as a guiding principle for agricultural development. This concept integrates a wide range of issues; quality, quantity, availability and origin of food. Although this case about Indian cotton farmers is not about food, the concept does provide a good theory for analysing the current cotton (seed) industry. Within the same line of thinking, here, Nemes (2010: 9) introduces the concept of seed security. She describes seed security as farmers or farmer groups having a stable physical, social and economic access to sufficient quantity and quality seeds, which meet their preferences of variety choice. The concept of seed security entails two main dimensions; the first is seed access, which stands for the means to access appropriate seeds. The second dimension is about seed availability; the availability of sufficient quantities of seeds of appropriate quality, at all times. Achieving seed security is about protection of local crop diversity and improving the seed supply sector.
Thus, seed access is about the means farmers have to access the seeds they want, which depends on their capital assets. It is assumed that a more sustainable and stronger capital base is inherently empowering a farmer in accessing appropriate seeds. This section will elaborate on both human capital and financial capital of smallholder Indian cotton farmers.

2.2.1.1 Human capital

Individual knowledge and skills are important determinants of human capital. Coping with risk starts with information. Knowledge about nature, agricultural practices, seeds and pesticides allow farmers to make well thought out decisions in what to produce and how. Knowledge creates a kind of independency, since you do not rely on external knowledge and experts for making deliberate choices. In India, farmers find it increasingly difficult to decide which seeds to use. The rapid modernization and industrialization of agriculture created a complex situation of different seeds, fertilizers, pesticides and “good” ways to produce the crop (Yamaguchi, 2007). McKinney (2013) and Stone (2007) did some elaborative studies on this topic. “At present, Warangal farmers have more to teach us about the social nature of decision making in unpredictable and unstable environments than about the benefits of genetically modified crops” (Stone, 2007: 69).

Stone (2007) argues that agricultural skilling is indispensable for sustainable development of agriculture. He describes agricultural skilling as a process of learning about the crop and environment. In his article, he identifies three factors that in contrast to skilling, contribute to the deskilling of farmers. The first is inconsistency of technology’s effects. The quality of seed and techniques became only to be apparent under special circumstances. For farmers it is difficult to monitor the constant changes in the performance of technology trough time. “Insecticidal sprays are an example, as their effects can vary from year to year in their impacts on target and predator species, leading to insecticide resistance and chaotic fluctuations in insect populations” (Stone, 2007: 73). The second constrain to agricultural skilling is unrecognizability of a technology; farmers are unable to see the technology they are planting. Farmers may distinguish between organic and hybrid seeds, but within hybrid seed varieties, differences do not show on the outside. Lack of recognisability impedes skilling. The third impediment is the rate of technological change; skilling takes time. “This is not to endorse a romanticized view of unchanging “traditional” farming; traditional agriculture changes all the time” (Stone, 2007: 73).

Most farmers receive information through corporate promotion. Advertising is everywhere; signs hang from trees, flyers are distributed and walls are painted. Also pitches blare from company vehicles. “Only cotton is so heavily promoted; rice seed, which is selected more on the basis of environmental learning and is overwhelmingly non-hybrid, is rarely advertised” (Stone, 2007: 76). The impact of advertising on the sales of cotton seed is not given, but it is not unlikely that the overload on (low-creditability) information in advertisements contributes to the choice farmers make concerning seed. In comparison to smallholder farmers, larger landowners tend to be better connected to non-local information sources.

“I don’t know much about Bt, but I do know that it does not get diseases, not that it doesn’t get any diseases, it just gets fewer than non-Bt. Non-Bt gets more seeds than Bt. You can get more cotton in Bt and fewer seeds. The money that can be made in seed production is always changing; it’s not fixed. If the year is good, you can make around 50 thousand.

(McKinney, 2013: 367)
I know there must be a difference between the seeds, but I don’t know what is. [...] The varieties are all different. The agent tells me, he is told by the company, and then he gives advice. Now they [the companies] have started saying that we should grow Bt because it is good for our land.

Male seed grower, interview
(McKinney, 2013: 372)

There is a risk. Farmers don’t have knowledge. If the agent tries something people wouldn’t even know.

Male seed grower, interview
(McKinney, 2013: 370)

These quotes McKinney (2013) conducted in his research show that farmers were not able to make a deliberate choice for the type of cotton they grow. While government officials advocate that the choice of selecting modern agricultural technologies should be left to the “wisdom of Indian farmers”, farmers lack the information and skilling process to create this kind of wisdom. Modernization created a difficult situation for farmers in which they do not know on what information their decision must be based. McKinney (2013) affirms this by stating that decisions around seed have little, if anything, to do with neoliberal market choices. Instead, these choices are based on power relations and social networks. Seed fads result from agricultural deskilling in which farmers fail to experiment and evaluate, because of the unpredictability of key variables in cotton cultivation (Stone, 2007).

Stone(2007: 72) states that Indian seed companies are well aware of the social component of adoption. Therefore, besides promotion through advertising, the seed companies donate seeds to selected farmers for demonstration plots. The company then invites farmers to inspect the field, which seems as a clear case of skilling and environmental learning. However, farmer do not consider agronomic details as most important; crops traits are even ignored to a certain extent. Due to the lack of knowledge/overview of their situation, farmers purely recall other farmer’s choices as a base for their own choice. In this case, deskilling turns farmers into passive customers of seed firms (Stone, 2007). In other words: “Since farmers have been disempowered by the fact that modernization of agriculture has brought in too complex a situation for farmers to handle without expert advice, the bureaucrats should take charge of decisions involving GM crops, moving still more decision-making powers into the hands of the ‘experts’ and away from the farmers, in the name of the good of the farmers” (Yamaguchi, 2007: 97). Again, this quote supports the idea that farmers have become more and more dependent on external sources of information due to modernization of agriculture. However, Roy et al (2007) say differently. They conclude that there is nothing passive about the adoption behaviour of farmers and that farmers are actively experimenting with different kinds of seed. However, they do acknowledge that the experiences of other farmers are a very important factor for adoption. Often, those “other farmers” belong to the same cooperative society (Roy et al., 2007: 165). But, after learning more about agricultural deskilling and the lack of adequate knowledge most farmers experience, it can be doubted how “active” this adoption behaviour then is..

As noted in one of the quotes above, agents (vendors of seeds) are also depending on the commercial seed industry for their information about the seeds. However, vendors always have a double agenda. Besides informing and advising the clients about good seeds and other inputs to maximize yields, the vendor himself wants to maximize income as well. Tirado (2010: 18) argues in a Greenpeace report that “the Bt cotton farmer is reliant on the shop vendor in his village for advice on how to maximise yields. This clearly promotes higher use of chemical fertilisers and pesticides by Bt cotton farmers. Given these realities, Bt cotton in India will always be input-intensive and can never be ecologically or economically sustainable”. Although this is a very extreme point of view, the fact
that vendors have their own interests who might compete with the interests of smallholder farmers is very important to note. A self-perpetuating cycle can be seen here; the less farmers know about the ecology of the seed they sow, the easier it is for a vendor to sell the most expensive seed. Farmers refer to their lack of information about the seeds and the sowing process, which allows vendors to have too much control (McKinney, 2013).

Discourses around seeds are actively created by the commercial seed corporations. In the bioindustry two discourses stand out; biotechnology as pro-poor and as an example of the farmer’s right to choose (McKinney, 2013). Within the neoliberal ideas of agriculture, individuals are responsible for making the “right” choices; failure is a cause of “poor” choice. Monsanto, among others, used these discourses to arouse interest in markets around the world. These discourses are also used for arguments against resistance and uncertainty. The rapid (geographical) spread of the Bt technology is used as a foundation of the discourse, as it “proves” the appropriateness and farmer’s preference (McKinney, 2013). However, as explained in this section, the widespread adoption of Bt cotton should be placed in a broader context of a socially driven “fad”. A growing disconnection between knowledge and learning, and decision making processes, together with the unavailability of “reliable” vendors causes that the process of decision making shifts away from rationality and consciousness.

3.2.1.2 Financial capital

Financial capital focuses on the economic means of farmers to access appropriate seeds; it is about their financial assets like savings and loans. In literature it is confirmed time after time that Indian smallholder farmers are increasingly in debt (e.g. Taylor, 2011; Brown, 2013; Tirado, 2010; Nemes, 2010; McKinney, 2013; Lerche, 2011; Mohanty, 2005; Stone, 2007). “On a per hectare basis, marginal farmers are three times more indebted than large farmers” (Brown, 2013). When this is scaled to income, it becomes clear that the stress of indebtedness is far greater for these poor farmers. Declining profitability is making small and marginal farms less viable. It should be clear by now that the industrialization of agriculture and the corresponding processes caused that the need for (external inputs) increased. Farmers started using industrial and/or chemical fertilizers, pesticides and seeds. Once chosen for hybrid seeds, a farmer cannot reproduce his seeds and needs to purchase new seeds every year. The Greenpeace report (Tirado, 2010) elaborates on the costs of cotton cultivation by comparing organic cotton to Bt cotton for 2008 and 2009. He concludes that the costs for Bt cotton farmers to produce cotton are much higher than for organic farmers. He ascribes this to the differences in costs of seeds, pesticides, fertilizers and interests of loans.

Figure 9: Costs of input for cotton cultivation – seeds

![Figure 9](source: Tirado, 2010: 10)

The costs for seed here reflect the price paid to sow cotton for 1 acre. This combines the price per bag and the amount of seeds used for 1 acre.
As explained previously in the first section of this chapter, contrary to expectations, Bt cotton farmers kept using a high amount of pesticides, especially insecticides, to protect their crop. Tirado (2010) points out that seed vendors recommend farmers to spray a lot of pesticides; “If you plant Bt cotton, you need to apply all these pesticides for the Bt to work” (p. 7). Comparing this to organic farmers, who only use bio-pesticides and natural pest control thus spending little money on pest control, Bt cotton farmers are double wore of. They buy expensive seeds in the hope of saving money on pesticides, but it turned out not to be true.

Traditionally, farmers use manure to fertilize their soils. For Bt cotton, chemical fertilizers are required to apply in order to maximize yields. While manure can be produce on the farm, so as en internal input, chemical fertilizers have to be bought (external input). All together: higher costs for seeds, pesticides and fertilizers (inputs) “must be borne upfront, with the possibility of indebtedness if the crop fails” (Roy et al., 2007: 171). Since smallholder farmers usually do not have (any) saving money, they default to pay back their loans if for example the yield next year is not as high as they hoped for, or if input prices increase. “In conditions of extreme poverty, households have a desperate necessity for the means to secure consumption, deal with unexpected expenditures and manage shocks. Such vulnerabilities are symptomatic of chronic poverty” (Taylor , 2011: 500). It is those vulnerabilities that are being challenged for farmers in debt.
On top of that, because of these higher amount of money for loans, and the frequency of payment defaulting, smallholder farmers are not able to loan money in formal institutions which offer favourable interest rates. They are mostly dependent on private and informal moneylenders with high-interest loans (Tirado, 2010). Mohanty (2005) confirms that only large farmers can loan money (on a regular basis) from formal lending agencies like the state or banks. Since these formal agencies charge much lower interest rates than informal lenders, larger farmers are in favour here (Taylor, 2011). Between 1995 and 2006, an increase in the amount of informal money lenders could be seen. The increase was 56%, from 12601 moneylenders to 19627 (Taylor, 2011), which does not even include the increase in non-registered moneylenders.

The Indian system of private hybrid seeds expelled to a certain extent the supply of non-hybrid seeds. The system involves several levels of middlemen and agents that set up contracts with farmers to produce what they recommend in order to get a loan (McKinney, 2013). Farmers choose what their neighbours choose as well. This farmers usually do not look critically at the seed they are buying. In that way, agents/vendors/middlemen manage production.

- **3.2.2 Availability of seeds**

The second dimension of seed security is the availability of sufficient quantities of seeds of appropriate quality, at all times. The paradox here is that on the one hand after the introduction of hybrid- and genetically modified seeds, way more varieties of (Bt) seeds became available for farmers. But, on the other hand local and non-Bt cotton seeds are gradually disappearing (Nemes, 2010; Brown, 2013; Tansey, 2011, Howard, 2009; Van der Ploeg, 2010). Nemes (2010) found for example that in Andhra Pradesh there was only one company left who sells non-Bt cotton varieties. On top of that, this company “acknowledged, ..., that there was no non-Bt seed production any more – all the seeds they had given recent years to organic projects were from old stock, and in few years they would have no more seeds. Till then, they are ready to produce non-Bt seeds for sale, but the orders have to be made well in advance and the price would be double (something the company could easily allow itself to do due to its total monopoly in the non-Bt seed business in Andhra Pradesh)” (Nemes, 2010: 67). A farmer in Nemes’s research confirms this and says “If you do not involve in seed production, there will be no non-Bt seeds left in 2-3 years” (2010: 69).
Also Roy et al (2007) who generally express themselves in the favour of Bt cotton production, concluded that the price of official (thus from a good brand) Bt cotton seeds carry a very high cost, that must be paid before the (potential increase in) income is received. They endorse the risk of indebtedness, as described earlier. The high cost of official Bt cotton seeds can exclude small farmers, who lack capital, to buy these seeds, whereby their choice for seeds decreases. Is can thus be said that industrialization of agriculture both broadened the availability of seeds, as well as declined the availability of seeds.

### 3.3 Treadmills

The questions remains why farmers participated in this process of purchasing off-farm inputs, taking loans and getting into debts while working very hard. Already in 1958 Willard Cochrane introduced the explanatory concept of the technological treadmill. He explains the technological treadmill on the basis of relative inelasticity of (commoditized) agricultural outputs. Inelasticity is an economic principle that explains; when supply exceeds the demand, prices will fall and thus reduce the price that farmers receive for their crop. For the first /early adopters of new technologies by increasing production, for example during the green revolution, financial benefits might grow initially. However, for the majority of farmers, the result is that due to growing supply, the prices lower, and to compensate the lower price per output, yields must increase for maintaining the same revenue. Farmers that are not able to keep up with this process, the treadmill, will “fall of” (Howard, 2009). Currently, farmers all over the world, are struggling to keep pace with this treadmill. Van der Ploeg (2009) argues then that the current peasant condition is constantly shaped by struggles for autonomy that take place in a context of dependency relations. Farmers cannot stop farming; because once they stop they “fall of” the treadmill and are financially ruined.

Brown (2013) looked at the agrarian crisis in Punjab and found that while the green revolution did bring considerable (short-term) economic benefits for the region, by the 1980’s and particularly the 1990’s, things began to sour. Growth in the yield of cotton began to stagnate, while prices declined as well. “This decline in growth has turned into an economic crisis for farmers because it coincides with farming becoming increasingly capital-intensive as the prices of chemical inputs and machinery rise continually. With farmers spending more and earning less, their income has gradually diminished” (Brown, 2013: 231). The technological treadmill thus contributes to the squeeze on agriculture, as explained in chapter 1. The figure shows that the adoption of new agricultural technologies eventually may result in additional treadmills; the first one involves the purchasing of seeds from commercial sources, the second is the pesticide treadmill and the third and last one involves the use of synthetic fertilizers.
To start with, seeds are especially important inputs, as they are the very foundation for (re)producing the cotton plant. Legal and biological protections of the commercial seed industry to keep farmers from reproducing “their” (the industry’s) seeds, prevent farmers from replanting the seeds they buy (see chapter 1). This, in combination with the earlier explained process of deskilling in agriculture, may lead to farmers who are increasingly locked in to purchasing seeds from off the farm, instead of producing them on the farm. Farmer’s reliance upon off-farm inputs thus increased a lot. “While the majority of farmers worldwide still engage in seed saving, the prevalence of this practice is declining rapidly, particularly in industrialized nations” (Howard, 2009: 1269). This treadmill demands farmers to constantly spend an increasing amount of money on their farm; even if net revenues decline as explained in chapter 1 as the squeeze on agriculture. These rising expenses are paid to upstream participants in the commodity chain. Key here are the bio-industry, both the seed and chemical (fertilizer/pesticide) industry, and money lenders. While on the one hand farm income is more and more under pressure, on the other hand profits in the earlier mentioned industries are increasing dramatically (Howard, 2009).

Another well-known treadmill in current agricultural practices is the treadmill that involves the use of pesticides. As previously explained, when the use of synthetic pesticides increases, populations of natural predators reduce and natural selection leads to pest populations with resistance to these insecticides (WWF-India, 2012; Nemes, 2010). This encourages applications of larger amounts of current pesticides, or the substitution of more toxic pesticides (Howard, 2009). This process will continue as selection processes will keep adapting pest populations to toxins. The last treadmill described by Howard (2009) is about the use of synthetic fertilizers. He argues that synthetic fertilizers reduce the organic matter of the soil, “particularly when combined with other industrial agricultural practices. This, in turn, leads to the need to maintain or even increase applications of synthetic fertilizer in order to achieve original yields on increasingly depleted soils” (Howard, 2009: 1269).
Chapter 4  Discussion

It really struck me that relatively a lot of Indian cotton farmers commit suicide. I assumed, like many other scientists and activists, that this represents some kind of distress on the Indian rural, specifically in the production of cotton. Based on the literature I reviewed, this assumption proves to be sustained; apparently, Indian cotton farmers are in a scrape. The focus of this thesis is whether or not the centralization of power in the seed industry can be seen as an explanation for this scrape. By doing so, I looked at the relation between seed security and sustainability of livelihoods. I started the research by making two assumptions. First, I hypothesised that the centralization of power in the commercial cotton seed industry undermines the seed security of smallholder farmers in India. Second, I hypothesised that the undermining of seed security leads to less sustainable or unsustainable livelihoods of farmers. To research these hypotheses, I set up the following question; 

How does a decline in seed security lead to less sustainable livelihoods for Indian smallholder cotton-farmers?

In order to be able to answer this question I formulated two sub-questions. The first is “Which factors led to the oligopolisation of the cotton seed industry?” I found here that the oligopolisation of the commercial seed sector must be placed in a broader context of developments in agriculture influenced by the modernization paradigm. The Green Revolution, started in India in 1969, framed the agricultural developments towards mechanization, capital investment, market integration, scientific research and drive for profit. Farmers were encouraged to buy external inputs like fertilizers and pesticides to increase the volume of their yield. Also cotton seeds, which always were reproduced at the farm, were gradually replaced by external hybrid varieties. These new varieties, introduced by the biotech seed companies have to be bought every year because farmers are legally restricted to reproduce this seeds, but also because these seeds are biologically (genetically) changed in such a way that they do not reproduce in a proper way. Thereby, farmers became dependent on external sources for their inputs. Farmers were thus encouraged to shift from being subsistence smallholders to more commercial and entrepreneurial farmers, integrated in global markets. Integration in larger markets means that farmers became not only dependent on external sources for their input, but now also external sources determine the income they receive. This process is referred to as the squeeze on agriculture.

Agricultural seeds, especially those of commodities like cotton, became part of the “capitalist logic” after the commercial seed industry “invented” the incentive to buy seeds. This changed the commercial seed industry a lot, because since then, profit could be made with selling seeds. The bigger companies started to buy up their competitors to secure and improve their own market power. This process of consolidation went so far that now only 6 companies have the oligopoly over commercial agricultural seeds. However, still, this does not provide clarity on the first hypothesis I posed that the centralization of power in the commercial seed industry undermines the seed security of smallholder cotton-farmers in India. For that purpose a livelihood analysis is needed. So, the question does not cover what I actually wanted to learn. The answer to my hypothesis must be found in the combination between the two sub-questions. With hindsight, I should have putted these assumptions, and the study of their truth, more central.

The introduction of genetically modified crops has not occurred quietly, over the past decade a storm of protests and a growing global debate has erupted. These debates centred around issues of commercialization of seeds, prospects of ‘terminator’ seeds and about wider concerns such as corporate control, patenting of living organisms and the consequences of globalized trade relations (Scoones, 2008).
While writing this thesis, I found it hard to cope with this paradox that on the one hand genetically modified (GM) crops are described as a certain doom, while on the other hand they are describe as a bright future for small farmers. Pro-GM activist argue that GM seeds would reduce costs for farmers by eliminating the need for pesticides and fertilizers. Also, by “creating” crops that are most resistant to pests and give higher yields, the income of farmers would increase. They argue that GM is a scale-neutral way of development and that all farmers, both rich and poor, can benefit (Scoones, 2008). Anti-GM activist argue on the other hand that due to the monopolistic power of companies like Monsanto, costs for inputs would increase and choice for seeds would decrease whereby “forcing poorer farmers out and allowing a form of uniform, corporate-capitalist agriculture to dominate” (Scoones, 2008: 317). I found that in articles written about this subject, it is usually very clear on which “side” the author is. Either the author expresses themselves (totally) in favour of Bt/GM cotton, or real critically.

The second sub-question is “What has been and is the impact of corporate reproduction of cotton seeds for farmer’s livelihoods in India?” Here I hypothesised that the undermining of seed security by the larger commercial seed companies causes that livelihoods of farmers become less sustainable. When looking for the more livelihood oriented articles concerning this topic, I found that most articles can (party) be placed within the group who expresses themselves critically towards the implementation of GM crops. I tried to find livelihood analysis’s of Indian Bt cotton farmers, written from a pro-GM perspective. However, I found that most articles in favour of Bt cotton are the more technical ones who do not elaborate on farmer’s circumstances. I feel that being able to look critical towards social phenomena is a very important aspect of the social sciences. In this case, I therefore think it is important to note that industrialization of agriculture did bring enormous increases in yields; it did improve the livelihoods of (particular) farmers. However, after reading many articles I found that seeds cannot be seen as something self-contained. Seeds must be placed in bigger agricultural contexts of market dependency, money lending and knowledge.

As argued in the introduction, I stated (based of Macini et al) that a livelihood is considered sustainable when it can cope with and recover from stresses and shocks; maintain or enhance its capabilities and assets in the present and through time, without degrading the natural resource base. For farmers, being secure of good seeds is very important to be secure of a sustainable livelihood, since a seed is at the complete basis of the yield and income. With the implementation of modern agriculture, the availability of seeds changed. Reproduction of cotton seeds became increasingly dominated by the commercial seed industry. I introduced the concept of seed security to analyse the effects of the increasing corporate reproduction of seeds. When looking at the availability of seeds, it was found that local and non-Bt seeds are gradually disappearing while hybrid and genetically modified varieties gain more ground. It can thus be concluded that the natural resource base is degrading. On top of that, due to increased use of pesticides and fertilizers the land is degraded or polluted. For this reasons, the sustainability of Indian cotton farmers’ livelihoods is threatened.

However, seed security is not solely about the availability of seeds, it is also about access to seeds. This is determined by a farmer’s human capital and financial capital. First, human capital consists of knowledge and skills. Coping with risk and anticipate to shocks and stresses start with information. Knowledge allows farmers to make well thought out decisions and thus creates some kind of independency. In India, farmers find it increasingly difficult to decide which seeds to use. Stone (2007) argues that agricultural skilling is indispensable for sustainable development of agriculture. He describes agricultural skilling as a process of learning about the crop and environment, and points out that this process is lacking in India. Instead, a process of agricultural deskilling is apparent. This makes it harder for farmers to sustain a sustainable livelihood for them and their families.
The second determinant of seed access is financial capital. Due to the increased use of agrochemical/external inputs, costs rose. Small farmers usually do not have (a lot) of financial capital to use and since the inputs have to be paid before the yield gives an income, farmers need to loan money. For most smallholders it is, for several reasons, not possible to loan money from official sources who charge low interest rates. They are dependent on informal money lenders who charge high interest, which doubles the burden of high input costs for farmers. This threatens farmers’ maintenance of assets in present and through time, whereby the sustainability of their livelihoods is threatened as well.

Thus, while the shifting discourse and Green Revolution technology did bring growth and development to India, I tried to explain that one has to look more critically; Industrialization of agriculture and integration in the world market also caused that small farmers are increasingly stuck within the agricultural treadmills and the squeeze on agriculture. The amounts of pesticides and fertilizers that are applied are still increasing and the availability of local and non-hybrid seeds is gradually decreasing. Brown argues that modernization as a unifying discourse is losing its hold. “Insofar as the Green Revolution approach is still practised in Punjab, it would appear that this approach is now merely ‘dominant’, rather than ‘leading’: it remains in place purely because of a lack of alternatives. High rates of farmer suicides would appear to indicate that although the practice of Green Revolution agriculture is still very much in place, this is more through a lack of viable alternatives than active consent ” (Brown, 2013: 234). I agree with him on this, the issues named above are not solely the problem caused by hybrid and GM seeds; they apply to a broader context of changing trends in the agricultural regime.

Very interesting in the case of India is that the “uphill struggles” of farmers did not end in a coordinated campaign, like for example in Brazil with the establishment of the MST (Scoones, 2008: 323). Anti-GM activists argue that reintroducing organic cotton farming could be a good response to the crisis situation in India. Organic cotton is cotton that is farmed without the use of synthetic chemicals such as pesticides and fertilizers (Rieple & Singh, 2010). Producing organically can be placed in a context of resisting agricultural treadmills (since no chemical inputs are used) and alternatives to oligopoly seed production (Howard, 2009). However, in the absence of significant changes in the hierarchical control in the global seed industry, organic farming as a livelihood strategy must be introduced from below. Without coordinated campaigns, this could be very hard. Especially since organic seeds are gradually disappearing in many Indian regions.

I would be really interested to study why farmers did not form a strong block against the further increasing hierarchical control in the cotton seed industry. However, not much can be found about this topic. Future research could therefore focus on how it is possible that (small)farmers on the Indian rural continue to kill themselves in large numbers, while they do not come together and try to form a strong opposition to the increasing dependency, indebtedness and decreasing (organic/local) seed choices.
Chapter 5  Conclusion

This main question of this thesis contains two hypotheses; first that centralization of power in the cotton seed industry undermines the seed security of Indian smallholder cotton-farmers, and second that by this process a situation is created in which these farmer’s livelihoods become less sustainable. To conclude this thesis I would like to comment on those two hypotheses and through that, answer the main question “How does a decline in seed security lead to less sustainable livelihoods for Indian smallholder cotton-farmers?”

The first assumption I made was that the centralization of power in the commercial seed industry, the corporisation of seeds, leads to less seed security for cotton-farmers in India. Still, seed security is defined as farmers having a stable physical, social and economic access to sufficient quantity and quality seeds, which meet their preferences of variety choice. I conclude that farmers in India indeed experience a decrease in their seed security. As previously explained, seed security depends on both access to seeds, determined by human capital and financial capital, and availability of seeds. Availability of seeds is paradoxically both increasing and declining, since more and more hybrid and genetically modified seeds are becoming available, while on the other hand local and non-genetically modified seeds are gradually disappearing from local markets. However, when looking at sustainable livelihoods, it is stated that importantly the natural resource base may not be degraded. For this reason I argue that the disappearance of local and non-hybrid seeds outweighs the increased availability of hybrids and genetically modified seeds, and on the basis of availability of seeds, seed security of Indian cotton farmers is decreasing.

Information makes farmers (partly) able to cope with and recover from shocks and stresses. Knowledge allows farmers to think critically and make independent choices. However, when looking at farmers’ human capital, it can be concluded that due to the rapid modernization of agriculture a process of agricultural deskillling is going on. The process where farmers constantly learn about the crop and environment is lacking in many parts of India; most farmers base their decision on what seed to buy on what their neighbours buy. The second determinant of seed access is financial capital. Farmers’ costs rose due to the increased use of external inputs. Since small farmers usually lack the money to invest (every year) in inputs, they need to loan money. For loaning money, most small farmers are dependent on high interest loans from informal money lenders. This doubles the burger of high input costs for farmers. On top of that, monocropping, which is increasingly used as a farming strategy, creates a full dependency on the market for one crop. If one year, the cotton price is low, or the crop is attacked by insects, the income is too low for farmers to repay their loans and interests go up and up. These farmers are stuck in the technological treadmill. So, it can be concluded that not only the availability of seeds decreased, but also the means farmers have to access seeds.

Thus, both dimensions of seed security confirm that Indian smallholder cotton-farmers are becoming less secure of their seeds. Centralization of power and control of the commercial seed industry did play a big role in this process, since it is the commercial seed industry that introduced the non-reproducing cotton seeds whereby farmers became dependent on external inputs, since it are the commercial seeds that are pushing the local seeds from the market and since it is the commercial seed industry that is responsible for the overload of advertisement that promises all farmers to become rich. However, one cannot overlook the importance of the “complete package of agrarian change” on these developments. Processes like these must always be placed in a specific and broader zeitgeist.
The second assumption I made was that the undermining of seed security leads to less sustainable livelihoods for smallholder cotton-farmers in India. I can conclude that the assumption has been proven true in this thesis. In India, the decrease of seed security leads to less sustainable livelihoods in several ways. First, “a livelihood is considered sustainable when it can cope with and recover from stresses and shocks” (Macini et al, 2007: 99). The decline of seed security, which goes together with the process of agricultural deskillling, the increased indebtedness and the grown dependency on world markets made Indian cotton-farmers less able to cope with stresses and shocks like pests, droughts and fluctuating prices on the global markets. Second, “a livelihood is considered sustainable when it can maintain or enhance its capabilities and assets in the present and through time” (Macini et al, 2007: 99). Here, the same factors play a role. Agricultural deskillling can be seen as the opposite of enhancing capabilities and the increased indebtedness also reflects the opposite of enhancing assets. Concepts like the technological treadmill and the squeeze on agriculture do not offer very good prospects for developments “through time”. Finally, “a livelihood is considered sustainable when is does not degrade the natural resource base” (Macini et al, 2007: 99). Here the most important aspect is the availability dimension of seed security; the disappearance of local cotton seeds, whereby the local natural resource base is degraded.

Thus, in India, all aspects of a sustainable livelihood are threatened by the decrease in seed security for smallholder cotton farmers.
Personal reflection

I have always been interested in and curious for circumstances of people from all over the world. Why do people do what they do? Which chances do people have? How does a society as a whole ‘work’? What are the social rules within families and networks of people? But, besides looking at the social circumstances of people, I always found it interesting to learn about the more geography like subjects. Problems of land degradation, pollution and desertification are really in my field of interest. Combing these two; my special interest goes to the rural: farmers and their relation with society and nature. It is also for this reason that I chose the major Sociology of Development, which is very much focused on farming and rural life. For these same reasons, I hope to start with the master of International Land and Water management in September.

Watching the documentary “Bitter Seeds”, edited by Micha X. Peled, made me aware of a problem I knew nothing about; the phenomena of farmers committing suicides. The documentary is about India, but apparently the problem is global. Coming from the countryside myself, although not being the child of a farmer family, this problem touched me. Why do farmers commit suicide more often than non-farmers? For this thesis I chose to focus on the problem that is highlighted in the documentary; Indian smallholder cotton farmers who are in a scrape, and sometimes even commit suicide. The documentary blames the introduction of genetically modified seeds by Monsanto, but since the documentary was the only source of information about the problem I had, I did not know how to feel about this. With the writing of this thesis I wanted to explore how the introduction of genetically modified seeds influenced the livelihoods of smallholder cotton farmers in India; is this really one main cause for the thousands of farmers who killed themselves since the 1990’s?

I am a person who loves to learn and obtain knowledge; I am very curious to all kinds of subjects. This curiosity together with the fact that I felt so touched by this subject made that I really “enjoyed” reading and learning more about this subject. However, although I like being curious, it can be difficult as well. In this thesis I learned that it is very important to choose one focus, and stick to that focus, because otherwise the report will lack structure and depth. I was happy that Dirk Roep reminded me of this several times.

To be able to start the master International Land and Water management, I have to finish two switch courses. One of them I already passed in the previous period. The other one, I have to complete before summer. The fact that both this switch course, and the writing of my thesis, had to be done in one period caused some time pressure. Due to this time pressure I was limited in time to dedicate to this thesis. However, I worked really hard and although things can always be better formulated and substantiated, I am happy with the result of this thesis.
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