From Betterment to Bt Maize

Agricultural Development and the Introduction of Genetically Modified Maize to South African Smallholders

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Jacket, front: Overview of village (photo: K. Jacobson, 2006).
Jacket, back: Cross-pollination in maize (photo: A. Sparrenborn, 2008).

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Abstract

Agriculture has received renewed attention in poverty reduction efforts in Africa in recent years, and there are hopes that GM crops could have an important role in helping increase smallholder yields and reduce poverty. Drawing on critical discourse analysis (CDA) and livelihoods perspectives, this thesis examines the ideas governing the Massive Food Production Programme (MFPP), an agricultural development programme aiming to reduce poverty by raising agricultural production in Eastern Cape Province, South Africa, and its local effects when implemented in smallholder communities. In particular, the effects of introduction of Bt maize, genetically modified to be resistant to some potentially damaging insects in the region, were studied.

The results reveal that the programme was not equipped to support the improvement of smallholders' livelihoods through agriculture. A core reason was the failure to break with a historically dominant unidirectional view of agricultural development, which was reinforced by a co ntemporary dominant neoliberal view of development as progress through growth. The programme thereby disregarded the effects of long-term marginalisation on smallholders' ability to engage in farming, and the associated need for substantial advisory, infrastructure and credit support to increase agricultural productivity. Local strategies for dealing with the effects of poverty were also unacknowledged; and practices and inputs originally developed for large-scale, capital-intensive farming were introduced without adaptation to smallholder conditions. The programme also failed to recognise the local heterogeneity of poverty, resulting in a bias towards comparatively better-off smallholders.

The Bt maize variety introduced, like hybrid maize varieties introduced during pre-democracy interventions, was not adapted to smallholders' farming environments. It was input-demanding and sensitive to environmental dynamics, and it was promoted for planting in monoculture. Bans on saving and recycling seed resulting from patents, plant breeders' rights and new regulations to ensure the biosafety of GM crops were largely incompatible with smallholders' practices and further undermined strategies for dealing with resource shortage. It is suggested that cheaper, open-pollinated maize varieties, which can be recycled and are more tolerant to low-input conditions, could be better suited to smallholders' needs and practices.

Keywords: agriculture, Bt maize, development, discourse, GM crop, GMO, livelihoods, smallholder, South Africa

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Photo: A. Sparrenborn, 2008.

To Natolo Alfred Pali, who passed away on the 16th of June, 2011 after a long life and hard work in the mines and in the fields. Mr Pali shared so much of his wisdom and ideas with me. Talking to him and walking with him in the fields gave me invaluable insights into farming, village life and history.

> Vad är då utveckling, och vad är fullkomning? Vägen från det enkla och likartade till det sammansatta och olikartade, säger evolutionsteoretikern! Därför stå de läppblomstrige och sammansatta sist i växternas skapelsekedja emedan de äro de mest sammansatta; men stå de därföre högst i fullkomning? Är prästkragen fullkomligare än rosen? Vad vill det säga? Är den skickligare att uthärda kampen för tillvaron än rosen? – Intet svar! Kanske utveckling endast är rörelse, framåt eller bakåt, likgiltig förändring! Och naturlagarna endast subjektiva förnimmelser av våra ordningsälskande hjärnor, som vilja spåra ett ändamål överallt (*August Strindbergs Samlade Verk 29. Nationalupplaga* 1985: 213).

Translation to English by Lars Rudebeck: What is development, and what is perfection? The path from the simple and undifferentiated to the composite and differentiated, says the evolutionist. Therefore the labiates and the composites come last in the chain of creation of the plants, because they are the most complex, but do they therefore stand highest in perfection? Is the daisy more perfect than the rose? What does that mean? Is it better at enduring the struggle for survival than the rose? – No answer! Perhaps development is nothing but movement, forward or backward, indifferent change! And the laws of nature only subjective perceptions by our order-loving brains, who want to trace a purpose everywhere.

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When I finally received funding for my PhD, I was having second thoughts and considered not going through with it. However, Professors Kjell Havnevik and Lennart Salomonsson managed to talk me into it. Thank you!

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List of illustrations

Contents

List of Publications

This thesis is based on the work contained in the following papers, referred to by Roman numerals in the text:

I Jacobson, K. (2009). The mismatch between smallholder realities and agricultural development interventions: From 'Betterment' to the massive food production programme. In: Guyot, S. & Dellier, J. (Eds.) *Rethinking the wild coast, South Africa: Eco-frontiers vs livelihoods in Pondoland*. pp. 191-226. Saarbrücken: VDM Verlag.

II Hajdu, F., Jacobson, K., Salomonsson, L. & Friman, E. (2012). But tractors can't fly… A transdisciplinary analysis of neoliberal agricultural development interventions. *International Journal of Transdisciplinary Research* 6(1), 24-64.

III Jacobson, K. (forthcoming). The massive food production programme: A case study of agricultural policy continuities and changes. In: Hebinck, P. & Cousins, B. (Eds.) *In the shadow of policy: Everyday practice in South Africa's land and agrarian reform*. Johannesburg/Leiden: Wits University Press/Brill Academic Publishers.

IV Jacobson, K. & Hajdu, F. Why are agricultural development programmes not helping the poor? A case study of the massive food production programme in South Africa. Submitted to *Geoforum.*

V Jacobson, K. & Myhr, A. I. (2013). GM crops and smallholders: Biosafety and local practice. *The Journal of Environment & Development* 22(1), 104-124.

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The contribution of Klara Jacobson to the papers included in this thesis was as follows:

I Performed the data collection, analysis and writing alone.

II Performed the data collection, analysis and writing in cooperation with the other authors. Contributed as the second author to all parts of the text.

III Performed the data collection, analysis and writing alone.

IV Performed the data collection and analysis. Wrote most of the text. Flora Hajdu was an active dialogue partner during analysis and contributed text and continuous comments on the whole paper.

V Performed the data collection and analysis alone. Wrote the paper drawing on helpful comments and discussions and some contribution of text by Anne I. Myhr.

Abbreviations

AsgiSA	Accelerated and Shared Growth Initiative of South Africa
Bt	*Bacillus thuringiensis*
CDA	Critical discourse analysis
CGIAR	Consultative Group on International Agricultural Research
ECDA	Eastern Cape Department of Agriculture
GM	Genetically modified
GMO	Genetically modified organism
HT	Herbicide-tolerant
MFPP	Massive Food Production Programme
IP	Intellectual property
IR	Insect-resistant
NGO	Non-governmental organisation
OPV	Open pollinated variety
PBR	Plant breeders' rights
PRA	Participatory rural appraisal
RRA	Rapid rural appraisal
SL	Sustainable livelihoods
SLA	Sustainable livelihoods approach

1 Introduction

Over the last decade there has been a renewed focus on the role of agriculture in reducing poverty. The African continent has been at the centre of attention and African governments, international funding bodies and researchers have emphasised the importance for poverty reduction of the revitalisation of agriculture (AGRA, 2013; CAADP, 2012; Magnusson *et al.*, 2012; Djurfeldt *et al.*, 2011; Diao *et al.*, 2010; Jayne *et al.*, 2010; IAASTD, 2009; World Bank, 2007; Djurfeldt *et al.*, 2005). Many argue that this revitalisation of African agriculture must essentially be smallholder-based[1] (Dethier & Effenberger, 2012; Djurfeldt *et al.*, 2011; Diao *et al.*, 2010; World Bank, 2007; Djurfeldt *et al.*, 2005).

Coupled to the renewed focus on the role of agriculture in poverty reduction is a debate about the role of genetically modified[2] (GM) crops in this effort (Juma, 2011a; Cleveland & Soleri, 2005; Scoones, 2002; Altieri & Rosset, 1999). Some people hope that by introducing GM crops into smallholder farming, yields would be raised and stabilised, directly as well as indirectly, for instance through reducing losses to various environmental stresses such as insects, drought and salinity (Mannion & Morse, 2012; FAO, 2011; Juma, 2011a; Atkinson *et al.*, 2001; Machuka, 2001; Borlaug, 2000; Chrispeels,

1. An account of how the term smallholder is used in this thesis is provided in section 3.1.

2. According to the European Union regulatory framework on GMOs (DIRECTIVE 2001/18/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC), a genetically modified organism (GMO) means "*an organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination*". The genetically modified (GM) crops that dominate the market today (herbicide-tolerant and Bt crops) are transgenic crops, meaning that sections of DNA from another organism have been inserted into the plant's DNA in order to produce new traits. There are also GM crops which are referred to as cisgenic, where genetic modification is used to move DNA fragments or genes within organisms from the same species.

2000; Wambugu, 1999). Others have voiced concerns that a narrow technical focus on the potential of GM crops might move attention away from issues of power and politics, which might affect the possibilities of the technology to be pro-poor. Some argue that less controversial agricultural applications could be used with similar benefits (Stone & Glover, 2011; Glover, 2010a; Mechlem, 2010; McIntyre *et al.*, 2009; Kiers *et al.*, 2008; Scoones, 2002; Altieri & Rosset, 1999).

The GM crops available on the market today were developed to suit large-scale, capital-intensive, industrialised and commercially orientated agriculture systems[3] (Kiers *et al.*, 2008; FAO, 2004; Royal Society, 2000). Despite the intense debate on the role of GM crops for smallholders, there is comparatively little research regarding if and how resource-constrained smallholders can benefit from the introduction of GM crops (Gouse, 2012; Glover, 2010b). This thesis aims to contribute to filling this research gap.

1.1 Starting points and aims

This thesis examines the contemporary effects of agricultural development on smallholders' livelihoods in South Africa, with particular focus on the role of GM maize in this. Two starting points guided the research work:

- The connection between agricultural development and poverty reduction is not straight-forward (cf. Brooks & Loevinsohn, 2011; Bahiigwa *et al.*, 2005a). In order to evaluate the role of agricultural development and GM maize for poverty reduction, the role of farming in the wider livelihoods context was studied here.
- Technology typically comes as part of a package of supporting practices and services. Its functioning is shaped both by the ideas and practices that have guided its development and by how it is adopted, adapted and understood by the end-users (Schnurr, 2012; Stone, 2011; Tripp, 2009a; Witt *et al.*, 2006; Sørensen & Williams, 2002; Song, 1998). In order to learn about the real-life effects when GM maize is introduced to smallholders, we need to understand the performance of the whole package in the local context (*cf.* Glover, 2010a).

3. In this thesis, it is acknowledged that large-scale farming in general is capital-intensive, industrialised and commercially orientated, and that much smallholder farming is not. Unless otherwise specified, when the term 'large-scale farming' is used it refers to farming which apart from being large-scale is also capital-intensive, industrialised and commercially orientated.

The research focuses on Bt maize, a cultivar genetically modified to be resistant to maize crop pests that can cause significant yield losses and economic damage. While Bt maize was originally developed with large-scale farmers as the target group, it has been suggested that the insect resistance of Bt maize could be of equal benefit to resource-constrained smallholders, in South Africa and elsewhere (Thomson, 2008; Gouse *et al.*, 2006).

Bt maize was first promoted to smallholders in the villages examined in this thesis through demonstration trials organised by the multinational seed company Monsanto in 2001. Subsequently, Bt maize was introduced during a South African agricultural development programme called the Massive Food Production Programme (MFPP), run by the Department of Agriculture in Eastern Cape Province (Eastern Cape Department of Agriculture, hereafter ECDA[4]). The MFPP was active in the case study villages between 2003 and 2007. Both hybrid and Bt maize seeds were introduced through the programme, as well as the use of agrochemicals, mechanisation and new farming practices, with the intention of increasing crop yields and consequently reducing rural poverty[5].

This thesis reports on how the MFPP interacted with smallholders, including the ideas that shaped its design and implementation (Papers I, II and III), and practical effects in the case study villages (Papers II, IV and V), especially those consequent on the introduction of Bt maize (Papers IV and V). The study highlights how ideas about agriculture, poverty and development shaped the design of the MFPP and the introduction of Bt maize. Subsequently it traces the effects of these ideas on the potential and actual contribution of the programme, and of the new maize, to increasing yields and reducing poverty.

Four overarching research questions guided the research process (RQ 1-4):

1. What are the barriers to and opportunities for enhancing smallholders' livelihoods through agriculture in the context studied?

2. Is the MFPP approach appropriate for enhancing smallholders' livelihoods through agriculture? If not, why not?

4. Since 6 May 2009, the former Eastern Cape Department of Agriculture (ECDA) is called the Department of Agriculture and Rural Development. The former name is used in this thesis when referring to documents and events occurring before 6 May, 2009.

5. A more detailed description of the case can be found in section 2.5.

3. Does the introduction of Bt maize contribute to the improvement of smallholders' livelihoods in the study area? If not, what are the limitations to this?

4. Is the MFPP approach an appropriate vehicle for Bt maize introduction? If not, why not?

The thesis aims to draw lessons from analysis of the findings related to each of these questions, in terms of:

- the role of agricultural development in poverty reduction, and
- the role of GM crops in smallholder agriculture.

1.2 Comments on the structure of the thesis

The research on which this thesis is based is presented in Papers I-V, which are appended at the end. This cover essay places the research in a broader context, presents the theoretical and empirical work in greater detail than permitted in scientific journals, and synthesises the findings.

Taken together, the research presented in the five papers clearly pays most attention to studying the MFPP, including the ideas that shaped its design and the outcome when these ideas were implemented in practice in the study villages. The only paper in which the Bt maize is the centre of attention is Paper V. In Papers I-V, however, the introduction of high-yielding, but input-demanding, varieties of hybrid and GM maize, is shown to be a core pillar of the MFPP. The focus on the introduction of new seed in the MFPP can be connected to a l arger current trend in research and policy directed at agricultural development for poverty reduction in Africa. I opted to use this cover essay to discuss my research results in the light of this trend, with specific focus on drawing lessons from the findings presented regarding the role of agricultural development in poverty reduction, and the role of GM crops in smallholder agriculture.

In the background section which follows this introductory section, specific mention is made of the current debate about the need for a new Green Revolution in Africa, and the role of GM crops in this. There follows a section introducing the main concepts that guided the research work, and a methods section, which presents the empirical work and analysis in some detail, including reflections on the research procedure and the role of the researcher. The summary of Papers I-V in Section 5 provides the background for the final discussion in Section 6 and allows the reader to assess the relevance and validity of the conclusions drawn in that section.

Figure 1. Farmer in her garden (photo: C. Fischer, 2008).

2 Background

The dominant view in policy and research is that the adoption of high-yielding varieties of seed and agrochemicals, most notably industrially produced fertiliser (hereafter only referred to as fertiliser), during the so-called Green Revolution was of key importance for reducing poverty in Asia by means of a significant rise in smallholder yields (Hazell, 2009; Evenson & Gollin, 2003). In contrast to their Asian counterparts, African smallholders adopted these agricultural inputs only to a limited extent and it is being argued that Africa's widespread poverty can be explained in part by the continent largely having missed out on the Green Revolution (AGRA, 2013; Djurfeldt *et al.*, 2011; World Bank, 2007; Djurfeldt *et al.*, 2005).

While it is recognised that production inputs might have little effect if the infrastructure, service and market conditions are inadequate, much emphasis is placed on the role of seed technology for raising the yields of African smallholders (AGRA, 2013; Juma, 2011b; Scoones & Thompson, 2011).

2.1 A new Green Revolution for Africa?

The Asian Green Revolution was in essence built on publicly funded research, technological development, credit services, infrastructure support and agricultural advisory and extension support (Hazell, 2009). Since then, there have been important changes in how agricultural technology is produced, controlled and distributed, with potentially significant impacts on the potential of new seed technology to have similar effects to those it had in Asia. Today, private companies control a far larger part of the investment in agricultural research and technological development, and play an already dominant and rapidly increasing role in service provision, farm enterprise development and marketing (Renwick *et al.*, 2012; Howard, 2009; Pray & Naseem, 2007). Information from 2006 indicates that five major multinational seed companies

combined spent 18 times more on agricultural research than the publicly funded CGIAR system (Leach & Scoones, 2006). The increasing private spending on agricultural research and development has been stimulated by the stepwise revision, expansion and global harmonisation of plant breeders' rights (PBR) and the simultaneous global extension of intellectual property (IP) rights into agriculture, which include the possibility to patent living organisms (Tansey, 2011). While farmer-to-farmer seed exchanges were a key channel for the rapid and wide-spread dissemination of the new wheat and rice varieties in Asia during the Green Revolution (Morris *et al.*, 1999), through the extended scope for seed protection by private industry, it is now illegal in many countries, including South Africa, for farmers to share commercial crop seeds. For GM crops, the use restriction is taken even further and farmers are also prevented from recycling seed for planting in the next season, even for non-commercial purposes (Collier, 2012; Collier & Moitui, 2009). With specific regard to GM crops, in order to recover the costs of research and development, private companies also commonly add a technology fee when selling GM seeds. As a result, GM seeds are more expensive than seed of conventional crop varieties, although the price differences between GM and conventional seed vary significantly between countries (Del Villar *et al.*, 2007).

Another trend over the last 40 years has been the increasing consolidation of the private seed industry. The companies that control agricultural research and development are becoming fewer and larger (Renwick *et al.*, 2012; Howard, 2009). This trend has been coupled with a decline in the range of seed varieties available and an increasing focus on the crops and varieties that are most profitable to the companies concerned (Howard, 2009; Tripp, 2009a). For example, figures from 2003 indicate that seven companies globally controlled more than 85% of the maize germplasm (Mulvany, 2005). Estimates made in 2008 indicate that three seed companies, Monsanto, DuPont and Syngenta, together controlled 65% of the global maize seed market (ETC Group, 2008). With specific reference to South Africa, by 2009 Monsanto alone controlled 50% of the maize seed market in the country and by 2011 it appears that only one of 140 GM maize varieties registered in South Africa contained a GM trait licensed to a company other than Monsanto (The African Centre for Biosafety, 2011).

Since the peak of the Green Revolution, it has been widely acknowledged that the large-scale intensification of agriculture that has occurred in many parts of the world has been accompanied by substantial environmental costs, for example in the form of pollution of ground-water by fertilisers and insecticides, and the loss of crop genetic diversity (Foley *et al.*, 2011; Hazell & Wood, 2008; Foley *et al.*, 2005; Brush, 2004; Tilman *et al.*, 2002; Tilman,

1998). The increasing realisation that several of the resources that have been central to the intensification of agriculture to date (*e.g.* oil, phosphate rock and potassium) are finite, also contributes to discussion of the need to find alternative ways to sustain agricultural production (Renwick *et al.*, 2012; Kenny, 2011; Aleklett *et al.*, 2010; Odum, 2007). In addition, the actual and potential effects of global warming on agricultural production are attracting increasing attention. Moreover, it is generally acknowledged that since the rural poor are often more directly reliant on ecosystem services, they are more vulnerable to ecosystem changes (IAASTD, 2009; Boko *et al.*, 2007; World Bank, 2007; MA, 2005).

Many see the use of GM crops as a possible way to meet future environmental challenges. Examples include existing and future insect-resistant (IR) crops, which could reduce the need for insecticides; herbicide-tolerant (HT) crops in combination with no-till agriculture, in order to reduce soil erosion; and the development of crops resistant to salinity or drought, which can be planted in adverse environments (Mannion & Morse, 2012; Juma, 2011a; Juma, 2011b; Fukuda-Parr, 2007). However, the introduction of GM crops to the environment and the food chain also leads to uncertainties with regard to effects in specific environments and on human and animal health. Specific environmental effects following the introduction of Bt maize include development of resistance among target insects, adverse effects on non-target organisms and cross-hybridisation with non-GM varieties (Andow & Zwahlen, 2006). In order to mitigate actual or suggested negative effects related to health and the environment, the introduction of GM crops is commonly regulated by biosafety legislation. This typically includes pre-release risk assessment as well as post-release monitoring of GMOs for any unintended adverse effects. How to deal with risks with regard to GM crops is a core issue of controversy based on fundamentally different perceptions about how to understand and deal with risk, both within science and in society at large (Shah, 2011; Glover, 2010a; Melo-Martin & Meghani, 2008; Stirling, 2008; Herring, 2007a). While international agreements have limited the diversity of approaches regarding regulation of GMOs, to some extent, because of differences in the conceptualisation of risk, countries still differ in their regulation of GM crops (Melo-Martin & Meghani, 2008; Ramessar *et al.*, 2008; McLean *et al.*, 2002; Jasanoff, 2000). This thesis does not enter further into this topic; neither does it discuss what would happen to smallholders' livelihoods if potential environmental and health risks were realised. The focus is rather on contemporary effects for smallholder farming practices and livelihoods of introduction of a particular GM maize technology, including the

effect of introducing new information and management practices, and in relation to the implementation of biosafety legislation.

This brings us to the last point in this section. While publicly funded agricultural advisory services were important for the successful distribution of new technology and inputs during the Asian Green Revolution (Hazell, 2009), today these have declined, and private agro-dealers play a key role in the provision of crop advice and varietal choice (Scoones & Thompson, 2011; Brooks *et al.*, 2009; Stone, 2007). Whether agro-dealers are sufficiently equipped to take on this role is considered to be an important factor in determining the contribution of GM crops for African smallholders (Tripp, 2001).

2.2 GM crops and smallholders - the current track record

The most common GM crops today are HT crops, followed by IR crops and crops containing the two traits combined (so called stacked trait crops). HT crops commonly provide resistance to broad spectrum herbicides containing glyphosate (*e.g.* Monsanto's Roundup Ready® crops and Roundup® herbicide). IR crops are modified to contain genes from the soil bacterium *Bacillus thuringiensis* (Bt), which makes the crops produce proteins that are toxic to certain insects. Soy bean, maize, cotton and oilseed rape are the most common crops to be genetically modified (James, 2012). The first generation of GM traits and crops has been significantly biased towards those for which there is a significant volume of commodity trade and a large market, *i.e.* where there are large-scale farms and highly commercialised farmers.

Today, only South Africa, Burkina Faso, Egypt and Sudan grow GM crops commercially in Africa, and of these only South Africa does so on any major scale. Indeed, counting hectares grown, South Africa is the eighth largest GM crop-producing country in the world (James, 2012). Bt cotton was the first GM crop to be introduced in South Africa in 1997, followed by Bt maize in 1998 (Gouse *et al.*, 2003). Today, significant areas of Bt and HT cotton and maize, as well as cotton and maize with stacked traits and HT soy bean, are grown commercially in South Africa (The Registrar of Plant Improvement, 2012). Bt maize was first introduced to South African smallholders through workshops conducted by Monsanto in 2001 (described in more detail in section 2.5). Bt maize is toxic to the African maize stemborer (*Busseola fusca*) and the Chilo stemborer (*Chilo partellus*), insects which if uncontrolled may cause significant damage to maize crops in South Africa (Van Wyk *et al.*, 2008; Kfir *et al.*, 2002).

Previous studies on the effect of GM crops in smallholder farming have mainly focused on the introduction of Bt cotton (Regier *et al.*, 2012). Studies on the use of Bt cotton in smallholder farming in Argentina, China, India and South Africa indicate that on average the adoption of Bt cotton raises yields, reduces pesticide use and improves economic returns for smallholders (Morse & Mannion, 2009; Morse & Bennett, 2008; Bennett *et al.*, 2006; Hofs *et al.*, 2006; Smale *et al.*, 2006; Qaim & De Janvry, 2005; Bennett *et al.*, 2004; Bennett *et al.*, 2003; Qaim & Zilberman, 2003; Pray *et al.*, 2002). Similar results have been presented in the few studies that have been made on South African smallholders' experiences of Bt maize. On average these studies show that smallholders have obtained increased yields and economic gains from planting Bt maize compared with when planting conventional hybrids (Gouse, 2012; Gouse, 2009; Gouse *et al.*, 2006).

While they reveal average positive trends with regard to yield and economic gain, the studies reviewed above regarding Bt cotton and maize also reveal significant variations between regions and years, important factors being varying insect pressure and rains. These seasonal variations have a particular impact on resource-constrained smallholders. In years and at sites with low insect pressure, the economic benefit from planting Bt crops can be negligible or negative (Gouse *et al.*, 2006; Hofs *et al.*, 2006). While large-scale farmers can buffer economic losses in one season with gains in other seasons, smallholders often do not have the economic capacity to do this. It has therefore been questioned to what extent average economic benefits spread over years in reality represent the actual benefit to smallholders (Dowd-Uribe, in press).

The research sketched above focuses largely on economic analyses; indeed, the majority of studies on GM crop adoption by smallholders have been performed by economists. However, as discussed further in section 2.3, high yields and economic gains are not always central issues in smallholder farming. Instead, yield stability, cost of seed and agroecological suitability of the seed are examples of other issues valued by smallholders (Soleri *et al.*, 2008). In addition, the surrounding institutional framework is a key factor in determining the local effects of the introduction of GM crops (Dowd-Uribe, in press; Qaim *et al.*, 2006; Smale *et al.*, 2006). Studies on the initial rapid adoption of Bt cotton by smallholders in the Makathini Flats in South Africa indicate that these successes were in large part due to initially supportive institutional provision of credits and market opportunities, which subsequently collapsed, making it increasingly difficult to sustain production (Schnurr, 2012; Gouse, 2009; Witt *et al.*, 2006; Gouse *et al.*, 2004). Issues such as these have

been much less in focus in the research done to date (Dowd-Uribe, in press; Soleri *et al.*, 2008; Witt *et al.*, 2006).

GM crops demand new management practices, both for the sake of ensuring their optimal use, and to ensure compliance with biosafety regulations and the use limitations posed by patents and PBRs. To ensure efficient use of Bt seed, farmers must, for example, be able to differentiate between various damaging insects present on their crop, know the types of insects to which the crops are resistant, and (if they use chemical controls) adapt their spraying regimes accordingly. In addition, to prevent the build-up of resistance to the Bt protein in the target insects, farmers planting Bt maize and cotton in South Africa, as in many other countries, must undertake to plant a specified amount of conventional hybrids together with the Bt crop in order to provide feeding grounds for target insects (Kruger *et al.*, 2009; Bates *et al.*, 2005; Stone, 2004). The role of the conventional hybrids is to provide ecological habitats for the target insects, commonly known as refugia. South African farmers also must certify, in a legally enforceable agreement, only to use the seeds for planting in a pre-designated area. The purpose of the agreement is to allow the industry to keep records of plant locations, monitor farmers' compliance with the terms imposed by biosafety regulations and avoid uncontrolled transfer of GM plants to other farmers and across international borders (South African National Biodiversity Institute, 2011; Thomson, 2008). An increasing number of studies point to the limited or faulty adoption of new management practices associated with Bt crops. For instance, pesticide applications may not be adequately adapted, or refugia may not be planted (Arza *et al.*, 2012; Kruger *et al.*, 2012; Assefa & Van den Berg, 2009; Pemsl *et al.*, 2005; Shankar & Thirtle, 2005; Yang *et al.*, 2005; Bennett *et al.*, 2004; Bennett *et al.*, 2003). Based on surveys of 78 South African smallholders in two provinces planting GM maize (Bt maize, RR maize and maize with stacked traits), Assefa and Van Den Berg (2009) reported that none of the smallholders could adequately explain the role of refugia, and that 58% of the smallholders had adopted GM maize on grounds that did not relate to genetic modification (*e.g.* they referred to higher yield, drought tolerance, shorter time to maturity and taste). Lack of adoption of new management practices has in part been associated with problems relating to information transfer, including lack of provision of information on the crop, and inaccurate information (Gouse, 2009; Wang *et al.*, 2009; Stone, 2007; Pemsl *et al.*, 2005; Yang *et al.*, 2005; Bennett *et al.*, 2004; Stone, 2004). In part, lack of adoption of new management practices might also have to do with reluctance to adhere to new regulations, especially in relation to re-using seed and seed sharing. As discussed in section 2.3, sharing and recycling seed are well established farming practices in many smallholder communities,

offering well-documented conveniences and benefits to those concerned. The fact that some farmers recycle and share GM seed, and the evidence that a considerable amount of GM seed is sold on the black market in some countries (notably in India), increases the likelihood that GM seed is planted by farmers who have not received information about its use. False labelling and lack of control over the source of the seed also means that both the quality of the seed and the expression of the GM trait are uncertain (Arza *et al.*, 2012; Lalitha *et al.*, 2009; Wang *et al.*, 2009; Herring, 2007b; Stone, 2007; Stone, 2004). On the other hand, unauthorised breeding and sale of GM seed has been shown to be an effective way to make GM crops affordable by resource-constrained smallholders (Huang *et al.*, 2009; Lalitha *et al.*, 2009; Herring, 2007b).

An interesting side-effect of the black market in Bt cotton in India has been that the Bt trait has been introduced into a much wider range of cotton varieties than initially offered by the patent-holder. It has been argued that this unauthorised breeding of the Bt trait into new varieties has been an important catalyst in making seed companies tailor their Bt cotton varieties to a wider range of environments (Lalitha *et al.*, 2009). Indeed, studies on Bt cotton in India and Bt maize in South Africa indicate that commercial varieties into which the Bt trait is introduced are outperformed by locally used non-GM varieties, which are better adapted to local fluctuations in rainfall (Gouse, 2012; Qaim *et al.*, 2006). This indicates that the varieties used for introduction of GM traits are an important factor in determining local suitability (Glover, 2010c).

The potential and limitations of GM crops for the rural poor have been much debated, but very few publications to date present results from studies on the effects of adopting GM crops in relation to poverty in smallholder contexts. The fact that there have been limited data available for studying this is one reason. Several studies from smallholder communities in South Africa and elsewhere report that early adopters of Bt crops are the relatively wealthier and more skilled farmers within these communities (Arza *et al.*, 2012; Gouse *et al.*, 2009; Zambrano *et al.*, 2009; Morse *et al.*, 2007a; Gouse *et al.*, 2003). This limits the possibility of early experiences to provide insights regarding the use of GM crops in the poorer sections of smallholder communities. Some studies on adoption of Bt cotton by smallholders also show that adopters spend more resources on their Bt cotton than on conventional cotton, and spend more than non-adopters on inputs. This complicates comparison between Bt and conventional cotton in farmers' fields (Stone, 2011; Zambrano *et al.*, 2009; Morse *et al.*, 2007b).

There are indications from India that the use of Bt cotton has been beneficial across wealth groups (Subramanian & Qaim, 2009). The results

from South Africa are inconclusive (Glover, 2010b). Some studies on the introduction of Bt cotton to South African smallholders specifically investigated the relative uptake and benefits of Bt cotton between smallholders from different wealth categories and found no difference in adoption rate (Morse & Bennett, 2008; Bennett *et al.*, 2006; Bennett *et al.*, 2004). In contrast, other studies from the same region have shown that Bt cotton adopters on average own more land (Shankar & Thirtle, 2005; Bennett *et al.*, 2003), a possible indicator of higher wealth status. Studies on the adoption of Bt cotton and maize by South African smallholders that report positive benefits for smallholders specifically state that they excluded from their analysis particularly marginal farmers, and also farmers who experienced yield losses due to insufficient rainfall (Gouse, 2012; Morse & Mannion, 2009). The way in which these studies have dealt with dynamic environmental and social circumstances as methodological problems (Gouse, 2012), rather than as important factors influencing smallholder farming, significantly reduces their capability to provide insights about how resource-constrained smallholders and those farming in more marginal environments[6] might or might not benefit from the introduction of Bt crops.

The above review of current knowledge on GM crops and smallholders indicates in particular a lack of clarity concerning the effects on poverty, and on the complex of factors that can influence smallholder adoption and management of a GM crop. It has been argued that a wider approach to the study of GM crop adoption, including a broadening of the focus on effects outside field level, would be better suited for identifying ways in which GM crops might or might not be of benefit to smallholders (Dowd-Uribe, in press; Schnurr, 2012; Stone, 2011; Glover, 2010b; Qaim *et al.*, 2006).

2.3 Maize in smallholder farming

Maize (*Zea mays L.*) is not indigenous to the continent but it has become the dominant staple crop in Africa (Haggblade, 2005), including in South Africa (Gouse *et al.*, 2005). It has been given a central role in the promise of the African Green Revolution (Brooks *et al*., 2009; Byerlee & Eicher, 1997).

6. Cleveland and Soleri (2005) and Cleveland *et al.* (2000) define marginal environments as environments of relatively high temporal and spatial variability and facing relatively high levels of stress. Dawson *et al*. (2008: 145) provide the following, similar, definition of marginal environments: "*Marginal environments include areas where environmental and socio-economic conditions result in complex stresses and high risks to agricultural production.*" These descriptions which fit well with how the term is used in this thesis.

Maize arrived in Africa in the 16th century and probably slightly later in Southern Africa. However, it took some time before maize acquired the dominant role as a food staple that it has today in many African countries (McCann, 2005). Beinart (1982: 21, 9 4-103) describes how throughout the 19th century, maize was grown together with sorghum in the Pondoland region of South Africa, where the villages studied in this thesis are located. By the 1930s, changes in the size of homesteads and the organisation of labour had led to maize becoming the main subsistence food crop. Sorghum, which has an open ear, has to be guarded from birds when it is ripening. Maize, which has a covered ear, does not have to be guarded to the same extent, and is also better suited for intercropping with other plants than sorghum. This enabled a more condensed planting pattern and thus allowed farm productivity to be maintained in the face of land and labour shortages[7]. As homesteads became smaller and labour migration increased[8], household labour became less abundant. In addition increasing school attendance amongst children (who previously had guarded the sorghum from birds) further reduced the household availability of labour, providing an added stimulus to the shift to maize (Beinart, 1982). Notably, the respondents in the present study connected this history directly to their own abandonment of sorghum.

Another consideration for rural resource-constrained households is the fact that maize can be consumed before it is fully ripe (McCann *et al.*, 2006). The opportunity to consume 'green' maize early in the season is important to food security and is common practice amongst South African smallholders (De Wet, 1990).

On maize breeding and development

Maize is an open-pollinating species, which means that it can both self-pollinate (pollination occurs within the same plant) and cross-pollinate (different maize plants pollinate each other) (Morris, 2002). Pollination has to be carefully controlled when developing maize varieties. As a result of this, if farmers do not take measures to control pollination in their fields (as was the case in the villages studied in this thesis), all of the maize plants will differ genetically and physiologically both from the parent generation and from each other (Smale & Jayne, 2003).

7. As described in section 2.4 and as also confirmed by Beinart (1982) colonial and apartheid policies, including enforced labour migration, still meant that despite maize being favourable over sorghum when labour is lacking, many households became short of labour and land to the extent that agricultural productivity was severely constrained.

8. The processes underlying these changes are described in some detail by Beinart (1982) and include both political-economic changes in the region and a succession of natural disasters including droughts and cattle diseases.

Because cross-pollination in maize also leads to what is called hybrid vigour, meaning in essence that some offspring commonly display favourable features, such as high yields (Morris, 2002), hybrid development has made a major contribution to modern maize improvement. Maize hybrids are produced by carefully controlling pollination to first achieve genetically homogeneous inbred lines of maize and, in the next step, to utilise the hybrid vigour by out-crossing specific inbred lines with each other (Duvick, 2001; Fitzgerald, 1993). However, the effects of hybrid vigour are quickly lost in following generations, so if maize farmers want to benefit from the high yields produced by new hybrids, they commonly become reliant on the seed industry for a continuous supply of seed (Smale & Jayne, 2003). Other major cereals, such as wheat and rice, that dominated the Green Revolution in Asia, are self-pollinating, and therefore the seeds retain their genetic and physiological identity over generations (Morris, 2002). Hence, Asian farmers who adopted new high-yielding varieties of wheat or rice could expect the high yield to be maintained as they recycled and shared seed.

Open-pollinated varieties (OPVs) of maize are related, but genetically diverse, plant populations[9]. There are certified (sometimes referred to as improved[10]) OPVs that have been bred under controlled conditions to express

9. Local open-pollinated maize varieties that farmers grow and purposefully maintain in their fields are sometimes referred to as landraces, implying that these local varieties have a certain genetic integrity. The comparatively late adoption of maize as a main crop in the South African communities studied in this thesis (compared with *e.g.* Mexico which is the origin of maize, or China, where records of maize cultivation date as far back as 600AD (Song, 1998)), in combination with the fact that farmers frequently recycle and share a range of varieties of purchased seed (depending on what is available in the nearest shop), and do not always distinguish even between purchased and local varieties (see Papers IV and V), suggest that the local maize populations grown by the smallholders studied in this thesis are not sufficiently distinct to be considered landraces. It should be noted, however, that in Mexican smallholder communities, with a much longer tradition of maize agriculture, and where local varieties are identified and purposefully maintained by farmers, farmers also frequently introduce seed lots from other communities and purchased hybrid seed into their local seed lots. This intermixing of local land races and external genetic material is a widely documented strategy in traditional maize farming communities for maintaining viable seed lots and for introducing new desirable features (Perales *et al*., 2003a; Perales *et al*., 2003b; Louette & Smale, 2000; Bellon & Brush, 1994).

10. Morris *et al.* (1999: 3) write "*By convention, the products of scientific maize breeding programs, whether OPVs or hybrids, are referred to as improved materials, reflecting the fact that their characteristics have systematically been altered in ways which bring economic benefits to those who grow them. Although use of the term improved is appropriate in this context, an unfortunate consequence of the convention is that the traditional varieties grown by farmers […] often end up being considered unimproved. This is clearly incorrect. Landraces have been subjected to numerous cycles of improvement at the hands of farmers, many of whom are skilled at identifying superior germplasm and expert at selecting individual plants that embody desired traits.*"

certain traits, but they are not purified to the same extent as hybrids. OPVs do not benefit from hybrid vigour, but they have broader adaptability and stability across environments than hybrid seed, and OPV seed can be reused without major effects on yields (Song, 1998).

The politics of maize breeding

The controlled process of hybrid development means that highly genetically homogeneous varieties are produced. This reduces diversity at genetic level, which might have negative consequences for farmers utilising biodiversity as a strategy for spreading risk (*cf.* Mercer *et al.*, 2012; Cleveland & Soleri, 2005; Song, 1998). Other features that are commonly associated with hybrids, such as high yields, high responsiveness to fertiliser and suitability in agro-ecologically optimal environments, are a result of choices made in the hybrid development process. Fitzgerald (1993) studied the introduction of hybrid maize to North American farmers in the 1930s and found that early hybrid varieties were commonly best suited to farms with good quality agricultural land, similar to that of the research stations, while farmers on marginal land were badly served by the new hybrids. This observation appears to apply with equal force to contemporary maize seed development in southern Africa; improved seed on average has not responded well to smallholders' needs and priorities (McCann, 2011; McCann *et al.*, 2006; Byerlee & Heisey, 1996).

Maize breeding programmes and policies during the colonial period were specifically designed to support the maize farming by European settler farmers, and reduce the competition from African smallholders. The focused breeding efforts by governments in Kenya, South Africa, Zambia and Zimbabwe resulted in the development of hybrid (and to a lesser extent OPV) maize varieties, which raised yields significantly on the large settler farms that occupied the land with the best soils and sufficient rain, and which had the means to provide fertiliser and sometimes also irrigation (Smale & Jayne, 2009; McCann, 2005). In Zimbabwe (then Southern Rhodesia) there was a break in this bias in the 1960s when settler farmers in the more marginal environments, as a result of sanctions, experienced losses in their export-orientated tobacco production. To support these farmers with an alternative crop, a special effort was made to develop maize hybrids specifically suited to these marginal environments. An unintended consequence of this was that smallholders adopted these hybrids widely and benefited from greatly increased harvests (McCann, 2005; Friis-Hansen, 1995).

Following independence in Kenya, Malawi, Zambia and Zimbabwe, attention was increasingly directed toward the needs of smallholders, and this resulted in new hybrids and OPVs suited to smallholder farming environments

and comprehensive policy-led efforts to introduce hybrids to smallholders, often in the form of maize-fertiliser packages. This led to significantly higher maize yields in smallholder farming (Smale & Jayne, 2009; McCann, 2005; Smale & Jayne, 2003). It can be noted in this context that South Africa achieved democratic government much later than the countries discussed above. This might explain why, despite its significant role in maize breeding efforts to benefit large-scale European settler farmers (McCann, 2005), South Africa is not included in the literature describing the later investments in maize improvements for smallholders. It might also explain the comparatively very low adoption rate of hybrids by South African smallholders. Estimates made by the South African seed industry in 2003 suggested that 90% of South African smallholders planted OPVs or recycled seed from OPVs or hybrids and that only 10% purchased hybrid seed in any given year (Gouse *et al.*, 2005). Other studies indicate that the hybrid adoption rate is considerably higher amongst smallholders in many other maize-dominated African countries (Jirström *et al.*, 2011; Leiman & Behar, 2011; Scoones & Thompson, 2011; Haggblade, 2005; Smale & Jayne, 2003; Byerlee & Heisey, 1996)[11]. Smale and Jayne (2009) report that in Kenya, Malawi, Zambia and Zimbabwe, the share of smallholders growing hybrid maize in 1990 was 87%, 43%, 65% and 98%, respectively. In Zimbabwe, sale of OPV seed was forbidden from the 1960s until after 2000, a fact that demonstrates that it is not only research and seed development efforts that explain hybrid adoption (Leiman & Behar, 2011; Friis-Hansen, 1995).

While there have clearly been considerable efforts by public sector breeders to raise yields in smallholder farming in southern Africa, these have not been sustained since the 1990s (Holmén, 2005a; Smale & Jayne, 2003). Maize research and development has increasingly passed to the private sector. Research on varieties suited specifically to smallholder environments is not prioritised, as it does not give high returns on investment, and varietal development has become increasingly focused on developing seed for large-scale farmers on optimal agricultural land (McCann, 2011; Smale & Jayne, 2009).

Another result of hybrids having been developed to suit highly homogeneous large-scale farming environments is that many hybrid (and

11. It should be noted, however, that hybrid adoption does not always refer to smallholders having adopted the practice of purchasing new hybrids every year. As a result of this, it might be somewhat misleading to compare the 10% of South African smallholders that purchase hybrid seed every year with other figures referring to hybrid adoption, which might include both those purchasing seed every year and those having adopted hybrid seed at some point in time.

current GM) varieties[12] are visually very similar. This visual similarity, in combination with insufficient information on new seed, may make it difficult for smallholders to distinguish between maize varieties (Stone, 2007; Tripp, 2001). With this in mind, coupling the introduction of new seeds with agricultural advisory services is central if smallholders are to successfully adopt and benefit from new seed (Tripp, 2001).

Beyond a focus on yields

The strong focus on yield in varietal development has side-lined other features in maize that smallholders value (Brooks *et al.*, 2009; McCann *et al.*, 2006). For example, smallholders commonly prefer the hard grain maize varieties that are more tolerant to local storage conditions and give a better return in home processing. However, modern hybrids are almost exclusively developed from softer varieties of maize that suit large-scale industrial processing (Li *et al.*, 2013; McCann *et al.*, 2006; McCann, 2005; Smale & Jayne, 2003; Byerlee & Heisey, 1996).

In stressing the importance of storability, Smale *et al*. (1991) noted that when maize yields are corrected for post-harvest losses in small farm storage and processing, many of the commercially available hybrids are inferior to local varieties at low input levels. Risk mitigation in smallholder farming (which is further discussed in section 3.4) also means that many smallholders value stability in yields over yield maximisation (Foti *et al.*, 2008; Soleri *et al.*, 2008; Brush, 2004; Cleveland *et al.*, 1994; Haugerud & Collinson, 1990). For this reason smallholders may prefer OPV seed over hybrids (Louette & Smale, 2000). Furthermore, smallholders may prefer local varieties or certified OPVs that can be recycled, since this allows farmers to keep costs down and to retain some degree of control of seed delivery (Brooks *et al.*, 2009; Pixley & Banziger, 2004).

12. The GM maize varieties that are on the South African market today are all bred into hybrid maize varieties (The Registrar of Plant Improvement, 2012).

Figure 2. Local storage container for maize. Many smallholders in the study considered local 'Xhosa' maize to have better storage qualities than the Bt and hybrid maize varieties distributed during the MFPP (photo: K. Jacobson, 2006).

2.4 A history of agricultural development in South Africa

In the study area for this thesis, farming is only one of many activities that households rely on for a living. Indeed, in many smallholder households in the former South African homelands, other activities are more central for creating livelihood outcomes than farming (Hajdu, 2006; Bryceson, 2004). A core reason for this can be found in history. African farmers in many countries experienced dispossession of land during the colonial era (Berry, 1993). Hendricks (2003), summarising other studies, shows how settlers in Zambia took 3% of the land, in Malawi 5%, in Namibia 43% and in Zimbabwe about 50%. In South Africa, however, the ruling minority grabbed 87% of the land and created a more comprehensive organisation of systematic control and dispossession of the majority population than anywhere else in the region (O'Laughlin *et al*., 2013; Hendricks, 2003). By forcing the majority population to live in 'homelands' on land areas too small to permit farming as a sole livelihood strategy, able-bodied men and women were forced into labour

migration (Hendricks, 1990). This undermined agricultural production in the homelands and made it dependent on the cash inputs from migrant labourers. Agriculture also became a form of old age security and fall-back strategy for retrenched mine workers (McAllister, 1992; Bundy, 1988).

Today, almost two decades after South Africa achieved democratic government, the highly skewed distribution of farmland largely remains, and poverty continues to be concentrated in the former homeland areas. Because of the historically high reliance on urban wage work as a central resource to secure rural livelihoods, the slump in demand for unskilled labour that occurred as South Africa became democratic and opened up to the outside world has hit rural areas hard, and has had a clear negative effect on smallholder agriculture. In contrast, the increased state spending on welfare payments since democracy has been found to have positive effects on poverty reduction in rural areas (O'Laughlin *et al.*, 2013; Devereux, 2007; Bryceson, 2004; Natrass, 2003; Nattrass, 2000).

As described in more detail in Papers I, III and IV, South Africa has a long history of agricultural development interventions focusing on reducing rural poverty by raising production levels and improving efficiency and environmental sustainability in smallholder agriculture. As will be described below, research shows how the strategies employed in past interventions in South Africa have not led to the improvement of smallholders' livelihoods through agriculture (Hebinck *et al.*, 2011; Fay, 2003; McAllister, 1992; De Wet, 1990).

A core idea with establishment of the homelands was to exploit them as labour reserves, so land was purposely limited to reduce the possibilities for subsistence solely on agriculture. The resulting high pressure on the land in many areas led to degradation of agricultural land and increasing poverty (Hendricks, 1990; Bundy, 1988). Several pre-democracy interventions were aimed at raising agricultural production and reducing degradation in the homelands, but the aim was always to do this without disturbing the larger political organisation in South Africa. Therefore such interventions focused solely on changing local land use, without addressing the larger political reasons for the situation (Lester *et al.*, 2000; Hendricks, 1990).

The Betterment reorganisations, referred to in the title of this thesis, aimed to raise agricultural production, reduce degradation and make it easier for authorities to intervene in rural areas, for example through agricultural development projects or provision of government services such as supply of water for domestic use (Fay, 2003; McAllister, 1992; Ferguson, 1990; De Wet, 1989). Previously scattered settlements were reorganised into nucleated villages and separate areas were designated for grazing and agricultural land

(McAllister, 1992). The organisation of agricultural land into larger units was intended to facilitate large-scale mechanisation, for example, which was envisioned to increase the efficiency of farming practices (De Wet, 1990). The reorganisations were made without any attempt by the authorities to understand local reasons for scattered settlement and farming patterns. As a result, they faced local resistance, were often only partially completed, and in many ways made it more difficult for people to rely on farming as they severely reduced the flexibility in the land use pattern (Andrew & Fox, 2004; Beinart, 2002; Bernstein, 1998; McAllister, 1992; De Wet, 1990; Beinart, 1984).

There were also a series of top-down agricultural interventions targeted at smallholders in the homelands during the apartheid years. These commonly aimed at raising agricultural production through the introduction of high-yielding hybrid maize varieties, fertiliser, monoculture production and mechanisation (De Wet, 1990; Ellis-Jones, 1984). These interventions undermined smallholders' possibilities to use agriculture for subsistence purposes and at the same time did not provide alternative subsistence means or make it possible for smallholders to actually engage in agriculture on an equal footing with large-scale farmers. The programmes reduced diversity and flexibility in farming by introducing costly inputs and hybrid seeds that were higher yielding but expensive and more sensitive to environmental dynamics. This increased risk-taking in farming. They also undermined local engagement in farming by only allowing smallholders to partake in programmes as labourers on their own land, without the possibility to influence design or implementation (De Wet, 1990). Scott (1998) describes how similar top-down standardised schemes have been implemented in poor rural communities throughout the world, in many cases with the focus on raising agricultural production through the introduction of inputs and practices originally designed to suit large-scale farming. He also shows how these schemes have largely failed, and cites insensitivity to local conditions as a key reason for such failure.

2.5 An introduction to the case

In 2001, Monsanto, with assistance from the provincial Department of Agriculture offices, introduced Bt maize in demonstration trials to a total of about 3000 smallholders in different parts of South Africa, including Eastern Cape Province (Gouse, 2012). The villages studied in this thesis took part in these demonstration trials and in an associated two-day workshop held by Monsanto (the Yieldgard® training programme). During the workshop, the stem-borer resistance of Bt maize was explained, as well as the obligation to

plant refugia. Participants were provided with samples of Bt maize (CRN 4549B), conventional hybrids (CRN 3549) and fertiliser, and were instructed to plant and compare the two maize samples with each other and with their local maize varieties. They were also instructed to monocrop the maize and not to recycle the Bt seeds from their harvest, with the warning that recycled seeds would give poor yield.

One year after the demonstration trials, in 2003, the study villages entered the Massive Food Production Programme (MFPP), planned and implemented by ECDA. The programme was active in the villages until 2007. The fieldwork described in this thesis was performed in 2006, 2008, 2009 and 2012, *i.e.* towards the end of the MFPP and after the programme had left the villages.

Based on the facts that rural poverty was increasing in the province and that many of the rural poor had access to agricultural land that they did not use, the MFPP aimed to reduce rural poverty by increasing agricultural production. The cornerstones in the MFPP were to raise yields through the introduction and 'appropriate use' of inputs such as maize seeds and fertiliser, increased mechanisation, and increased economic responsibility and commitment to farming amongst targeted smallholders. The latter was to be achieved through a conditional grant, which specifically aimed at mitigating a perceived 'dependency syndrome' created by past unconditional support. Thus in the MFPP, grants were conditional upon compliance with the programme and were planned to be reduced stepwise during five years. It was envisaged that participating smallholders, by using the new inputs and transforming their farming practices in accordance with programme guidelines, would manage to produce successively higher yields and would be able to sell surplus maize, thereby after five years managing to pay fully for their inputs.

Monsanto, which already had contact with the villages, took part in planning discussions on the MFPP and was the key input supplier in the villages studied in this thesis. During the first three years, the villages were provided with Monsanto's Bt maize varieties CRN 4549B and DKC 7815B based on an agreement between the local chief and Monsanto. The chief based his choice of Bt maize on the fact that Monsanto was the only seed company that had demonstrated its seed in a local trial. During the fourth year of the programme, a large-scale commercial farmer was contracted by the MFPP as a consultant to act as a 'mentor' to participating smallholders in the villages. The consultant who took over the ordering of inputs, was unaware that Bt maize had been planted previously and ordered a conventional hybrid from Monsanto (SNK2551) to be planted in the fourth season. Due to lack of communication between the consultant and the chief, the chief believed that Bt maize had also been planted in the last season.

Due to practical problems in the MFPP administration, mechanisation and inputs repeatedly arrived late in the studied villages, as well as in other villages participating in the programme (Damgaard Hansen, 2006). As a result of this, smallholders either planted maize very late, resulting in suboptimal yield, or they did not plant at all and saved the seeds and inputs for the next season. Therefore, in 2007/2008, when the villages studied here were no longer part of the MFPP, many smallholders were still planting seeds remaining from the programme.

Because of the input delays, the villages studied here, like many other participating villages in the MFPP, managed to negotiate a waiver on the pay-back of the conditional grant during some years. However, the participating villages and the MFPP management did not agree about the extent to which payment should be waived, or about the general capability of smallholders to pay for seeds and inputs. Other issues in the programme, such as the choice of seeds, monocropping and the exclusion of smallholders with unplanted fields, as described in more detail in Papers I-V, did not create upfront dissent among the participants, but disagreement was shown in a variety of other ways, for example through non-compliance with the programme guidelines. Non-compliance was interpreted by the MFPP management as a confirmation of their conceptualisation of local people as uncommitted and incompetent. The disagreements between programme management and the villages studied here caused the three villages, along with many other villages, to leave the MFPP after completing four of the intended five years (Masifunde Education and Development Project Trust, 2010; Damgaard Hansen, 2006). The MFPP management for its part argued that the villages had not paid back a sufficient amount of the conditional grant to be allowed to enter the last season and also insinuated that local corruption was the main reason for their exclusion.

The fact that there was an obvious clash between how programme managers interpreted smallholder farming and the reasons for non-compliance, and how the same issues were interpreted by smallholders, led me to the conclusion that it was not the practical implementation problems that were the core reason for the failure of the programme. While these practical problems had obvious and significant effects for the outcome of the programme, this thesis takes as a starting point the fact that the practical problems to a large extent stemmed from smallholders and programme managers having fundamentally different ideas about the nature of the problem that the MFPP targeted, and about how it should be addressed. Therefore, when investigating whether the MFPP approach was appropriate for enhancing smallholders' livelihoods through agriculture (RQ 2), this thesis focuses on the ideas about agriculture, poverty and development that shaped the design and implementation of the MFPP and

studies these in the light of an analysis of the broader livelihood situation of the targeted smallholders' and their farming practices (RQ 1). By investigating in depth the extent to which ideas and practices associated with Bt maize were a result of its association with the MFPP, or resulted from processes that were not specific to the MFPP, it was also possible to learn about particular effects of the introduction of Bt maize to smallholders in this context (RQ 3; Paper V), and effects of the association between the Bt maize introduction and the MFPP (RQ 4; Paper IV; Section 6).

Figure 3. Field area outside village. Individual fields were relocated and arranged together in large field units in 1977 as part of the Betterment reorganisations (photo: K. Jacobson, 2008).

3 Conceptual framework

Much research shows that if new agricultural technology is to be of benefit to smallholders, those who develop and introduce the technology must understand the farming context of smallholders (Scoones & Thompson, 2009; Cleveland & Soleri, 2005; Scoones & Thompson, 1994; Chambers *et al.*, 1989). Farming is often only one of several livelihood activities drawn on by the rural poor. Therefore, when seeking an understanding of the role that agricultural development can have in reducing rural poverty, it is of value to place farming in a wider livelihoods context (Ellis, 2000). With this in mind, a livelihoods approach was adopted in this thesis (section 3.2).

The strength of livelihoods research lies in its detailed engagement with local practices and perspectives in analysing how people deal with poverty (Scoones, 2009). However, poverty is also caused and maintained by larger processes that are outside the control of the poor (Lines, 2008; Du Toit, 2005a). To understand the effects of macro-level processes on local livelihoods, the local contemporary perspective has to be broadened in scope and extended in time. In this thesis, the historical literature on political developments in the region and their effects on smallholders contributed an important perspective on contemporary local livelihoods, as outlined in section 2.4 and in Papers I-IV. It also contributed to analysis of the strength of the ideas on which the MFPP was built, as part of Critical Discourse Analysis (CDA) (Fairclough, 2001; Chouliaraki & Fairclough, 1999; Fairclough, 1995). CDA was used theoretically and methodologically to examine the ideas that governed the MFPP, and how the introduction of Bt maize was envisioned from a policy perspective.

In this thesis, the livelihoods approach in combination with CDA constituted the main conceptual and methodological framework which guided data collection and analysis. However, other complementary research traditions were also important for me in developing my understanding of rural

livelihoods and farming and the connections between farmers and their surrounding dynamic social and natural environment. In particular, I drew on ideas from resilience thinking (Gunderson & Holling, 2002; Holling, 1994; Holling, 1973) and systems ecology in the version developed by H.T Odum (Odum, 2007)[13]. How ideas from these theoretical traditions provided a complement to livelihood research and CDA in the conceptualisation of possibilities and constraints in smallholder farming is further described in sections 3.3-3.5.

3.1 A definition of smallholders

The term 'smallholder' is central in this thesis. Therefore at this point it is important to clarify what is meant when the term is used in this thesis. The term has been used to describe a wide range of rural producers with the common denominator that they have comparatively small land holdings (Cousins, 2010; Netting, 1993). For example, Kremen *et al.* (2012) define smallholders as those with access to a land holding not larger than 2 hectares. However, this focus on the size of landholdings might obscure other differences or similarities between farmers that are of relevance for how farming is organised (Cousins, 2010), such as quality of land, access to credits, markets or labour, *etc.* Djurfeldt (2005) uses smallholder to refer to farmers with land holdings which are mainly worked on and managed by a family or household and where the production mainly goes to household subsistence. In Africa today, including South Africa, smallholder farming is commonly organised at the household level, using mainly family labour, with access to 1-2 hectares of arable land (Cousins; 2013; Scoones & Thompson, 2011; Larsson, 2005).

Drawing on Altieri and Toledo (2011), Kremen *et al.* (2012), point out that while there are smallholders who operate throughout the spectrum from using no external inputs to being heavily dependent on modern seed varieties, mechanisation, fertilisers and pesticides, up to 50% of smallholders are thought to employ low-input farming methods. This is the case for the majority of African smallholders, and those in the villages included in the case study for this thesis.

Another reason for using the term smallholder is to make the specific point that the people referred to are not chiefly farmers, but engage in many other livelihood activities. Hajdu (2006) and Beinart (pers. comm. 4/4/2012), both of whom conducted detailed research on rural livelihoods in villages located in

13. Hereafter, when the term systems ecology is used it refers specifically to the theory developed by H.T Odum.

the same South African region as those in the present study, use the definition in this way. Ellis (2000) argues that smallholders almost invariably rely on a multitude of livelihood activities, including farming, and therefore it should not be taken for granted that farming is the central livelihood strategy for smallholders. By analysing the role of farming in the wider livelihoods context, Ellis (2000) also argues that we can gain new insights about the role of agriculture for the rural poor. This might be of specific importance when studying South African smallholders, because of the historical interdependency between subsistence farming and urban wage work (Carr & McCusker, 2009; Slater, 2002).

Drawing on the definitions provided above, and acknowledging that many smallholders also fall into the 'rural poor' category, in this thesis the term smallholder is reserved for people that farm small (about 1-2 hectares) land holdings, draw mainly on family labour, and use limited amounts of external inputs such as fertilisers and pesticides. While the term is not specifically used here for subordinating the role of agriculture in favour of other livelihood activities, it is acknowledged that farming should not be uncritically placed at the centre in analysis.

3.2 Livelihoods perspectives

In its simplest form, a livelihood can be defined as a means of securing a living (Chambers & Conway, 1992). Livelihoods research has developed as a field of poverty-related research, often specifically examining rural livelihoods (O'Laughlin, 2004). At the roots of much contemporary livelihoods research is the concept of sustainable livelihoods (SL), as developed initially by Chambers and Conway (1992), which inspired the development of the sustainable livelihoods approach (SLA) and associated frameworks for analysis (Farrington *et al.*, 1999; Carney, 1998; Scoones 1998).

The concept of a 'sustainable livelihood' was developed in the 1990s as a reaction to earlier, more structurally focused, perspectives on poverty (De Haan & Zoomers, 2005). It was argued that this structural focus created an unhelpful pessimism about the possibilities to escape rural poverty. To counter this tendency, emphasis was placed on the fact that people, while limited by various structural conditions, still have some room to make their own history. Livelihoods research was thus directed at building knowledge about how poor people draw on the resources they have at hand to make a living, while being enabled and constrained by larger structures and dynamics (Chambers & Conway, 1992).

The SL framework was also a reaction against one-dimensional and top-down approaches to studying poverty. While quantifiable measures of poverty are useful for indicating statistical trends and whether phenomena found locally are part of a wider trend, contemporary poverty research acknowledges that how poverty plays out is context-dependent. Therefore, for quantitative measures of poverty to be relevant, they must be informed by an understanding of what poverty actually means to the people whose poverty is being measured (Addison *et al.*, 2008; Rakodi, 2002). The SL framework recognises that the rural poor commonly draw on a multitude of assets and activities to secure a living for themselves and their families, and that they commonly describe their poverty in other terms than only low incomes or lack of resources. In summary, livelihoods approaches emphasise:

1. The agency of the rural poor, including the fact that they have important insights about their own poverty.
2. That the assets that poor people draw on, and the strategies they employ to make a living, are diverse and multidimensional and can only be fully understood by embracing local perspectives.

A central aspect of the multidimensionality of livelihoods is that the effects and experiences of poverty, and the ways people organise their livelihoods, differ between people in rural communities (Carter & May, 1999; Scoones 1998). Francis (2006: 1) emphasises that "*studying "the poor" as a homogeneous category is superficial and misleading*", while Ellis (2000) points out that as a result of failing to acknowledge local heterogeneity and the effects of poverty on marginalisation, many development interventions have unintentionally been biased towards those who are better-off. In the present thesis, a participatory wealth ranking exercise (described in section 4.4) was performed with the dual purpose of better understanding local conceptualisations of poverty and organising households into different poverty groups based on local poverty categories. This allowed poverty-sensitive analysis of qualitative and quantitative data, presented in Paper IV in particular.

There are a set of commonly used concepts within livelihoods research. However, there is some diversity in how these concepts are defined and used. Following the definition by Chambers and Conway (1992: 6) in brief a livelihood can be defined as the combination of "*the capabilities, assets (stores, resources, claims and access) and activities required for a means of living*". The capabilities concept included in this definition draws on Sen (1983: 334), who argued that *"[t]he commodity ownership, or availability itself is not the right focus since it does not tell us what the person can, in fact, do"*. With this concept

of capabilities, Sen (1985) thus shifted attention towards what people can be and do with available resources. The importance of the focus on capabilities is visualised for example in Paper IV, which revealed that despite having similar numbers of household members to wealthier households, poorer households were still *de facto* more labour-constrained, with negative effects on their engagement in farming. One reason for this was that these households were harder hit by old age and disease, reducing the capability of household members to engage in farming.

While acknowledging that what people can *do* rather than only what they *have* is central in all livelihood research, Ellis (2000) deliberately opted not to use the concept of capabilities when defining livelihoods, since the concept overlaps in meaning with both assets and activities. Thus Ellis (2000: 10) defines a livelihood as:

> The assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household.

A broad definition of assets, including material and non-material resources, is central to most conceptualisations of livelihoods (Rakodi, 2002). As in the definition provided by Ellis above, assets are often defined as a number of forms of capital (Ellis, 2000; Bebbington, 1999; Farrington *et al.*, 1999), commonly divided into physical, human, natural, financial and social capital. Examples of physical capital might be roads or fencing; an example of human capital might be education, and examples of natural capital might be soil quality or forest products used for firewood. Farrington *et al.* (1999) emphasise that the list of capitals is not exhaustive, but should be used as inspiration to acknowledge the diversity of capital forms apart from financial capital that exist and are important for understanding how poor people create their own living in rural areas. Central to the discussion of multiple capitals is the acknowledgement that they are in part interchangeable (De Haan, 2002; Bebbington, 1999; Farrington *et al.*, 1999).

Livelihoods research has been accused of conceptualising capitals in general and social capital in particular as conditions of individual households rather than as products of relations, and as a result failing to pay sufficient attention to the effects of power relations between groups on households' capabilities and access to assets (Van Dijk, 2011; Du Toit, 2005b; Schuurman, 2003; Murray, 2001). Van Dijk (2011: 101) argues that livelihoods research constructs poverty as "*a lack of 'capitals' (a condition) rather than as an absence of entitlements (a relation).*" Murray (2001)

similarly argues that capitals should be understood as a result of social relations, not as attributes of rich or poor individuals or households. This critique, in my understanding, calls for a shift of attention from comparing the actual capitals that certain individuals or households enjoy to studying the processes and relations that enable and constrain certain individuals or households in acquiring and using certain capitals; the argument being that it is by understanding these processes that we can learn more about the causes for poverty.

Figure 4. Left: Piles of firewood. Right: Local sled used for transporting maize from the fields. Wealthier households could pay others, or use their cattle, to perform laborious tasks such as collecting firewood, which released labour time for investing in other activities (photo: K. Jacobson, 2008).

In his definition of livelihoods Ellis (2000: 10) specifically emphasised the importance of access in determining whether available assets will be used, with specific emphasis on the role of social relations in mediating access to assets. It is acknowledged in this thesis that poor people often invest considerable resources in maintaining social relations in order to improve their livelihood security (McAllister, 2008; Berry, 1993). One example of this in the present

work is the important role that neighbours and friends had for ensuring seed supply when households failed to save sufficient seed themselves (Paper IV). This can also serve as an example of the interchangeability between different capitals, where households with good relations with neighbours and friends in part could replace this with having their own supply of seed.

It has also been noted, however that social relations between people are not always or necessarily mutually beneficial; one party may benefit to the detriment of the other (Du Toit, 2005b; O'Laughlin, 2004; Carter & May, 1999). Paper IV describes how the possibility to engage in farming in the case study villages was partly determined by the ability of the household to draw on labour from outside the household. Wealthier households could pay poorer households to perform laborious tasks, which strengthened the ability of the wealthier households to engage in farming. Poorer households, in contrast, further reduced their chances of planting their own field when, in order to satisfy their own immediate household needs, they provided their labour to someone else. This example also highlights the well-established fact that poor people are often forced to make choices for the sake of meeting immediate needs, despite being aware of the negative long-term livelihood effects (Wood, 2003).

To capture the diverse and context-dependent features of rural poverty and livelihoods, this thesis studied:

1. The different assets and activities that people draw on when constructing their livelihoods.
2. The ways in which people access assets (including reasons why people might fail to access assets).
3. The capabilities people have to use available assets.

The livelihoods framework, described above, is useful for understanding how people respond to larger processes that constrain and enable them in reaching their livelihood outcomes. However, if we acknowledge that poverty is also caused and maintained by processes outside the hands of the rural poor, to understand the reasons for rural poverty we must also study these larger processes. How the relations between smallholders and these larger processes are conceptualised in this thesis is further discussed in sections 3.3-3.6.

3.3 Smallholders' livelihoods in a dynamic world

Already in early livelihoods approaches the need to understand micro-macro links was emphasised as a core principle in an otherwise flexible framework (Farrington *et al.*, 1999; Scoones 1998). Despite this, it has been argued that much livelihoods research has failed to make these micro-macro links in analysis, or has done so insufficiently by treating macro issues as matters to be dealt with locally, rather than being critically analysed from a pro-poor perspective (De Haan & Zoomers, 2005). It has also been argued that having a strong actor/micro focus in livelihoods research has sometimes led to conclusions that are somewhat naively positive about the possibilities of poor people, through their own strategies, to reduce their poverty (De Haan, 2002). With this in mind, it has been suggested that a way to make livelihoods research produce more relevant knowledge for rural development is to combine the insights about local livelihoods derived from detailed empirical work with research on the effects of power and politics (Scoones, 2009; Bryceson, 2004; O'Laughlin, 2004; Francis, 2002; Murray, 2001). In this thesis this is done mainly by placing livelihoods in a historical perspective and by combining livelihoods analysis with a CDA of agricultural policy directed at the rural poor (described further in section 3.6). In Papers I and II, the results from the discourse analysis are discussed drawing on research on the concept of development, which provides further understanding about the dominance of certain ideas, in South Africa and globally, for shaping smallholder agricultural development.

This thesis also draws on insights from systems ecology in the version by H.T Odum (2007) and resilience thinking (Folke *et al.*, 2010; Gunderson & Holling, 2002) for the purpose of better understanding how access to different resources affects the organisation of farming and how smallholders are affected by, and relate to, their surrounding dynamic (social and natural) environment. Both resilience thinking and systems ecology are associated with a tradition of complex systems thinking, but they have developed in different ways and focus on different properties of complex systems. I did not use either resilience thinking or systems ecology as a complete theory, but drew on them specifically for the purposes stated above, as further described in sections 3.4 and 3.5. In this section I briefly describe how complex systems thinking was important for me in forming a way of conceptualising the interaction between processes occurring at different scales (*e.g.* local farming in relation to agricultural policies or dynamic weather patterns), and how I connect this to my use and understanding of livelihoods and CDA.

At the core of complex systems thinking is an acknowledgement of the world as an intertwined web of processes at different scales[14]. While locally ordered structures of interrelated processes (which might be studied as systems) exist everywhere around us, a foundation for complex systems thinking is that these structures are neither static nor isolated, but are subjected to constant (slower or faster) change in relation to their surrounding environment. Central to the acknowledgement of the world as interconnected and constantly moving is that this makes it impossible to understand it, or any part of it, by studying individual components outside their context (Ison, 2010; Schiere *et al.*, 2004). This perspective is central to this thesis, and to livelihoods research in general (Scoones, 2009). Based on an understanding of complex systems, it is acknowledged in this thesis that for research on Bt maize to be relevant for the smallholders studied, it is not sufficient, or maybe even relevant, to present results about how the new seed performs in a controlled agricultural research setting. Rather, to provide knowledge which is relevant for the smallholders in the study, we need insights about how Bt maize performs in complex and dynamic smallholder contexts. This perspective might be termed 'systemic' (*cf.* Ison, 2010) and in essence it has to do with engaging with a complex subset of reality in order to produce context-dependent knowledge which is of relevance to those engaged in that reality. While findings from this kind of research are essentially context-dependent, by also studying how the local context is nested within larger and slower processes it might be possible to reveal certain larger patterns in these relationships, which might be of relevance for understanding events in other similar contexts. This has to do with the interaction between dynamic processes at different scales and is further discussed below.

A starting point of complex systems thinking to which both resilience thinking and H.T. Odum's systems ecology relate is that as processes in the world are intricately intertwined, changes in one place can have unexpected effects in other unexpected places (Schiere *et al.*, 2004). At the same time, because of the way processes sometimes organise more tightly and reinforce each other, there are temporary forms of comparative predictability and growth (Schiere *et al.*, 2004; Holling & Gunderson, 2002; Holling, 2001). During periods of this kind of comparative predictability and growth the world might

14. There is a diversity within complex systems research with regards to how 'systems' are conceptualised, from meaningful metaphors to studying certain situations (*cf.* Ison, 2010), to ontologically real (but still open and in interaction with the surrounding environment) (*cf.* Odum 2007). My own perspective is that 'systems' in themselves are not real but the interconnectedness between processes in the world is, and that this interconnectedness produces certain empirically observable effects that we can only see by taking a systemic approach.

appear to be behaving in a quite linear and predictable manner. Many large-scale farmers have long been tightly connected to and benefited from a socioeconomic support structure in the form of infrastructure, credit support and advice on new inputs, and they rely on what to date has been a seemingly stable flow of fossil fuels. As long as this supportive structure and the flow of fossil fuels continue to appear rather stable, farmers might perceive their farming as a linear and predictable process and organise it accordingly (*cf.* Odum 2007). As described in section 2.4 and in Papers I-V the resource-constrained smallholders who are the focus in this thesis have not benefited from the same socio-economic support that large-scale farmers have long enjoyed. They also rely to a lesser extent on a stable and predictable flow of fossil fuels. Therefore, the world appears much more unpredictable and dynamic to them. Under these circumstances, it makes sense to buffer for this uncertainty through diversification and remaining flexible in the face of change, as described in section 3.4. However, according to complex systems thinking a more stable phase is always temporary, and because of the intertwined nature of the world, there is at any point in time always a possibility of change (Odum, 2007; Schiere *et al.*, 2004; Holling *et al.*, 2002). Today, the effects of anthropogenic climate change as well as changes in the availability of fossil energy affect our view of large-scale farming as a stable and predictable process. Another example of where this comparative stability has been disrupted is when large-scale South African farmers, who had long been subsidised and protected from the dynamics of the global market, were faced with increasing competition and uncertainty as South Africa opened up to the rest of the world and liberalised its agricultural policies (Gran, 2009; Vink, 2004). Many of these large-scale farmers found it difficult to cope in this changing environment, and a common strategy to deal with this change and increasing uncertainty was, like smallholders, to diversify into other activities than farming as well as into other crops (Vink, 2004).

A concept of scale is central in both resilience thinking and systems ecology. This is implicit in the examples mentioned above, where the description of events indicates how markets, a social support structure and fossil fuels are processes that to some degree control the outcomes for individual farmers. Indeed, according to resilience thinking, larger and slower processes generally set the boundaries for smaller, faster processes. However, processes are dynamic and their openness to change varies over time. This means that there are moments when smaller, faster processes also have the possibility to affect the trajectory of larger processes (Holling *et al.*, 2002). For me this means in practice that the hierarchical relationship between processes should never be presupposed, but needs to be studied empirically. From a

theoretical perspective informing the version of CDA drawn on in this thesis, Chouliaraki and Fairclough (1999: 22) define social structures as "*long term background conditions for social life, which are indeed transformed by it, but slowly*". Thus while discourse, as a form of social structure, is more long-lasting and generally sets the boundaries for human agency, the extent to which a discourse is open to change at any point in time depends on the strength of the discourse in itself and its relationship to other interacting discourses and practices, and this has to be empirically investigated (Fairclough, 2003). This thesis combines this perspective with the conceptualisation of dynamic cross-scale interactions presented above. Thus, in this thesis, structures are conceptualised as relatively permanent conditions (or slower and larger processes) which both set boundaries for action and make it possible. Because of the dynamics, nestedness and unpredictability of processes in the world, however, we cannot presuppose that larger processes (or structures) control agency at any particular point in time, but these relationships must be empirically determined.

3.4 Livelihoods, diversity and farm resilience

The surrounding social environment (lack of social security, changing market prices, low and insecure incomes gained from wage work, *etc.*) is commonly perceived as highly unpredictable for poor households (Dercon, 2005; Ellis & Freeman, 2004). In the absence of outside support structures, this unpredictability in the surrounding environment to a large extent has to be managed locally (Robbins, 2004; Bryant & Bailey, 1997). The way in which smallholders must relate to dynamics in the surrounding social and natural environment is described in a short passage by Cousins (2010: 10):

> Farming (as with small enterprises in general) is inherently risky, and the simple reproduction of rural households is by no means assured. Producers have to contend with both risks and opportunities arising from their conditions of access to land, credit and markets, their relationships with powerful groups such as landowners or agro-processing companies, the vagaries of nature, relative prices within markets for inputs, outputs and consumer goods, and state policies. Shocks such as drought and disease can undermine productive capacity. Inevitably, some producers fare better than others in responding to these risks and opportunities.

Much livelihoods research has shown how diversification is a key strategy for ensuring livelihoods in uncertain circumstances (Dercon, 2005; Bouahom *et al.*,

2004; Niehof, 2004; Slater, 2002; Murray, 2001; Ellis, 2000). Households can diversify by relying on a multitude of assets and activities, and diversification is also common within farming through *e.g.* planting a variety of crops. I found it useful to draw on insights from resilience thinking for better understanding the role of diversity for dealing with uncertainty and spreading risks in smallholder farming. Resilience thinking (Folke *et al.*, 2010) has its origins in ecology, but much research using resilience as a concept has come to focus on finding ways to build resilience in ecosystems managed by humans, such as farming systems (Darnhofer, 2010; Enfors & Gordon, 2007; Milestad & Darnhofer, 2003; Folke *et al.*, 2002; Walker *et al.*, 2002). Resilience as an ecological concept was described by Holling (1973: 17) as the: "*persistence in relationships within a system*" and "*a measure of the ability of these systems to absorb changes […] and still persist*". This definition of resilience, which is sometimes also termed adaptive capacity (Holling, 2001), refers to the possibility of a developed set of interacting and mutually reinforcing processes to stay within that domain of interaction or stability (Walker *et al.*, 2004). This does not mean that relationships are fixed or static; on the contrary it is inherent in resilience thinking that the world is interconnected, dynamic and changing (Fraser, 2006; Walker *et al.*, 2004; Holling, 2001). Resilience in this context means being able to deal with this uncertainty and change (Berkes, 2007).

Resilience as a concept can be used for studying how farmers might be affected by larger scale dynamics, and how they respond to these by adapting their farming practices (Darnhofer, 2010; Darnhofer *et al.*, 2010; Enfors & Gordon, 2007; Milestad & Darnhofer, 2003). The resilience of a system, such as a farm, towards change depends both on the relationship with larger scale dynamics and on features inherent in the system (Gunderson & Holling, 2002). Dynamic weather patterns or changing agricultural policies can for example be seen as larger scale dynamics that smallholders must deal with, but have limited possibilities to influence (Bacon *et al.*, 2012; Darnhofer, 2010). Resilience in the farming system is thus mainly built by managing dynamics at lower scales, such as by nurturing diversity (Darnhofer, 2010; Milestad & Darnhofer, 2003). Nurturing diversity has been found to be a key component in building farm resilience at local level (*cf.* Kremen *et al.*, 2012; Maina *et al.*, 2012; Brooks & Loevinsohn, 2011; Lin, 2011; Milestad, 2003; Vandermeer *et al.*, 1998). Equally important is the possibility for the farmer to use available diversity, for example by keeping an openness to change through the possibility to move between different activities or draw on different resources. This is sometimes referred to as flexibility (Kenny, 2011; Darnhofer, 2010; Darnhofer *et al.,* 2010; David *et al.,* 2010). This ability to be dynamic and move between different activities in the face of changing circumstances is also

acknowledged within livelihoods research (De Haan, 2002). Chambers and Conway (1992) refer to this as dynamic capabilities. Both diversification and flexibility are important strategies used by smallholder maize farmers for dealing with fluctuations in weather and risks caused by social constraints. With specific reference to maize farming, smallholders might for example plant genetically diverse maize populations, intercrop maize with other plants; adapt the timing of planting in relation to weather and availability of local resources; and spread planting dates to ensure that some maize planted gets sufficient rain (Foti *et al*., 2008; Brush, 2004; Louette & Smale, 2000; Byerlee & Heisey, 1996; Haugerud & Collinson, 1990).

In this thesis, insights from resilience thinking about the connections between diversity and resilience, as described above, proved important during analysis of livelihoods data, as they provided a more developed framework for understanding the role of diversity for rural livelihoods than was provided by only drawing on livelihoods research.

Figure 5. Maize and pumpkins in a garden. Maize was often intercropped, in fields with pumpkins and beans, and in home gardens often together with a wide range of vegetables. Some naturally occurring plants were also commonly harvested and eaten together with maize (photo: K. Jacobson, 2008).

3.5 Systems Ecology and the organisation of farming systems

To better understand how access to different resources affects farmers' possibilities to organise farming in different ways, Paper II draws on systems ecology (Odum, 2007; Odum, 1994). The Odum approach to systems ecology has generated detailed studies describing how the organisation in a system, such as a farm, depends on the resources available for energy use.

Systems ecology draws on theoretical insights about the thermodynamics of self-organising processes and studies the flow and transformation of energy in self-organising systems (Odum, 2007; Odum, 1988). The theory is based on an observation that everywhere in the world around us we can observe locally hierarchically ordered systems, such as ecosystems. Importantly, as described in section 3.3, these locally ordered systems are not static or closed but are dynamic and in constant interaction with the surrounding environment. In this thesis I did not apply the theory in full and I not did engage in the extensive calculations of energy flows that are needed for applying the theory methodologically. Instead, I specifically drew on insights from systems ecology for conceptualising how the availability of different resources affects the organisation of farming, and, in combination with resilience thinking, for understanding how the organisation of farming is affected by the relationship with surrounding dynamic processes working at different scales, as described above (section 3.3). Below I describe in brief the parts of the theory that I found useful in my work.

H. T. Odum introduced the concept of 'emergy' (with 'm' standing for energy memory), meaning all the available energy it has taken to create and/or maintain a structure or process, or in other words the amount of accumulated work done by humans and nature (direct and indirect) to arrive at a certain state or to produce a certain product (Odum, 1996). By calculating the emergy input per unit of available energy (exergy), Odum also developed a quality aspect of the emergy, which he called transformity (Odum, 1988). He showed that high transformity corresponds to increased ability to impact on other interrelated processes, but that more resources are required to develop these high transformity structures (Odum & Odum, 2001).

Based on his understanding of systems ecology, Odum (2007) describes how farmers, by practising agriculture, concentrate the diluted solar, wind and rain energy available into energy qualities that can serve as human food. When farming mainly draws on these local renewable resources, it has to organise in relation to the availability of these resources. The result is that yields are limited by the amount of energy that is possible to extract from the dynamic and fluctuating flow of local energy resources, and production has to be paced to ensure that soil fertility is rebuilt continuously. To speed up production and

raise yields, today's industrialised agriculture draws on stores of high transformity resources, in the form of fossil fuel-dependent machinery and agrochemical inputs imported into the local farming system. This enables a significant rise in yields and a reduction in the need for human labour, which is replaced by high transformity machinery (Rydberg & Haden, 2006). Since the main energy source is a store (fossil fuels) and not a continuous flow (such as sunlight), as long as the store is available the system can increase its pace of resource extraction and grow in a way that farming organised around flow-limited resources cannot. Simplified homogeneous farming systems develop because they facilitate this increasing rate of resource extraction (Odum, 2007).

Relating to the cross-scale interactions discussed above, the reason that large-scale farming can be so simplified without reducing resilience to the extent that production collapses, is that resilience to change is not only built from below but also depends on relationships with larger scale dynamics (Holling *et al.*, 2002). When resilience is built by relying on external high transformity inputs, farmers are therefore not dependent to the same extent on favourable local conditions to secure a decent harvest, but in contrast they are more dependent on *e.g.* fluctuations in global oil prices[15].

By combining insights from resilience thinking and systems ecology it can be better understood why large-scale farmers, supported by *e.g.* credits, infrastructure and fossil fuels, can simplify production and maximise output, while smallholders who lack this larger scale support, instead must use available resources to build resilience at local level through nurturing diversity and keeping an openness to change.

3.6 Discourse, power and critique

> A critique does not consist in saying that things aren't good the way they are. It consists in seeing on what type of assumptions, of familiar notions, of established, unexamined ways of thinking the accepted practices are based (Foucault, 2000: 456).

15. An additional factor determining the differences in productivity between large-scale and smallholder farming is that many large-scale farmers have had the benefit to acquire land with good suitability for agriculture, whereas many of the rural poor are confined to live and farm in marginal environments, less well suited for farming, which further raises uncertainty with regards to crop performance (Altieri *et al.*, 2011; Dawson *et al.*, 2008). While this is the case in many other parts of South Africa, it does not apply to the smallholders studied in this thesis, which were targeted for the trials on Bt maize and for the MFPP particularly because they lived in areas considered to be suitable for rainfed maize agriculture. However, Dawson *et al.* (2008) explain that low-input farming, as practised by the smallholders in the present study, poses similar stresses to crops as does farming in heterogeneous environments.

Discourses are structures that make the world coherent by reducing complexity and simplifying relationships (Jorgensen & Philips, 2002; Foucault, 1993). In this thesis the understanding of discourse is inspired by CDA, which is both a method for analysing discourse and a broader theoretical framework laying the foundations for this method (Wodak & Meyer, 2009; Fairclough, 2003; Fairclough, 2001; Fairclough, 1995). The basis for all discourse analysis is that we can only know the world through language. In comparison with other forms of discourse analysis, however, CDA pays comparatively close attention to language, drawing on insights from linguistics. Nevertheless, in contrast to some other discourse analytical approaches, CDA sees the social world as only partly constructed by discourse (Chouliaraki & Fairclough, 1999; Fairclough, 1995). As discourse, as a form of social structure, only determines practice in ways which are historically contingent (as discussed above in section 3.3), CDA advocates a combination of discourse analysis and other forms of social analysis (Fairclough, 2003).

CDA highlights three analytically distinguishable parts in discourse analysis: the production of the text, the text itself and how the text is received. In this thesis, the two last stages are the main focus, *i.e.* the text (in this case programme documents from the MFPP) and the practical effects when it has been enacted as a programme in smallholder communities. Methodologically, CDA was used in this thesis to identify the guiding assumptions about smallholders and development that govern MFPP, place these in a broader historical context and, in combination with the analysis of local livelihoods and farming, discuss the lived effects for the targeted smallholders of implementing a programme based on these assumptions. This is described in section 4.6. A brief description of how CDA and other discourse theory informed the thesis work theoretically is provided below to clarify the relationship between policy discourse, implementation and local practices.

The ways that discourses work to simplify the world, or a certain problem, can be seen as a manifestation of power. This way of defining power, as the precedence to define truth, draws on the works of Foucault (Foucault, 1993; Hall, 1992). Discourses, for example typically work to disguise struggles between conflicting interests by portraying one side of the argument as natural or inevitable. Power is thus at work in the discourse through giving one side the interpretative prerogative. Drawing on the discourse analysis of the MFPP (presented in section 4.6 and in Papers I-III), smallholders did not in general agree with the basic assumptions of the programme, *e.g.* that poverty was largely determined by levels of agricultural production, and that yields would best be raised through getting smallholders to adopt inputs and practices designed to suit large-scale farmers. Despite the fact that there were thus

clearly conflicting views between smallholders and the programme management as to what determined poverty and what constituted agricultural development, there was no sign of these conflicting interests in programme documents, where the meaning of agricultural development and its relations to poverty was fixed and unquestioned. As a result of this fixation of meaning, when smallholders acted on the programme by trying to modify it in ways that made sense to them, *e.g.* by sharing inputs or continuing to recycle seed and intercrop maize with other plants, local actions were interpreted by those implementing the programme as incompetence or lack of engagement, reinforcing the view of smallholders as backwards and uncommitted to farming. This indicates the strength of the discourse at policy level.

Drawing on Foucault's concept of governmentality, Bacchi (2009) argues that as the ultimate role of government is to maintain order in society, heterogeneous populations have to be controlled in ways that make them possible to govern. This might be done discursively through another way of simplifying the complex: the creation of a limited number of 'subject positions', frames of identity that describe the target populations. Subject positions simultaneously provide the room within which diverse populations can act, and limits the actions that can be taken (Fairclough, 2001). The discourse informing the MFPP provided a clear definition of what it meant to be a farmer, and this in essence meant embracing the practices and tools used by large-scale farmers. As a result, smallholders in the programme were either interpreted as being potential prospective farmers if they followed the guidelines, while if (like the majority) they did not, they were interpreted as being bad farmers or non-farmers. Power was thus at work in the discourse by labelling those who tried to modify the programme to fit with their circumstances, as described above, as bad farmers or non-farmers who did not qualify for help.

The discursive simplification of relationships also means that polices created within a certain discourse will inevitably not comprehend or address the full complexity of the issue they are targeted to address. Therefore the specific problem that the policy aims to target does not necessarily correspond to how people targeted by the policy would define the same problem (Bacchi, 2009). In the MFPP, the strong connection made between low agricultural production and poverty for example, worked to obstruct alternative understandings of the reasons for rural poverty within the programme. With regards to development policy in general, research shows how development interventions throughout the world have been highly standardised despite widely differing empirical situations (Ellis & Freeman, 2004; Bebbington, 1999; Scott, 1998; Ferguson, 1990).

> Tanzania may be very different from Lesotho on the ground, but from the point of view of a "development" agency's head office, both may be simply "the Africa desk" (Ferguson 1990: 258).

A reason for these standardisations might be found by looking at the level of text production. Many development projects are closely linked to, and strongly influenced by, a global development apparatus; more so than by specific local contexts (Ellis & Freeman, 2004; Ferguson, 1990). It is in this larger development discourse, rather than in the interaction with groups targeted by development, where problems are framed. In relation to the MFPP, it has been noted that even after the end of the specific colonial efforts to support large farmers and undermine smallholder production, the large farmer bias in plant breeding has remained strong in African graduate education in agriculture in general (Haugerud & Collinson, 1990), and in South African agricultural education and development practice in particular (Aliber & Cousins, 2013; Hebinck *et al.*, 2011). As a result of this standardisation in development programmes in general, and in agricultural development in particular, programmes have repeatedly failed to acknowledge and take into account context-specific circumstances, and as a result they have not delivered the change they set out to do (Bebbington, 1999; Scott, 1998; Roe, 1995; Roe, 1991; Ferguson, 1990).

From the perspective of complex systems thinking, as described above (section 3.3), it is indeed predicted that standardised programmes applied in widely different contexts will result in unpredictable outcomes. A specific aim of CDA is to highlight these discursive ways of simplifying complex relationships and to reveal, through discourse analysis, that it is possible to think and do otherwise (Fairclough, 2001). By combining CDA with livelihoods analysis in this thesis, it became possible not only to describe the way that the discursive framing of relations between agriculture, poverty and development in the MFPP worked to simplify the world in a certain way; but also to study, through livelihoods analysis, what was made invisible in this way of conceptualising the local context. The livelihoods approach provided tools for visualising and understanding the local diverse web of activities, assets, and relations. My experience is that using the livelihoods analysis as a basis for discussing the results from the CDA made the discourse analysis more relevant for informing agricultural policy in the region.

Figure 6. Damaged fencing. Fences around field areas, which had been provided by government in association with Betterment, were old and commonly damaged. The resulting high risk that animals would enter fields and eat crops was a common reason for not planting the field (photo: T. Bøhn, 2012).

4 Methodology and description of the research process

The empirical work for this thesis comprised a combined micro-macro approach. The work was guided by research questions 1-4 (presented in section 1.1) and focused around five overarching themes:

1. Smallholders' livelihoods.
2. The relationship between farming and other activities and assets.
3. Local use and understanding of maize.
4. The effects of poverty on how smallholders organise their livelihoods in general and how they practise farming in particular.
5. The interaction between smallholders, the MFPP and Bt maize.

The micro approach consisted of a case study of livelihoods circumstances for smallholders in three villages that had taken part in the MFPP. Analysis of macro level effects on local livelihoods and farming was studied through a CDA of agricultural policy targeted at smallholders, drawing on interviews with those planning and implementing the MFPP and Monsanto's interaction with smallholders, and analysis of documents from the MFPP. Subsequently, the local effects of micro-macro links were investigated though studying the interaction between smallholders, the MFPP and Bt maize.

Two Swedish undergraduate students, Anna Nilsson and Hanna Karlsson, performed some of the interviews with the village chief, and with people working for the MFPP and Monsanto, as part of their Bachelor's degree in Rural Development (Nilsson & Karlsson, 2008). Their contribution is indicated in the text below.

4.1 A case study approach to livelihoods

Gillham (2000) defines a case study as a study of an activity embedded in the real world. As such, case studies are useful for developing context-dependent and rich examples of how certain phenomena play out in real world settings (Stake, 1995). Case studies are mainly inductive. The idea is that until one begins to learn about the case one does not know which theories will help understand it (Gillham, 2000). The case study in this thesis was guided by a conceptualisation of livelihoods and poverty, described in more detail in section 3.2. Perspectives from complex systems thinking were included in the stage of analysis at which they were found to be of importance for making sense of the data.

As the focus of livelihood studies is commonly on the multidimensional aspects of livelihoods, it often makes sense to employ multiple methods. This is a key feature of case study research, with the intention of obtaining a rich and multidimensional understanding of the case (Gillham, 2000). A combination of qualitative and quantitative methods has been found to provide useful and complementary understanding about rural livelihoods and poverty (White, 2002; Murray, 2001; Ellis, 2000; Carter & May, 1999). The combination of methods is also a key part of triangulation. Drawing on different methods to study the same phenomenon is one way to ensure validity of results (Gillham, 2000). In the present study, quantitative data were important for exploring *e.g.* quantitative differences between households at different levels of poverty, and the relations between asset holdings and agricultural performance. Qualitative data were central for providing an understanding of why people chose to employ certain livelihood strategies, how they did this, and to understand the processes that constrained or enabled them in doing so. The following sections describe the research process, from the selection of villages included in the case study, to analysis of the data.

4.2 Selection of the villages included in the case study

The design and implementation of Monsanto's Bt maize demonstration trials and the MFPP were in essence performed in the same way in the case study villages as in other villages which took part in the trials and in the programme (see section 2.5). Furthermore, key controversies that arose in negotiation of the programme design and implementation between villagers and those implementing the programme were similar in many other cases and chiefly centred around the late arrival of inputs and the possibility of smallholders to contribute financially to inputs (Masifunde Education and Development Project Trust, 2010; Damgaard Hansen, 2006). Interviews with Monsanto

employees and information from other publications confirmed that close interaction between Monsanto and the provincial Department of Agriculture, in this case through the MFPP, was common practice when the company introduced its products to smallholders (Assefa & Van den Berg, 2009; Nilsson & Karlsson, 2008; Gouse *et al.*, 2005). Thus, the MFPP and Monsanto's demonstration trials, as well as the cooperation between Monsanto and the ECDA, are indicative of many other South African cases.

Both MFPP and Monsanto's demonstration trials specifically targeted subsistence-orientated, historically disadvantaged [16] farmers, mainly in the former homeland areas. MFPP focused specifically on historically disadvantaged farmers (smallholders and large-scale farmers from historically disadvantaged groups) in the Eastern Cape Province, while Monsanto also performed trials in other locations in South Africa.

Many parts of the former homelands are located on land of suboptimal quality for agriculture. This does not apply to the case study villages, as a precondition for participation in the trials as well as in the MFPP was that villages were located in regions where soils and climate were considered comparatively well-suited for rainfed maize farming. Another precondition of the MFPP for smallholder participation was that village land had been reorganised during Betterment so that individual fields were located together in larger field sections. The purpose of this was to facilitate large-scale mechanisation. The villages included in the present case study fulfilled all these preconditions.

With help from South African researchers and NGOs and employees at Monsanto South Africa, five villages belonging to the same traditional authority, located in the OR Tambo District of the Eastern Cape and which had participated in Monsanto's demonstration trials and the MFPP were identified. To protect the identity of participants, especially those who were engaged in MFPP implementation and Monsanto demonstration trials, the names of the specific villages included in the case study are not mentioned in this thesis. The results presented here on implementation and design of Bt demonstration trials and the MFPP should not be interpreted as targeted towards specific persons. However, the region is described in some detail, since this is of relevance for allowing the reader to judge the plausibility of the research findings.

OR Tambo District is considered to be the poorest of the districts in the Eastern Cape Province and comprises 80% of the former Transkei homeland (Eastern Cape Provincial Government, 2004). Furthermore, the municipality in which the villages are located is one of the two poorest municipalities in the

16. The term historically disadvantaged is used to refer to those groups of South Africans who were discriminated against by pre-democratic regimes.

district. Unemployment in the region is high and has risen since democratisation, with 80% of the economically active population in the municipality being unemployed. Furthermore, as a result of long-term marginalisation, only 42% of the adult population is literate, compared with 71% in South Africa as a whole (OR Tambo District Municipality, 2011). While the MFPP specifically aimed at targeting the rural poor, the villages included in the present case study are thus likely to comprise a higher proportion of poor households than in many other participating villages.

The district at large and the particular case study villages are located away from larger urban centres. In comparison with many other villages, it was not considered possible to commute daily to the nearest town for work from the study villages. This might mean that the study villages were at a disadvantage in comparison with less geographically marginal villages with regard to commercialising agriculture in line with the goals of the MFPP. The geographical marginalisation might also mean that the study villages on average were reached to a lesser extent by agricultural advisory services and development interventions (Ellis, 2000; Bernstein, 1990). Nevertheless, case study results indicate that the chief of the study villages was active in getting development interventions to approach the villages; at least in recent years this would have counteracted their otherwise marginal location.

In order to get sufficient in-depth knowledge about the case within a limited time frame, for pragmatic reasons it was decided to include three of the five villages in the case study, in total 265 households. According to the chief, the villages had taken part as a joint venture in the MFPP and thus there were no major differences in experiences of the programme between the five villages. Field work was further focused within one of the three villages. This village was chosen because the experience of planting Bt maize was more widespread here than in the other four villages: 58 of 105 households had planted Bt maize in the village. Thus it enabled more data collection on the Bt maize than the other villages would have permitted. This was also the village where the chief resided. The two other villages were sampled in the participatory mapping, wealth ranking and household surveys described below, but participant observation and in-depth interviews were focused on this particular village, in which I lived during field work.

The selection of villages first of all was biased towards villages which were approached by the MFPP and the demonstration trials. Later field work revealed that villages within the same traditional authority but further away from the chief's residence, as well as one nearby village where the chief and the headman had fallen out (this village had also resisted Betterment and therefore did not have fields reorganised into larger units and thus did not

qualify for participation in the MFPP), had not been approached by Monsanto or the MFPP. While the case study villages were geographically marginalised in a wider South African context, as described above, the choice of villages approached for participation in the MFPP within the traditional authority was biased in favour of the less marginal villages.

Figure 7. Walking to the fields. Large circular areas fenced with bushes seen in the distance are large home gardens of households that had resisted Betterment and refused to move into the grid pattern residential areas (photo: A. Sparrenborn, 2008).

The selection of the three villages, and the further focus within one village also resulted in a focus on those villages in the traditional authority with the smallholders who were most likely to attend information meetings. Meetings were often held at the local 'office' near the chief's residence and participant observation revealed that the vast majority of participants in meetings were from that particular village, or the villages nearest by. It is thus likely that smallholders in villages farther away from that of the chief who had decided on planting Bt maize would have been reached with less information about the maize than the results in this thesis would indicate.

4.3 The household as the unit of analysis

Livelihoods research commonly uses the household as the smallest analytical unit (Ellis, 2000: 18-21; Ellis, 1998). Ellis (1998: 6) defines the household as: "*the social group which resides in the same place, shares the same meals and makes joint or coordinated decisions over resource allocation and income pooling*". Similarly, Niehof (2004: 323) defines the household as *"a family-based co-residential unit that takes care of resource management and the primary needs of its members"*. An important point in these definitions, from a livelihoods perspective, is that while individuals might specialise in certain activities, a multitude of activities and assets combined at household level are important for securing the livelihood outcomes of its members (Anderson, 2012; Ellis, 2000: 4-5). Consequently, the relative importance of various activities and assets and the relations between access to assets (including stores and resources) and consumption levels are better studied at household than at individual level (Anderson, 2012).

Taking a household perspective does not have to mean that interactions crossing the household boundary are not acknowledged. Indeed, such interactions proved to be of key importance for household livelihoods in the present study. In South Africa, the mutual dependency between labour migration and farming is one obvious example of an important inter-household relationship, although as noted in Paper IV, such relationships have become weaker in the study area in recent years. In line with what Niehof (2004) suggests, in this thesis remittances from migrant household members are treated as resources on which the household draws for livelihoods provision of its members, but only the current residents are treated as household members. This allowed the various resources (including remittances from migrant labour) drawn in by the household to be analysed in relation to the number of household members with claims on these resources for their daily living. There are of course a range of other social relations that cross the household boundary. Indeed, social relationships between individuals or households are often central for providing livelihood outcomes. Therefore, households were not studied in isolation but were studied as open units interacting with their surroundings. Inter-household relationships were found to be of great importance for the possibilities for different households to farm the field, for example, as described further in Paper IV.

An acknowledged drawback of using the household as the smallest analytical unit is that the role of intra-household bargaining over resources and the effects of intra-household dynamics on household decision making are not included in the analysis (Anderson, 2012; Carr, 2005; De Haan & Zoomers, 2005; Agarwal, 1997). For example, women have been found to bear a

disproportionately large part of the burden of increased household poverty (Bengtsson, 2010; Dercon & Krishnan, 2000). In the present case, an analysis of intra-household differences could indeed have enriched the poverty analysis by providing accounts of differences in the experiences of the MFPP and the Bt maize between men and women, or potential differences in labour allocation due to changes in agricultural practices resulting from the interventions, for example. In-depth interviews provided examples of such differences being present in the study area, and confirmed that women in general bear a large burden in farming. However, as this study was not designed to acknowledge these relationships, I do not consider evidence collected regarding this to be sufficiently robust to be further analysed in the thesis.

A key reason for focusing the present research at household level was to capture the role of farming in the broader livelihoods context. Many household members commonly contribute to smallholder farming, and are supported by the food generated (Djurfeldt, 2005). In addition, smallholder farming is interlinked with (affected by and affecting) other livelihood activities generated at household level. Ellis (2000) argues that rural development thinking has long placed farming at the centre of analysis and, as a result, programmes have been implemented aiming to reduce poverty by raising agricultural production, without an adequate understanding of the role of farming in relation to other livelihood activities. By placing the household rather than the farm at the centre of analysis, the role of agriculture in relation to other incomes and activities in poor rural households can be better understood and the assumption that higher yields will lead to poverty reduction can be empirically studied rather than presupposed (Ellis, 2000).

4.4 Notes on the village field work

Village field work was carried out during three separate visits in January 2006, January-May 2008 a nd March 2009. A final visit was also performed in December 2012 with the main purpose of reporting back findings from the research in local communities. During all my visits, I lived with the same family and used the same two key interpreters, who became valuable informants throughout the research. The majority of the field work was performed in 2008, when I lived in South Africa with my own family for five months and lived in one of the villages for two to seven nights every week. In the sections below, the field work and methods used are described. The aim is to give a transparent account of how the research was carried out.

Participant observation and being part of village life

Participant observation is a key method in cultural anthropology where it is described as an attempt to "*experience the lives of the people you are studying as much as you can*" and as "*immersing yourself in a culture*" (Bernard, 2006: 344) (and being able to withdraw and critically reflect on this). In practice this commonly includes spending a long time in the field and learning local languages. Participant observation is also a central method within case study research (Gillham, 2000). Case studies, such as the one presented here, are commonly shorter in time than classical anthropological field work, and participant observation as a method in case study research hence does not necessarily yield the same richness of contextual information as long-term anthropological participant observation might do. As a method in combination with others, participant observation was nevertheless of key importance for the present thesis. It was used for cross-checking and enhancing understanding of verbal information and for identifying issues that seemed important in people's lives, but which were so self-evident to them that they did not think about mentioning them in interviews.

A starting point for conducting participant observation is to build trust with the people studied (Gillham, 2000). In my case, staying in a family in one of the villages and taking part in village life was important for making people comfortable in going about their business around me. It also enriched my understanding of the case as a whole. Making my role as a researcher clear to people from the beginning was also central for building trust (Place *et al.*, 2007). In the village in which I lived, I visited each of the 105 households and introduced myself at the beginning of the field work. If the situation allowed, I also asked briefly about the household and farming. These short interviews provided background information on the questions to be included in the survey and how to phrase them. In the other two villages, a village meeting was called by the local sub-chief at the beginning of the research process, at which I introduced myself and the research project.

People in the study villages had not been engaged in research projects before, but had many, in part negative, experiences of agricultural development interventions and rural planning schemes. Taking this into account, I made it clear from the beginning that I was not coming with any form of development project and that, while I was interested in learning more about people's lives and their maize farming, the information that I collected would not lead to any development intervention. In relation to this, since I could not argue that people would benefit in any obvious and short-term way from taking part in my research, I did not want to take up people's time more than I had to. I

therefore performed interviews and other research activities as much as possible by visiting people where they were, at times that suited them.

Note-taking and moving back and forth

Intimately connected with participant observation is the practice of writing field notes (Bernard, 2006; Southwold-Llewellyn, 2002; Gillham, 2000). My practice was to carry a notebook with me at all times and to write down things regularly during the day; observations, reflections and interviews. In the evening, or sometimes in the morning of the next day, as there was no electricity, I went through my notes and clarified them. During days when I was not in the villages, I rewrote my field notes on the computer.

My weekly commute from the case study location to the town where my family stayed provided an important way for me to step out of village life and reflect critically over my field work. Switching between ethic and emic perspectives during field research can be used as a form of regular validity check, allowing researchers to step outside the field work situation and critically reflect over the data and question their understanding of issues noted during field work (Bernard, 2006). During periods outside the villages, I went through the data and highlighted discrepancies or things that did not make sense to me, which I needed to follow up. As I rewrote my field notes, I also started formulating theories about how issues were connected, which I tested during further field work.

Working with interpreters

As I could not speak more than a few sentences in the local language (*isiXhosa*), I was invariably dependent on interpreters. Interpretation is not only about translating words, but also about being able to interpret what one person says and translate this into another language while keeping the essential meaning. This is difficult in itself and requires the interpreter to be a very good listener and communicator. Translation also often includes having to summarise what the informant is saying, to make the interview run sufficiently smoothly (Smith, 2003). This means that the interpreter must have an understanding about what it is that the researcher wants to know, and requires the researcher to develop a close and trusting working relationship with the interpreter.

Being a good interpreter, like being a good participant observer or a good interviewer, also requires an ability to build trust with the people being interviewed. Finding good interpreters was therefore of key importance for my field work. During my first visit to the study villages in 2006, I had the possibility to use an experienced interpreter from the region who helped me

find people in or near my case study villages who spoke good English. These were trained by the senior interpreter during pilot interviews. From this initial training, I found one interpreter with whom I worked throughout my field work. She came from a village suburb to the nearest town and lived in the study villages with me during field work. Apart from being my interpreter, she also became a key informant and research assistant with whom I discussed the data continuously, and who helped me make sense of things. The fact that she developed good insights into what I wanted to know was very important for the quality of data we were able to collect. The friendship that we developed throughout the research process was also of key importance in allowing me to question her interpretations and ask her for further details, for example. This was central for ensuring the reliability of the information I obtained through translation. The second interpreter I used came from one of the villages in the study. He was engaged in the beginning of 2008 and was trained by my first interpreter. He became an important point of entry for me to the villages. People knew him and liked him and this increased the local trust in me and my research. He was also a valuable key informant, with many insights about village life.

Participatory mapping and ranking

Participatory methods are acknowledged for their usefulness in gaining access to local people's perceptions of their own situations (Ansell *et al.*, 2012; Pain, 2004; Pain & Francis, 2003; Kesby, 2000; Chambers, 1992). They have proved useful for understanding local perceptions and experiences of poverty (Murray, 2001; Carter & May, 1999), for gaining qualitative insights into local livelihoods (Ellis, 2000) and for learning about how smallholders understand, categorise and value different maize varieties (McCann *et al.*, 2006), for example.

Participatory methods in the tradition of Robert Chambers (commonly referred to as participatory rural appraisal, PRA, and rapid or relaxed rural appraisal, RRA) (Chambers, 1994; Chambers, 1992) became very popular in the 1990s for making policy and research more sensitive to local conditions (Kapoor, 2002). However, the methods were often used without researchers and development practitioners reflecting particularly about the process. As a result, much work failed to acknowledge *e.g.* the effect of local power relations or the effects of the researcher on the outcomes (Pain, 2004; Kapoor, 2002). In essence, the uncritical use of participatory methods has been accused of reinforcing existing power relations, failing to lead to the intended bottom-up change, and failing to produce reliable and valid data for research (Ansell *et al.*, 2012; Pain, 2004; Kapoor, 2002). The participatory activities used in the

present case study were largely planned and performed with this in mind, and the information obtained was also triangulated with information gained from other methods. Overall the participatory methods used proved to be positive and engaging processes that provided invaluable information on *e.g.* local people's perceptions and categories regarding wealth and maize varieties.

During the first weeks of field work in 2008, participatory mapping of each village was carried out. In two of the villages, this was performed as a group activity in which villagers with the aid of the interpreters drew a map of the village and indicated all households. The exercise made it very clear to me how competent people were in visually picturing their home villages, as also experienced by others (Chambers, 1992). In the third village (the one in which I lived), I drew a village map while walking around the village with two men who were locally recognised for their in-depth and historical knowledge about the village. Subsequently, I cross-checked and corrected the map in discussion with these men. This way of mapping the village was clearly much more time-consuming than the participatory mapping activity in the two other villages. However a benefit gained from drawing a map while walking was that I obtained a good understanding of village geography; the location of different households in relation to fields, grazing lands and forest used for fire wood collection, and the differing quality of the land in different parts of the village, for example.

One key focus of the case study was to get a comprehensive picture of what it meant to be poor in the study villages and, based on the knowledge that rural communities are heterogeneous (Carter & May, 1999), to create a locally relevant stratification of the community which could be used in later analyses. For finding locally relevant definitions of what it meant to be poor and for grouping the population into different household wealth groups, a wealth ranking activity (modified from Pretty *et al.*, 1995)[17] was performed in each of

17. The wealth ranking procedure described by Pretty *et al*. (1995) is a modified version of the wealth ranking tool developed by Grandin (1988). In the version of the wealth ranking procedure described by Pretty *et al*. (1995) cards are made, representing each household, and individuals (or groups of individuals) are asked to sort the cards into different piles depending of their wealth. The number of piles is defined by the individual (or group) sorting the cards. The same procedure is repeated by two other individuals (or groups) and the wealth rank of each household is then calculated based on the ranking each household received in the different individual rankings. It has been acknowledged that for larger villages (villages with more than 50 households according to Chambers (1992) and over 100 households according to Pretty *et al*. (1995)), the activity of sorting cards becomes difficult to manage. As all three villages contained well over 50 households, I modified the activity in a way that I thought would be locally practical, while yielding valid and reliable results. Based on the finding that there commonly is a strong correlation between individuals in how they rank households in their community (Chambers, 1994), only one collective ranking was performed in each village.

the three villages. In each village four categories of household wealth were agreed upon between the interpreters and local participants: rich, middle, poor and very poor. It was discussed what it meant to belong to each group. It was not only the obvious conditions of a household that provided the basis for household wealth according to participants. The history of the household and the social networks that the household could draw on in case of need were also accounted for. Using the participatory map, each household was assigned a wealth category. This often created vivid discussion amongst participants. My interpretation is that discussing each other's relative wealth was not a sensitive topic and that participating men and women enjoyed the activity. While there was not always consensus regarding which rank a particular household should have, based on discussion with the interpreters the overall results were considered to be sufficiently valid. Comparing the wealth ranking results against household interviews and survey information also revealed a strong correlation between the ranking obtained and other qualitative and quantitative data (as further discussed in Paper IV). The interpreters established that the wealth categories were described in very similar ways in all three villages. In addition, two households were ranked in two separate village meetings, as they were considered to belong to one or the other village depending on the village definition used. These two households received the same ranking in both villages, which further confirms the similarity between the rankings made in these villages. Based on this information, I decided that it was acceptable to pool the wealth ranking data from the three villages during data analysis.

During field work in 2009, I organised a focus group discussion and participatory ranking activity about maize (with inspiration from ranking and scoring activities presented in Pretty *et al.*, 1995) with the purpose of gaining a better understanding of local perspectives on maize. Smallholders are found to define maize varieties based on different criteria than those used by the formal seed development system (Brush, 2004; Louette & Smale, 2000; Louette & Smale, 1998). Furthermore, it has been established that smallholders place value on many features of maize which are not acknowledged within formal seed development (Brooks *et al.*, 2009; McCann *et al.*, 2006; Brush, 2004). Therefore, this was investigated through a participatory exercise, in which participants were asked to define the maize varieties they recognised and decide on the features that were relevant for them when judging which maize to plant..

The focus group discussion centred on establishing an exhaustive list of locally used varieties of maize and discussing their drawbacks and advantages regarding a number of features that were acknowledged as being relevant by local participants, such as storability and tolerance to drought. Subsequently,

the varieties were ranked in terms of each feature by the participants. The activity included a core of eight smallholders selected by one of the interpreters on the basis of being regarded as experienced maize farmers. However, at the outset I failed to specify in detail who I would like to take part, and as a result only men were selected for the activity. Women do a large part of the farming and men and women to some extent perform different tasks and have different experiences and knowledge about farming. During the event, in addition to the pre-selected men, a number of women gathered around and engaged in the discussion. While this somewhat mitigated my failure, it was clear that the voices of the women were subordinate in the discussion.

To avoid the perspectives of dominant people in the group governing the discussion, resulting in a false consensus, it is generally advised to conduct focus group work with people who are expected to be able to speak equally freely (Bernard, 2006; Gillham, 2000). It would therefore have been appropriate to conduct separate focus groups for women and men, which I failed to do in this instance due to time constraints. However, I gained insights about the use and experience of maize throughout the field work, which I used to verify the information gained in the focus group discussion. With the specific intention of complementing the focus group information, I also made sure specifically to talk with women about their use and experiences of different maize varieties in informal and unstructured interviews during subsequent field work.

The questionnaires

Questionnaires are best suited for collecting straightforward factual information (Iarossi, 2006; Gillham, 2000). Here, questionnaires were used to collect information about *e.g.* household composition, monetary incomes, crops planted and purchase of farm inputs. Some questions regarding perceptions of the new maize and questions where respondents were asked about the relative importance of different assets and expenses were also included. These questions were placed towards the end of the questionnaire, to avoid confusing the respondent with difficult questions in the beginning (Iarossi, 2006). All 265 households in the three villages were surveyed. In the village in which I lived, households received a somewhat more detailed questionnaire. Both questionnaires can be found in Appendix A.

To ensure the validity of the survey questions, *i.e.* that they were well anchored in local people's understanding of the issues raised, the questionnaires were developed and conducted after I had acquired some background knowledge about the case. The questionnaires were developed in cooperation with the local interpreters and pilot-tested to ensure that the

questions were interpreted in the same way by both interpreters and were formulated in a way that made sense to the respondents (Iarossi, 2006). The questionnaires were completed in a structured interview, where the interpreter read out the questions to the respondent and wrote down the answers. Initially, I surveyed a number of households together with my interpreters. After this the interpreters performed surveys independently and reported back the results. To ensure the reliability of the answers in the surveys, I went through all answered surveys on site with my interpreters and asked for clarifications and discussed issues that appeared unclear to me. For example, a number of respondents answered that they had taken part in the MFPP, but that they had never received any seed. At first I thought this was a mistake made by the interpreter. However, on discussing this with the interpreters I found out that people who had given this answer had attended the initial village meeting and signed up for the MFPP, but later had not been allowed to take part for various reasons, for example because their fields were not previously planted or were inaccessible to tractors.

Despite taking care to design a good questionnaire, some questions created problems and the responses could thus only be used in part, or not at all, in the analysis. One example was the frequent under-reporting of the types of crops apart from maize, beans and pumpkins planted in the garden. In general, despite some survey questions not yielding reliable results, the fact that information from questionnaires was cross-checked through other methods already in the field allowed this to be taken into account during further analysis of data, and thus ensured the reliability and validity of the results presented in this thesis.

Interviews

The case study included different types of interviews. Informal and unstructured interviews (Bernard, 2006) were performed as part of participant observation. Unstructured interviews discussing issues around farming and maize were performed with all 105 households in the village in which I lived. These interviews enriched the information obtained through the more structured data collection.

In-depth semi-structured interviews were performed with informants in 11 households in the village in which I lived. Selection of these households was made by multivariate statistical processing based on Esbensen's so-called SIMCA classification (Esbensen, 2002), using the software Unscramble (CAMO Proess AS, Norway), performed by Professor Lennart Salomonsson, my supervisor. The 58 of 105 households that had experiences of the MFPP and had planted Bt maize in the village were used in the selection. Variables

regarding age and gender of head of household, wealth ranking and the types of maize (distributed from the MFPP, bought in shop or locally saved seeds) planted in the home garden and field were fed into the model. The aim of the analysis was to capture the variety of households in the village based on all these variables. Households were subsequently handpicked from the different multivariate classified groups so that the selection was representative for the overall village variation regarding the specific variables. To the greatest extent possible, in the latter process I selected households with which I had already interacted more than others and knew more about. With a better pre-understanding of the household, I was able to conduct more in-depth interviews. A summary of the households targeted by in-depth interviews can be found in Appendix B.

The purpose of the in-depth interviews was to examine how people organised their livelihoods, how they perceived their own capabilities and access to assets, how they perceived the role of farming in their struggles to secure livelihood outcomes for their families, and their experiences of the MFPP and with growing Bt maize. As households from the four household wealth categories were included in these interviews, the material obtained was also subsequently used for analysing the qualitative differences between different wealth groups, as defined in the participatory wealth ranking exercise. The interviews were conducted towards the end of the field work for three reasons: to ensure that I had gained sufficient trust to be able to get the information I wanted from the interviews (Gillham, 2000), to ensure good interpretation, and to ensure that I had sufficient background understanding of the issues that I wanted to discuss in order to ask relevant questions.

An adult person with overall household responsibility was interviewed in each household. On three occasions a husband and wife took part together in the interview. The interviews were audio-recorded and participants were always asked if they agreed to being recorded before starting the interview. A list of topics to be covered was available, but I opted to follow the informant in discussion and only direct the interview towards the listed topics if necessary (Longhurst, 2003). This worked well with some informants, but other informants were less talkative and initially unused to or uncomfortable with expressing personal views to me. These less talkative informants thus required more frequent prompting and as a result of this, and due to the fact that interpretation filters what is being said, the interviews were not always as in-depth as desired. To mitigate this, all of the households selected for in-depth interviews were re-visited on on e or more occasions during field work, in 2008, 2009 and 2012, to follow up on i ssues that seemed incomplete or that

emerged as contradictory as other evidence piled up. These repeated visits also made some less talkative informants speak more freely.

The two undergraduate students and I also interviewed the chief on a number of occasions in 2006, 2008, 2009 and 2012. These interviews were all performed directly in English, without interpretation.

4.5 Interviews with Monsanto and MFPP management

Interviews and collection of documents from the MFPP were used to perform a CDA on the MFPP and to examine the perspectives of Monsanto and MFPP officials on the issues researched.

To ensure that all relevant stakeholders were targeted for interviews, snowballing was used (Bernard, 2006). Initial contact with officials within the MFPP and Monsanto South Africa was made through information given by other researchers. During interviews, these officials were asked to name all the people that they could identify as being relevant to the research and that were accessible for interviews. The number of people engaged in the planning and implementation of the MFPP in the specific region studied was relatively small, and in essence all stakeholders knew of each other. This allowed the snowballing technique to work well and it was easy to reach saturation. Many of these interviews were performed by the two undergraduate students on a semi-structured basis, drawing on a list of topics that I had prepared. The students interviewed eight people engaged in the MFPP from local municipal level to provincial level planning and administration. This included two out of three persons at the ECDA who had designed the MFPP, and all stakeholders from local to provincial level who had been involved in the MFPP in the study villages specifically. I then performed additional interviews with two of these eight people, including the senior manager for resource planning at the ECDA, who was the administrative head of the MFPP, and the MFPP consultant acting as a mentor for the study villages. I also interviewed another consultant who was contracted as a mentor by the MFPP, but was working in another part of the Eastern Cape.

In total, four people working for Monsanto had visited the villages and provided training and information during the demonstration trials and/or the MFPP. Interviews were performed with two of these, including the person that had coordinated Monsanto's engagement in the particular villages. Two other Monsanto employees interviewed had not been engaged in the villages of this particular case study, but were engaged in the region with the introduction of Monsanto's GM maize (Bt and HT) to smallholders. The two undergraduate

students performed three out of four of these interviews. All these interviews were performed in English, without the need for interpretation. They were audio-recorded and transcribed in full.

Interviews were also performed on several occasions in the three local agricultural supply stores, two of which sold Bt maize. Two of these interviews were performed by the two undergraduate students. The purpose of the interviews was to learn about the kind of information customers received when wanting to buy maize seed and, in the stores selling GM seed, the kind of training retailers received and the kind of information customers were given when they purchased GM seed.

Gillham (2000) points out that interviewing people in expert positions often creates different problems than interviewing other people. For example, it is commonly difficult to steer the interview, as the informant often has strong ideas about what needs to be said, and how. This was particularly true for interviews with the people who had designed the MFPP. As a result, it was sometimes difficult to make the interviewee cover all the topics on the prepared list. At the same time, however, these informants tended to speak very freely and at length about the possible reasons for the failure of the MFPP to transform farming in targeted communities. This made it possible to analyse their views and perceptions of this in some detail.

In addition to the interviews, 11 documents on the MFPP were acquired either directly from the Senior Manager for Resource Planning at the ECDA, who was the Administrative Head of the MFPP (six documents), or from other researchers studying the MFPP (five documents). A list of these documents can be found in Appendix C. Information obtained in discussions with other researchers on the MFPP and through literature reviews in two MSc theses on the MFPP (Damgaard Hansen, 2006; Lange, 2006) was used to ensure that the collected documents represented the majority of relevant documents concerning the MFPP. These documents were the key material used in the discourse analysis of the MFPP, described in section 4.6 below.

4.6 Data processing and analysis

Analysis was divided into a livelihoods analysis and a CDA of policy documents and interviews. Based in the five overarching themes of investigation (Section 3), the research work was an iterative process in which engagement with the case, reflection over empirical findings and engagement with the scientific literature resulted in the development of more specific research questions and a stepwise more focused approach to the empirical material.

Processing and analysis of field notes and interviews

Field notes were typed up directly in the field. Audio-recorded interviews were transcribed before further processing. Only the English parts of the interviews were transcribed. Transcriptions, repeated listening to interviews and reading through field notes comprised the first step of analysis where broad themes of interest were identified (Bernard, 2006; Cope, 2003).

Initial stages of analysis were broadly guided by the four first themes for the case study (Section 4): smallholders' livelihoods; the relationship between farming and other activities and assets; local use and understanding of maize; and the effects of poverty on how smallholders organise their livelihoods in general and how they practise farming in particular. Investigating the data based on these broad themes subsequently provided answers to RQ 1. Theme number 5 (the interaction between smallholders, the MFPP and Bt maize) was addressed after the first four themes had been investigated and subsequently contributed in part with answers to RQ 2-4, which also were addressed through CDA, as presented later in this section. The qualitative analysis software Atlas.ti was used for assigning codes to marked sections of text identified as belonging to the overarching themes, and subsequently more specific sub-themes, and to perform word searches for certain issues, which helped provide an overview of the data. The overarching themes were not strictly adhered to, but issues that appeared inductively from the data during analysis were also coded and included in analysis.

Analysis was an iterative process. Guided by the overarching themes for the case study, more specific themes of interest and connections between themes emerged as I engaged with the empirical material. Out of the initial broad theme about local use and understanding of maize a more specific theme about smallholders' not recognising Bt maize emerged, for example. Themes and links between themes were subsequently approached more analytically, through engaging with other research relating to the various topics, with the aim of developing ways of comprehending the themes. The ways in which I made sense of the different themes (*e.g.* local understanding of maize in relation to the understanding of Bt maize), by engaging with the empirical material and other research literature, were subsequently tested by describing the themes in running texts and by critically examining whether these texts held together and were sufficiently supported by data. Finally, a couple of themes emerged that I considered to be sufficiently well supported by empirical data, and which had the potential to contribute new knowledge to the broader research literature on the topic. These themes are developed in Papers I-V.

SPSS processing of survey data

SPSS stands for Statistical Package for the Social Sciences, a software system that allows statistical analysis of numerical data sets (McKendrick, 2003). Here, SPSS was used to analyse household data from the questionnaires. Each household had been assigned a numerical code during field work, which was used throughout the data set. This enabled coupled analysis of data from household surveys and interview data for specific households. It also made it possible to enter wealth ranking categories into SPSS and analyse quantitative household data (such as number of cattle, household members or monetary income) in relation to wealth category assigned by the participatory ranking. Analysis of survey data mainly served to display quantitative trends in the villages regarding issues identified as being of interest based on the qualitative analysis (Gillham, 2000). SPSS was thus used for providing an overview of household data, *e.g.* for displaying mean incomes or ownership of cattle for the whole village and for different wealth categories, and for making simple statistical analyses such as calculation of differences in mean incomes between wealth groups.

Critical Discourse Analysis

In order to learn more about the ideas that guided the MFPP and the introduction of Bt maize, a discourse analysis of the MFPP was performed, drawing on CDA (Fairclough *et al.*, 2006; Fairclough, 2001; Fairclough, 1995), and on Bacchi's approach to policy analysis (Bacchi 2009), drawing on the works of Foucault. Fairclough *et al.* (2006; 2001) emphasise that CDA does not include a ready-made way to carry out an analysis, but that it is important to keep the details of the analysis fairly open to suit the particular research context. Here the analysis focused on the conceptualisation in MFPP of the people targeted by the programme, and on how development was conceptualised. The analysis was divided into three steps:

1. Mapping what the problems are presented as being in the MFPP and how these problems are framed in the discourse. Bacchi (2009) refers to this as the conceptual logic of the discourse, *i.e.* the meanings that need to be in place for the particular problem representation to make sense. Fairclough (2001) refers to it as the common sense assumptions that make the texts make sense and hold together.
2. Tracing the problem formulations in the MFPP to their larger discursive and extra-discursive roots (Bacchi, 2009; Foucault, 2002), and how they are enacted in social practice (Stevenson & Cutcliffe, 2006). This includes finding competing problem representations that for various reasons did not come to dominate.

3. Analysing the practical effects of the problems that the MFPP sought to target being conceptualised in the way in which they were (Bacchi, 2009).

The text analysis of MFPP documents was complemented by analysing interview transcripts from the two officials interviewed at the ECDA who took part in designing the programme. In this first part of analysis, linguistic tools helped reveal how statements in the texts could be made into a coherent 'conceptual logic' (Bacchi, 2009). The central focus was on understanding how the target group for the MFPP was positioned and described in the documents in the form of subject positions, which were defined as frames of identity that the discourse provides (Neumann, 2003; Fairclough, 2001). How identity is framed in a subject position can be established by studying chains of equivalence where certain signs are associated with it and used to define it, often in positively or negatively charged ways (Jorgensen & Philips, 2002: 42-45; Laclau & Mouffe, 1985). In the MFPP documents, the subject position 'farmer' was filled with meaning by being connected with positively charged signs such as entrepreneur and competent. The target population was commonly not defined as farmers, but given more inclusive subject positions as land users, inhabitants, people and rural communities, and the MFPP sought to turn the target population into farmers. By studying the use of binaries (or dichotomies), not only in relation to subject positions but also more generally in the texts (Bacchi, 2009), it was easier to understand the conceptual logic of the discourse by revealing which signs were positively and negatively charged and how these signs were placed in opposition to each other in the texts. Important binaries in the MFPP were for example entrepreneur versus dependent, and traditional versus modern.

Another important part of mapping the conceptual logic was understanding how causality was described (Fairclough, 2001), *i.e.* what was seen to be the cause of various current states and who was to blame for this. This analysis mainly drew on the concepts of nominalisation and modality. Nominalisation has to do with how agency is presented, or hidden, in the texts in ways which are often ideologically charged (Fairclough, 2001). In the MFPP documents, nominalisation was used as a way to seemingly depoliticise the text, blaming no-one for the current situation. An example of nominalisation is the statement "*traditional methods of cultivation have led to massive soil erosion and land degradation*". This sentence does not make clear who has employed these traditional methods. However, traditional methods were clearly coupled to the target population of the programme elsewhere in the texts and implicitly the text thus still made clear that the target population was to blame. In addition,

nominalisation was at work in a more subtle way in that past or present government policies were not mentioned once in the texts and were not at all connected to the structural limitations that people face. For example, lack of market access was only listed as a problem for agricultural production, but without highlighting who or what caused this lack of access. This can also be seen as an attempt to depoliticise the programme. However placing the text analysis in a wider context, as is done in the second and third stages of analysis, shows how this depoliticising only works to support the current order of things (Fairclough, 2001). Modality can be defined as how the probabilities or obligations involved in what is stated are judged in the text (Halliday, 1994). Returning to the above example "*traditional methods of cultivation have led to massive soil erosion and land degradation*", "have led" in this sentence implies a factual causality. Alternatively, more doubt about this relationship could have been presented.

The second stage of analysis investigated the discursive and extra-discursive roots of the ideas about smallholders and development found in the MFPP. In this case, the textual analysis included the strategic plans for agriculture for the province, in order to examine to what extent the ideas in the MFPP were influenced by provincial agricultural policy in general and also to understand if and in what way the ideas presented in the MFPP were extended to provincial level. Ideas central in the MFPP were also traced historically and, connecting to the extra discursive dimensions, the analysis examined how ideas in the past had been enacted in practice in agricultural development interventions in the region. An example of how this was done is once again the statement in the MFPP that "*traditional methods of cultivation have led to massive soil erosion and land degradation*". Stage one of the analysis was concerned with how the signs were filled with meaning in the MFPP documents, for example traditional as opposed to and subordinate to modern. During stage two of the analysis, the discursive tradition of contrasting and subordinating traditional to modern was traced to more widespread and historically dominant ideas about development. Studying past practices revealed that defining development as a move from traditional to modern, and defining smallholder farming as traditional, enabled a development practice where local poverty was solely targeted as a problem caused by local incompetence. This could be traced extra-discursively to a wider political will in South Africa in the past of upholding the pillars of apartheid (Hendricks, 1990).

The third and last stage of the analysis studied what Bacchi (2009) calls the 'lived effects' of the discourse and connected the discourse analysis to analysis of livelihoods data collected in the case study. The lived effects concern how a

certain problem formulation when enacted in policy results in certain effects for the people who are the target of the policy. In line with the overall focus of the analysis, emphasis was placed on understanding the lived effects of 'development' being conceptualised in a certain way in the discourse, and of the target group being homogenised and simplified in a certain way in the form of subject positions. In order to emphasise that the target group was not a homogeneous group of people and considering the aim of this thesis regarding understanding the effects of poverty, special attention was paid to the lived effects for people of different wealth groups, in accordance with the participatory wealth ranking.

The role of the researcher and the possibility to see discourse and practice from the outside

On the one hand, from the perspective of CDA people are not fully aware of the effects of the social practices of which they are part, and on the other hand it is envisioned that the researcher can step outside this and see relationships more clearly, as they truly are (Chouliaraki & Fairclough, 1999). Many would object strongly to this way of conceptualising the world and the possibilities it gives (or the burden it places on) the researcher to see the world from the outside. Clearly, researchers, just like participants in a discourse, draw on frames of reference, which are socially determined and ideologically shaped, to interpret discourses of which they form part (Fairclough, 2001). What sets researchers apart from most other participants in the discourse, according to this way of perceiving things, is that it is the specific role of researchers to reflect over their frames of reference and their role in the discourse (Fairclough, 2001; Alvesson & Sköldberg, 2000). This is essential for being able to reveal that the common sense assumptions made in the discourse are contingent (Fairclough, 2001). I believe that this is possible, but not easy, and it is something that researchers must work consciously to achieve. Apart from actively reflecting over my role as a researcher, in the present thesis I also employed some tools that helped me see issues from different perspectives and question my own frames of reference on the information collected. During field work this was for example done through drawing on a multitude of methods to see issues from different angles (Gillham, 2000) and participatory methods, where local perspectives were placed at the fore (Chambers, 1994). During analysis, I actively questioned how I was interpreting the data (Bernard, 2006) and tested my interpretations in relation to a broad body of research literature, which opened the way for contrasting interpretations (Alvesson & Sköldberg, 2000).

What is regarded as common sense is also largely socially and culturally determined (Fairclough, 2001), and my experience is that coming from outside the world of South African smallholders as well as policy makers made it easier for me to question the common-sense assumptions made by the smallholders and by the policy makers in this case.

Figure 8. Pumpkins drying on roof (photo. K. Jacobson 2009).

5 Summary of the papers

The research work for this thesis is presented in Papers I-V. These papers are summarised below and are included in full at the end of the thesis.

Papers I and III present the discourse analysis of the MFPP. While there are significant overlaps between these two papers in the theoretical approach and the empirical material presented, Paper III extends the discourse analysis of the MFPP and includes more recent agricultural policies for the Eastern Cape. Paper III is thus included in the thesis particularly because it is of policy interest. Paper II also adds policy relevance, as it includes another recent development intervention in the region and compares it with the MFPP. Taken together, the results from the discourse analyses presented in Papers I-III show that the discursive underpinnings of the MFPP can be extrapolated to provincial level.

While results from the livelihoods analysis also are presented in the other papers, Paper IV is the only one where the case study on s mallholders' livelihoods is the core focus. In addition, as the papers in this thesis represent research work performed over an extended period of PhD studies, Paper IV also displays a more comprehensive livelihoods analysis than that presented in Paper I, which was written at the beginning of the PhD period. The livelihoods analysis presented in Paper IV serves as an important basis for discussing the role of agriculture in the wider livelihoods context, and the possibility of the MFPP, and the introduction of Bt maize, to contribute to the improvement of the livelihoods of the targeted smallholders in general, with specific focus on poverty-related differences.

Paper V is the only paper in the thesis to focus exclusively on Bt maize. It does this with specific focus on the introduction of associated information and practices to ensure biosafety, how new practices are understood, adopted and adapted by smallholders, and the resulting possibility of Bt maize to contribute to improving smallholders' livelihoods.

5.1 Summary of Paper I

Jacobson, K. (2009). The mismatch between smallholder realities and agricultural development interventions: From 'Betterment' to the massive food production programme. In: Guyot, S. & Dellier, J. (Eds.) *Rethinking the wild coast, South Africa: Eco-frontiers vs livelihoods in Pondoland*. pp. 191-226. Saarbrücken: VDM Verlag.

This book chapter was the outcome of a thematic session on research in Pondoland, South Africa, held at the International Conference on Ecofrontiers hosted by the University of Limoges, France, 27-30 May 2009. The paper is based on a critical discourse analysis of the MFPP. It studies the discursive roots of how the target group was framed and the conceptualisation of development that emerged in the MFPP, drawing on research on the concept of development (Escobar, 2008; Leys, 2008; Eriksson Baaz, 2002; Eriksson Baaz, 2001; Arce & Long, 2000; Adams & McShane, 1996; Hall, 1992). The analysis shows how colonial representations of Africans as backward and lazy (Eriksson Baaz, 2002; Maddox, 2002; Mbembe, 1992) were central for constructing the target group in the MFPP. Evolutionary ideas about development, traced back to the age of enlightenment in Europe (Hall, 1992), dictating a unidirectional path of development with Western societies as a model, were central to the conceptual logic of the MFPP. As a result, tools and practices of large-scale, capital-intensive, industrialised and commercially orientated farmers were introduced uncritically, as they were seen as the only way towards 'development'.

Drawing on other research about past development interventions in South Africa, Paper I reveals that the conceptualisation of development and of the targeted smallholders in MFPP has strong historical roots in past South African development programmes. As a result, past interventions and the MFPP regarded poverty in rural areas as largely stemming from local incompetence, unsustainable use of natural resources and lack of 'modernisation' of agriculture (meaning the adoption of high-yielding seeds and agrochemicals and increasing market orientation) (Ainslie, 2005; Bank, 2002; Maddox, 2002; McAllister, 1992; De Wet, 1990). As with past interventions, the MFPP aimed to reorganise smallholder agriculture, commercialise it and introduce 'modern' agricultural tools and techniques. As local incompetence, rather than shortage of land and labour, was seen as a central reason for the current situation, the programme was developed completely without smallholder engagement, and without considering the connection between agricultural development and access to land. Furthermore, the failure of the programme to transform smallholders to commercially orientated farmers was not seen as a reason for

revising the programme, but was simply explained by smallholders not having the right 'mindset', which shows the strength of the discourse at work.

In essence, Paper I argues, the dominant ideas about smallholders and development made programme managers blind to the role of local practices. There were no serious attempts to understand why people practise farming the way they do. Apart from the strong historical roots of the ideas presented in the MFPP, the evolutionary understanding of development also remains strong within highly influential global institutions such as the World Bank (Scoones, 2009). This can be seen as an important contemporary root to this discourse globally and it shows that the MFPP is far from alone in its way of framing agricultural development.

Paper I also shows that when rural poverty and what is perceived as 'under-production' in smallholder agriculture are taken to be the result of the target population being backward and lazy, the problems of rural poverty and low agricultural production are only targeted as if they stemmed from the local situation. The role that history, contemporary South African legislation and policy, and global institutions play in shaping the possibilities and limitations for South African smallholders is largely ignored. Furthermore, the dominant understanding of development as a path towards industrialised and commercially orientated agriculture obscures the fact that industrialised agriculture has been made possible by, and is dependent on, non-renewable natural resources that are not endless. This is not further developed in Paper I, but is a central theme in Paper II.

While the results from the critical discourse analysis of the MFPP presented in Paper I remain valid, a comment is needed on some of the data presented in the livelihoods section, as Papers II-V, based on more detailed data analysis, present slightly different and often more accurate figures. The results presented in Paper I state that 36% of households took part in the MFPP, while the later publications report that 30% took part in the MFPP and/or planted the maize distributed from the programme. The reason for the different figures is that some households had gone to the initial information meeting about the MFPP and intended to take part, but were not allowed to because they had unplanted or mechanically inaccessible fields, for example. These households sometimes reported in the survey that they had taken part in the MFPP but that they never had received any maize from the project. In later analysis these households were therefore not counted as having taken part in the project. Some households that had received seeds from the chief but had not officially taken part in the project and had not received help from tractors also responded that they had taken part in the project. This is why later publications refer to participation as having "*taken part in the MFPP and/or planted the maize*".

Paper I states that 75% of households had access to a field, whereas in later publications a value of 77% is given. This is because the analysis of data for Paper I erroneously used the percentage of all households, failing to remove the eight households (of 265 in total) which had not answered the question. Thus the true percentage of households with access to a field is 77%. It is also stated that 86% of households had planted their garden, a figure based on all households who reported having a garden in the survey. However, participant observation revealed that households that did not report having a garden were new households which were in the process of, or had not yet started, establishing a garden. All households had space to make a garden. Therefore in later publications all households are assumed to have a garden and the resulting percentage of households planting the garden is thus slightly lower (83%).

Paper I reports that on average, households received 985 rand/month in welfare payments. It should be specified that this is the mean income from welfare payments within the group of households who received welfare payments. The total average was lower, 819 rand/month. Likewise, the mean monetary income received regularly (defined as monthly or more frequently) is reported to be 752 rand/month, but this too is the average income in the group of households who received any regular monetary income. Since most households did not receive any regular income from work or business, the average income in the total population is substantially lower, 309 rand/month.

Paper I states that 69% of households owned livestock. The correct information is that 69% of households owned one or several of the animals: cattle, goat, sheep, donkey or horse.

The results from the multiple response analysis, presented in more detail in Paper V, are also presented in Paper I (p. 14), but the figures differ from those presented in Paper V. The reason is that the figures given in Paper I are based on the total population answering the question. In later analysis, only respondents with first-hand experience of the project maize were included in the analysis, which is more accurate. While 26% of all survey respondents considered the project maize to give higher yields, 29% of the respondents with first-hand experience of the project maize said the same. Out of all respondents, 72% considered the project maize to grow faster and 81% of those with first-hand experience said the same. Most notably, 53% of all responses mentioned the project maize as having bad storage qualities, while 72% amongst those with first-hand experience said the same.

On page 16 in Paper I states that "*if the households had not received free inputs from the MFPP, village data clearly show that they would not have bought inputs for the amounts of money used in the MFPP*". However, no costs are presented for the inputs purchased within the MFPP and thus it is difficult

for the reader to assess the veracity of this statement. In Paper IV, the input costs per hectare in 2008 are presented. These were 4600 rand/hectare in 2008, according to a consultant engaged in the study villages, which is clearly a substantial amount when compared with average monthly monetary income.

5.2 Summary of Paper II

Hajdu, F., Jacobson, K., Salomonsson, L., & Friman, E. (2012). But tractors can't fly… A transdisciplinary analysis of neoliberal agricultural development interventions. *International Journal of Transdisciplinary Research* 6(1), 24-64.

Paper II was written as a result of the interdisciplinary research project 'Global Patterns of Production and Consumption: Current Problems and Future Possibilities (GloPat)', funded by the Swedish Research Council. I took part in the project during parts of my PhD studies.

Paper II draws on additional empirical material to that presented in the methods section of this thesis. Apart from one of the villages from my case study of the MFPP, an additional village was included in the study. This village was also located in the Eastern Cape, and had been targeted by another, more recent agricultural development programme run by AsgiSA EC, within the national framework of Accelerated and Shared Growth Initiative of South Africa (AsgiSA). In these two villages we specifically interviewed smallholders who were deemed to be more deeply involved with farming than the average village resident. The intention was to specifically study those who were most likely to have had the possibility to benefit from the agricultural development programmes. Smallholders that had taken part in the MFPP were selected based on information from my previous field work. In the other village, smallholders were selected based on the first author's (Hajdu) knowledge of that village gained from previous field work for her PhD. I took part in one out of three field visits to gather empirical material for this paper in March 2009, and visited both case study villages. The other researchers in the group made two more field trips, later in 2009 and in 2010, where they also reported back results to participating communities and to South African policy makers.

Paper II takes as its starting point the fact that several agricultural development interventions targeted at smallholder farming in South Africa have failed in their aims to reduce rural poverty and raise agricultural production. The reasons for this are studied through an interdisciplinary approach combining local perspectives in the form of a livelihoods analysis, an understanding of the farming system drawing on systems ecology as developed

by H.T. Odum (1994), and a literature review and discourse analysis of policy guiding the two programmes.

The discourse analysis of MFPP and AsgiSA EC in Paper II is broader than that presented in Papers I and III, and includes a review of research on contemporary developments in South African socio- economic policy. The review shows how South African economic development thinking is governed by a neoliberal discourse where the economy is seen as having no absolute limits and development equals growth. The discourse analysis shows how this view has strongly influenced the agricultural development programmes studied. The practical outcome in the two case studies is that the programmes envisions a unidirectional development path which takes little consideration of local contexts and prescribes that smallholders should develop by adopting the ways agriculture is performed by large-scale farmers.

Paper II also shows how the AsgiSA EC project to a large extent followed in the same vein as the MFPP and, like the MFPP, was minimally adapted to the local smallholder context and rather presupposed that agricultural technology and methods adapted to large-scale farming would work equally well in the smallholder system. In fact, the analysis shows that while the MFPP was a highly top-down designed and implemented programme, AsgiSA EC, following after the MFPP, in practice reduced smallholder participation even further, and in essence completely took over agricultural production from smallholders.

Based on his theory of systems ecology, Odum developed a method called emergy synthesis where the emergy support for all interlinked structures and processes in a defined system is calculated and visualised in a d iagram. Drawing on the livelihoods analysis of the organisation of smallholder farming, and on approximations of emergy support for all the components in the smallholder farming system, the organisation and resource dependency of smallholder farming is visualised in such a diagram in Paper II, and compared with the type of agriculture promoted by the development programmes. This diagram was drawn by others, while I contributed insights about the case. The analysis indicates that through the way smallholder farming is organised, it is highly multifunctional and largely a local activity. It draws on local labour and to a large extent on local natural resources and it supplies not only maize for human consumption, but a variety of crops, as well as feed for animals. In contrast, the commercially orientated high external input agriculture that the programmes promote does not simply represent an increase in efficiency in the use of resources, as the programmes assume. Rather, the diagram of the farming system shows how higher yields achieved in the agricultural development programmes are to a large extent the result of increased reliance

on non-renewable resources and external financial support. The way agriculture is organised in the programmes also reduces the multifunctionality of agriculture, resulting in fewer by-products, and increased risk taking. The level of detail of the analysis did not allow exact quantification of resource use by smallholders practising multifunctional farming compared with smallholders fully following programme guidelines. Nevertheless, the analysis indicates that since the multifunctional type of farming commonly practised by smallholders in the study draws mainly on l ower-transformity[18] local and renewable resources and produces a range of products apart from maize, the way that the programmes equate efficiency with high maize yields and resulting economic gain greatly underestimates the input-output efficiency in resource-constrained smallholder agriculture and overestimates that of large-scale, capital-intensive, industrialised and commercially orientated agriculture systems.

The livelihoods analysis presented in Paper II highlights how the failure by the programmes to acknowledge local perspectives resulted in the programmes failing to achieve their stated goal of raising agricultural production levels through the transformation of smallholder farming. The fact that these conclusions apply even when smallholders who were particularly engaged in farming were studied highlights the complete mismatch between the local roles of agriculture in a wider livelihoods context and the transformation postulated by the programmes. The insensitivity to local conditions is highlighted in the quote 'but tractors can't fly' in the title, which refers to a comment by one smallholder regarding tractors sent to plough fields in a village that had not been visited by programme managers. The tractors that arrived could only plough half the fields in the village, as the other fields lay on the opposite side of a river with no bridge.

In my view, Paper II contributes to this thesis in particular in that it a dds policy relevance by showing that the MFPP is not an isolated event but has been followed by AsgiSA EC in the studied region. The fact that AsgiSA EC aimed to gain relevance by further removing local participation, thus in essence moving back towards the pre-democratic tractor schemes, is notable.

Scientifically, Paper II also adds interesting insights from combining livelihoods analysis and an analysis of the farming system based on systems ecology in a farming systems diagram. The farming systems diagram provided a basis for discussing the potential and limitations of the kind of agricultural development programmes studied here from a resource perspective. This adds to the more qualitative livelihoods perspective.

18. Transformity is the emergy input per unit of available energy (exergy), also described on page 60.

5.3 Summary of Paper III

Jacobson, K. (forthcoming). The massive food production programme: A case study of agricultural policy continuities and changes. In: Hebinck, P. & Cousins, B. (Eds.) *In the shadow of policy: Everyday practice in South Africa's land and agrarian reform*. Johannesburg/Leiden: Wits University Press/Brill Academic Publishers.

Like Paper II, Paper III aims to reveal the reasons for the failure of the MFPP to reach its goals of reduced poverty and increased agricultural production. It also aims to study whether the conceptual logic in the MFPP, presented in Paper I, is an extension of the contemporary agricultural strategy at provincial level, or a more isolated phenomenon. Thus, recent provincial agricultural strategies were included in the discourse analysis. The results show how the provincial strategy for agricultural development that preceded and informed the development of the MFPP, like the programme, conceptualised the target population as unmotivated and incapable of taking care of its land, and thus justified a top-down development approach. As in Paper I, these ideas are also traced back to past agricultural development interventions targeted at smallholders in South Africa.

To contrast these ideas, Paper III draws on an analysis of local livelihoods and the effects of poverty on farming, which is presented in much more detail in Paper IV. The results show that farming is mainly restricted by shortage of labour and money in the poorest households. As a result of long-term structural marginalisation, wealthier households that are not limited mainly by lack of labour or money also face serious constraints to commercialised production. Long-term lack of adequate agricultural advisory support and lack of sufficient infrastructure are key limitations. As shown in the discourse analysis, presented in more detail in the full-length paper, neither provincial agricultural strategy nor the MFPP address these constraints. Having said that, Paper III ends with a look ahead, where the most recent provincial strategic plan for agriculture, 2010/11-2014/15, is analysed. The analysis shows that there has been a clear change in the provincial policy discourse about smallholder agriculture. Contemporary effects of the long-term structural marginalisation of smallholder agriculture are placed at the centre of the policy and all talk about changing smallholder 'mindsets' is completely erased. As a result, the policy highlights the importance of increased availability of agricultural advisory services and advocates an increased focus on infrastructure support. However, the plan retains the perspective that agricultural development equals commercialisation, but it does not specify what commercialisation entails. Past agricultural policies have strongly connected becoming a commercial farmer

with adopting the practices and inputs that large-scale South African farmers use. In light of this and the fact that the new policy does not clearly position itself in relation to this trend, Paper III concludes that it is likely that this view of development remains unquestioned and thus will continue to result in programmes promoting the adoption of practices and inputs of large-scale farmers by smallholders. Based on the results presented, the paper emphasises the need to reconsider this view of development and acknowledge the context dependency of agricultural technology and practices.

5.4 Summary of Paper IV

Jacobson, K. & Hajdu, F. Why are agricultural development programmes not helping the poor? A case study of the massive food production programme in South Africa. Submitted to *Geoforum.*

Paper IV provides a more solid basis for suggesting alternatives to the MFPP that could have better prospects in improving smallholder agriculture and reducing poverty. It adds to the body of research studying the effects of agricultural development on rural livelihoods and poverty. It provides a basis for questioning the assumption of a direct link between yield outputs and poverty reduction in the study area and describes a more complex picture of this relationship. In addition, it has scientific relevance in that it presents findings about how the introduction of Bt maize affected, and was affected by, smallholder agricultural practices in the study villages.

Paper IV shows that poorer households were significantly less likely to plant their field than wealthier, and highlights a couple of central reasons for this. Poorer households, in contrast to wealthier, lacked basic financial security, for example in the form of access to a wage earner or accumulated wealth in the form of cattle. As a result of this, they had to use their labour to secure immediate livelihood needs, for example by offering their services to households who could pay for labour. This labour-relationship between poorer and better-off households reinforced the time constraints experienced in poorer households, whereas it released time and contributed to the relative success in farming for the better-off.

Lack of cattle led poorer households to depend on others for ploughing, and as a result they commonly planted late, or not at all. The exclusion of unplanted fields from the MFPP, done with the purpose of ensuring programme success, excluded the poorest disproportionally, as they were less likely to have planted their field. At the same time, help with ploughing was most needed by the poorest.

Even in wealthier households that were not severely limited by labour or general livelihood insecurity, farming was almost exclusively carried out for subsistence. Central reasons for this were that these, like the other households, were still marginalised in the larger South African context. The remaining effects of this marginalisation were expressed locally as limited local knowledge about new maize varieties and marketing, lack of access to markets and lack of access to maize processing facilities, for example.

Smallholders relied mainly on local maize populations, commonly referred to as 'Xhosa maize'. While many people regarded purchased maize seeds as giving higher yields, local maize populations were generally appreciated for their drought tolerance, better storability and better suitability for home processing. Seeds were commonly saved from the previous year's harvest. Neighbours and friends were also important for seed supply, particularly to the poorest households which, due to food shortage, frequently failed to save maize for seed. As a result of the historically low availability and suitability of agricultural advice, many smallholders could not distinguish between different maize varieties available in agricultural supply shops. This is described in more detail in Paper V, but one key outcome of this lack of information on seed was that many smallholders believed that no s eed bought in shops should be recycled, despite the availability in local shops of OPV seed, which in contrast to hybrid and GM seed is suitable for recycling.

Smallholders in the study villages often intercropped maize, chose local maize over purchased varieties and commonly recycled and shared seed. These strategies are found in Paper IV to spread risks in farming and reduce economic risk taking. The MFPP advocated maize monocropping for the sake of rationalising mechanisation and promoted expensive and genetically homogeneous high-yielding hybrid and Bt maize, that should not be recycled or shared. It thereby undermined local risk mitigation strategies, without providing alternative ways to ensure livelihood security.

Smallholders in the study have historically organised their livelihoods to be able to deal with the coupled land and labour shortages in agriculture. A certain level of wealth and security, historically established through dependency on migrant labour, was essential for being able to plant the field. The results show that in the increasing absence of migrant labour wages, welfare payments have become important for investment in agriculture. The predictability of government welfare payments and the fact that they provided money without demanding labour time are found to increase livelihood security and release time otherwise spent on securing immediate livelihood needs in the poorest households. These aspects are found to be of central importance for the ability of poorer households to engage more in farming. The MFPP completely failed

to acknowledge this. Instead it interpreted the local diversified livelihood strategies as lack of commitment to farming which could be cured by grant conditionality.

Following the MFPP, the study villages have been engaged in a new agricultural development programme that in many aspects follows in the tradition of the MFPP. Grant conditionality remains, agricultural advisory support has not been strengthened, and seeds are still not adapted to local farming practices or preferences. This time, HT Roundup Ready® GM maize is being used, a maize which by definition demands monocropping, and which is even more expensive than Bt maize.

While establishing that the MFPP was particularly badly suited to the poorest smallholders, based on the findings presented, Paper IV also argues that it is possible to provide generic agricultural support which is beneficial across wealth groups. Increasing access to draught power would improve the possibility to farm across wealth groups. Raising the general awareness of the seed and agricultural inputs available in local stores and how to use them would also make it increasingly possible for the poor as well as the wealthier to optimise their use of agricultural inputs in a way that suits their budgets and local ecological conditions.

5.5 Summary of Paper V

Jacobson, K. & Myhr, A.I. (2013). GM crops and smallholders: Biosafety and local practice. *The Journal of Environment & Development* 22(1), 104 - 124.

Paper V focuses on the introduction of Bt maize to smallholders, with specific attention given to the introduction of associated information and practices to ensure biosafety. It draws on data from village field work, interviews with people at Monsanto South Africa and with employees in agricultural supply stores that sell GM seed.

South African biosafety regulations place responsibility with the permit holder for commercial release a GM crop (commonly private industry, in the present case study Monsanto) to ensure that farmers meet the special requirements placed on them by biosafety regulations (South African National Biodiversity Institute, 2011). To enable compliance with biosafety requirements, two new planting practices were introduced with Bt maize in South Africa. These are similar to those in many other countries. Firstly, a proportion of each maize field should be planted with a conventional non-GM hybrid (referred to as a refugia), with the purpose of delaying the development of resistance in target insects. Secondly, GM seeds are only to be planted in a

location specified by the farmer upon purchasing the seed. The purpose of this is to enable post-release monitoring to detect potential unanticipated adverse effects. It also ensures that purchased GM seed is not moved across international borders. The specified procedure is that the farmer commits to these requirements in a legally enforceable agreement signed with the industry when buying seeds (Thomson, 2008).

Paper V points out that much smallholder maize farming is different from large-scale agricultural production and thus that biosafety practices and information, originally developed to suit large-scale farming, must be adapted to fit the smallholder context. Many smallholders have limited access to agricultural advice and are thus left to their own best judgement when learning about new seeds. At the same time, features specific to maize and smallholder environments make this difficult. The fact that maize is a cross-pollinating species means that, if uncontrolled, all plants in a field will differ from the preceding generation and from each other. This means it becomes difficult to attribute specific traits to a particular maize variety in farmers' fields (Smale & Jayne, 2003). In addition, smallholder farming environments are often more diverse and complex than those of large-scale farmers, which makes it difficult for farmers and experts alike to evaluate the outcome of the combination of stress factors on crop performance (Dawson *et al.*, 2008). The majority of South African smallholders also have limited experience with hybrid seed (Gouse *et al.*, 2005), and different hybrid varieties, as well as GM crops, are often visually very similar, making it difficult for farmers to distinguish between the different varieties without expert help (Tripp, 2001; Fitzgerald, 1993). As a result, it might be difficult for smallholders to identify Bt maize in shops as well as in the field and to acknowledge its stemborer resistance.

Due to the limited local knowledge about purchased maize seeds, the majority of smallholders were found to be incapable of distinguishing different purchased seed from each other. The results presented in Paper V also show that villagers could not distinguish Bt maize from conventional hybrid maize distributed simultaneously during demonstration trials and during the MFPP. Some smallholders also believed that they had bought Bt maize in local stores, while they unknowingly had bought OPV seeds.

The stemborer resistance of Bt maize was almost completely unnoticed locally. Survey results and interviews showed that while many smallholders saw stemborer damage as a problem in maize production, they still did not recognise stemborer resistance in Bt maize.

Monsanto had informed smallholders about refugia plantings and supplied small bags of conventional maize to be planted as refugia. Despite this, the vast majority of smallholders were unaware of refugia requirements and the

purpose of the small bags. Interviews also confirmed that not even all Monsanto employees working with smallholders knew the purpose of refugia, which clearly obstructed the potential for transferring this practice to smallholders.

It was also found that people were unaware that they were not allowed to share Bt seeds. On several instances smallholders who wanted to try the new maize had been given it by neighbours, so that many smallholders who planted Bt maize had not taken part in training and information meetings. Many smallholders had also been given the small bags of conventional seed by a friend to try, and thought that they had planted Bt maize.

An additional misconception amongst smallholders was that Bt maize should not be intercropped with other plants, since it would be sprayed with a chemical which would kill plants intercropped with maize. The results confirmed that Monsanto habitually promoted a range of their products together and that the misconception thus was most likely a mix-up between Bt maize and Roundup Ready® (HT) maize and Roundup® herbicide.

When dealing with smallholders, Monsanto had delegated the responsibility for signing agreements and transferring biosafety information to local retailers. Retailers who sold GM maize in the local area had taken part in Monsanto training about GM crops and biosafety, but they did not know about any technical agreements and not all staff knew about biosafety. As a result, the information about GM crops and biosafety given to customers varied greatly depending on the sales assistant.

In light of the results from the case study and a review of other research Paper V concluds that smallholders in the case study clearly had difficulties identifying Bt maize and its stemborer resistance and that this had to do with the fact that a range of maize varieties are planted and shared locally, that stemborers are difficult to identify in the field due to their concealed lives, and that inadequate information was received about the Bt maize, its stemborer resistance and associated biosafety measures. The problem of smallholders receiving inadequate and insufficient agricultural advisory services is not specific to the present case, but is widespread in smallholder settings in South Africa and elsewhere. This regards both general agricultural advise (Hebinck *et al.*, 2011; Tripp, 2001; Bembridge, 1991; De Wet, 1990) and specific advice on GM crops and biosafety (Kruger *et al.*, 2012; Assefa & Van den Berg, 2009; Kruger *et al.*, 2009; Stone, 2007; Van Rensburg, 2007; Pemsl *et al.*, 2005; Bennett *et al.*, 2004; Stone, 2004; Bennett *et al.*, 2003). Similarly to the present case, studies on Bt cotton farmers in India by Stone (2007; 2004) point specifically at the combination of not being able to interpret the effect of GM crops in the field due to environmental dynamics, and lacking and faulty

information on GM crops and biosafety being provided to smallholders, as central reasons for low compliance with biosafety regulation.

Lastly, Paper V points out that non-compliance with biosafety measures amongst smallholders may partly also relate to the fact that some biosafety practices are incompatible with current smallholder practices. Recycling seed from the previous year's harvest and sharing seeds with others are important smallholder strategies to ensure seed supply and keep costs down. Restrictions on sharing and saving seeds are connected with plant breeders' rights and patents attached to the crops, but are also central in complying with biosafety regulations. If seeds are shared or saved from previous harvests, it will be impossible to trace the spread of GM crops, which is a cornerstone in current biosafety legislation. Paper V shows that South Africa has comprehensive biosafety legislation in place, yet it completely fails in practice. Central reasons for the failure are that:

- The industry fails to take the responsibility it bears according to biosafety legislation.
- Effects of maize-environment interactions in combination with farmers seed sharing practices, make it difficult to identify Bt maize in the fields.
- Smallholders have limited knowledge and experience with new maize seeds due to long term lack of appropriate government agricultural advisory services.
- Practices of saving and recycling seed, which go a gainst current biosafety legislation, are deeply rooted smallholder practices with importance for local farming.

Finally, based on the results presented, Paper V argues that it is unrealistic to believe that records will be kept by all smallholders planting GM crops, or that smallholders will completely abandon seed saving and sharing. Therefore, if tracing and removing GM crops once released is considered necessary for ensuring a sufficient level of protection against potential future risks, GM crops should perhaps not be planted in regions unable to guarantee compliance.

Figure 9. Cross-pollination in maize. To the extent that cross-pollination was visible in the maize cobs, its effect was commonly recognised, but farmers did not have strategies to control it (photo: K. Jacobson, 2008).

6 Discussion of key conclusions

Research questions 1-4 are revisited below and discussed in the light of the findings presented in Papers I-V and in relation to other literature.

Section 6.1 summarises the main features of the conceptual logic of the discourse that guided the MFPP. By combining discourse analysis with livelihoods analysis, the conceptual logic of the discourse was scrutinised in the light of local practices and perspectives. Through analysing the role of agriculture in the wider livelihoods context, the results show that the MFPP approach was not appropriate for improving smallholders' livelihoods through agriculture (RQ 1-2). Reasons for this are discussed in section 6.1 against the background of other literature.

Section 6.2 focuses specifically on whether the introduction of Bt maize contributed to the improvement of smallholders' livelihoods in the study area (RQ 3). As this thesis shows that the MFPP approach is not an appropriate vehicle for Bt maize introduction (RQ 4), section 6.2 discusses to what extent the introduction of Bt maize was attached to, and affected by, the agricultural development approach employed by the MFPP. Findings about this, presented in Papers IV and V, are discussed in relation to other literature and some lessons are drawn based on the findings with regard to the role of GM crops in smallholder agriculture more generally.

A specific aim of this thesis was to contribute to the debate about the role of seed technology in a new Green Revolution for Africa. Therefore, in section 6.3 the lessons that can be drawn from the findings presented in this thesis about role of new seed in the revitalisation of African smallholder agriculture are summarised.

Lastly, as the thesis specifically investigated agricultural development in the Eastern Cape, in section 6.4 the thesis ends with a look ahead and some suggestions for future agricultural policy in the Eastern Cape based on findings presented in this thesis.

6.1 The MFPP discourse and smallholder farming - a synthesis

Discourse analysis of the MFPP, and provincial strategic plans for agriculture (Papers I-III) revealed that two dominant ideas guided the agricultural development discourse in Eastern Cape Province during the time when the MFPP was planned and implemented in the villages studied here:

1. Smallholders are incompetent and uncommitted to farming, practising backward, 'traditional' agriculture.
2. Agricultural development follows a unidirectional path, where the move from 'traditional' agricultural practices towards the 'modern' way of agriculture requires the practices and tools of large-scale commercial farmers.

The dominance of these two ideas is explained in this thesis by their historical discursive roots in the Western view of 'the Other' in general (Paper I), and ideas guiding colonial and apartheid policies in South Africa in particular (Papers I and III). The idea of a unidirectional development path is further reinforced by the contemporary dominant neoliberal view of development as progress through growth, in South Africa and globally (Paper II). As a result of the dominance of these ideas, the conceptual logic that emerged within the MFPP contrasts and subordinates smallholder farming to large-scale, capital-intensive, industrialised and commercially orientated farming and turns a blind eye to:

1. The historical political reasons for contemporary rural poverty and low agricultural productivity.
2. Local ways of dealing with poverty and the resulting role of farming.
3. The heterogeneity of rural poverty.

The historical political reasons for contemporary rural poverty

While the MFPP largely failed to acknowledge the effects of the long-term political marginalisation of smallholders, these proved central in explaining current rural poverty and low agricultural productivity. With regard to farming, lack of land, agricultural credit support, infrastructure and advice had severe, long-term detrimental effects on the ability of smallholders in the present study to compete fairly with large-scale farmers (Papers I-V). It is noted specifically in this thesis how the long-term lack of suitable agricultural advice had clear negative effects on people's ability to make informed choices regarding seed (Paper V). The way that the programme coupled traditional practices and dependency on support and contrasted these to what was seen as 'modern' and

entrepreneurial practices also resulted in a conceptual logic where entrepreneurial meant independent of support services. The result was that the MFPP envisioned commercial farming as self-sufficient and independent of support in a way that it has never been.

As discussed in sections 2.3 and 2.4, the more comprehensive and longer term marginalisation of smallholders in South Africa than in many other African countries might have resulted in particularly severe contemporary effects on farming in general and on smallholders' knowledge of maize seed in particular (Paper V). Nevertheless, much research shows how smallholders in many other African countries, as a result of lacking infrastructure, credit and agricultural advice tailored to their circumstances, have had similar difficulties in making a living off farming (Amberntsson, 2011; Holmén, 2005b; Bryceson, 2004), indicating the wider applicability of the results presented in this thesis.

Local ways of dealing with poverty and the resulting role of farming.

Livelihoods analysis showed how the smallholders studied had developed ways to deal with the effects of poverty (Paper IV). Within farming, these strategies included recycling seed, relying on neighbours and friends for seed, intercropping maize with other plants, and to some extent choosing maize better adapted to local circumstances (although smallholders could clearly gain from increased advisory support to learn to differentiate between varieties). As discussed in sections 2.3 and 3.4, these strategies are widespread in smallholder communities and are found to be effective for buffering the effects of environmental and social dynamics and constraints. In addition, as farming was something that smallholders felt that they had relatively more control over than other livelihood opportunities, farming served an important security function at household level, buffering the effects of risky ventures by other family members into other areas, such as wage work.

The MFPP fundamentally ignored the local importance of mitigating risk in farming and as a result it attempted to change smallholder farming into a more risky entrepreneurial activity, introducing seed and agricultural practices developed for large-scale agriculture without providing security from elsewhere. Genetic homogeneity of seeds and monoculture plantation reduced diversity (the effects of choice of seed are discussed in more detail in section 6.2). The prescribed way of farming introduced by the MFPP; with strict guidelines on when to plant and harvest, taking only into account what was optimal for the seed introduced; also presupposed a more controlled farming environment. It thus reduced flexibility in farming, *e.g*. the possibility to adapt planting time to wait for traction, or staggered planting to increase stability at

the cost of reducing output. As described in section 3.4, diversity and flexibility are two important features for building resilience at local level.

Drawing on the complex systems perspective developed in sections 3.3-3.5 and in Paper II, if the household is viewed as a system nested in a network of processes working at different scales, household livelihood security might be ensured by building resilience either from below, by increasing local diversity and flexibility (*e.g.* diversifying at genetic level, crop level, or between livelihood strategies), or from above, by increasingly connecting with and relying on supportive structures at larger scales (such as credit support or insurance). The analysis in Paper II indicates that the high yields produced in large-scale farming are strongly linked with and highly dependent on external support such as fossil fuels and other limited resources, and a supportive framework of infrastructure and credits. As the smallholders in the villages studied in this thesis do not currently benefit from the same supportive framework, they cannot produce as high yields, and they also need to use local resources for building resilience. Livelihoods and poverty research provide support for this conceptualisation of poverty and risk spreading, as presented in section 3.4. Research on the Green Revolution in Asia confirms the need for large-scale support if smallholders are to be willing and able to change their farming into a high-yielding activity. It has been acknowledged that for the Asian Green Revolution to reach smallholders, it was essential that Asian governments (and international donors) contributed significantly to build up sufficient infrastructure, supply credits, subsidise inputs and educate farmers about new technology (Hazell, 2009; Djurfeldt *et al.*, 2005). It has been pointed out that this investment was not a one-time effort, but was a process beginning well before the introduction of new seed and inputs and sustained long afterwards (Hazell, 2009).

The findings in this thesis emphasise the need for larger scale support if smallholders are to be able to re-direct their farming practices to a focus on high yielding strategies. Such large-scale support is clearly costly (Holmén, 2011) and the high-yielding strategies are resource-intensive, as described in Paper II. As noted in section 2.1, many of the resources that have been central to the growth of large-scale, capital-intensive, industrialised agriculture, and which were readily available and central to the yield increases experienced during the Asian Green revolution, will not be as easily available in the future (Renwick *et al.*, 2012; Kenny, 2011; Aleklett *et al.*, 2010; Odum, 2007). Increased variability in rainfall can also be expected as an effect of climate change (*cf.* Mercer *et al.*, 2012; Boko *et al.*, 2007). In light of these future challenges, it has been suggested that smallholders must be supported in dealing with uncertainty and change (Enfors, 2009; Ellis, 2000). In contrast, by

envisioning a linear development path and ignoring complexity, the MFPP worked to undermine these strategies.

The heterogeneity of rural poverty

Livelihoods analysis showed that people had different possibilities to engage in farming depending on their level of poverty. The poorest were less likely to plant their field, and lack of traction (or means to pay for the service) was an important reason for this (Paper IV). The MFPP, despite its aim to reduce poverty, in fact excluded the poorest disproportionally, since only fields in locations suitable for mechanical ploughing and fields that had been planted before the programme were allowed to take part. In fact, as described in section 4.2 both the MFPP and Monsanto, with the specific purpose of ensuring success, excluded participants (whole villages as well as individual smallholders) that did not fit into the pre-set frame modelled on large-scale farming. There are many accounts of agricultural development interventions, in the quest to meet policy goals of raised yields, failing to acknowledge local heterogeneity and as a result ending up focusing on better-off sections of society or better land (Amberntsson, 2011; Coughlin, 2011; Scoones & Thompson, 2011; Glover, 2010b; Witt *et al.*, 2006; Bahiigwa *et al.*, 2005b; Bernstein, 1990). Clearly, there is reason to emphasise the importance of acknowledging local heterogeneity.

Paper IV shows how poorer smallholders who addressed immediate livelihood needs by offering their labour to better-off smallholders, simultaneously undermined their own ability to engage in farming and supported that of wealthier smallholders. Findings by Ellis and Freeman (2004) indicate that this labour relationship between poorer and wealthier households is more widespread in smallholder communities in Africa. A similar relationship (with the significant difference that it was to a greater extent enforced) can be identified historically between the comparative success of large-scale South African farmers, who benefited from cheap migrant labour, and the poverty and low agricultural productivity of land and labour-constrained smallholders in the homelands. These findings add to the weight of the evidence showing that individuals (or households) are not isolated units, but that their possibilities and constraints are in part dependent on their relations with others (Van Dijk, 2011; Du Toit, 2005b; Murray, 2001). If poverty in part is an effect of social relations, development cannot at the same time be a linear process, as presumed in the discourse informing the MFPP. These results also provide a basis for questioning the assumption in the MFPP that there were smallholders who were committed (and thus more productive in their farming) and those who were uncommitted (and thus not worthy of

support). Looking at it differently, perceived lack of commitment to farming might instead be serious commitment to trying to secure daily subsistence.

By acknowledging local heterogeneity and starting off from local perceptions and practices, the livelihoods analysis presented in Paper IV also revealed that there are other ways to support smallholder farming than those employed in the MFPP, which might be beneficial across wealth groups, *e.g.* infrastructure support (tarred roads, fenced fields) and locally adapted agricultural advice. Connecting to the previous section, there is substantial evidence of the success of these strategies from research on the Green Revolution in Asia (Dethier & Effenberger, 2012; Hazell, 2009; Djurfeldt *et al.*, 2005).

Notably, however, while locally suited agricultural advice, better infrastructure and credit support would be beneficial across wealth groups, it might be of most benefit to the relatively wealthier sections of the smallholder societies studied here. As Paper IV shows, the poorest are likely to be unable to farm themselves out of poverty, as they are too time- and resource-constrained to invest substantially in agriculture in the first place. The poorest thus first need help with reducing their time and resource poverty, using strategies other than agriculture. This finding is also supported by others. Ellis (2000) argues that a focus on farming *per se* leads to an emphasis on technical development as an engine for growth, which often fails to benefit the poorest and which clearly sidelines other sectors. This emphasises the importance of acknowledging the heterogeneity of poverty and not addressing the rural poor as a homogeneous group.

The wider effects of the unidirectional view of agricultural development

The MFPP is not alone in its unidirectional view of development. With slight modifications it has been found to be widespread in contemporary development policies in general and agricultural development interventions directed at smallholders in particular (Aliber & Cousins, 2013; Iles & Marsh, 2012; Amberntsson, 2011; Kay, 2010; Brooks *et al.*, 2009; Havnevik *et al.*, 2007; Akande *et al.*, 2005; Holmén, 2005b; Eriksson Baaz, 2002). Other publications, like this thesis, show how the dominance of this perspective in many situations has resulted in failures to acknowledge the extent to which the high-yields in today's industrialised agriculture are connected with supportive policies, as well as a high direct and indirect reliance on non-renewable natural resources (Iles & Marsh, 2012; Kay, 2010; Havnevik *et al.*, 2007; Odum; 2007). It has also resulted in a disregard for local contexts and the role of local practices (Amberntsson, 2011; McCann, 2011; Brooks *et al.,* 2009; Holmén, 2005b). To give just one example, a review of a recent Swedish agricultural

development initiative in Zambia by Amberntsson (2011) showed how smallholders were depicted as uncommitted and backward, and how these 'mindset problems' amongst targeted smallholders were used as a key explanation for programme failure and worked to obstruct any aims for self-criticism at policy level. Indeed, this bears very strong similarities to the results presented in this thesis.

As shown above, the unidirectional view of development that guided the MFPP did not prove capable of transforming farming in ways which improved smallholders' livelihoods. As a result, the potential of Bt maize to contribute to improving smallholders' livelihoods in the study area is highly dependent on the extent to which it can be disconnected from the unidirectional view of development that guided the MFPP. The potential of Bt maize to contribute to the improvement of smallholders livelihoods is discussed in the next section.

6.2 The role of Bt maize in agricultural development

First of all it can be noted that the focus on new seed as the core strategy for raising yields in the MFPP may be fundamentally misguided, since the core reason why many smallholders studied here did not plant their fields or obtained suboptimal yields was not lack of suitable seeds but lack of fencing (resulting in cattle damage to crops), lack of labour, draught or capital for tillage at the correct time and lack of, or too much, rain (Paper IV). All these issues can be solved through strategies other than introduction of new seed. Notably, there were detailed plans in the MFPP regarding the seeds and other inputs that should be used, with the emphasis on raising yields, but not on how to support smallholders with agricultural advice or infrastructure (Papers I-V).

There is of course no fundamental incompatibility between focusing on seed and focusing on smallholder needs. Indeed, many publications emphasise the essentially coupled role of introducing new seed and substantial support in terms of credit, infrastructure and agricultural advice to smallholders (see *e.g.* Dethier & Effenberger, 2012; Djurfeldt *et al.*, 2011; Jayne *et al.*, 2010; Hazell, 2009; Tripp, 2009b; Djurfeldt *et al.*, 2005). In the present case, however, the focus on seed seems to have shifted attention away from other reasons for low productivity, as also occurred in past development interventions in South Africa (De Wet, 1990; Hendricks, 1990). Having said that, the following paragraphs review the local effects of Bt maize introduction in the present case.

This thesis shows that the introduction of Bt maize was largely determined by the accompanying package of information and practices and the choice of hybrid variety used. Bt maize was initially developed to be used in large-scale capital-intensive farming, and in the present case the package of Bt maize had

clearly not been adapted to suit the smallholder context. However, as highlighted in Paper V, it is not certain that the Bt maize would be able to help improve smallholders' livelihoods, even if it managed to break with the unidirectional development discourse. The results presented in this thesis indicate that biosafety regulations associated with GM crops, introduced amongst other purposes for ensuring their environmental sustainability, might not be compatible with smallholders' practices, indicating a more deeply embedded conflict between GM crops and smallholder farming.

Choice of maize variety

The variety of Bt maize introduced to smallholders in the present case and in other South African smallholder communities is a high-yielding, but high-input demanding, hybrid adapted to suit large-scale, capital-intensive farming. As a result of this, Bt maize is sometimes outperformed in smallholders' fields by other locally used hybrids with better adaptability to fluctuations in rainfall (Gouse, 2012).

This thesis shows how smallholders' own estimates of yield differences between varieties indicate that under local conditions there was no major difference in yield between purchased OPV seed and hybrid or Bt seed provided by Monsanto and the MFPP (Papers IV and V). While no substantial or systematic data collection regarding smallholders' yield estimations was made in the present study, previous literature on the topic reveals that this finding is not novel. Under low input conditions, OPVs sometimes yield almost as much as hybrids and, since OPVs are much cheaper, less fertiliser-dependent and their seed can be recycled, they can provide a cost-effective alternative for smallholders (Pixley & Banziger, 2004; Chiduza *et al.*, 1994). In addition, in the present case (Papers IV and V) and in other studies, many smallholders have been found to value features other than yield, such as storability, yield stability, seed cost and the possibility of recycling seed, features which hybrids developed to suite large-scale farming and industrial processing seldom provide (Li *et al.*, 2013; McCann, 2011; Soleri *et al.*, 2008; McCann *et al.*, 2006; Pixley & Banziger, 2004; Cleveland *et al.*, 1994). Indeed, smallholders in the present study reported in particular that the hybrid and Bt maize distributed by the MFPP had very bad storage qualities compared with local maize populations. This feature was much more commonly recognised than the Bt maize insect resistance (Paper V), and is a general feature of modern hybrids designed to suit large-scale processing (Smale & Jayne, 2003).

The Bt maize variety that was introduced in this case can be seen as a continuation of a trend in sub-Saharan Africa where a strong focus on maximising yield output has led maize varieties originally developed to suit

large-scale farmers to be promoted to smallholders (Brooks & Loevinsohn, 2011; Smale & Jayne, 2003; De Wet, 1990). The results presented here show how the dominance of this trend clearly obstructs the potential of new seed to support smallholders in using their farming to improve their livelihoods. Furthermore, as discussed above, agricultural development aiming to equip smallholders to improve their livelihoods through farming must help smallholders deal with future challenges. This is likely to include reduced availability of external inputs and more climate variability. In light of this, it is of relevance to support smallholders in their strategies to deal with uncertainty and to develop and introduce seed varieties that tolerate low-input conditions and environmental dynamics. As shown in section 2.1, this is not the case currently, where seed development, in South Africa and elsewhere, is dominated by a few large companies, with resulting narrowing of the diversity of varieties and GM traits released on the market, and a focus towards where the money is, *i.e*. towards large-scale, capital-intensive farmers.

Monoculture production

Another feature of the prevailing unidirectional development discourse on Bt maize introduction is that Monsanto and the MFPP both recommended the Bt maize be monocropped with the purpose of facilitating mechanisation and herbicide application. This runs counter to local practices of intercropping maize with other plants, which is common practice in many smallholder communities as it spreads the risk of crop failure and adds to a more varied diet (Papers IV and V). Despite this, smallholders have often been actively discouraged from intercropping maize with other plants, in South Africa (De Wet, 1990) and elsewhere (Byerlee & Heisey, 1996). There are no features inherent in the Bt maize that make it impossible to intercrop with other plants, which indicates the strength of the discourse at work here.

As noted in Paper IV, a new development programme for the case study villages has introduced Roundup® Ready (HT) maize and Roundup® broad-spectrum herbicide. This further reinforces the monoculture trend, as broad-spectrum herbicide sprayings make monoculture maize production essential.

Bt maize and agricultural advisory services

As presented in section 2.2 and Paper V, understanding, adoption and adaptation of new information and practices by smallholders have substantial effects on how GM crops function in the smallholder context (see also Stone, 2011). In the present case, the low local knowledge about commercial maize varieties in combination with the effects of heterogeneous environments, cross-pollination in maize and the limited and in part faulty information given by

Monsanto, the MFPP management and local seed retailers trained by Monsanto, led smallholders to be unaware of, and unable to recognise, the new features of Bt maize. Smallholders were unable to distinguish between the Bt maize and other varieties in the field and in shops, they were unaware that they should not share seed, and were even unaware that the Bt maize is insect-resistant. They also did not know the purpose of refugia plantings (Paper V). This is not an isolated case (Assefa & Van den Berg, 2009; Stone, 2004), and the severity of the problem is shown in that low adoption of refugia amongst large-scale farmers has already led to resistance in target insects in other areas in South Africa (Kruger *et al.*, 2012). It can be noted that the role of Bt crops for increasing environmental sustainability in agriculture is lost as soon as resistance develops. Based on examples of several incidences of resistance development and the rise in secondary pests following from the extensive use of Bt cotton in China and India, Stone (2011) suggests that rather than representing the obvious environmental benefit, Bt cotton might be part of a continuation of the pesticide treadmill. The likelihood of this happening clearly increases if smallholders have as limited knowledge about the features of new seed and associated practices as those in the present study.

While the smallholders in the present study might have been particularly disadvantaged with regard to historical provision of agricultural advice and thus in particular need of substantial and adequate agricultural advisory services, the difficulty in delegating responsibility for giving agricultural advice to local seed retailers has been noted in several other cases. The results in these cases, as in this thesis, show how smallholders have often ended up with insufficient or faulty information on new seed (Stone, 2004; Tripp, 2001). In plans for the new Green Revolution for Africa, it is envisioned that the distribution of new seed as well as associated information will be largely handled by local seed retailers (Brooks & Loevinsohn, 2011; Scoones & Thompson, 2011). Paper V shows the problems this can cause.

Effects of patents PBR and biosafety

Smallholders in the present study were unaware that patents and biosafety regulation meant that the Bt seeds should not be given to others (most likely because they had not been informed; Paper V). However, even if smallholders had been aware of this, it is likely that they would not have complied with the regulation. Sharing and recycling seed offer well-documented benefits to smallholders. Furthermore, farmers sharing seed is an efficient way of spreading new seed in smallholder communities and it was of key importance for the spread of new varieties during the Asian Green Revolution (Morris *et al.*, 1999). Informal development and spread of GM seed has also been found

to be an important strategy in adapting initially released GM varieties to diverse smallholder conditions (Lalitha *et al.*, 2009; Shah, 2008; Herring, 2007b). Clearly, the globally increasing control over how farmers may use seed in recent decades significantly reduces the possibility of farmers to adapt new technology to their circumstances and use it in a way that suits their farming practices.

Nevertheless, while it is technically possible to introduce insect resistance into an OPV maize variety, enabling smallholders to recycle seeds, allowing GM seed recycling and exchange would not only contravene current patents, but also impede the transfer of information accompanying the Bt maize (Paper V). The results presented here point at the importance of *more* rather than *less* information accompanying Bt maize. Furthermore, introducing the Bt trait into OPV maize and allowing seed recycling would also make it difficult to control its spread, which is part of current South African biosafety regulations. The extent to which we might want to control the release of GM crops in the environment has to do with different perceptions of risk, and is also likely to vary with the features of the GM crop released. This thesis indicates that if and when we want to have strict control mechanisms for the spread of GM crops, these are likely to be largely incompatible with the use of GM crops for the benefit of smallholders, as these kinds of strict control measures reduce the possibility of adapting GM crops to smallholders' agroecologies and farming practices.

6.3 The role of seed in a new Green Revolution for Africa

In conclusion, the results presented in this thesis provide grounds for questioning an uncritical focus on high-yielding seed in general and GM technology in particular as a means to raise smallholder yields and reduce rural poverty. This is not to say that technology has no role in agricultural development. Rather, the findings indicate that we must critically examine the role of technology in relation to other possible ways to raise yields, as well as the focus on yields *per se*; and we must critically reflect over the local suitability of the technology introduced. Based on the findings in this thesis, three main points can be made with regard to the role of new seed:

1. Seed must be developed with smallholders' circumstances in mind. This includes considering current and potentially increasing future needs for smallholders to be able to deal with uncertainty and change.

2. The role of agricultural advisory services should not be understated. In essence, without knowledge of how to use new seed, efforts to develop new seed are wasted. In the present case these services might be even more necessary than elsewhere, but other literature suggests that advisory services adapted to the smallholder farming context are widely needed. The increasing reliance on local seed retailers for delivering seed technology and information can be questioned in this context. This applies with even more force to GM crops with new features that are unfamiliar to farmers and that are not obvious from the look of the seed or plants.

3. While GM technology can clearly be incorporated into varieties that are much better suited to the smallholder context than the Bt maize in the present case, it must be noted that there is a serious incompatibility between comprehensive biosafety implementation to ensure environmental sustainability of GM crops and sharing and reuse of seed, which are central strategies for dealing with resource constraints and uncertainty in smallholder farming.

6.4 Eastern Cape agricultural policy beyond the MFPP

By studying the role of farming in the wider livelihoods context, this thesis showed that it plays an important role for rural livelihoods in the study region. However, for reasons of historical disadvantage, it is mainly is used for subsistence purposes and for general livelihood security. The smallholder farming studied in the thesis would need significant support if it were to take a more dominant role in rural economies.

The most recent strategic plan for agriculture in the Eastern Cape[19] (Paper III), in contrast to past strategic plans and the MFPP, acknowledges this need for support. In doing so, the new plan represents a clear break with the past agricultural policies reviewed in this thesis. It completely omits the idea of changing smallholders' 'mindset' and places much emphasis on the role of the historical marginalisation of smallholders in determining their current situation. Consequently, it stresses the need for policy implementation to reduce the remaining inequalities between large-scale farmers and smallholders and to increase and improve agricultural support services for smallholders.

On the other hand, the new policy still considers that agricultural development means commercialisation, and it does not clearly distance itself from the view that this means following the pattern set by large-scale

[19] *Strategic Plan 2010/11-2014/15*, Eastern Cape Department of Agriculture and Rural Development, Bisho.

agriculture (Paper III). As shown in Paper IV, under current conditions, adopting a high-input, high-output strategy would lead to minimal economic gain but significantly increased economic risk for the smallholders studied. This indicates that if smallholders are to benefit from employing the high-yielding strategy envisioned in the MFPP, inputs would need to be significantly subsidised. State subsidies on agricultural inputs have been used in many other African countries, both in the past and more recently, and from a smallholder perspective they are often helpful. However, they are costly and their long-term economic sustainability can be questioned.

Based on the role that farming plays today in the majority of households studied in this thesis, it seems unlikely that these smallholders would want to transform their farming from being an important backup-strategy providing household livelihood security (where its risk-spreading function is more important than high yields) to a riskier, but higher-yielding, entrepreneurial activity. Three factors might be of central importance in determining how to support smallholder farming in the study region in the future:

- the fact that the majority of smallholders in the study region use their farming to increase livelihood security rather than for maximising output,
- the questionable longer-term financial and natural resource sustainability of smallholders adopting capital-intensive, high-yielding farming strategies dependent on state subsidies,
- the fact that farmers in many parts of Africa will need to deal with increasing climate variability.

With these factors in mind, supporting smallholders in building resilience in their farming system might be the best way of employing farming in poverty reduction. The smallholders studied in the thesis already employ several strategies to deal with the risk and uncertainty that poverty entails, including the intercropping of maize with other plants and planting a diversity of maize varieties. These strategies could be supported and their possibility to contribute to building resilience in the farming system could be improved by *e.g.* providing agricultural advisory support to increase farmers' knowledge of maize varieties and equip them to accurately choose varieties suited to their needs and practices.

While there appears to be some trade-off between nurturing diversity and flexibility, and maximising output, there are also indications in the results presented here that there is room to raise smallholder yields by introducing cheaper, more genetically diverse, open-pollinated maize varieties. OPVs are more tolerant to local environmental dynamics, low levels of fertiliser and

suboptimal storage conditions than current high-yielding, input-demanding hybrid and GM maize varieties and they can be recycled when needed. In addition, providing new fencing around field areas would increase engagement in farming in the study area and thus lead to increased yields, without undermining resilience or resulting in a major burden on the national agricultural budget.

Figure 10. Farmer in her garden. Field areas and another village can be seen in the distance. (photo: M. Iversen, 2012).

The strategies proposed here will not lead to the yield increases envisioned in the MFPP. Based on the findings presented in this thesis they are, however, more likely to be adopted by smallholders. Thus, in contrast to the MFPP, they might provide a real, rather than only a theoretical, increase in yields. They might also allow farming in the study area to increase its importance as a secure livelihoods base from which household members could venture out into other, less secure but potentially more rewarding livelihood activities. It should also be noted that if the core aim is to reduce rural poverty, other forms of social support are of key importance. In this thesis, government welfare

benefits were found to have significant positive effects on the livelihood security of rural households and also allowed increased engagement in subsistence agriculture by releasing labour time.

In essence, future policies must acknowledge that while smallholder farming has a role in rural livelihoods, it does not follow the rationale of large-scale, capital-intensive, industrialised and commercially orientated farming. Only when smallholders' perspectives and practices are allowed to affect the focus of agricultural development support will it have the potential to provide real, locally acceptable change in rural communities.

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Appendix A

Questionnaire, long version

Village name: ..……..……..…
Household No: ……
Interviewed by (name): ……..……
Date of interview: ……...…...

(Ask if someone is at home that is involved in the farming. If not, go back later)

1) Are you speaking to a person involved in farming (circle):
Yes No

2) Who are you speaking to? (circle more than one if appropriate)
Man Woman age: (M) …… (W).....

3) Is any of those you are speaking to head of household (circle):
Yes No

4) Who lives in this household? (only those who live here, not those belonging to family but living somewhere else)

Number of adults (over 18y): ……....
Number of children (under 18y): ……..….

5) Who does the farming in this household? (circle more than one if appropriate)
Man Woman Children ages: (M) …… (W)..... (C)…….

6) Do you have a field (circle)?
Yes No

7) Do you have a garden (circle)?
Yes No

8) List all you grow in the field:
Type of maize (circle): xhosa from shop from project

If growing xhosa, what types of xhosa maize, if from shop, what name of shop and maize type:
……
……
……
All other things grown:
……

……
……

9) List all you grow in the garden:
Type of maize (circle): xhosa from shop from project

If growing xhosa, what types of xhosa maize, if from shop, what name of shop and maize type:
……
……
……

All other things grown:
……
……
……

10) Did you ever take part in the project with the new maize distributed by the chief (circle)?
Yes No

11) Did you ever grow the new maize distributed by the chief (circle)?
Yes No

12) Do you find any differences between the xhosa maize and the project maize when growing
(for example differences in how it is affected by weather, soil, insects)?
……
……
……

13) Do you find any differences between the xhosa maize and the project maize in how it works to store it?
……
……
……

14) Do you find any differences between the xhosa maize and the project maize when cooking and eating it?
……
……
……

15) What do you spend most money on per year? (don't forget small spendings that add up to much money)

costs most money?:
……
costs next most money?:
……
costs third most money?:
……

16) What do you buy for farming each year, and for how much?
Fertiliser (circle): Yes No
(how big bag, how many bags and price):
……
……
Maize seeds (circle): Yes No
(how big bag, how many bags and price):
……
……

Other seeds and plants (circle): Yes No
(price):
……
……
Chemicals (circle): Yes No
(price):
……
……
Pills for the tank (circle): Yes No
(price):
……
……
Rent tractor/draught cattle (circle): Yes No
(price):
……
……
Other, (specify what and price):
……..
……
Buying new animals (circle): Yes No
(price):
……
……
Buying medicines for the animals (circle): Yes No
(price):
……
……

Paying a herd boy (circle): Yes No
(price):
……
……
……
Other costs for the animals (circle): Yes No
(specify what cost and price):
……
……
……

17) What income do you have in the household?

Pension: how many: ……...,
How much money per pension: ……Rand/month

Child grant: how many: ……..….
How much money per grant: ……Rand/month

Foster care grant: how many: …..……...
How much money per grant: ……Rand/month

Disability/ sickness grant: ……..…
How much money per grant: ..…..……. Rand/month

Other grant: (which and how many)
……

How much money per grant: ……Rand/month

Work (specify if the money is per week, month or year):
……
……
Money from relative or other person (specify if the money is per week, month or year):
……
……

Does anyone in the household sell things sometimes? (for example buy things in town to sell, or sell produce from the field or garden, or sell an animal). Specify what you sell and for how much. For each item, specify if the money is per week, month or year):
……
……
……

Does anyone in the household receive some money from any other business (for example having a public phone, renting out cattle for ploughing etc). For each thing, specify if the money is per week, month or year:
……
……
……

18) Do you have animals? Which and how many of each?

Number of cattle: ……..……..
Number of donkeys: ……
Number of sheep: ……..……..
Number of ducks and geese: ……...……
Number of goats: ……...……..
Number of chickens: ……
Number of horses: …….
Others (specify what and number):
..……..……..……..…

19) Rank what is the most important (number 1) to the least important (number 4) for the household of: - animals that go to the grazing lands, - the produce from the garden, - the produce from the fields, - money (the one you could most easily do without is number 4)
..... (1. 2, 3, or 4) animals that go to the grazing lands,
..... (1. 2, 3, or 4) the produce from the garden,
..... (1. 2, 3, or 4) the produce from the fields,
..... (1. 2, 3, or 4) money (all money you get from grants, work etc.)

20) If the project is not coming back, what kind of maize will you grow next year and where will you get seeds?
……
……
……

Questionnaire, short version

Village name: ..……

Household No: ……..….

Interviewed by (name): …….……

Date of interview: ……...…...

(Ask if someone is at home that is involved in the farming. If not, go back later)

1) Who are you speaking to? (circle more than one if appropriate)

Man Woman age: (M) ….....…… (W).....

2) Is any of those you are speaking to head of household (circle):

Yes No

3) Who lives in this household?

(only those who live here, not those belonging to family but living somewhere else)

Number of adults (over 18y): ……....

Number of children (under 18y): ……..….

4) Who does the farming in this household? (circle more than one if appropriate)

Man Woman Children ages: (M) …… (W)..... (C)…….

5) Do you have a field (circle)?

Yes No

6) Do you have a garden (circle)?

Yes No

7) List all you grow in the field:

Type of maize (circle): xhosa from shop from project

All other things grown:

……

……

……

8) List all you grow in the garden:

Type of maize (circle): xhosa from shop from project

All other things grown:

……

……

……

9) Did you ever take part in the project with the new maize from the chief (circle)?

Yes No

10) Did you ever grow the new maize from the chief (circle)?
Yes No

11) What do you buy for farming each year?
Fertiliser: Yes No
Maize seeds: Yes No
Other seeds and plants: Yes No
Chemicals: Yes No
Pill for the tank: Yes No
Rent tractor/cattle: Yes No
Other (specify what): Yes No
Buying new animals: Yes No
Buying medicines for the animals: Yes No

12) What incomes do you have in the household?
Pension: how many: …….
Child grant: how many: ……..……..
Foster care grant: how many: ……..…….
Disability/ sickness grant: ……..…..

Money from someone who works, business or other: Yes No
How much:……..…..

13) Do you have animals? and how many of each?
Number of cattle: …….
Number of sheep: …….
Number of goats: ……..
Number of horses: ……
Number of donkeys: …….
Number of ducks and geese: ……....
Number of chickens: …….
Number of others: …….

14) If the project is not coming back:
what kind of maize will you grow next year?:……
where from will you get seeds?:…….……...

15) Rank what is the most important (number 1) to the least important (number 4) for the household of: - animals that go to the grazing lands, - the produce from the garden, - the produce from the fields, - money (the one you could most easily do without is number 4)
..... (1. 2, 3, or 4) animals that go to the grazing lands,
..... (1. 2, 3, or 4) the produce from the garden,
..... (1. 2, 3, or 4) the produce from the fields,
..... (1. 2, 3, or 4) money (all money you get from grants, work etc.)

Appendix B

Overview of households targeted by in-depth semi-structured interviews, based on survey data collected 2008, 4 tables

Overview very poor households

Poverty level	Household composition	Monetary income	Animals (cattle, sheep, goat, horse, donkey)	Field (has field or not and comments on types of maize planted)	Garden (comments on types of maize planted)
Very poor	Middle-aged widow with three grand-children.	One child grant.	No animals.	No field.	Small part of garden planted with purchased seed.
Very poor	Young widow with five children.	Four child grants.	Nine goats.	Not planted.	Planted with maize seeds remaining from the MFPP.
Very poor	Old widow with three children.	One pension and three child grants.	Cattle has recently been stolen.	Not planted.	Not planted.
Very poor	Old widow with two children.	One pension.	Two head of cattle.	Not planted.	Planted with Xhosa maize.

Overview poor households

Poverty level	Household composition	Monetary income	Animals (cattle, sheep, goat, horse, donkey)	Field (has field or not and comments on types of maize planted)	Garden (comments on types of maize planted)
Poor	Elderly couple with three teenage children.	Two pensions, two child grants.	Four sheep and two horses.	Not planted.	Planted with seeds remaining from the MFPP and purchased seeds.
Poor	Old widow with two adult children and four grandchildren.	One pension, two child grants. Two daughters at work outside village.	Three sheep. Cattle died recently.	Not planted.	Planted with seeds from the MFPP received from a neighbour.

Overview middle households

Poverty level	Household composition	Monetary income	Animals (cattle, sheep, goat, horse, donkey)	Field (has field or not and comments on types of maize planted)	Garden (comments on types of maize planted)
Middle	Old widow head of household. In total six adults and four children live with her for part or all the time.	One pension. Three child grants. Three family members in employment outside the village.	Nine head of cattle, 12 goats.	Planted with Xhosa maize and maize from the MFPP.	Planted with Xhosa maize and maize from the MFPP.
Middle	Old couple with one teenage grand-daughter.	Two pensions. Three adult children in employment outside the village.	12 head of cattle, 13 sheep, 11 goats and one horse.	Two fields planted with Xhosa maize and maize from the MFPP.	Planted with maize from the MFPP.
Middle	Old widow woman with one child.	One pension and support from an adult son employed as a teacher in the village.	Four head of cattle. Six sheep.	Planted with Xhosa maize and purchased maize seeds.	Planted with Xhosa maize and purchased maize seeds.

Overview rich households

Poverty level	Household composition	Monetary income	Animals (cattle, sheep, goat, horse, donkey)	Field (has field or not and comments on types of maize planted)	Garden (comments on types of maize planted)
Rich	Old couple and husband's mother. Five grandchildren.	Three pensions, two child grants. Several children at work outside the village. The husband is a traditional healer.	24 head of cattle, 54 sheep, 21 goats, six horses, four donkeys.	Two fields planted with purchased seed and seed from the MFPP.	Planted with purchased seed and seed from the MFPP.
Rich	Old couple with four children.	Two pensions, one child grant, three foster care grants.	Eight head of cattle, 56 sheep, one horse.	Planted with Xhosa maize and maize from the MFPP.	Planted with Xhosa maize and maize from the MFPP.

Appendix C

ECDA documents about the MFPP used in discourse analysis

Document name	Year of publication
Massive Food Production Conditional Grant Contract for Field Crop Production	2002
Memorandum: Massive Food Production Scheme through a Conditional Grant Scheme for Crop Production and a Rural Mechanisation Scheme	2002
Massive Food Production	2004
Massive Food Production Scheme	2004
Massive Food Programme: Notes and Observations'	2004
Massive food program: Siyakula & Massive food components	2005
Massive Food production Programme: Critical Matters of Implementation as at September 2004	2004
Eastern Cape Department of Agriculture Massive Food Production Programme	unknown
Massive Food Production Campaign	unknown
Massive Food Production Conditional Grant Scheme and Rural Mechanisation Scheme'	unknown
Massive Food Programme: Note on Equipment and Fertilizer Required	unknown

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Figure 11. Farmer weeding field with hoe (photo: K. Jacobson, 2008).