

***LOWER EXTERNAL INPUT FARMING METHODS AS A MORE
SUSTAINABLE SOLUTION FOR SMALL-SCALE FARMERS***

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DECLARATION

By submitting this thesis, I declare that the entirety of the work contained therein is my own, original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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ABSTRACT

The main aims of this thesis were to assess the sustainability of the original Green Revolution (GR) farming methods for small-scale farmers in developing countries, to identify alternative farming methods which may be more sustainable and to comment on the New GR for Africa, currently being promoted by the Alliance for a Green Revolution in Africa (AGRA). A key element of the thesis was primary research done in India, in order to gather the experience of selected small-scale farmers in that country who had converted from GR to low-external input farming methods. The experience of the farmers in India was used to highlight points made in the thesis.

Both primary and secondary data were used to inform the study. Firstly, a literature review was conducted in order to assess the original GR, identify alternative farming methods and gather information on the New GR for Africa. In order to assess sustainability, a framework was developed which defined sustainability at a global level and also at the level of the individual small-scale farmer. This framework was based on a discussion of sustainable development and the sustainable livelihoods approach. Key elements of GR and alternative farming methods were identified and assessed according to this framework. Secondly, primary data was gathered in India from a group of small-scale farmers who had taken part in a programme by a non-governmental organisation called Dharamitra. The data was collected through semi-structured interviews and participant observation techniques. This data was used in order to illustrate points made in the literature review.

The study concluded that many elements of farming methods from the original GR are unsustainable, both globally and at the level of the small-scale farmer. The main findings were that GR farming methods caused damage to the environment and in particular made small-scale farmers reliant on external inputs. Alternative farming methods which used organic and low external input approaches were found to enhance and preserve the environment, while at the same time being more affordable for small-scale farmers. The experience of the farmers interviewed in India confirmed these findings and provided a useful illustration of concepts presented from the literature review. Lastly, the New GR for Africa was found to present elements of the

original GR which are unsustainable for small-scale farmers, especially in terms of the reliance that would be created on external inputs.

The study concluded with recommendations around the need to promote farming methods to small-scale farmers which promote better care of the environment and are better able to promote sustainable livelihoods, namely organic or low external input methods. Recommendations were also made regarding the need for further research into the influence of AGRA's policies and documentation of sustainable farming practices in Africa.

OPSOMMING

Hierdie tesis is daarop gemik om die volhoubaarheid van die oorspronklike Green Revolution (GR)-boerdery metodes vir klein-skaal boere in ontwikkelende lande te assesser, om alternatiewe boerdery metodes wat meer volhoubaar is te identifiseer en om op die New GR for Africa, wat tans deur die Alliance for a Green Revolution in Africa (AGRA) bevorder word, kommentaar te lewer. 'n Sleutelement vir hierdie tesis is primêre navorsing wat in Indië uitgevoer is ten einde die ondervinding van geselekteerde klein-skaal boere wat van GR na lae eksterne insette boerdery metodes in daardie land oorgeskakel het. Die ondervinding van die boere in Indië is aangewend om onderwerpe wat in die tesis aangeraak word, uit te lig.

Beide primêre en sekondêre data is aangewend om die studie toe te lig. Eerstens is 'n literatuur oorsig onderneem ten einde die oorspronklike GR te assesser, alternatiewe boerdery metodes te identifiseer en inligting rakende die New GR for Africa in te samel. Ten einde volhoubaarheid te assesser, is 'n raamwerk ontwikkel wat volhoubaarheid op beide 'n universele asook die klein-skaal boer se vlak gedefinieer het. Hierdie raamwerk is gebaseer op 'n bespreking oor volhoubare ontwikkeling en die volhoubare lewensmiddele benadering. Tweedens is primêre data van 'n groep klein-skaal boere in Indië, wat aan 'n program wat deur 'n nie-regeringsorganisasie, genaamd Dharamitra, deelgeneem het, ingesamel. Die data is by wyse van semi-gestruktureerde onderhoude en deelnemer observasie tegnieke ingesamel. Genoemde data is aangewend ten einde onderwerpe in die literatuur oorsig toe te lig.

Die studie bevind dat baie elemente van die oorspronklike GR boerdery metodes onvolhoubaar is beide op 'n universele sowel as op die klein-skaal boer se vlak. Die hoofbevindinge is dat die GR boerdery metodes skade aan die omgewing berokken het en veral die klein-skaal boer afhanklik gemaak het van eksterne insette. Daar is bevind dat alternatiewe boerdery metodes wat organiese en lae eksterne insette benaderings gevolg het die omgewing versterk en bewaar het. Terselfdertyd is dit meer bekostigbaar vir klein-skaal boere. Die ondervindings van die klein-skaal boere met wie daar in Indië onderhoude gevoer is, ondersteun hierdie bevindinge en verskaf waardevolle toeligting tot konsepte vanuit die literatuur oorsig. Laastens is daar

bevind dat die New GR for Africa elemente van die oorspronklike GR wat onvolhoubaar vir klein-skaal boere blyk te wees, bevat, veral in terme van die steun wat daar op eksterne insette geplaas word.

Die studie sluit af met voorstelle rondom die behoefte wat daar bestaan om boerdery metodes aan die klein-skaal boer bekend te maak wat beter sorg van die omgewing sowel as volhoubare lewensmiddele, naamlik organiese of lae eksterne insette metodes, te bevorder. Voorstelle aangaande die behoefte aan verdere ondersoek na die invloed van AGRA se beleid en dokumentasie ten opsigte van volhoubare boerderypraktyke in Afrika, word ook gemaak.

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LIST OF ACRONYMS AND ABBREVIATIONS

AGRA	Alliance for a Green Revolution in Africa
AKST	Agricultural Knowledge, Science and Technology
ASPO	Association for the Study of Peak Oil and Gas
AU	African Union
CAADP	Comprehensive Africa Agriculture Development Programme
CAP	Common Agricultural Policy
FAO	Food and Agriculture Organisation
EU	European Union
FSG	Farmer Study Group
GHG	Greenhouse Gas
GM	Genetically Modified
GR	Green Revolution
HDR	Human Development Report
HEI	High External Input
HYV	High-yielding Variety
IAASTD	International Assessment of Agricultural Knowledge, Science & Technology for Development
ICAR	Indian Council of Agricultural Research
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
IMF	International Monetary Fund
IPM	Integrated Pest Management
IPCC	International Panel on Climate Change
ISFM	Integrated Soil Fertility Management
LEI	Low External Input
MA	Millennium Ecosystem Assessment
MDG	Millennium Development Goal
MV	Modern Variety
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental Organisation
NPK	Nitrogen Phosphorous Potassium

OECD	Organisation for Economic Co-operation and Development
PPP-AGR	Public-Private Partnership for an African Green Revolution
SAP	Structural Adjustment Programme
SD	Sustainable Development
SLA	Sustainable Livelihoods Approach
SSA	Sub-Saharan Africa
TNC	Transnational Corporation
TRIPS	Trade-Related Intellectual Property Rights
TWN	Third World Network
WDR	World Development Report
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
UN HABITAT	United Nations Human Settlements Programme
WCED	World Commission on Environment and Development
WFP	World Food Programme
WTO	World Trade Organisation

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

Over the past century, the human population has experienced its highest growth rate yet, with the population almost trebling between 1950 and 2008 (UN DESA, 2008:3), but agriculture has, through significant innovation, kept pace with this growth and produced enough food to feed the world. The food produced has not been evenly distributed (IAASTD, 2008a:7), with the result that millions of people are still hungry and malnourished. Despite the global food availability increases which have already been achieved, the human population is predicted to increase by 50 percent, to around nine billion people, by 2050 (UN DESA, 2008:1). And while there is consensus that food output will need to increase to meet the demands of the growing population, there are highly differing opinions on how to achieve this increase (Borlaug, 2000; Tilman *et al*, 2002; Huang, Pray and Rozelle, 2002; Pretty and Hine, 2001; Badgeley *et al*, 2006).

One of the most celebrated achievements of agriculture in the past century was the Green Revolution (GR) which began in the 1950s. This introduced “high technology, chemical fertilisers, high-yielding seeds, irrigation, and labour-saving machinery” (Madeley, 2002:28) to farming, especially farming in the developing world. This approach to farming dominates the world today such that current agriculture is referred to as modern, industrial, green revolution or high external input (HEI) agriculture. While there is no doubt about the enormous success of the GR in increasing yields, there are now many studies highlighting the long-term environmental unsustainability of the GR (Tilman *et al*, 2002; Bowler, 2002; Pretty *et al*, 1995; Goering *et al*, 1993; Shiva, 1991).

During a sustainable agriculture course presented at the Sustainability Institute, Stellenbosch in 2007, the course presenter, Dr Tarak Kate, presented the work of his non-governmental organisation (NGO) in India. The NGO, Dharamitra, has been tackling the problems of small-scale farmer indebtedness and suicides in the area around Wardha in Central India. These farmers had been engaged in GR farming

methods and Dharamitra helped many of them to convert to organic¹ methods, decrease their cost of production, reduce their debt and stabilise their income generation from farming. It was clear that the farmers were motivated to convert to organic farming by a need to get out of debt and generate greater income, rather than by a desire to farm with less harm to the environment. This made me aware of another aspect of unsustainability surrounding the GR, namely economic unsustainability for small-scale farmers.

At roughly the same time, I became aware of strong calls and actions by groups pushing for a GR in Africa. One of the largest proponents is an organisation called the Alliance for a Green Revolution in Africa (AGRA). AGRA was formed in 2006 with funding from the Rockefeller Foundation and the Bill and Melinda Gates' Foundation. The Rockefeller Foundation is a philanthropic organisation which aims to uplift poor communities. It was largely responsible for setting in motion the GR in the 1940s by assisting the Mexican government with plant breeding research. It is now calling for the same in Africa, to be directed at small-scale farmers, and is already providing funding for plant breeding, training of African scientists and public-private partnerships to promote the spread of fertilisers, among other initiatives (The Rockefeller Foundation, 2006:9).

It is certainly understandable to push for increased agricultural output in Africa, as Africa has the lowest agricultural production levels in the world (IAASTD, 2008a:16) and the original GR did not take hold in Africa (Daño, 2008:4). But it seems worrying that the approach being suggested is to repeat farming methods which have been proven to have negative environmental consequences for the planet and are perhaps economically unsustainable for small-scale farmers. An initial scan of the literature revealed that there are serious concerns with the long-term consequences of GR farming methods. It pointed to environmental degradation (which in turn leads to loss of soil fertility), falling yields and high costs for small farmers (Bowler, 2002; Madeley, 2002; Shiva, 1995; Thakur and Sharma, 2005).

¹ Please note that organic has a specific meaning within the context of this thesis. See 1.3 Key Concepts.

My studies in sustainable development (SD) have given me an idea of the challenges facing the planet in terms of ecosystem degradation, climate change, social inequity, urbanisation and the need to lift millions of people out of poverty. I decided to use this understanding of sustainability and sustainable development as a framework against which to assess the original GR. This assessment of the sustainability of the GR for small-scale farmers could then be used to evaluate the proposed GR for Africa, to determine how similar it is the original GR, and whether it is suitable for small-scale farmers in terms of sustainability.

Literature was used to identify the core farming practices of the original GR, and assess these against the criteria developed for sustainability in section 3.4. Literature was also used to identify alternative farming methods and assess them in a similar way. I then interviewed farmers in India who were part of Dharamitra's programme, in order to gain insight into their experience with GR and organic farming methods. It seemed, at the outset of this research, that organic farming methods applied by Dharamitra farmers are providing a solution for these farmers. My research attempted to find out more about these farmers personally and whether organic farming has improved yields, reduced their costs and improved income. It also sought to find out why conventional farming had been unsuccessful for them. Next, I attempted to compare the major trends from the literature to the personal experience of the farmers interviewed in India. I feel that the experiences of ordinary individuals can deepen an understanding of broad trends outlined in literature. The conclusions from this literature review and the interviews in India were then compared to the GR in Africa, to assess how sustainable this proposed GR is, both for the environment and small-scale farmers.

I am guided in my approach by the following quote: "the purpose of much research at Master's or PhD level is not so much to prove things – but more to *investigate* questions and *explore* issues. Many researchers either want to understand a situation more clearly or to change things by virtue of their research – some want to do both" (Clough & Nutbrown, 2002:4). I hoped to understand the situation around the long-term sustainability of GR methods for small farmers through reference to literature and the example of farmers in India. India has been using GR farming methods since

the 1950s, thus the experience of its farmers can provide an indication of what the long-term impacts of a GR approach may be for Africa. If my research suggests that GR is not sustainable for small farmers in the long run, I hope to influence those calling for a GR in Africa – and perhaps suggest that further research needs to be done in this area in Africa. I also hope to demonstrate that there are other productive options (i.e. low external input (LEI) organic farming) which are more economically sustainable for small farmers.

1.2 RESEARCH PROBLEM AND OBJECTIVES

After clarifying the reasons and aims for the research, it is necessary to formulate research objectives which will set parameters for the study, give it a clear focus and indicate the path forward (Clough & Nutbrown, 2002).

Mouton (2001) says that, in “transforming research ideas into research problems” (2001:49) there are three steps which can help. The first is to conduct a preliminary literature review which helps to demarcate the field of study and illustrate how other researchers have approached the subject before. The next step is to identify the “units of analysis” (2001:51), i.e. what the object of the study is. There are two parts to this thesis: firstly, a literature review is used and so the unit of analysis is “the ideas and writing of other scholars” (Mouton, 2001:52); secondly, the experience of small-scale farmers in India will be obtained and the unit of analysis for this is individuals. Mouton says that research done through a literature review is non-empirical because it can be resolved through “an analysis of the body of scientific knowledge” (2001:53); whereas gathering the experience of farmers would be empirical research as it requires the gathering of new data about a real-life problem (Mouton, 2001:53). The third step is to focus the research problem by expressing it in the form of questions (2001:53).

The specific research objectives are to:

- i. From the literature, assess the sustainability of GR farming practices, particularly for small-scale farmers in developing countries

- ii. From the literature, identify alternative farming methods which may be more sustainable for small-scale farmers in developing countries
- iii. Illustrate the findings in i. and ii. with the personal experience of six small-scale Indian farmers who have converted from GR methods to LEI methods
- iv. Determine whether the findings from the literature and/or the personal experience of these farmers suggest the need for further primary research in response to the drive for a GR in Africa

It is necessary to review the proposed research objectives in order to ensure they are not too broad or too narrow and to strip away all complication and obscurities until the very essence of the question is exposed (Clough & Nutbrown, 2002:37). It is clear that research objectives i. and ii. require a definition of the term ‘sustainability’; such a definition would serve to make the focus of the objectives clearer and also to narrow the literature study. These terms are defined in section 3.4 after a discussion of sustainable development and sustainable livelihoods². Other terms used in the research objectives are defined in the following section on Key Concepts. I also decided not to deal with genetically modified (GM) crops in too much detail in this thesis in order to limit its scope. GM crops and technologies have been discussed at various points in the thesis however (see sections 3.2, 4.1.5 and 6.4) where it was necessary. Please note also that this thesis is focussed on the farming of food crops (cereals and vegetables).

1.3 KEY CONCEPTS

It is necessary at this point to define some of the key concepts that are expressed in the research problem and elsewhere which will be used repeatedly in this study.

- i. Small-scale farmer: for the purposes of this study, small-scale will be defined as farming less than five hectares.

² Reasons for using a sustainable livelihoods approach to define ‘sustainability’ are explained in more detail in section 1.5 and Chapter Three.

- ii. Green Revolution (GR) farming: this refers to farming methods which incorporate all or most of the following: use of high-yield varieties of seeds, chemically derived fertilisers, pesticides and herbicides, irrigation and mechanisation.
- iii. Low external input (LEI): this refers to farming with minimum use of off-farm inputs (Pretty *et al*, 1995). It is similar to definition of organic farming below and the two are used interchangeably in this thesis.
- iv. Organic: this term can refer to a specific form of farming which is governed by an international body and various regional bodies. For this thesis, it will be used to refer to farming methods which aim to promote the health of soil, ecosystems and people through promotion of ecological processes, biodiversity and adaptation to local conditions. It also means farming without chemically-derived inputs (fertilisers and pesticides)³.
- v. Pesticides: this term will be used to refer to any chemically-derived pesticide, herbicide, insecticide or fungicide used on crops. For the purposes of this thesis, it is not necessary to distinguish between them.

1.4 SIGNIFICANCE OF THE STUDY

Firstly, this study will make a useful contribution in assessing the original GR in terms of sustainability both at a broad level and at the level of individual small-scale farmers. While this alone may be valuable in assessing the GR in a slightly new way, this study will be valuable in bringing to light the personal experience of selected small-scale farmers in India who were struggling with GR farming methods and have successfully converted to LEI, organic methods. This personal experience can highlight and ‘make real’ certain issues which seem distant and largely theoretical on paper. Additionally, Dharamitra’s work has never been formally published and doing so may prove useful in sharing their knowledge and experiences with a wider audience.

³ This definition of ‘organic’ is adapted from the International Federation of Organic Agriculture Movements (IFOAM, 2008).

Lastly, this thesis will be one of very few assessments of AGRA which exist in formal literature at this time. It will provide an assessment against a broader sustainability agenda which may be useful for those who want to learn more about AGRA and what it means for Africa.

1.5 INTRODUCTION TO RESEARCH DESIGN AND METHODOLOGY

Since the main research objectives of this study are to assess the sustainability of the GR and to identify alternative farming methods which may be more sustainable (for small-scale farmers in developing countries), the most useful research design would be a literature review. Literature reviews are able to address non-empirical questions such as this (this is discussed in greater detail in Chapter Two).

The third research objective is to compare the experience of small-scale farmers in India to findings from objectives i. and ii. Thus another type of research design was required to obtain the information about the personal experience of selected small-scale farmers in India which could answer the empirical question of what the experiences were of small-scale Indian farmers who have converted from GR to LEI/organic farming methods. The most appropriate design was one based on ethnographic research, using interviews and participant observation.

In terms of the literature review section of the study, literature was sought which provided an assessment of the original GR in sustainability terms and which presented alternative farming methods. In order to provide for a methodology against which the impacts of GR farming methods and alternative farming methods could be assessed and evaluated, a framework was developed in section 3.4 based on SD and the sustainable livelihoods approach (SLA).

The findings from the literature review were presented in a discussion to be found in Chapters Three to Six. Chapter Four, which answers research objective i. (assess the sustainability of GR farming methods for small-scale farmers), and Chapter Five, which answers research objective ii. (identify alternative farming methods which may be more sustainable for small-scale farmers), each contain full conclusions which

assess the sustainability of the respective methods against the definition of sustainability from section 3.4. The reason for doing this was so that these sections could stand alone, meaning future users of the thesis can read selected sections and still gain a full understanding of certain topics.

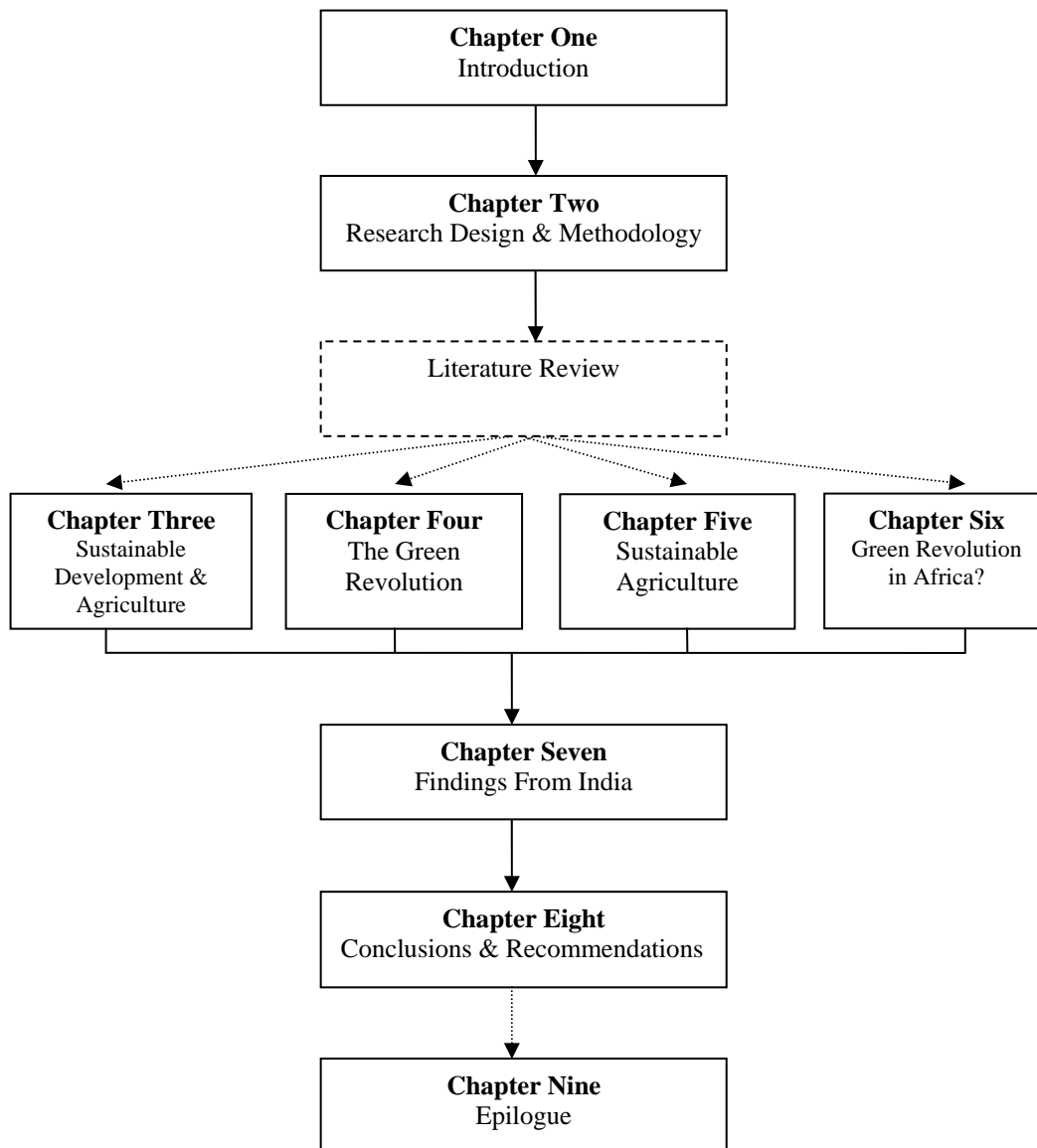
For the part of the study which sought to obtain information on the personal experience of Indian farmers, six farmers were interviewed who were part of Dharamitra's programme to convert from GR to LEI organic farming methods. The findings from the interviews and observations in India were analysed and grouped according to certain themes and are presented in Chapter Seven.

Chapter Eight provides an overall conclusion which highlights the findings from the literature study with the personal experience of the Indian farmers. Although this conclusion may repeat points made in earlier conclusions on the sustainability of the GR and alternative farming methods in Chapters Four and Five, it was deemed necessary in order to highlight the interconnectedness of all the subsections of the thesis and bring these points together in a coherent and clear whole. These findings are then applied to the proposed GR in Africa in an attempt to address research objective iv.

Chapter Nine contains an Epilogue. This deals with information which changed or came to light at the end of the preparation of the thesis.

1.6 OUTLINE OF THESIS

Figure 1: Outline of Thesis and Chapter Contents



CHAPTER TWO: RESEARCH DESIGN AND METHODOLOGY

2.1 INTRODUCTION

In this chapter, the approach to the gathering of information and the procedures followed are detailed and justified. It is important to note that there are two distinct sections to the thesis and that different methodologies were used for each. These are the literature review and the ethnographic research in India. As explained in Chapter One, the literature review will attempt to assess the sustainability of GR farming methods for small-scale farmers in developing countries and what alternative farming practices may be more sustainable; these findings will then be compared to the experience of six small-scale farmers from India.

The research design focuses on the end result: what kind of study is planned and what kind of result is aimed for? (Mouton, 2001:56). The research methodology, on the other hand, concerns the process of research and what tools and procedures will be used to gather and process information (Mouton, 2001:56).

As mentioned in Chapter One, two major research design types will be used in this study. The first is a literature review (to address research objectives i. and ii⁴.) and the second is perhaps most closely related to ethnographic research using interviews and participant observation (to gather the experience of farmers to address research objective iii⁵).

In terms of the actual methodology employed, it is my understanding that methodology is not so much about choosing an already prescribed set of tools or methods within which to conduct one's research, as it is an "ongoing task of justification" (Clough & Nutbrown, 2002: 22). One needs to make explicit one's

⁴ Research Objectives:

i. From the literature, assess the sustainability of GR farming practices, particularly for small-scale farmers in developing countries
ii. From the literature, identify alternative farming methods which may be more sustainable for small-scale farmers in developing countries

5

iii. Illustrate the findings in i. and ii. with the personal experience of 6 small-scale Indian farmers who have converted from GR methods to low input methods

research assumptions and reasons for choosing particular tools and methods for gathering information. All research activities involve “endless processes of selection; and in constantly justifying this selection, a ‘good methodology’ is more a critical design attitude to be found always at work throughout a study, rather than confined within a brief chapter called ‘Methodology’” (Clough & Nutbrown, 2002:31). This section aims to outline not only the methods and tools employed in this research endeavour but, more importantly, the justifications for using such tools and their shortcomings, where this was apparent.

2.2 LITERATURE REVIEW METHODOLOGY

2.2.1 Type of Literature Review Methodology

Mouton defines literature reviews as a research design type which “provides an overview of scholarship in a certain discipline through an analysis of trends and debates” (Mouton, 2001:179). Mouton says further that conducting this type of research is an exercise in inductive reasoning: “where you work from a ‘sample’ of texts that you read in order to come to a proper understanding of a specific domain of scholarship” (Mouton, 2001:179). Mouton refers to three typical types of literature reviews which may be used: integrative research reviews, state-of-the-art reviews and critical literature reviews. However, he neglects to define them and almost all references which he lists are for meta-analysis only.

I endeavoured to learn more about the different kinds of reviews in order to determine which would be best for my purposes and what methods are best suited to that type of review. There were very few books dedicated to literature reviews available at Stellenbosch or Cape Town university libraries. I found one concerning integrative research reviews (Cooper, 1984) and another on systematic literature reviews (Petticrew and Roberts, 2006).

Petticrew and Roberts (2006) list several more types of literature reviews and provide definitions. From my reading on the topic, I felt the following could perhaps be relevant:

Table 1: Types of Literature Reviews

	Type of Review	Description
1.	Systematic review	a review that aims to comprehensively identify all relevant studies to answer a particular question , and assess the validity (or 'soundness') of each study taking this into account when reaching conclusions
2.	Narrative review	sometimes used to refer to a systematic review that synthesises the individual studies narratively (rather than by means of a meta-analysis). This involves systematically extracting, checking and narratively summarising information on their methods and results
3.	Conceptual review (conceptual synthesis)	a review that aims to synthesise areas of conceptual knowledge that can contribute to a better understanding of these issues. The objectives of these syntheses are to provide an overview of the literature in a given field, including the main ideas, models and debates
4.	'Traditional' review	term sometimes used to refer to a literature review that does not use systematic review methods. Such reviews can still represent excellent overviews of wider literature and concepts – not just reviews of outcomes
5.	Critical review	term sometimes used to describe a literature review that assesses a theory or hypothesis by critically examining the methods and results of the primary studies, often with a wealth of background and contextual material, though not using the formalised approach of a systematic review
6.	'State of the art' review	this term is sometimes used to refer to reviews designed to bring readers up to date on the most recent research on a specific subject. What constitutes 'recent' can vary, as can the reviews' methods. State of the art reviews tend to focus on technical subjects such as engineering or transport

(Excerpted from Petticrew & Roberts, 2006:38-40)

After consulting the above table, and reading more about systematic reviews, I came to the conclusion that a systematic review would not be the best for my proposed research topic, as a systematic review “is more ‘fit for the purpose’ of answering specific questions and testing hypotheses than the traditional review. It is less of a discussion of the literature, and more of a specific tool” (Petticrew and Roberts, 2006:10). It became clear too that integrative reviews and meta-analysis also use statistical techniques to aggregate the results of studies which test a similar hypothesis. As this study is not testing a specific hypothesis, it would seem that these

types of literature reviews were not appropriate. In fact, the statistical methods recommended by meta-analysis, systematic and integrative reviews, are not relevant because, from a preliminary reading of the literature, it seems there are unlikely to be many studies in this field which make use of “probability theory and sampling techniques to make inferences about populations” (Cooper, 1984:83). Cooper says that statistics can only be used when “a series of studies have been identified that address an identical conceptual hypothesis. If the premises of a review do not include this assertion, then there is no need for cumulative statistics” (Cooper, 1984:82).

Based on this, and from the above table, it was clear to me that the best design was the ‘traditional’ literature review. It does not use systematic methods (i.e. to test a hypothesis), but rather can give a thorough overview of wider literature and concepts.

Despite the decision not to use systematic or integrative reviews, these approaches do still offer useful guidelines and methods and some of these have been adopted into my approach and are listed below.

2.2.2 Problem Formulation

After clarifying the reasons and aims for the research, discussed in Chapter One, it was necessary to formulate research questions which would set parameters for the study, give it a clear focus and indicate the path forward (Clough & Nutbrown, 2002).

The research objectives were outlined in section 1.2 as follows:

- i. From the literature, assess the sustainability of GR farming practices, particularly for small-scale farmers in developing countries
- ii. From the literature, identify alternative farming methods which may be more sustainable for small-scale farmers in developing countries
- iii. Illustrate the findings in i. and ii. with the personal experience of six small-scale Indian farmers who have converted from GR methods to low input methods
- iv. Determine whether the findings from the literature and/or the personal experience of these farmers suggest the need for further primary research in response to the drive for a GR in Africa

The research objectives which were to be investigated through the literature review were objectives i. and ii. Although these objectives may seem very broad from the point of view of searching the literature, the decision to do this was based on Cooper’s advice to start with the widest possible definitions. Cooper says it is possible to “stumble upon operations that were not initially considered but that, upon inspection, the reviewer decides are relevant to the construct” (Cooper, 1984:20). Although Cooper is referring to systematic or integrative reviews, this advice still seems valid for a traditional literature review.

Furthermore, Cooper says reviewers need to pick and define the target population “those individuals, groups or other elements that the inquirer hopes to represent in the study” (Cooper, 1984:37). By defining the population, you can list all its constituent elements. You may need to re-specify the target population once the inquiry is complete. The target population for this study was papers relating to the sustainability (or unsustainability) of GR farming methods for small-scale farmers and alternative farming methods which are more sustainable.

2.2.3 Preparing to Search the Literature Base

In practical terms, this meant the search started very broadly – looking for all papers which could be relevant. The “search vocabulary” (Hart, 1998:32) included:

Table 2: Search Vocabulary

Long-term impact of GR	Ecological impact of GR	Economic impact of GR	Social impact of GR
Debt levels of small-scale farmers	Sustainability and the GR	GR and small-scale farmers	Sustainable farming methods
Sustainable agriculture			

Variations which were tried for some of the key terms:

Impact = effects = effect; sustainable agriculture = low input agriculture = organic agriculture; Green Revolution = chemical farming methods = high external input farming methods.

The search was not limited to studies or papers which only dealt with small-scale farmers, as the preliminary literature search did not show up enough papers specific to small-scale farmers.

It was clear that decisions would need to be made as the search was conducted about which papers to include and which to exclude. “Judgements about the relevance of studies to a literature search are related to a reviewer’s openmindedness and expertise in the area, the way the research is documented in the retrieval system and even the amount of time the reviewer has for making relevance decisions” (Cooper, 1984:25)

Cooper also highlights the different channels through which one can search for literature. These include:

- Informal channels:
 - use of own prior research
 - the “invisible college” – groups of researchers linked through interest in a topic (Cooper, 1984:39)
 - attendance at conferences/professional meetings
- Primary channels:
 - use of personal libraries or journals
 - ancestry approach – tracking research cited in already obtained research
- Secondary channels: “should form the backbone of any systematic, comprehensive literature search. This is because secondary sources probably contain the information most closely approximating all publicly available research” (Cooper, 1984:42) i.e. indexing and abstracting services

The channels which I focussed on were secondary channels and the ancestry approach. I have not conducted prior primary research on this area, nor do I have an extensive personal library or journal subscriptions.

Cooper makes an interesting point about over reliance on published studies. Dharamitra, the NGO in India where the farmers who were interviewed are based, has found that the farmers in its local area are in debt due to the high costs of chemical farming methods. This work would never have come to my attention had I not met Dr

Kate in South Africa while he was here teaching. It is very likely that there are other NGOs who are doing work which has not been studied or published and who do not have websites. This is a potential weakness of this thesis which relied mainly on published work and the internet. However, through the connection with Dr Tarak Kate, who is widely connected to other Asian NGOs, I am part of an 'invisible college', as well as through the links of the Professors and lecturers at the Sustainability Institute.

Clough and Nutbrown provide an interesting approach to critically reviewing the literature which I thought was useful to bear in mind. They talk about a 'radical' approach (radical listening, reading, questioning and looking) which will help the reviewer to:

- Work out positionality, understand what lies behind what is said by researchers and their subjects (i.e. their intentions) and also what this means within their social or political framework
- Uncover gaps in knowledge
- Justify the critical adoption or rejection of existing knowledge or practices

(Clough and Nutbrown, 2002)

2.2.4 Searching the Literature

Meetings were held with the sustainable development subject librarian at Stellenbosch University. He assisted me in using the online research database search tools. Searches revealed a very large selection of papers which could be relevant to the thesis. Based on this, a decision was taken to approach the literature from a new angle, in order to focus the search. Many of the papers found in the search were highly specific to certain crops or small sites in different countries. Since the aim of the thesis was to obtain a high-level, broad overview of the sustainability of GR farming methods, literature was selected which could provide this. Literature from my sustainable agriculture studies last year was used as the starting point for obtaining literature related to alternative approaches to the GR; this includes some of the seminal works of recent years on sustainable agriculture. An ancestry approach was then used working from the papers found in the literature search and these seminal papers. Literature was included in the study if it related directly to the sustainability

themes which were identified in Chapter Three. It was also found that many of the proponents of alternative and sustainable agriculture provided very good analyses of the sustainability issues surrounding GR farming methods.

2.2.5 Data Analysis

In order to analyse the literature, a framework was developed. This was based on a discussion of SD and the SLA in section 3.4 which defined the term 'sustainability' as used in research objectives i. and ii. The framework was necessary both to narrow the focus of the research, as well as to provide a format through which the literature could be critically analysed. Most importantly, the framework provided criteria which could be used to answer the research objectives.

It was decided to present full conclusions on the sustainability of the GR and alternative farming methods after each of those sections, as well as at the end of the thesis. This was done in order to allow each of the major sections to stand alone, so readers of the thesis could read particular sections and still gain a full understanding of their importance.

2.2.6 Objectivity

“Few social scientists would want to insist that their work is neutral, value-free or uninfected by personal and political ideology” (Clough and Nutbrown, 2002:148)

It is worth mentioning here that I am of the opinion that research, especially in the social sciences, can never truly be objective. You, the reader of this thesis, will already have noticed the liberal use of the personal “I”. I acknowledged openly in the first section my personal reasons for doing this research and I do not agree with trying to pretend that this piece of research is objective. Researchers will always be driven by their “existing values, morals and knowledge base... In this sense then, is it realistic to divorce ourselves from our research? Is it intellectually honest to separate ourselves, to silence our voices as researchers within our research processes and reports?” (Clough and Nutbrown, 2002:70). I think that not only is it intellectually dishonest to separate one's self from the research, but also virtually impossible.

However, this is not to say that I will not attempt to respect the work of others and their opinions, to represent what they have to say fairly and to have “scholarly respect for the ideas of others” (Hart, 1998:25). “A critical account of anything seeks to be *rational*, but cannot fail to reflect the values and beliefs of its author; the most *persuasive* critical accounts reveal the full range of values at work in the analysis” (Clough and Nutbrown, 2002:25). It is hoped that, by disclosing my reasons for undertaking the research, where I have been prejudiced or unfair to other authors without realising it, the reader will be able to pick up this prejudice.

I also feel that there is value in expressing one’s personal opinions in research work. My own experience in conducting the research and in visiting the field (India) can add another layer to this research. In fact, Clough and Nutbrown feel that the researcher’s voice should be as present in the work as those of the research participants: “the informed researcher’s voice no longer provides an authoritarian monologue but contributes a part to dialogue” (Mitchell, in Clough and Nutbrown, 2002).

2.3 ETHNOGRAPHIC METHODOLOGY

2.3.1 Introduction

The research objective being considered through this section of the project is objective iii: illustrate the findings in i. and ii. with the personal experience of six small-scale Indian farmers who have converted from GR methods to low input methods. It was thus necessary to gather data on the experience of small-scale farmers who had converted to LEI farming methods. Although the type of research undertaken here was not true ethnographic research, it is perhaps most closely linked to ethnographic approaches. Maykut and Morehouse explain that ethnography arose among anthropologists who wanted to explain culture or aspects of culture (1994:69). Mouton says that ethnographic research based on participant observation and interviewing “aim to provide an in-depth description of a group of people or community” (Mouton, 2001:148). All these authors stress the fact that the understanding of culture can only happen when one investigates it within its context. Although I am not aiming to provide an in-depth discussion about these farmers or their way of life, but rather trying to understand part of their experience, I feel there

are certain techniques which can be useful to me from the realm of ethnographic research.

2.3.2 Justification

As was mentioned earlier in this section, methodology is not about picking a research design type and then implementing an already specified set of tools. Good methodology is about being able to justify one's approach and having a critical attitude at all times during the research process.

I chose to use semi-structured interviews and elements of participant observation as my sources of data (Mouton, 2001:148). This is because I essentially wanted to find out: "What is happening here? What is important in the lives of the people here?" (Maycut and Morehouse, 1994:69). However, I was not aiming to explain the entire culture of the farmers interviewed, and therefore did not spend extended amounts of time in one setting.

Here I would like to give some justifications for my approach.

Why India? The reasons I chose to interview *Indian* farmers were both practical and theoretical. My interest in the long-term effects of GR farming methods was stimulated by meeting Dr Kate and hearing of the work his NGO is doing in India to assist small-scale farmers who are in debt. The Sustainability Institute also had funding available for a research trip to India and its management and funders were very interested in sending a group of researchers there to speak to farmers. It was an opportunity I could not refuse to access farmers who were struggling with GR farming methods. Also, India was one of the first countries in the world which implemented the original GR on a large-scale. The GR was very successful there in terms of raising agricultural output but it seems the long-term financial and ecological damage that has been done warrants more research. Also, the farmers with Dharamitra seemed to have found a solution or alternative to GR methods which works for them and I wanted to learn more about it.

Why small-scale farmers? Dr Kate's NGO, Dharamitra, deals only with small-scale farmers. But I come from Africa where the predominant farm size is also small and it is these farmers that require assistance in poverty reduction and sustainable livelihood options. Also, the major drive for a GR in Africa is being focussed on small-scale farmers.

Why six farmers? This was due to the constraints I faced in India in accessing farmers who met my requirements. More detail will be given on this in section 2.3.4. I did not plan to interview many farmers though or get a representative sample; I intended to keep the number small in order to ask more in-depth questions to get a better idea of their personal experience.

In order to gather the information needed to inform this study, I travelled to India from 10 February 2008 to 2 March 2008 with a group of three other researchers. All of us went to learn as much as we could about agriculture in India, but I and another Masters candidate, Katlego Moloto, had the additional aim of interviewing farmers for our theses. Dr Kate from Dharamitra hosted the tour and arranged the interviews and interpreters.

2.3.3 Target Population of Study

The target population was resource-poor, small-scale farmers who had converted to organic methods. They were chosen because they could provide insight on why they changed to organic methods and why chemical methods were not working for them.

2.3.4 Selection Criteria

Katlego Moloto (who is producing a Master's thesis on soils) and I wanted to interview farmers who were part of the formal group of farmers covered in Dharamitra's publication, *A Ray of Hope* (a detailed description of Dharamitra and this document is provided in section 7.2). At the time, this seemed to be the best approach as the farmers we spoke to could be compared to the average results published in the Dharamitra report. However, we spoke to and visited many other farmers who Dharamitra works with in other districts who are not part of the group covered in *A Ray of Hope*. During these visits the other members of our study group

asked their own questions so I was not always able to ask all the questions I wanted to.

The six farmers were interviewed from 20 to 22 February 2008 on their farms in Ghantanjee (a profile of the area is provided below). I would have liked to have more time with the farmers and have tours of their farms too, but certain practical considerations made this impossible. These limitations included:

- Ghantanjee does not have any hotels or other suitable accommodation. We stayed in Yeotmal town which is an hour and a half drive on very poor roads from Ghantanjee. Thus three hours of every day was spent travelling to and from our accommodation. There were often travel times between each farm too.
- We needed to have an interpreter with us at all times. Thus the trip to Yeotmal needed to be timed so that the interpreter could travel with us.
- We also needed to have at least one of Dharamitra's local representatives present at each interview. The interpreter who travelled with us was new to Dharamitra and worked mainly in Wardha. She did not have relationships with the farmers and could not have set up the meetings nor introduced us and facilitated.
- Our arrival and presence in the villages was generally quite an occasion and we were often greeted with fresh flowers and expected to sit and drink sweet chai with the farmers. This is all part of the culture there and we could not speed up the process without appearing rude.

Katlego and I were interviewing the same farmers and we agreed that we wished to speak to six farmers (this seemed a reasonable number to accomplish in the three days that Dr Kate set aside for this purpose). We wanted to speak to two farmers who were performing above the Dharamitra average for the project, two who were about average and two who were underperforming; this would hopefully provide a range of answers. Unfortunately, this did not happen. It seems there was a lot of confusion and logistical problems with the planning arrangements which were totally out of our control. Although this was frustrating, we realised that this is simply the way things happen in India and we had to accept that we had very little control over which

farmers we accessed. However, the farmers we did interview were very interesting and quite varied, and still provide a useful insight into the challenges facing small-scale farmers and possible solutions. Since the purpose of this study was never to generate comprehensive primary data, but rather to use experience to add depth and insights to the literature, this lack of control over the number and specific details of the farmers was not seen as a major challenge to the validity of the data.

2.3.5 Ghantanjee Area Profile

The farmers chosen to interview were from Dharamitra's main operational area of Ghantanjee, which is an area within the Yeotmal district of Maharashtra. This area is about 150 kilometres away from Wardha, where Dharamitra's head office is located.

Figure 2: Map of Ghantanjee, India (marked with star)



Maharashtra is the second largest state in India, about the size of Italy (Government of India, 2008). Its capital is Mumbai on the west coast, but the area we visited is in the far east of the state, almost directly in the centre of the subcontinent. Yeotmal (sometimes written as Yavatmal) is generally hot and dry with short cool winters. The hot season is from March until May with average daily temperatures of 46°C, the monsoon begins in June and lasts until September, then the dry winter begins in

October until January with average winter temperatures of about 13°C (Government of India, 2008). The district has an average rainfall of 946mm a year, with most of this falling from June to September; it is unusual for any rain to fall outside this period. The parts of the district we visited were hilly, rocky and dry. The agro-climatic region is Deccan Plateau, characterised by hot, semi-arid conditions with shallow to medium black soils (Dharamitra, 2007:4). The soils have extremely low levels of humus and therefore low productivity (Dharamitra, 2007:4). The district is mainly involved in agriculture with the main town of Yeotmal being dedicated to agricultural processing activities (e.g. cotton spinning etc) and sometimes referred to as ‘cotton city’. The main kharif season (monsoon season) crops are jowar (sorghum), cotton, green gram, groundnut and rice (although rice is not grown in the area we visited). The main rabi season (dry season) crops are wheat and black gram. Black gram is also known as urad bean or black lentil, green gram is also known as mung bean.

The average size of farms in Yeotmal is 3.65ha although 40 percent of farmers in the area hold below 2ha (Dharamitra, 2007:5). The land is undulating, with poor soils and very little irrigation facilities. The literacy rate is only 45 percent and there is a general lack of sanitary facilities. Added to the general poverty and high debt levels, this has made the area of Yeotmal the most susceptible to farmer suicides in recent years (Dharamitra, 2007:5).

2.3.6 Instruments

The main instruments used for data collection were interviews and observation.

2.3.6.1 Interviews

Intuitively, it seemed that having an interview would be the best method for my purposes as it is most like a conversation where the farmer could tell his story. Also, this format seemed almost expected by the staff at Dharamitra who asked when we wanted to ‘interview’ farmers. Once we actually arrived at our first location for interviewing, it became apparent that, culturally, this was the best way to engage with the farmers. It seemed to me that our visits to the villages were a highlight and honour for the villagers, as large groups gathered to watch the proceedings and we were often asked for our autographs by villagers. Although focus groups may have allowed for

speaking to more farmers in a shorter space of time, this would not have allowed each farmer's individual story to come through clearly, and was thus not appropriate for the type of information that was being sought. My aim was always to allow the farmers to tell their stories, in order for their personal experience to show through. I felt this would offer depth and insights which just identifying trends from the literature never can. "Telling stories is a meaning-making process. When people tell stories, they select details from their stream of consciousness... it is this process of selecting constitutive details of experience, reflecting on them, giving them order, and thereby making sense of them that makes telling stories a meaning-making experience" (Seidman, in Clough and Nutbrown, 2002).

Clough and Nutbrown recommend the need to consider the following when selecting interviewing as data collection tool:

- is it the best method for your purposes?
- what kind of data do you want?
- how much do you want to control the interview?
- can you explain and justify your choice of questions?

(Clough and Nutbrown, 2002:103)

In terms of the level of control, a semi-structured interview was used to gather data from farmers (Appendix A). The interviews were semi-structured in that often they were adapted as the interview was conducted in order to pursue new lines of questioning as they became apparent or to word the question differently when it seemed the answer did not match the question. Although some questions were close-ended to allow for some comparability between farmers later, many were open-ended in order to gather as much information possible from the farmer and not direct his questioning along any particular path. However, I had learnt from my piloting that I needed to have prepared questions. The farmers were always communicating with us through an interpreter and only ever really answered what was asked of them, they did not diverge from the question.

This part of the study seeks to gather information on the experience of small-scale farmers in India who have converted to organic/LEI farming. Due to the fact that

many of these farmers do not keep standard records of input costs, yields and income received, it was impossible to calculate or compare costs of organic/LEI and chemical farming systems, except in general terms. It was unclear to me initially whether costs and income are true measures of success or improvement in quality of life for these farmers. The farmers were therefore also asked whether they feel they are now successful farmers. I also aimed to determine whether the GR option was more expensive and if it had any other negative effects on them or their land. There is another part to the research problem: trying to determine why the GR failed these farmers.

It is always a good idea to pilot interview questions first with a group similar to the intended sample (Clough and Nutbrown, 2002:104). Although the interview structure was not piloted in its final form (as time constraints did not allow for this), many of the questions were 'tested' on several other farmers who were interviewed in the two weeks before the specific study subjects. It was possible to refine the questions and the order to ask them in this way, although it was not a true pilot as the other members of the study team were asking their own questions in-between. These informal conversations and meetings with farmers before interviewing the six farmers presented in the study were very useful; they gave me an idea of the context in which these farmers live and a general understanding of how they make decisions and what meanings they attach to certain phenomena in their lives. Although elements from these conversations will be mentioned in the findings, they were not included as part of the sample for the reasons listed in section 2.3.4, and also because I could not probe as deeply as I would have liked nor ask my full set of questions.

Obviously we had to work through interpreters at all times, which was a great challenge and slowed things down a lot. We worked predominately with one interpreter, Shamika Mone, a recent Honours graduate who specialised in biodiversity. We got to know Shamika well during our time in India and I feel that she understood well the aim of my study and what information I sought to get out of the farmers. In this way I am confident that she interpreted my questions as accurately as she could. She also guided me on what questions may be inappropriate or considered rude. Tape recordings were made of all interviews so that the field notes could be

checked against them later. Shamika assured us that we did not need to ask the farmers for permission to record the interviews.

2.3.6.2 Observation

During the interviews, certain participant observation techniques were used in order to glean additional information. I made a point of observing farming practices, cultural traditions as well as the social status of the farmer within his village. Maycut and Morehouse talk about participant observation relying heavily on the observer “functioning without interpretation, taking in through sight and sound what is unfolding” (1994:72). Clearly, this was not entirely possible for me as I did not speak the language of the people I was observing, nor have a deep understanding of their culture and societal norms. For this reason, I tried to check my observations with Shamika to determine if I was correct in my interpretation of what I had seen. Extensive field notes and photographs were taken in order to assist recall at a later stage.

Time was also spent talking to Dharamitra’s founders and staff in order to find out the main reasons why farmers want to get involved with them. There was also a lot of informal information-gathering that took place, while speaking to farmers who were not part of the sample for the formal interviews and as time was spent at local people’s homes and travelling to and from meeting venues with them. For this reason, I carried a journal with me at all times to record all informal conversations, observations and personal interpretations of what I had seen and heard. Clough and Nutbrown (2002:69) agree that your personal experience gives you an added dimension to authenticate your work.

2.3.7 Data Analysis

Upon return to South Africa, the interviews were transcribed and key findings or trends were recorded. This is not as simple as it may seem, however. Clough and Nutbrown warn that once you have conducted the interview, you will have a wealth of data to work with; you need to process and analyse it (Clough and Nutbrown, 2002:105). They say these points must be borne in mind:

- you must remain true to the voices of the research participants
- you must develop a response to your research questions
- you need to become familiar with interview transcripts and notes
- you have to get a ‘feel’ for the data
- you should note your ‘feelings’ and ‘intuitions’

(Clough and Nutbrown, 2002:105)

Mouton says that the main function of analysis is taking one’s data and organising it into “themes, patterns, trends and relationships” (2001:108). The next step, interpretation, is about attempting to explain the reasons for the perceived trends or relationships (Mouton, 2001:109). This can involve comparing one’s findings to existing frameworks, models or theories but must also take into account whether one’s findings could also be explained by rival explanations (Mouton, 2001:109).

Since my data was all qualitative and from a very small sample, the analysis and interpretation were fairly simple, without requiring any statistical analysis. The data was organised around the major questions asked in the interviews, comparing and highlighting the answers of the six respondents. This analysis can be found in Chapter Seven, and the interpretation in Chapter Eight.

2.3.8 Possible Sources of Error

Firstly, it is clear that the spoken or written word always has some level of ambiguity attached to it. However, Scheurich (1997) goes a step further to criticise interviewing as a research tool under the positivist or conventional model of thinking. He says that the conventional approach assumes that the researcher knows exactly what she is doing, that the meaning of questions is stable and that interviewees themselves are not influenced by the manner or setting in which an interview is conducted, nor by the interviewer herself (Scheurich, 1997:62). During the second part of the interview process, which involves transcribing and interpreting the data, there is more room for error because the “physical, non-verbal aspects of communication disappear” (Scheurich, 1997:62). Scheurich is a proponent of postmodernism which, in the case of interviewing, would suggest that:

- researchers and interviewees have multiple objectives – both known to them and unknown to them
- language is not stable and is ambiguous from person to person
- relationship between language and meaning varies and people give different answers at different times

(1997:62)

But this criticism does not mean that Scheurich rejects interviewing completely. He suggests further research needs to be done to find ways to “represent interviews that highlight the indeterminacy of interview interactions” (1997:74). For myself, I think that he makes some good recommendations which I can bear in mind. In particular, that the “written result, the final interpretation, of the interview interaction is overloaded with the researcher’s interpretative baggage” (Scheurich, 1997:74). I should highlight my ‘baggage’ – although it is impossible to name all the conscious and unconscious baggage I bring to the interaction, I can make a reasonable statement about my disciplinary training, social positionality, institutional imperatives, funding sources and requirements etc. This will allow the reader to make some sense of what I am bringing to the interaction.

With this in mind, here follows a brief list of my baggage:

- I studied a Bachelor of Business Science degree with Honours in Finance at the University of Cape Town. I came to realise that I had been taught a fairly one-sided view of economic theory (the free trade and neoliberal doctrine) once I left university and came across books and people critical of this approach.
- I decided to change my career path by studying a BPhil in Sustainable Development Planning and Management last year, and the MPhil this year.
- I am fairly strongly in favour of sustainable development – which I deem to mean better livelihoods for all but within the carrying capacity of the earth.
- My funding for this thesis was through a bursary at the Sustainability Institute. I am under no requirement to produce any predetermined result or conclusion in this thesis.

Another clear source of error could be through the interpreter. This was unavoidable. But, as mentioned in 2.3.6.1 above, I felt that Shamika understood the aims of my study and tried her best to ask the questions in the best way possible. She was very accommodating and often explained to me where she had adapted the question when she felt the farmer did not understand it.

Although only six farmers were interviewed, I do not feel this challenges the validity of my study. The aim of the interviews was to gather the experience of farmers who had converted to organic farming, in order to highlight the conclusions drawn from the literature review. The aim was never to draw a representative sample and attempt to generalise the findings to a wider group.

CHAPTER THREE: SUSTAINABLE DEVELOPMENT AND AGRICULTURE

3.1 DEMARCATION OF THE LITERATURE

The literature review is spread over four chapters. Chapter Three begins with an overview of agriculture globally – this is to provide a context for the thesis and the arguments to be developed. It will highlight the main issues and debates around agriculture.

The next section of the literature review (the remainder of Chapter Three) introduces the concept of SD and the SLA. This discussion provides a framework in which to hold the arguments developed. It serves also to refine research objectives i. and ii. by defining what this thesis regards as ‘sustainable’ (to be found in section 3.4).

Next, in Chapter Four, a review of GR farming methods is given, starting with a brief historical overview of how and why this way of farming came to dominant world agriculture. This discussion will use the framework developed around what would make farming practices sustainable or unsustainable against which to assess GR farming methods. Included in this review of modern agriculture will be special reference to the Indian case, to contextualise the findings gathered in India.

This will be followed by a discussion of possible alternatives to the modern farming regime in Chapter Five. Again, the main elements of alternative farming methods will be assessed against the sustainability framework developed in section 3.4.

One of the main objectives of this research is to critique the proposed GR for Africa. Thus an introduction to the mission and planned approach of AGRA and others who propose a GR for Africa will be given in Chapter Six, in order to set the stage for this critique in Chapter Eight.

3.2 OVERVIEW OF GLOBAL AGRICULTURE

This section attempts to provide an overview of the status of agriculture and the main issues facing agriculture in the future. Two recent, globally mainstream documents are used for this purpose, the *International Assessment of Agricultural Knowledge, Science and Technology for Development* and the World Bank's *Agriculture for Development*. Next one of the major debates in agriculture is presented – namely, the issue of producing enough food for the growing world population. The aim of this section is to provide a context for the thesis and the arguments developed later.

3.2.1 International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) 2008

The first document reviewed in this section is the *International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) 2008*. The IAASTD is “an international assessment of the role of agricultural knowledge, science and technology (AKST) in reducing hunger and poverty, improving rural livelihoods and facilitating environmentally, socially and economically sustainable development” (IAASTD, 2008a:2). It is the first time such a large global overview of the status and future of agriculture has been performed. The reports were drawn up by 400 of the world's experts on agriculture in a peer review process and then reviewed by stakeholders, in this case 30 government and 30 civil society representatives. Due to the peer review process and large number of scientists involved, this document can be regarded as being a fair representation of the current state of global agriculture and the consensus opinion about its future.

The goals of the IAASTD were noted as being “consistent with a subset of the Millennium Development Goals (MDGs): the reduction of hunger and poverty, the improvement of rural livelihoods and human health, and facilitating equitable, socially, environmentally and economically sustainable development” (IAASTD, 2008a:2). The IAASTD states that it is not policy prescriptive but rather aims to present a range of policy options which can help to achieve sustainable development. It also focuses on small-scale farmers and the rural poor. Due to the fact that stakeholders included the private sector, NGOs, producer and consumer groups and

international organisations, the IAASTD admits that there was much conflict during the peer review process and “one of the key findings of the IAASTD is that there are diverse and conflicting interpretations of past and current events, which need to be acknowledged and respected” (IAASTD, 2008a:5). The need to incorporate very different viewpoints on the history and future of agriculture results in the IAASTD being a fairly confusing document at times; it seems to recommend very disparate approaches at different points in the document. It should also be noted that the governments of Australia, Canada and the United States of America did not fully approve the Global Summary for Decision Makers.

Key statistics relating to agriculture are provided by the IAASTD:

- 40 percent of the world’s population derives their livelihood from agriculture
- 70 percent of the poor in developing countries live in rural areas
- agriculture impacts ecosystem services like water purification and supply, pollination, pest and disease control and carbon absorption and release

(IAASTD, 2008a:14)

The key findings of the IAASTD are discussed in this section. The first is that AKST has increased agricultural output and improved food security – but people have not benefited evenly. There are still large numbers of people living with hunger, food insecurity and malnutrition in South Asia and Sub-Saharan Africa (SSA) (IAASTD, 2008a:16). The IAASTD found that the increases in agricultural output have in some cases had negative impacts on the environment: 1.9 billion ha of land today is subject to extreme land degradation, water withdrawal from rivers has increased threefold in the past 50 years, 70 percent of freshwater withdrawal globally is used for irrigated agriculture, salinisation of soils is increasing, agriculture contributes about 60 percent of methane (CH₄) emissions and about 50 percent of nitrous oxide (N₂O) emissions, fertiliser misuse has led to eutrophication and large dead zones in a number of coastal areas, and inappropriate use of pesticides has led to groundwater pollution, and other effects such as loss of biodiversity (IAASTD, 2008a:7). Another key finding is that the multifunctionality of agriculture has been neglected in research - the IAASTD

uses the term multifunctionality “solely to express the inescapable interconnectedness of agriculture’s different roles and functions. The concept of multifunctionality recognises agriculture as a multi-output activity producing not only commodities (food, feed, fibres, agrofuels, medicinal products and ornamentals), but also non-commodity outputs such as environmental services, landscape amenities and cultural heritages” (IAASTD, 2008a:8).

If current policies and practices persist, there will be increased demand for food and changing dietary patterns. But there is likely to be restricted growth in agricultural output due to competition for scarce resources (e.g. water and land), the influence of terms of trade and the impact of a changing climate (IAASTD, 2008a:8). Demand for meat and milk products is forecasted to grow as incomes rise. This is likely to increase the prices of grains because “it takes 4.5 plant derived calories to produce one calorie of egg or milk and 9 plant derived calories to produce one calorie of beef or lamb meat” (IAASTD, 2008a:16). This implies that growing demand for meat will have significant environmental implications but will not necessarily result in better nutrition for poor people (IAASTD, 2008a:17).

The IAASTD says that AKST should be redirected towards agroecological⁶ approaches, to cope with environmental stresses – interestingly, the USA and Botswana objected to this point, they felt that it should only read ‘AKST should incorporate agroecological approaches’ (IAASTD, 2008a:9). There is a definite focus on the importance of incorporating traditional agricultural knowledge into AKST; the USA objected to some findings, saying there was not enough emphasis on the possible contribution of biotechnology (IAASTD, 2008a:10). There is also acknowledgement that women have benefited least from AKST in the past, and that there needs to be a focus on involving women to a greater degree in agriculture, as this can “advance progress towards sustainability and development goals” (IAASTD, 2008a:9).

⁶ Agroecology “defines, classifies and studies agricultural systems from an ecological and socio-economic perspective” (Goering *et al*, 2001:62). It attempts to find methods which can assess the health of agricultural systems and develop healthy and sustainable production systems (Goering *et al*, 2001:62).

The IAASTD focuses on the need to assist small-scale farmers and rural labourers, but the interventions seem to centre on incorporating these groups into market-based agriculture, as opposed to meeting their own food needs through subsistence agriculture. The IAASTD prescribes: “investments in infrastructure and facilitating access to markets and trade opportunities, occupational education and extension services, capital, credit, insurance and in natural resources such as land and water” (IAASTD, 2008a:11). But the IAASTD does recognise that the strength of large-scale buyers and stringent market standards presents significant barriers to entry for small farmers and producers (IAASTD, 2008a:11). To assist small farmers in competing, the IAASTD recommends heavier investment in training, education and extension with “suitable legal, regulatory and policy frameworks” (IAASTD, 2008a:11), which seems to place importance on government actions to assist small-scale producers.

The IAASTD approaches the issue of agricultural trade from a strong viewpoint of protecting small-scale farmers in developing countries. It states that, while some developing countries with large export sectors have increased their GDP, their small-scale farmers have not benefited and that, in fact, the “small-scale farm sector in the poorest developing countries is a net loser under most trade liberalisation scenarios” (IAASTD, 2008a:12). The IAASTD lists several policy options which would allow for greater protection of the small-scale farming sector, such as increased regional trade between developing countries (IAASTD, 2008a:12). Furthermore, the IAASTD highlights the impact that the globalised food system can have on “local food systems that support the livelihoods of the poor” (IAASTD, 2008a:18). Low food commodity prices are good news for poor consumers in net food-importing countries, but if these prices are lower than the cost of production in the importing country, this can destroy local farmers and rural development (IAASTD, 2008a:18). The IAASTD stresses the need to strengthen local food systems, buffering them against outside shocks, by stabilising production and increasing food security (IAASTD, 2008a:18). This seems somewhat contradictory to the IAASTD’s focus on incorporating small-scale farmers into international trade.

The IAASTD has a strong focus on sustainability stating that we need to reflect on the negative environmental and social consequences of agriculture to date and to draw up

better policies to deal with the challenges ahead. It says these are “perhaps best characterised as the need for food and livelihood security under increasingly constrained environmental conditions from within and outside the realm of agriculture and globalised economic systems” (IAASTD, 2008b:3). A point made often in the IAASTD is that there is a strong need to reduce the negative environmental consequences of agriculture; it suggests that an effective way to do this would be to internalise the externalities of agriculture and introduce some kind of payment or reward mechanism for agricultural methods which provide environmental services (IAASTD, 2008a:12). Payment mechanisms are either punitive or reward-based. Punitive measures are aimed at reducing harmful effects by encouraging producers to shift to more environmentally-friendly or low-emission agriculture and may include taxes on carbon emissions, agrochemical use and water pollution (IAASTD, 2008a:33). Reward-based measures value and pay for the benefits of sustainable agriculture “such as low-input and low-emission production... and conservation of agricultural biodiversity” (IAASTD, 2008a:33). These types of payments can be structured in such a way that they provide an additional reliable income stream for small-scale producers.

The IAASTD calls for increased investment in agriculture and rural development by both public and private sectors (IAASTD, 2008a:13). Then the IAASTD qualifies this statement by recommending that public-private partnerships be closely monitored by government and universities and research institutions to ensure that conflicts of interest are avoided and sustainability goals are not compromised by private sector funding (IAASTD, 2008a:13). The IAASTD raises a very pertinent point which relates to the power and politics that influence which agricultural technologies are promoted. The IAASTD says: “understanding the underlying sources of competing interpretations of AKST is crucial to addressing goals. Some interpretations have been privileged over others and have helped push formal AKST along certain pathways, to the neglect of other scientifically sound options. Some of the by-passed options originate in traditional knowledge or civil society experience and may be better able to contribute to poverty reduction, social inclusion, equity and generate multifunctional outcomes” (IAASTD, 2008a:13). I interpret this statement to be a quiet recognition that the GR technologies were not necessarily the best, but have

been promoted due to vested interests and powerful private sector players. It clearly indicates the need to now consider alternatives – such as the work done by Dharamitra in India.

3.2.2 Agriculture for Development

This year, the World Bank's International Bank for Reconstruction and Development released the World Development Report (WDR) for 2008. This report is fairly highly regarded because "the World Bank has become the central international agency prescribing economic development policy to the world's nation-states" (Havnevik *et al*, 2007:9) – especially for countries which have borrowed money from the bank. It is useful because it has reliable statistics and also because it is likely to shape World Bank policy related to agriculture for some years to come.

The focus of this year's Development Report is *Agriculture for Development*; the last time a WDR focussed on agriculture was 25 years ago in 1982. The justification for focussing on agriculture is that it is still a major tool for "sustainable development and poverty reduction" (IBRD, 2007:1). This is because in developing countries, three of every four people live in rural areas and most of them depend on agriculture for their livelihoods. The World Bank also believes that "promoting agriculture is imperative for meeting the Millennium Development Goal of halving poverty and hunger by 2015" (IBRD, 2007:1).

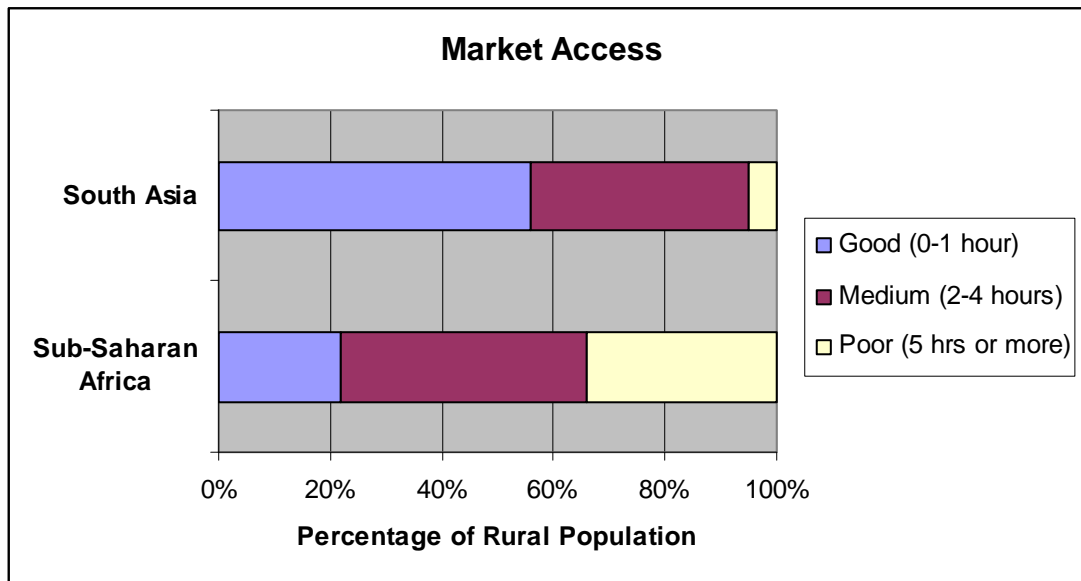
The World Bank gives its vision of agriculture for development as one where production is mainly by smallholder farmers, "who often remain the most efficient producers" supported by "their organisations" (I assume this means co-operatives and the like) (IBRD, 2007:8). When smallholders are unable to compete due to not being able to reach economies of scale, the World Bank feels labour-intensive commercial producers are the next best thing. The private sector is seen to be the driver of economic growth in agriculture, responsible for promoting value chains. The state should only intervene to correct market failure, regulate competition and engage in public-private partnerships to "promote competitiveness in the agri-business sector and support the greater inclusion of smallholders and rural workers" (IBRD, 2007:8).

While many question and even oppose the World Bank's policies (Havnevik *et al*, 2007; Madeley, 2002; Shiva, 1991 and 1995), this report at least provides reliable statistics on the status of agriculture, especially in developing countries and SSA in particular. This report tells us that "two-thirds of the world's agricultural value added is created in developing countries"; agriculture is a livelihood "for an estimated 86 percent of rural people" and although overall rural poverty has declined in the last 20 years, this decline has occurred in East Asia and the Pacific, while in South Asia and SSA, the number of rural people living in poverty has increased (IBRD, 2007:3). It should be noted that this report defines smallholder farmers as holding farms of two hectares or less, although this thesis chooses to define them as holding five hectares or less.

The report identifies agroecological conditions and market access as two key determinants of success for farmers (IBRD, 2007:54). Agroecological conditions include soil quality, temperature and rainfall; two-thirds of the rural population in developing countries live in favourable conditions but one-third live in less-favoured areas with no irrigation and subject to frequent water stress (most of SSA live in these areas) (IBRD, 2007:54). Performance also relates to access to markets and services. In SSA, over 30 percent of the rural population live in areas five hours or more from the nearest market (only 20 percent live within an hour of the market), while in South Asia, only five percent need to travel more than five hours (55 percent live within an hour of the market).

Figure 3: Market Access in SSA and South

Asia



When one puts both agroecological conditions and market access together, one can clearly see the difference between SSA and South Asia: two-thirds of SSA has either poor market access or limited rainfall, compared with only one quarter in South Asia. But “investments can convert less-favoured areas with low rainfall or poor roads into high-potential areas” (e.g. irrigation, roads) (IBRD, 2007:54).

One of the most contentious issues related to agriculture is protection taxation of agriculture. The World Bank seems, in this report, to propose further liberalisation of agriculture – in other words, removing price distortions through reducing taxes on imports and exports and reducing producer support and subsidies (IBRD, 2007:10 and 11). The report says that, if there were full trade liberalisation, the welfare impacts for developing countries would be massive – “estimated to be five times the current annual flow of aid to agriculture” (IBRD, 2007:11). But the effects would not be evenly spread; for example, international commodity prices are expected rise by 5.5 percent on average, with cotton prices rising 21 percent and oilseeds by 15 percent. Developing countries which are net buyers of such products would lose out. In this case, the World Bank recommends mitigating the negative impacts through complementary policies such as transfers which compensate poor country losers

(IBRD, 2007:11); although it does not elaborate on what from these transfers would take, or who would pay for them.

In Organisation for Economic Co-operation and Development (OECD) member countries producer support has only decreased slightly over the last 20 years (from 37 to 30 percent of gross farm receipts). The OECD is an organisation of 30 countries (almost all of them high income) which subscribe to participative democracy and free market economics. Almost 90 percent of agricultural support in the OECD occurs within the European Union (EU), Japan, the United States and the Republic of Korea (IBRD, 2007:97). The problem with the support given to farmers by these countries is that it encourages farmers to produce more (which often leads to dumping of the excess product in developing countries). There has been an attempt to shift to “less-distorting” forms of support such as cash transfers (especially in the EU); but these still reduce farmers’ aversion to risk, reduce variability in farm income and allow banks to make loans to farmers who they otherwise would not (IBRD, 2007:11).

It seems that the World Bank is suggesting that free trade should prevail; that both developed and developing countries should remove protection of their farmers. To see how unfair these policies are for developing countries, it is worth looking at how the Western developed countries went about achieving their success. Most of them grew their economies by “wisely and selectively protecting some of their industries until they were strong enough to compete with foreign companies” (Stiglitz, 2002:16). Also, most European countries did not allow the “free flow of capital until the seventies” (Stiglitz, 2002:17). However, in the 1980s the IMF and World Bank heavily controlled developing country economic policy through their conditional lending policies. The International Monetary Fund (IMF) and World Bank espoused neoliberal doctrine as “global policy” (Nederveen Pieterse, 2004:1). The particular form this neoliberal policy took was as the Washington Consensus. It was developed in the 1980’s as a “set of economic prescriptions for developing countries” (Nederveen Pieterse, 2004:10). It stipulated policies of privatisation, reducing controls over trade and financial markets, export-led growth and a reduction in government spending (Nederveen Pieterse, 2004:10).

These policies effectively took away the protective measures which developed countries had used to grow their economies in the past – forcing the developing countries to open themselves up to the world markets before they had put any protective measures or safety nets in place, and before their economies were strong enough to handle it. This created competition among producers and farmers across the developing world and kept prices low.

Economic globalisation has thus had the effect in developing countries of reducing their ability to reduce poverty and inequality – they have been forced to accept neoliberal policies that call for a weaker state and a cutback on social spending. As Nederveen Pieterse puts it “when neoliberalism in the global South fails to bring development and produces income polarisation, it’s not because of the failure of neoliberalism but because of its success” (2004, 12). Havnevik *et al* say that debt-ridden African countries, desperate for loans and aid from the World Bank, accepted the structural adjustment conditionality of the 1980s (until the present) (2007:9). “Thus, most African countries have to greater or lesser degrees espoused and implemented World Bank development policy for the last 25 years, and African agricultural sectors, in effect, demonstrate through continuous low growth rates and deepening rural poverty, the impact of World Bank policies” (Havnevik *et al*, 2007:9).

Nederveen Pieterse concludes that, “as a development policy neoliberalism has been an utter failure”. Also, that the IMF and World Bank have completely failed to reduce global poverty (Nederveen Pieterse, 2004:14). A recent review of World Bank research and policy by Princeton University criticised the World Bank for using untested results as proof that its preferred policies work. This report singled out the “flagship World Development Reports published annually as a medium through which advocacy of the World Bank’s favoured policy recommendations sometimes takes precedence over balanced analysis” (Havnevik *et al*, 2007:9). Madeley is also critical of the World Bank and says that it “cannot hide its dismal record on agricultural and related issues” (Madeley, 2002:154). Due to the poor results of many World Bank policies, Madeley says that it is not at all surprising that in 1995 “a network of worldwide NGOs launched a campaign: ‘fifty years is enough’. Some pressed for the Bank and IMF to be closed down in 1995, their 50th anniversary year. The Bank survived but calls for reform have increased. Madeley feels that the Bank

needs to be scaled down so that it no longer has such a strong influence over developing country economic policy (Madeley, 2000:157). Both of these comments bring into question the appropriateness of the policies prescribed in *Agriculture for Development*.

When trying to review *Agriculture for Development*, I struggled to get a sense from the report of exactly what the World Bank was proposing as policy for SSA agriculture. I sought out commentaries on the Report by independent bodies to assist me in interpreting it. I realised that the reason for my difficulty is because the report contains “starkly contradictory objectives: the humanitarian concerns of poverty alleviation clash with a Darwinian market fundamentalism” (Havnevik *et al*, 2007:10). Havnevik *et al* say that this report seems to be a continuation of the World Bank’s policies of the last 25 years. *Agriculture for Development* argues that agriculture is the answer to poverty alleviation for smallholder farmers in SSA but then it also “stresses that liberalised national markets will remain the primary force for achieving productivity increases and poverty alleviation” (Havnevik *et al*, 2007:10). It is not clear that ‘liberalised national markets’ will necessarily result in poverty alleviation for smallholder farmers: the IAASTD certainly questions this when it states that the “small-scale farm sector in the poorest developing countries is a net loser under most trade liberalisation scenarios” (IAASTD, 2008a:12)

Stiglitz’s criticism of the World Bank around forcing developing countries to open their markets and reduce state investment is echoed by Havnevik *et al*. They say that agriculture in Asia was successful because of strong state investment and subsidised support for agricultural inputs during the GR; but the World Bank is proposing that African states be restricted and that growth is led by market actors (Havnevik *et al*, 2007:10). *Agriculture for Development* says that “smallholder households will participate in commodity, capital, land and labour markets, to seek multiple pathways out of poverty; either through encompassing agricultural production, rural non-agricultural enterprises or out-migration” (Havnevik *et al*, 2007:10). Havnevik *et al* say that the World Bank’s vision for agriculture actually implies that productive agriculture in the future will be large-scale agriculture, which will “prevail over uncompetitive small-scale producers” (Havnevik, 2007:11). The Report does say that

when the organisations which support smallholders “cannot capture economies of scale in production and marketing, labour-intensive commercial farming can be a better form of production” (IBRD, 2007:8). This does seem to imply that small-scale farmers should not be given support by government, but rather through producer organisations, i.e. market-driven mechanisms. Havnevik *et al* point out that African smallholder producers have been losing market share rapidly in global agricultural commodity markets, to more efficient or highly subsidised producers from abroad (Havnevik *et al*, 2007:10). They warn that there is no evidence presented in the Report which shows that smallholder producers will be able to improve their ability “in meeting the rigours of global commodity market chains with their highly regulated standards and time schedules” (Havnevik *et al*, 2007:11).

Agriculture for Development then goes on to stress that creating rural non-farm employment is essential because of “rapid rural population growth and slow expansion in agricultural employment” (IBRD, 2007:17). Policy priorities should be stimulating growth in agriculture, fostering a good investment climate and incentivising rural parents to educate their children so they have skills to engage in the nonfarm economy (IBRD, 2007:18). The Report says that migration out of agriculture ‘can be a climb up the income ladder for well-prepared, skilled workers, or it can be a simple displacement of poverty to the urban environment for others’ (IBRD, 2007:18). The Report seems to be advocating for a shift in skills out of agriculture and implying that small-scale farmers should give way to larger-scale producers who are more efficient. This is despite the Report’s ‘vision’ of agriculture for development being dominated by small-scale producers. It seems to imply that the World Bank is in fact proposing the industrialisation of farming in SSA, as opposed to employment creation and livelihood improvement in agriculture for the rural poor. Havenik *et al* agree and worry that the “depeasantisation process” (2007:61) is ill-advised, given that the current economic situation in most SSA countries is such that there is an “absence of clear employment prospects” (Havenik *et al*, 2007:62) for those smallholders who are being encouraged to give way to more efficient producers and leave farming. The IAASTD says that, if present trends continue unchecked, the rate of increase in off-farm employment will not be able to keep up with the loss of on-farm livelihoods (IAASTD, 2008a:20).

3.2.3 Producing Enough Food

Another major debate in agriculture is around how to go about achieving the massive increase in production which will be required to meet the food needs of a growing population. “By 2050, global population is projected to be 50% larger than at present and global grain demand is projected to double” (Tilman *et al*, 2002:671). The differing viewpoints range from those that believe biotechnology is the only hope (Borlaug, 2000); to those who suggest organic or LEI farming is the only option (Madeley, 2002). There are a range of viewpoints in between these two extremes though and this section will examine some of the major points on which various parties disagree.

Trewevas (2002) and Borlaug (2002) point out that the GR saved land from being brought under agriculture because it allowed increases in yield without the expansion of farmed area. Currently half the good quality soil available in the world is under agriculture, the remainder under tropical forests: “this leads to an obvious dilemma. Unless we can pull off a second Green Revolution, increasing yield but limiting it to land currently used for farming, there will be further deterioration of natural habitats and biodiversity at a rate that could even threaten the further existence of humanity” (Trewevas, 2002:668).

Borlaug, who won the Nobel Peace Prize in 1970 for his crop breeding work which jumpstarted the original GR, is convinced that the only way to reduce global food insecurity and meet the needs of the growing population is if “farmers across the world have access to current high-yielding crop production methods as well as new biotechnological breakthroughs” (Borlaug, 2000:490). The IAASTD’s view on genetically modified crops is that, because biotechnology is “on the cutting edge of change” (IAASTD, 2008b:14), assessments are lagging behind the development of new technology, and this makes uncertainty unavoidable. The IAASTD acknowledges further that “there is a wide range of perspectives on the environmental, human health and economic risks and benefits of modern biotechnology, many of which are as yet unknown” (IAASTD, 2008b:14). The IAASTD also says that data around the use of GM crops in the field is inconclusive, with some data showing “highly variable 10-33 percent yield gains in some places and declines in others” (IAASTD, 2008b:14).

Borlaug and Huang, Pray and Rozelle do not agree. They are both strongly in favour of GM crops. Borlaug says GM crops are safe for human consumption and the environment (2000:489) and that those who oppose modern agricultural technology or biotechnology are “extremists in the environmental movement... doing everything they can to stop scientific progress in its tracks” (Borlaug, 2000:488). Borlaug thanks the environmental movement for advances made in environmental protection but then goes on to say “it is ironic, therefore, that the platform of the antibiotechnology extremists, if it were to be adopted, would have grievous consequences for both the environment and humanity. I often ask the critics of modern agricultural technology: What would the world have been like without the technological advances that have occurred?... Nevertheless, the antibiotechnology zealots continue to wage their campaigns of propaganda and vandalism” (Borlaug, 2000:488).

While Huang, Pray and Rozelle acknowledge some of the negative impacts of the original GR (e.g. falling yields, increased disease from high nitrogen use, increased soil pests from monocropping, falling levels of organic matter in soils etc⁷.) (2002:679), they then continue to promote further crop breeding and biotechnology. Although Huang, Pray and Rozelle are a lot less impassioned than Borlaug, they still feel that “over the longer run... agricultural research will almost inevitably depend on high-technology methods” (Huang, Pray and Rozelle, 2002:683) and that both conventional plant breeding and biotechnology will contribute to overcoming present constraints on production. However, Huang, Pray and Rozelle are perhaps biased towards GM, saying “GM technologies have benefited the farmers who have adopted them, mainly through time-saving gains, increased yields and reduced chemical pesticide inputs... Mexican and South African Bt⁸ cotton farmers increased the yields at the same time that they reduced their costs” (Huang, Pray and Rozelle, 2002:681). They do not quote any statistics which mention falling yields, as the IAASTD pointed out.

However, one point that Borlaug and the IAASTD agree on with regard to biotechnology is the issue of intellectual property rights and patents. Borlaug says the

⁷ These are discussed in detail in section 2.6

⁸ Bt cotton is cotton which has been genetically modified using genes from the *Bacillus thuringiensis* bacterium to resist insects

only matter which should concern people around GM “should be equity issues related to genetic ownership, control and access to transgenic agricultural products” (Borlaug, 2000:489). The IAASTD is concerned that patents will not only increase costs but also inhibit the independent research community and restrict individual farmer experimentation (IAASTD, 2008b:14).

Tilman *et al* provide an interesting middle ground between proponents of LEI agriculture (especially those who are opposed to biotechnology) and proponents of biotechnology. Tilman *et al* advocate ‘sustainable agriculture’, which they define as “practices that meet current and future societal needs for food and fibre, for ecosystem services and for healthy lives, and that do so by maximising the net benefit to society when all costs and benefits of the practices are considered” (Tilman *et al*, 2002:671). They advocate precision agriculture (“applying fertilisers during periods of greatest crop demand, at or near the plant roots, and in smaller and more frequent applications” (Tilman *et al*, 2002:673)); practices like crop rotation, reduced tillage, cover crops, fallowing, integrated pest management (IPM); removal of subsidies which promote unsustainable agricultural practices; biotechnology and conventional breeding which can increase output and factors like drought tolerance; and payment for ecological services provided by agriculture.

Despite Borlaug’s conviction that those who oppose biotechnology also oppose science, there has been a large scientific focus on alternative, low input approaches to agriculture. One of the heavily researched areas has been agroecology which “provides the scientific basis to address the production by a biodiverse agroecosystem able to sponsor its own functioning” (Altieri and Nicholls, 2005:99). Another has been biological processes in soil systems as these offer opportunities to increase agricultural output with minimal use of external inputs (Uphoff *et. al*, 2006). Uphoff *et al* cite growing evidence which shows that proper management and intensification of soil resources on the farm can achieve substantial yield increases of 50 to 100 percent; these increases can be achieved using existing genetic potential and at substantially lower cost (2006).

3.2.4 Conclusion

This section provided a brief overview of the status of global agriculture and some of the major debates and differing viewpoints surrounding the best path forward. It painted a picture of agriculture facing the dual challenge of desperately needing to increase output to feed a growing population, but within severe environmental constraints – namely, climate change, degradation of ecosystems and competition over scarce natural resources. It also showed that there are a wide range of views around how best to proceed with agriculture in the future. It seems difficult to know which of these approaches has the most merit. The following section of the literature review will provide tools for distinguishing between these alternative approaches: it develops criteria to assess the sustainability of different farming methods.

3.3 SUSTAINABLE DEVELOPMENT

The challenge of a more sustainable agriculture for small-scale farmers, which this paper seeks to address, is framed within the dominant discourse of sustainable development (SD). SD has a famous and oft-quoted definition: “development which meets the needs of the present without sacrificing the ability of future generations to meet their needs” (WCED, 1987) which was coined in the Brundtland Report in 1987. It is necessary to go back in time briefly, to provide a background to the rise of SD which also provides an explanation for some of the problems surrounding it today.

Sachs explains how President Truman of the US coined the term ‘underdeveloped’ in the 1940s thereby imprinting upon the world the idea that “the degree of civilisation in a country is indicated by the level of its production” (1999:73). So began the development era. SD came to centre stage in the 1980s at a time when two camps were competing for dominance in global policy making. Sachs calls these two camps: “the crisis of justice” and “the crisis of nature” (1999:76). Those supporting the differing viewpoints can roughly be divided into interest groups from the developing countries and those from the developed world.

The crisis of justice camp was a reaction to the failure of almost 40 years of ‘development’; the poor had not caught up to the rich, in fact, the gap had widened

even further. They were opposed to anything which may prevent “the legitimate aspirations of the poorer nations of the world to overcome poverty and reach a standard of living that is comparable to that of the richer countries of the world” (Hattingh, 2001:4). Those touting the crisis of nature were worried about the over-exploitation of nature as “mine and dumping ground” (Sachs, 1999:73) and wanted stricter environmental laws and limits imposed. It is clear that these two camps were diametrically opposed: any action taken to ease the crisis of nature could be seen to aggravate the crisis of justice, and vice versa. As Sachs says, the dilemma that needed to be solved was to find a way to engender development which uplifted the poor, without further harm to the environment. The concept of SD “promise[d] to square the circle: to identify a type of development that promotes ecological sustainability and international justice” (Sachs, 1999:76).

But, although widely adopted the world over in governments and private organisations, SD has not achieved as much as many would have hoped (more on this in sections 3.3.1 to 3.3.8). Many authors now suggest (Sachs, 1999 & 2002; Hattingh, 2001; Pezzoli, 1997; Mebratu, 1998) that the conception and vague definition of SD itself is at fault. Mebratu says that the vagueness of its definition, along with the importance it has gained worldwide, has resulted in “a large political battle for influence over our future by linking interpretation to the concept” (1998:493). Sachs (1999) says that, because SD was formulated to gain consensus, it lacks clarity. He highlights “deep political and ethical controversies” around SD (Sachs, 1999:76). Hattingh claims that the concept of SD is “internally incoherent” (2001:2). Moreover, he says that the definition of SD does not make explicit which assumptions or ethical and value judgements have been made and is therefore open to interpretation (Hattingh, 2001).

Without going into detail of the different interpretations of SD or the conceptual problems with it, I would like to agree with both Hattingh and Sachs, that a more radical interpretation of SD is needed. It is important that my position on SD should be made explicit at the beginning of this paper; otherwise there could be confusion among readers who may not share the same ethical or moral interpretation of the concept.

The following sections explain my reasons for believing a more radical form of SD is needed. I will draw on academic writers and also practical examples of why the weak model of SD thus far applied has achieved neither greater environmental protection, nor better economic development for developing countries.

Hattingh makes it clear that, so far, we have only adopted a very weak model of SD, “that pretty much leaves the world as it is” (2001:26). Sachs feels the notion of ‘development’ is to blame. He says that people are blinded by the idea of economic growth and progress when in reality we have arrived at a “civilisational impasse – namely, that the level of productive performance already achieved turns out to be not viable in the North, let alone for the rest of the globe” (Sachs, 1999:68). Based on evidence presented later in this section, I tend to agree with both Sachs and Hattingh. We need to re-evaluate our goals and values as a society and develop “intelligent self-limitation” (Sachs, 1999:67). We need a radical model of sustainable development which focuses on “structural changes in the economy, politics, institutions and individual lifestyles so as to ensure that a fairer distribution of resources can be achieved throughout the world and between generations, while staying within the carrying capacity of supporting ecological systems” (Hattingh, 2001:21).

The evidence of the failure of SD mentioned above is presented in the form of six “globally significant mainstream documents, plus a key website” (Swilling, 2007) that provide a snapshot of the current situation globally. These documents give a review of the current status of human society and the ecosystems on which society depends. It will also allow for a later discussion on sustainability issues that are already impacting and will impact agriculture in future.

3.3.1 Climate Change

The document used as a main reference point on climate change is the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report 2007. This is a summary of the findings of the working groups of this organisation. As a result of the work done by the IPCC, it has become almost universally accepted that human activity is causing rises in global temperatures which will have significant impacts on the global climate now and in the future.

The IPCC says the increase in temperatures is due to increased carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) gases in the atmosphere. Of these, both methane and nitrous oxide have mostly been a result of agriculture (IPCC, 2007:5). If current levels of greenhouse gas (GHG) emissions continue, there will be at least a 0.2°C rise in temperature per decade (IPCC, 2007:7). This is a conservative estimate as it is most likely that GHG emissions will continue to rise. The effects of these rising temperatures will differ geographically but include:

- Rising temperatures (which will be highest over land and high Northern latitudes)
 - Reduced snow covered area
 - Increased heat waves and heavy precipitation
 - Flooding of low-lying coastal areas due to rising sea levels
 - Increased precipitation in Northern latitudes and decreased in subtropical areas
- (IPCC, 2007:8)

It is clear that the situation is extremely serious. There are now 180 countries which have signed the Kyoto Protocol, an international agreement which requires the 37 developed country signatories and the European Union (EU) to reduce GHG emissions by five percent from 1990 levels (UNFCCC, Accessed 13 June 2008). Despite the United States not signing the agreement to date, this is one of the most successful international attempts to reduce GHG emissions, although heavy debate still remains on how successful the protocol will be.

The IPCC says that all countries need to prepare adaptation strategies to deal with effects of climate change which are now unavoidable. It also says that certain mitigation policies are needed to reduce the extent of further warming in the future (IPCC, 2007). Climate change will affect the poorest countries most heavily as they are least equipped to adapt to it, their inhabitants the most vulnerable to it; yet these countries have contributed the least to the emissions causing it (IPCC, 2007). For example, in SSA, the IPCC predicts that by 2020, yields in rain-fed agriculture could fall by as much as 50 percent, which “would further adversely affect food security and exacerbate malnutrition” (IPCC, 2007:11).

3.3.2 Human Development

The United Nations Development Programme releases a Human Development Report (HDR) each year with a different focus. The 1998 report, focussed on Consumption for Human Development, made a significant contribution in shifting the global policy focus from poverty to inequality. It found that 20 percent of the world's population who reside in wealthy nations account for 80 percent of private consumption expenditure, while the poorest 20 percent account for a meagre 1.3 percent. (UNDP, 1998:2). As Swilling says, "inequality is increasingly seen as a driver of many threats to social cohesion and a decent quality of life for all" (Swilling, 2007). This means that, instead of following the maxim of neoliberal economics which says that economic growth will eventually cause a trickle down effect of wealth to the poor, we need to focus on reducing the gap between rich and poor now.

The 1998 HDR says that consumption can be a means toward achieving human development when it enriches people's lives without negatively affecting others' or future generation's human development (UNDP, 1998:1). Currently consumption is damaging our "environmental resource base" and "exacerbating inequalities" (UNDP, 1998:1). The report gives suggestions for how consumption patterns should be changed to allow for greater human development. For example, it encourages the use of more environmentally sustainable technologies (UNDP, 1998:9) and the removal of subsidies which cause environmental damage (UNDP, 1998:10).

3.3.3 Urbanisation

In 2007, the United Nations released a report which said that, by the end of 2008, over half the world's population would live in cities for the first time (UN DESA, 2008:2). The world population is expected to increase from 6.7 billion (2007 population) to 9.2 billion by 2050 (UN DESA, 2008:1). Almost all this population growth will occur in developing countries, more specifically, in their urban areas. In about a decade's time, the population in rural areas of the developing world will begin to decline as people move to urban areas.

Clearly an increasingly urban population will put significant strain on urban infrastructure (see the next section on slums) and also increased pressure on rural areas to provide food for this urban population.

3.3.4 Challenge of Slums

The United Nations Human Settlements Programme (UN-HABITAT) released its report *The Challenge of Slums* in 2003. This is the biggest global attempt to assess the extent and future of slums and suggest policy options for dealing with them. It found that “one third of the world’s population live in slums” (UN-HABITAT, 2003:xxix). More importantly, the cities of the developing world will see the addition of another two billion people over the next 30 years, which will double their size (UN-HABITAT, 2003:1). It is a grave concern that governments are not planning for this increase in urban populations or ways to improve the living standards of current populations. The “locus of poverty” (UN-HABITAT, 2003:xxix) is shifting to cities as a result of urbanisation; thus cities need to find ways to reduce poverty among slum-dwellers in order to reduce inequality and improve progress towards human development goals.

3.3.5 Peak Oil

The Association for the Study of Peak Oil and Gas (ASPO) is an informal “network of scientists affiliated with institutions and universities, having an interest in determining the date and impact of the peak and decline of the world's production of oil and gas, due to resource constraints” (ASPO, 2008). It was founded in 2000 by Dr Colin C. Campbell who has worked in the oil industry for over 40 years. He also started the Oil Depletion Analysis Centre, a UK-based charity which aims to raise public awareness about depleting oil supplies in the hope that energy policy will start to take this into account. They maintain up-to-date reports on the state of oil supplies and the latest thinking on oil peak.

Two articles by Colin Campbell and Bob Lloyd are useful as they sum up the dearth of information on oil supplies. As Lloyd points out, environmentalists have “cried wolf” (Lloyd, 2005:1) one too many times with inaccurate forecasts of mineral resources running out; people are not willing to listen to predictions that oil is about to

run out for this reason. However, Lloyd and Campbell argue convincingly that world oil production has already peaked and will start to decline. As Campbell succinctly puts it, for a world built on cheap oil, “a disruption of this magnitude is hard to grasp” (Campbell, 2002). Lloyd hopes that people will realise the urgency with which we need to “make the transition to sustainable energy resources” (2005:18).

In an economic report released in April 2008 by the Chief and Senior Economists of CIBC World Banks, a large investment bank, it was predicted that the recent doubling in the oil price which had occurred since 2005 (Rubin & Buchanan, 2008:5), would continue for the foreseeable future. They predicted that prices are “likely to soar to an average of US\$150/bbl by 2010 and continuing to rise to over US\$200/bbl by 2012” (Rubin & Buchanan, 2008:4). They feel this rise will occur as global supply falls⁹.

“A debate rages over the precise date of peak, but rather misses the point, when what matters — and matters greatly — is the vision of the long remorseless decline that comes into sight on the other side of it” (Campbell, 2008).

3.3.6 Ecosystem Degradation

The Millennium Ecosystem Assessment (MA) was commissioned by the United Nations to review the existing science base to “assess the consequences of ecosystem change for human well-being” (MA, 2005:v) and review strategies for conservation and sustainable use of ecosystems. The MA used 1360 experts from 95 countries who worked from 2001 to 2005 (MA, 2005:viii).

It is important to note that ecosystems do not just provide us with resources and waste sinks, but also essential life supporting services. We need a specific set of conditions to be present on the planet in order for life to be possible – for example, the correct temperature and levels of solar radiation. Destroying the planet’s ability to provide us with these will affect our ability to survive. The MA uses the term ‘ecosystem services’ to describe any benefit obtained by humans from ecosystems (MA, 2005:v).

⁹ At 29 October 2008, just before this thesis was handed in, the oil price had dropped to around US\$60 barrel. This must be seen in light of the current economic crisis (see Epilogue)

These services are divided into:

- Provisioning services – food, timber, water etc.
- Regulating services – that influence climate, water quality etc.
- Cultural services – recreational, aesthetic and spiritual benefits
- Supporting services – soil formation, photosynthesis etc.

(MA, 2005:v)

The MA published four main findings (MA, 2005:1). The first is that, over the past 50 years, human activities have changed ecosystems faster than ever before and led to a large loss of diversity. The second says that, while certain ecosystem changes have allowed increased living standards and economic development, they have resulted in degraded ecosystems, poverty for certain groups and an increased risk of nonlinear changes. This could result in a substantial decrease in the ability of future generations to benefit from ecosystems. The third finding is that ecosystem degradation could become much worse during the second half of this century and will be a barrier to achieving the Millennium Development Goals. The final finding says that trying to reverse ecosystem degradation while meeting increased needs for their services is possible, but only if very significant changes occur which are not happening at the moment (MA, 2005:1).

3.3.7 Agriculture

The IAASTD has been discussed extensively in section 3.2.1. It is included within this list of important documents because it is the first time such a large global overview of scientific and academic opinion on the state and future of agriculture has been presented. It was also compiled using an approach which was a mixture of those employed by the IPCC and the MA, in other words, a fairly reliable method of distilling the essence of worldwide knowledge and opinion on agriculture.

To reiterate, the IAASTD says that “the ecological footprint of industrial agriculture is already too large to be ignored” (IAASTD, 2008a:32). The IAASTD says that the main challenge for AKST is to increase productivity in agriculture in a sustainable manner, with a focus on the improvement of welfare and livelihoods of small-scale farmers (IAASTD, 2008b:5).

3.3.8 Summary

Taken together, these trends reflect a “highly unequal urbanised world dependent on rapidly degrading eco-system services, with looming threats triggered by climate change, high oil prices and declining agricultural yields, which is marked by extreme inequality between rich and poor” (Swilling, 2007). It is clear that SD has not managed to stop humanity from damaging the planet which supports us or reducing poverty. Sachs (1999) says this is because SD discourse has been biased towards increased growth through “better engineering, integrated planning and more sophisticated models” which promise resource efficiency and rationalisation (Sachs, 1999:41&67). Both he, Hattingh and Daly and Goodland argue that it is impossible for low income countries to reach affluence levels found in wealthy nations: “to accomplish the possible parts of the imperative of development, we must stop idolising the impossible” (Daly & Goodland, 1996:1004). Goering *et al* say that farmers in developing countries are led to believe that through the adoption of modern agricultural practices, they can live like people in the developed countries. But this can never work: “we would need four or five more planets if all the world’s inhabitants were to consume and pollute at the same rate as the North” (Goering *et al*, 1993:88).

I agree with these authors that we need to apply a radical model of sustainable development (defined as one which focuses on “structural changes in the economy, politics, institutions and individual lifestyles so as to ensure that a fairer distribution of resources can be achieved throughout the world and between generations, while staying within the carrying capacity of supporting ecological systems” (Hattingh, 2001:21)) if we are to solve the world’s problems of inequality and environmental damage.

This section has given an overview of the concept of sustainable development, as well as the major challenges which face humanity. This discussion provides a holding space for the rest of the thesis, defining my viewpoint as the researcher as well as serving to introduce the following section.

3.4 DEFINING ‘SUSTAINABILITY’ FOR SMALL-SCALE FARMERS

This section attempts to build on the discussion of sustainable development in order to further refine research objectives i. and ii¹⁰, by defining what is meant by the term ‘sustainability’ or ‘sustainable’ in the objectives and this thesis.

3.4.1 Global Sustainability

The preceding section has highlighted major challenges to sustainability on a macro or global scale. It is clear that true sustainability involves considering the wider impact of any action or policy on intra- and inter-generational equity. But how does one justify asking small-scale, poverty-stricken farmers to forgo farming methods which claim to offer higher yields, based on the notion that they need to farm in a sustainable manner, to save the planet upon which all of humanity depends for its survival? As Swilling points out (2007), “contrary to what most development economists think, the depleted resource base is such that we can no longer first eradicate poverty and then ‘clean up the environment’. This was a key finding of the Millennium Ecosystem Assessment”. In other words, it is no longer possible to prescribe farming methods to small-scale farmers which damage the environment as it could mean the collapse of ecosystems on which those same farmers depend. This means that ecological sustainability is no longer at odds with economic growth goals; whereas, in the past, protecting the environment was seen as expensive, a ‘nice to have’ and not the responsibility of developing country inhabitants, the state of the environment is such that not protecting the environment can now be seen to have a direct impact on small-scale farmers within their lifetimes. And international pressure around the adoption of more ecologically-friendly farming practices is likely to increase as certain ecosystem problems become more threatening. For example, the Kyoto Protocol on climate change does not yet require developing countries to reduce

¹⁰ Research Objectives:

- i. From the literature, assess the sustainability of GR farming practices, particularly for small-scale farmers in developing countries
- ii. From the literature, identify alternative farming methods which may be more sustainable for small-scale farmers in developing countries

their GHG emissions, but it is likely that it could in the near future¹¹. Thus, farming practices for small-scale farmers need to consider broader sustainability issues too.

Agricultural methods or policies which can be considered sustainable on a global scale include:

- Those which, directly or indirectly, result in low or reduced emissions of GHGs
- Those that do not rely heavily on fossil fuels
- Those that promote urban resilience
- Those which protect or enhance ecosystems
- Those which promote equality
- Those which allow future generations to meet their own needs

This is a fairly simple list but it serves as a starting point against which to assess farming practices.

3.4.2 Farmer-level Sustainability

The discussion in 3.3 of sustainable development and the challenges facing humanity on the planet give some indication of what sustainability on the level of the individual small-scale farmer in a developing country may imply, but does not give the whole picture. For these kinds of farmers, farming is usually the main source of livelihood for themselves and their families (IAASTD, 2008; IBRD, 2007). Therefore, in order to better define sustainability at this level, I will refer to the sustainable livelihoods approach (SLA). The reason for using this approach is that it expresses sustainability at the level of the individual farmer and his family very clearly, in a way which resonates with many of the points made in the section on sustainable development and elsewhere in the thesis so far. The IAASTD says that the most important challenge for AKST is “how to improve social welfare and personal livelihoods in the rural sector” (IAASTD, 2008b:5).

¹¹ By the end of the first commitment period of the Kyoto Protocol (2008-2012), the new framework for international emission reduction targets needs to have been ratified. It is believed that developing countries may receive binding targets in this round.

Firstly, the SLA recognises that, especially in the poorer countries, rural resources are already being exploited unsustainably and that “any strategy for environment and development for the 21st century which is concerned with people, equity and sustainability has, then, to confront the question of how a vastly larger number of people can gain at least basically decent rural livelihoods in a manner which can be sustained, many of them in environments which are fragile and marginal” (Chambers and Conway, 1991:2). The SLA also takes issue with certain aspects of conventional development thinking: “problems defined variously as hunger, undernutrition, malnutrition and famine are in this mode seen as problems of production, of producing enough food. There is, though, overwhelming evidence... that these are much more problems of entitlements, of being able to command food supplies, than of production or supply” (Chambers and Conway, 1991:2). Chambers and Conway go further to criticise approaches which attempt to use “production, employment and cash income as indicators of wellbeing” (1991:3), they are irrelevant measures imposed in a top-down manner from the industrialised North and “do not fit or capture the complex and diverse realities of most rural life” (Chambers and Conway, 2002:3).

Instead, the SLA defines livelihoods as “people, their capabilities and their means of living, including food, income and assets... A livelihood is environmentally sustainable when it maintains or enhances the local and global assets on which livelihoods depend, and has net beneficial effects on other livelihoods. A livelihood is socially sustainable when it can cope with and recover from stress and shocks, and provide for future generations” (Chambers and Conway, 1991:i). The authors use three terms: capabilities, equity and sustainability to describe concepts which are both a means and an ends to livelihoods. The authors’ definition of capabilities, largely influenced by Nobel Prize Winner, Amartya Sen, is “being able to perform certain basic functionings” (Chambers and Conway, 1991:4): to be adequately nourished, to live a long and healthy life, to be adequately clothed etc. as well as being able to react to stress and shocks¹² – not only reactively but proactively. Equity is about the equal distribution not just of income but access to assets, capabilities and opportunities, and

¹² This ability to react to stress and shocks could also be termed resilience. The terms will be used interchangeably in the thesis.

an end to discrimination, particularly against women (Chambers and Conway, 1991:4). The SLA's definition of sustainability is where its resonance with the views already expressed in this thesis become clear. The authors say that "in the livelihood context, we will use sustainability in a more focussed manner to mean the ability to maintain and improve livelihoods while maintaining or enhancing the local and global assets and capabilities on which livelihoods depend" (Chambers and Conway, 1991:5). In other words, the SLA views environmental sustainability as concerning the external impact of livelihoods on other livelihoods (both present and future) and social sustainability as concerning the internal capacity to withstand outside pressures (Chambers and Conway, 1991:9).

The authors further divide environmental sustainability into local and global. Global environmental sustainability considers "whether, environmentally, livelihood activities make a net positive or negative contribution to the long-term environmental sustainability of other livelihoods" and is concerned with issues such as pollution, greenhouse gases and global warming and the use of non-renewable resources. Local environmental sustainability is where livelihood activities maintain or enhance the local natural resource base (e.g. air, river water, soils and trees) (Chambers and Conway, 1991:9).

Social sustainability¹³, as mentioned above, refers to whether households can obtain and hold onto adequate livelihoods. The first level is reactive, involving avoiding stresses or shocks or bouncing back from them. Stresses and shocks are seen as sudden (e.g. floods) or gradual (e.g. declining yields on soils, increasing costs of inputs) (Chambers and Conway, 1991:10-11). The second level is proactive, meaning farmers could predict and adapt to, or even exploit, changes in their surroundings; for small-scale farmers this would mean they "are enabled to improve their own experimentation, to conduct their own extension and to organise to manage and exploit links with the wider economy... Through these, a farm family's livelihood can

¹³ Chambers and Conway (1991) do not explicitly refer to economic sustainability. However, economic sustainability is implicitly incorporated into social sustainability; for example, being able to obtain an adequate livelihood would mean farmers either produce enough food to nourish their families or can sell their produce at a suitable price in the market.

become more sustainable in uncertain and changing conditions where markets and prices fluctuate” (Chambers and Conway, 1991:12).

Thus, for the purposes of determining research objectives i. and ii., farming methods can be considered sustainable for small-scale farmers if they promote sustainable livelihoods for the farmers. In other words, if the farming methods meet the following criteria, they contribute to sustainability at the level of the individual farmer:

- Maintain or enhance local and global assets
- Have net beneficial impacts on other livelihoods
- Improve the ability to avoid or cope with stresses and shocks (i.e. increased resilience)
- Allow farmers to take advantage of changes in surroundings
- Provide for future generations

(Adapted from Chambers and Conway, 1991)

3.4.3 Conclusion

This section has drawn together previous sections of the literature review and introduced the SLA approach in order to provide a working definition of ‘sustainability’ which will be used to determine research objectives i. and ii. The following section will discuss the farming methods of the GR and use this working definition to assess these farming practices against.

3.5 A BRIEF HISTORY OF MODERN AGRICULTURE

This section aims to provide a brief overview of the history of modern agriculture. It is useful to review this history in order to understand how political and economic factors have influenced farming around the world. Without an understanding of this history, it is hard to make effective suggestions on where to intervene to create a more sustainable agriculture. Sub-section 3.5.2 will give an introduction to the history of farming in India, to provide a context for the farmer interviews.

3.5.1 History of World Agriculture

Humans first began to domesticate plants for agriculture almost 10 000 years ago in the Fertile Crescent in the Middle East (Madeley, 2002:10; Trewevas, 2002:670). Until the mid-1800s, agriculture was practised as a subsistence activity on small family farms, developed to suit the local conditions and culture (Madeley, 2002:11). The first major change to agriculture occurred during the colonial era when European colonists “ruptured age-old systems of agro-ecology by creating colonial monocultures” (McMichael, 2006:170). Crops were grown in the colonies and removed to be consumed in Europe. Cecil John Rhodes, British proponent of colonialism, wrote in the 1890s: “we must find new lands from which we can easily obtain raw materials and at the same time exploit the cheap labour” (Madeley, 2002:13). Farmers no longer grew food crops for their families’ consumption, but export crops such as cocoa, sugar and tea (Madeley, 2002:13).

After World War II, colonies were mainly relinquished and the “US then reconstructed the world economy under the aegis of an international ‘development project’” (McMichael, 2006:171) – nation states were encouraged to focus on their own development and self-sufficiency. At roughly the same time, the “agri-chemical revolution” began (McMichael, 2006:176) as companies found an outlet for nitrogen which had been used to manufacture bombs during the war – producing fertilisers (McMichael, 2006:176; Shiva, 1991:104). The twentieth century was also the “era of plant breeding and genetics... the genetic base of crop production could be controlled and easily adjusted to accommodate differing climates” (Trewevas, 2002:668). However, the first stage of the GR in the 1960s and 1970s was focussed on favourable (in terms of good soils and growing conditions), irrigated areas and the second stage in the 1980s and 1990s on favourable, rain-fed areas; less favourable areas were neglected by plant breeding (Huang, Pray and Rozelle, 2002:679).

In response to the pressure from the West to adopt these modern agricultural methods, the farmers in developing countries tended to react in one of two ways. “Some began to use excessive amounts of external inputs” – using fertilisers and pesticides seemed easier than their traditional methods (Madeley, 2002:13). For many of these farmers, these methods introduced from the West “had an almost iconic status as ‘modern’ and

this continued in post-colonial days” (Madeley, 2002:13). The other group of farmers stayed with their traditional methods – usually because they could not afford the inputs. This adoption of modern inputs, along with mechanisation, “increased farm demand for fuel oils, gasoline and electricity, thus increasing agricultural dependence on the energy sector” (McMichael, 2006:176).

Most recently, globalisation has been a major influence on agriculture and has seen “the deepening of global supply chains by transnational corporations” and “the associated explosion of offshore money markets” (McMichael, 2006:171). Globalisation is characterised by states being “servants of trade, cross-border investment, deepening agro-exporting and the construction of an ecologically-invasive world agriculture” (McMichael, 2006:171). International trade in agricultural inputs and products has grown remarkably in the past 50 years and 70 percent of this trade is between transnational corporations (TNCs) (Madeley, 2002:121).

An important feature of globalisation was the structural adjustment programmes (SAPs) forced on developing countries by the IMF and World Bank (McMichael, 2006:174)¹⁴. These programmes forced developing countries to open markets and focus on crops grown for export rather than internal consumption. This situation got so bad that an Indian policy analyst is quoted as saying that India will need to import staple food to feed its own people, while growing large areas of crops for overseas customers (McMichael, 2006:174).

Part of these SAPs forced developing countries to open their markets and not to provide any support or subsidies for their farmers. However, countries in the North who are not subject to SAPs, often have large subsidies available to their farmers. Madeley says that Western ‘modern agriculture’ only survives because of these high subsidies, but due to economic recession and “financial realism” these subsidies are getting smaller (2002:15). Subsidies encourage farmers to produce more which leads to ‘dumping’ or selling below the cost of production in developing countries. SAPs also “maximise the impact of artificially-cheapened prices for agricultural

¹⁴ Although trade has been briefly discussed in section 2.2, it is included here to show the perspective of other authors.

commodities in world trade” and developing world farmers lose out (McMichael, 2006:174).

In the EU, the main subsidy mechanism for farmers is the Common Agricultural Policy (CAP). Three-quarters of CAP subsidies go to one-quarter of the farmers in the EU, namely, the largest farmers. Small farmers could not compete, many taking on debt which forced them into bankruptcy. The scale of the collapse of small-scale farming in Europe has been dramatic (Madeley, 2002:15). But the effects in developing countries have been even worse; Madeley (2002:17) cites several examples: in West Africa, pastoralism has dwindled due to cheap meat imports from the EU; Indian farmers growing seed oils are losing ground to cheap soya from the US and Mexican beef farmers are losing out to subsidised US producers. The United Nations Food and Agriculture Organisation (FAO) estimates “that between twenty and thirty million people have lost land through the impact of trade liberalisation” (McMichael, 2006:175) – they are forced to leave their land in search of another livelihood because they cannot compete economically.

Although the above is a very brief overview of the history of modern agriculture, it hopefully serves to highlight how farming has been shaped very strongly by politics and economics. One needs to understand the globalised nature of agriculture and its integration with agri-business and political power – “agriculture is having to develop under an emerging neo-liberal trading regime supervised by the World Trade Organisation” (Bowler, 2002:205). Without such an understanding, it is difficult to suggest alternatives that could be effectively implemented, as one will always be working within this context. The next section, which looks at various concerns around the current state of agriculture, will add more detail and more varied viewpoints to the story above.

3.5.2 History of Indian Agriculture

The overview provided above is reflected very clearly in the experience of Indian agriculture.

India had very productive traditional agricultural systems and has a history of 6000 years of farming (Shiva, 1991:28). Madeley cites an example of a study by Thomas Barnard in the 1700s in India (2001:26). Barnard looked at the rice yields of 800 villages; he found the average production to be 3600 kg/ha, with the best 130 villages averaging 8200 kg/ha: “this is higher than the average yields the farmers were to obtain two centuries later under the so-called ‘Green Revolution’ of the 1960s” (Madeley, 2001:26). Barnard said these yields were achieved through optimal seed selection to suit the site, sophisticated yet simple tools, extreme care in tending the fields and techniques such as intercropping and fallowing.

Then colonisation occurred with the East India Company controlling most of India by the mid 1800s (Shiva, 1991:48). This began to change traditional systems to replace them with systems that suited their needs – cultivating cash crops for export to Britain (Shiva, 1991:29). The British instituted heavy taxes on the villages and also removed some of the traditional support structures which had existed in villages to protect people from famine if the monsoon failed or arrived earlier or later than normal. By the end of colonisation, the Indian economy was the poorest in the world, (Kate, 2007) with its agricultural system unable to feed the growing population.

When India gained independence from Britain in 1947, India’s agricultural system was “in tatters” (Swaminathan, 2008:14). Despite a population of 350 million people, almost three-quarters of whom were farmers, agricultural “growth was barely 0.01 per cent between 1940-47” (Swaminathan, 2008:14). Shiva says there were three groups of international agencies involved in bringing the GR to India: the Ford and Rockefeller Foundations, the America Government and the World Bank. Initially, many in India tried to resist the GR, expressing concerns over issues like foreign exchange costs of importing fertiliser, reduction of Indian autonomy in agricultural research, displacement of small farmers and fears over rushing into a new agriculture (Shiva, 1991:29 and 30). But when a major drought occurred in 1966, and India was

desperate to import grain from the US, the then American President, Lyndon Johnson, “refused to commit food aid beyond one month in advance until an agreement to adopt the Green Revolution package was signed” (Shiva, 1991:31). Shiva’s view contrasts with the view of Heitzman and Worden who claim that the Indian government welcomed the introduction of the GR technologies by the US-based Rockefeller and Foundation (Heitzman & Worden, 1995).

The GR in India is generally agreed to refer to “the introduction of high-yielding varieties of seeds after 1965 and the increased use of fertilisers and irrigation” (Heitzman & Worden, 1965). It is also not disputed that the GR (over the period 1965-1990) resulted in India moving from a situation of severe food shortages “to one of frequent surplus, improved food security, and higher aggregate nutrition levels” (Goldman & Smith, 1995:244). This is even more impressive in light of the fact that, during the same period, India’s population grew by “almost 390 million people”; an annual population growth rate of 2.2 percent (Goldman and Smith, 1995:244). In recent years there has been criticism of the GR for environmental and economical unsustainability (Singh, 2000; Rao, 2002; Ghosh, 2004) and a spate of suicides among small-scale Indian farmers.

CHAPTER FOUR: THE GREEN REVOLUTION – A LITERATURE REVIEW

4.1 COMPONENTS OF ‘MODERN AGRICULTURE’

In order to answer research objective i. (assess the sustainability of GR farming methods for small-scale farmers in developing countries), this section will begin with an analysis of the major components that make up what is referred to as ‘modern agriculture’. The discussion in 3.3 of sustainable development and the seven major documents which indicate the state of human society and the planet, as well as the factors identified which indicate what constitutes ‘sustainability’ at the level of an individual small-scale farmer in 3.4, will be used as a framework against which these major components are assessed.

It should be noted that, while the research objectives specify that farming methods will be examined, it is impossible to separate farming methods from factors like trade or government policy. This is because a farmer’s decision to adopt certain farming methods will always be influenced by outside factors. For this reason, certain aspects of the GR are assessed which are not strictly related to the farming methods chosen but do have a major impact on farmers.

4.1.1 High-yielding Seeds

One of the cornerstones of the GR was the high-yield seed, known as “modern varieties (MV)” (Pretty *et al*, 1995:126) or high-yielding varieties (HYVs). These seeds were created by agricultural scientists for their ability to mature quickly, be insensitive to day length – expanding their geographical range of growth, and hence to give better yields (Pretty *et al*, 1995:126). The seeds were distributed to farmers with a whole package of other inputs including chemically-derived fertilisers and pesticides (Pretty *et al*, 1995:126). Initially, they did increase yields. However, many farmers did not achieve these yields because the seeds were bred to respond to a perfect set of conditions – including a specific climate, and exact amounts of water, fertilisers and pesticides. “If one element of the package is missing... then yields may not be much better than those for traditional varieties” (Pretty *et al*, 1995:129; Goering *et al*, 1993:7). Shiva quotes a United Nations Research Institute for Social

Development study which looked at the impact of the new seeds in 15 countries. The study concluded that term high-yielding variety is a misnomer, because without inputs, the seeds may perform worse than traditional varieties; these seeds should rather be called 'high-responsive varieties' (Shiva, 1995:72). The study found further that "with the additional inputs, the gain in output is insignificant compared to the increase in inputs. The measurement of output is also biased by restricting it to the marketable part of crops" (Shiva, 1995:72).

Shiva highlights this point: that the HYVs in many cases reduced the overall biomass of crops, which meant that additional outputs, such as fodder, were reduced, forcing farmers to purchase them externally (Shiva, 1995:75). She feels that the true way to compare farming systems is to look at the full range of inputs and outputs (Shiva, 1991:69). The IAASTD supports this viewpoint, criticising the GR for its focus on maximising the output of one component of a harvest "generally ignoring other supporting, provisioning, and regulating ecological functions and services. When these practices have been associated with policies that provide resource price-distorting incentives, this has often led to degradation of environmental and natural resources" (IAASTD, 2008a:20).

HYVs threaten biodiversity by displacing "traditional methods and variety" (Pretty *et al*, 1995:129). In as short a time as the past 25 years, "genetic stock has been greatly narrowed" (Pretty *et al*, 1995:129) and replaces the traditional practice of planting a wide variety of seed types and crops to minimise the "risk of crop failure" (Pretty *et al*, 1995:129). Shiva highlights that "the technology for breeding high-yield varieties is... a technology which breeds uniformity and threatens a collapse in yields" (Shiva, 1995:47). She is pointing out the connection to monocropping, another feature of modern agriculture, which is discussed in more detail below. Shiva gives many examples of areas which have planted one variety of high-yield seeds and experience pests or diseases which wipe out an entire crop (as do Goering *et al*, 1993:7). She also sums up that "the commoditised seed is ecologically incomplete and ruptured at two levels" (Shiva, 1995:51). These two levels are that these seeds do not reproduce themselves, thereby transforming "from a renewable into a non-renewable resource" (Shiva, 1995:52), and that the seeds do not produce by themselves, they need all

manner of off-farm inputs in order to grow (Shiva, 1995:52). Hybrid seeds lose the characteristics of the original parent plants in later generations, meaning that farmers need to buy new seed every year (Goering *et al* 1993:7).

4.1.2 Monocropping

Monocropping is one of the other main features of modern agriculture. Because of the HYVs and the package of inputs which came with it, farmers began to plant larger areas under a single crop type. Madeley tells us that even though resource-poor farmers could often not afford the whole package of inputs necessary for monoculture systems, “millions were nonetheless persuaded” (2002:28). And yields did rise initially, causing these farmers to scorn and reject their traditional methods. However, as time has passed, so the “disadvantages of monocropping” have become evident (Madeley, 2002:28). He cites the dependence on chemical inputs to prevent disease and pests and the resultant expense for farmers, whereas crop rotation used to provide this protection for free under traditional methods (Madeley, 2002:28). Studies suggest that monocropping is less productive than mixed cropping: “Shiva cites a study of a polyculture system which found that ‘you need 5 units of inputs to produce 100 units of food. That’s a productivity of 20. For monoculture you need 300 units of input to produce 100 units of food. That’s a productivity as low as 0.33’. To the farmer it is overall output that matters” (Madeley, 2002:29).

Shiva says that “monocultures are ecologically unstable, and that reason alone should be enough to NOT view them as essential to production” (1995:46). She calls them ecologically unstable because they invite diseases and pests – if one plant is susceptible, the whole crop could be lost; Trewevas agrees that monocultures have led to increased vulnerability to disease (2002:668). Monocropping is also a threat to the ability of ecosystems to provide services; monocultures reduce biodiversity and “the ability of ecosystems to provides some services also depends both on the number and type of species in an ecosystem” (Tilman *et al*, 2002:672). Shiva also highlights the fact that, for small-scale farmers, “biodiversity has been the source of sustenance for basic needs such as food, clothing, shelter, and medicine” (1995:51). By losing the diverse crop systems they had under their traditional systems, these resource-poor farmers also face threats to their food and nutritional security “by reducing the variety

of available foods” (Madeley, 2002:29). As Shiva puts it, in the South, “biodiversity conservation takes on the significance of a struggle for self-reliance” (Shiva, 1995:43).

Another issue with the loss of diversity inherent in monoculture is a loss of resources for scientists to use in developing new varieties of crops which can resist pests and diseases and tolerate harsh environments. Madeley gives a pertinent example from the 1970s when the Tungro virus devastated the Indian rice crop. Plant scientists examined 17,000 wild and cultivated varieties of rice before they found resistance to the virus in one wild variety (Madeley, 2002:140). It is clear that humankind is perilously reliant on a small number of crops as “20 crops provide 90 percent of the world’s food” (Madeley, 2002:140), three cereals (wheat, rice and maize) provide 60 percent of the world’s food (Tilman *et al*, 2002:674). Because a central rule of epidemiology¹⁵ says that the number of diseases and the frequency of occurrence increase in proportion to the abundance of the host plant, the “potential instability of a global strategy of food production in which just three crops account for so high a proportion of production” (Tilman *et al*, 2002:674) becomes obvious.

4.1.3 Use of Chemical Fertilisers and Pesticides

Chemically derived fertilisers and pesticides started being produced in mass quantities after World War II, in order to find a market for excess nitrogen. They were also necessary for the new high-yielding seeds that were being produced – these seeds were planted in a monoculture and needed pesticides and fertilisers to protect them and encourage rapid growth. While Goering *et al* acknowledge that fertilisers and other industrial inputs have “significantly improve[d] yields around the world” (1993:10), they say that fertilisers have also caused severe problems.

Fertilisers are “chemical inputs produced from finite resources and manufactured in an energy-intensive fashion” (Lampkin, 1999:7). They are produced through the mining of finite sources of the chemicals (e.g. phosphorous) and energy-intensive conversion processes which are “dependent on massive infusions of fossil-fuel based inputs” (Goering *et al*, 1993:57). Because one kilogram of nitrogen fertiliser uses the

¹⁵ Epidemiology is the study of the distribution and causes of disease occurrence in a population

energy equivalent of one-and-a-half litres of oil to produce, fertiliser prices closely follow oil prices (Goering, *et al*, 1993:10). This sensitivity to oil prices makes farmers and countries more vulnerable to inflation. For poor countries, rising oil and fertiliser prices means they need to use more scarce foreign exchange to purchase these inputs “generally from foreign multinationals” and has contributed to many countries’ debt problems (Goering *et al*, 1993:10). Fertilisers thus contribute to global warming and could also become prohibitively expensive as oil prices rise.

Chemically derived fertilisers are used to provide nutrients to the soil which plants can then absorb while growing. Proponents say that chemical fertilisers are necessary in order to replace the nutrients lost when plants are removed from the soil (Borlaug, 2000; Huang, Pray and Rozelle, 2006). However, “chemical fertiliser is costly for small-scale farmers and can damage the long-term health of the soil” (Madeley, 2002:136). Goering *et al* cite the World Bank’s 1984 World Development Report on agriculture as admitting that long-term use of chemical fertilisers can decrease soil fertility (Goering *et al*, 1993:11). Chemical fertiliser can make some soils more acidic and other soils more saline because they cause soil pH to fluctuate more widely than organic manures would (Goering *et al*, 1993:12). “‘The devil’s salt’ is how some small farmers in Ghana, for example, have come to describe such fertilisers” (Madeley, 2002:136). These fertilisers also reduce the organic content of the soil (Madeley, 2002:136) through disrupting natural processes in the soil, adversely affecting soil microfauna and flora and speeding up decomposition in the soil (Goering *et al*, 1993:12).

These fertilisers and pesticides are “never used entirely efficiently by the receiving crops or livestock” (Pretty *et al*, 1995:129; Goering *et al*, 1993:13) and are lost into the environment. They cause pollution of ground and surface water and can also contaminate food, fodder and the atmosphere (Lampkin, 1999:6; Goering *et al*, 1993:13; Trewevas, 2002:668). Farming operations using these inputs can thus have severe repercussions on the environment – even in very far removed geographic localities. Bowler mentions the rise in concern recently for human health as result of the current farming practices – for example, pesticide residues on fruits and vegetables containing toxins (Bowler, 2002:206).

Pesticides “are often inefficient at controlling pests” (Pretty *et al*, 1995:132) – they can kill the natural predators of the target pest and pests can also become resistant to the pesticides (Goering *et al*, 1993:16; Huang, Pray and Rozelle, 2002:679). This resistance requires farmers to apply larger doses and stronger chemicals (Goering *et al*, 1993:16); killing and weakening the population of the natural predators of target pests means that the pests can return in greater numbers in following years (Goering *et al*, 1993:18). Tilman *et al* quote research which shows that weeds can develop resistance within one or two decades, while insects can do this within a decade; in other words, as scientists develop stronger pesticides “each defence sows the evolutionary seeds of its own demise” (2002:674). But the environmental impact of pesticides begins in the manufacturing stage – “one tonne of DDT produces two tonnes of toxic sludge as well as corrosive and toxic waste waters” (Goering *et al*, 1993:16); there are no completely safe disposal methods for this kind of waste. Pesticides pose health risks especially to those who work with them (factory workers who produce them and farmers and farm workers who apply them) (Goering *et al*, 1993:20). While proving direct causality between pesticide exposure and long-term health is difficult, evidence is growing (Goering *et al*, 1993:19). Most disturbing is the poorly regulated use of pesticides in poorer countries – “seventy percent of the pesticides used in India are banned or severely restricted in the West” (Goering *et al*, 1993:20).

The IAASTD criticises chemical pesticides on the grounds that it affects the health of farmers, labourers and consumers as well as causing pollution; these negative effects on health and the environment have been well documented (IAASTD, 2008a:19). While proponents of such chemicals would acknowledge these risks but recommend stricter regulations around their use, the IAASTD says that such regulations can “help reduce exposure but do not eliminate risk” (IAASTD, 2008a:19). In fact, it recommends that countries which do not have the resources to implement regulations should stop the use of hazardous chemicals altogether and instead “promote alternative pest management including IPM [integrated pest management], agroecological approaches, biocontrols, organic farming and farmer field schools” (IAASTD, 2008a:27). This view of pesticides corresponds with that of Huang, Pray and Rozelle who say that studies in developing countries show that “the cost of the

adverse health consequences for the farmer applying the pesticide more than offsets the savings that the farmer earns by reducing the loss of pest-inflicted damage to the crop” (2002:679).

As with fertilisers, Goering *et al* feel that pesticide prices will continue to rise too (1993:22). This is due to the fact that new pesticides require more complex chemicals and need to meet stricter safety standards (Goering *et al*, 1993:22). With many developed countries imposing strict rules regarding the use of pesticides in their own countries, many TNCs have focussed their efforts on selling these pesticides in developing countries, because “these chemicals represent a highly profitable, multi-billion dollar industry” to them and because developing country governments do not have the means to enforce strict pesticide laws and often do not want to scare off these powerful economic interests (Goering *et al*, 1993:22).

4.1.4 Machinery

Modern agriculture has replaced human and animal labour with machinery which has made agriculture more efficient in terms of the yields per hour of human labour and contributed to cheaper food prices (Goering, 1993:29). Obviously it has also meant a large reduction in farm jobs and made farmers even more reliant on energy and external inputs (Goering *et al*, 1992:29). It has “increased farm demand for fuel oils, gasoline and electricity” (McMichael, 2006:176). Machinery also makes farming on a larger scale more attractive, output increases and food prices fall which means that many small farmers who cannot afford to compete are forced to leave their land (Goering *et al*, 1993:29).

Machinery is obviously expensive to purchase and to run, makes farms more susceptible to oil price increases and heightens farming’s contribution to climate change. Machinery use also contributes to the problem of “soil compaction” (Bowler, 2002:206) which makes soils less fertile. Soil is compacted into permanent furrows which channel water – resulting in increased water run-off and erosion and lower water retention (Goering *et al*, 1993:29). Goering *et al* say that mechanisation is usually coupled with large-scale irrigation schemes. While these irrigation schemes have allowed larger areas to be farmed, they are “pumping groundwater at

unsustainable rates”, faster than they are being replenished (Goering *et al*, 1993:30). Also, if soil has been degraded through modern agricultural methods, its water retention capacity is often reduced, meaning more water is needed to irrigate the land (Goering *et al*, 1993:30).

4.1.5 Scientific Research

Modern agriculture is founded on scientific research. The problem with this, according to McMichael, is that its “vision was founded in reductionist scientific representations of agricultural modernisation” (McMichael, 2006:172). This approach sees human beings as separate from nature, and believes “that we can manipulate and control the natural world to serve our needs... This reductionist perspective has allowed the earth under our feet to be seen as little more than a ‘factor of production, soil as more or less inert matter, ecosystems as ‘resources’ to be exploited” (Goering *et al*, 1993:3).

Another issue with current scientific approaches is that scientists tend to be highly specialised and focus on their own area of knowledge. This means that they can create solutions or technologies without considering how it fits into a broader picture or the long-term impacts it may have (Goering *et al*, 1993:4; Shiva,

Risks of GM Crops

Although this thesis avoids the in-depth discussion of the risks of genetically modified (GM) organisms, I feel it is worth mentioning a few of the major concerns highlighted in the literature I reviewed. McMichael (2006), Shiva (1995) and Madeley (2002) view GM as a threat to self-reliance because the GM technology is controlled by a small number of companies. And these “corporations show no sign of letting go of the patents they hold on the seeds. On the contrary, Monsanto has applied for patents on its Terminator Technology – seeds which self-destruct after one season – in over 70 countries” (Madeley, 2002:63)

Shiva focuses on the injustice of GM: “centuries of innovation are totally devalued to give monopoly rights on life forms to those who manipulate genes with new technologies, placing their contribution over and above the intellectual contribution of generations of Third World farmers... in the areas of conservation, breeding, domestication and development of plant and animal genetic resources” (Shiva, 1995:57). 24 African governments issued a “strongly worded statement saying that GM technologies ‘will destroy the diversity, local knowledge and sustainable agricultural systems that our farmers have developed for millennia, and thus undermine our capacity to feed ourselves’” (Madeley, 2002:64).

McMichael also highlights the potential environmental risks of GM: destruction of biodiversity, increased use of herbicides and pesticides and the risk of irreversible genetic pollution (McMichael, 2006:183). Madeley cites a study in India which found no reduction in pesticide use in GM versus conventional cotton fields ((2002:62). Although GM advocates claim that GM crops can provide higher yields that developing countries need, “there is little evidence of higher yields from GM crops, conventional varieties of soya are still mostly outperforming GM varieties in the US” (Madeley, 2002:64).

From section 2.2.3, it is clear that there are those who feel GM crops offer the only hope for increasing yields sufficiently to feed the world population. While this point will be debated further in section 2.11, by reviewing studies on the ability of organic agriculture to feed the world, it is clear that there are concerns around GM in terms of affordability for small-scale farmers and environmental impacts.

1991:21). A scientific approach, such as the one which underpinned the GR, values the supremacy of science over traditional knowledge – and because the approach is fairly “high-tech... many decisions were taken out of the hands of farmers and local people, thus decreasing self-reliance and confidence” (Madeley, 2002:28). This can have the unfortunate result of “knowledge of the systems which have worked for decades, even centuries” (Madeley, 2002:29) being lost.

There is also a drive within science to find universally applicable laws and technologies which can be applied to any and every situation (Goering *et al*, 1993:5). The problem with this is that these findings are often invalid when conditions deviate from the assumed standard – “increasing nitrogen, for instance, enhances plant growth only if a myriad of micronutrients remains available, while hybrids will outperform traditional varieties only when soil, climate and chemical inputs are optimised” (Goering *et al*, 1993:5). Standardisation suits manufacturers and corporations as it allows them to minimise the costs of production but has meant the demise of regionally-adapted plant species and practices which “failed in some way to meet the narrow requirements of the industrial food production system” (Goering *et al*, 1993:5). Shiva feels that science is viewed as above society: “it cannot be judged, it cannot be questioned” (1991:21). Scientists regard their work as “socially and politically neutral” (1991:21). Yet science still attempts to provide solutions for social and political problems, but when these scientific fixes create more problems, science “delinks” itself, avoiding any responsibility (1991:21).

4.1.6 Meat Production

Although this thesis focuses on farming of plants rather than of livestock, the issue of meat production is becoming increasingly more pressing as populations increase and living standards rise in developing countries. In “some developing countries, China for example, demand for products such as beef and poultry is rising (in contrast to Western countries where demand for red meat is declining)” (Madeley, 2002:143).

McMichael raises the issue of how much of the world’s food production goes to the feeding of cattle, “cattle consume more than one-third of the world’s grain” (McMichael, 2006:180). This is a highly unsustainable and inequitable situation

because it “redistributes food from low- to high-income populations, undermining the staple food systems upon which a large proportion of the world’s population depends” (McMichael, 2006:180). Rising demand for grain to feed livestock increases grain prices on world markets “to the detriment of net food importing countries – about three-quarters of all developing countries – and food security” (Madeley, 2002:147). This has led to debate about whether the world can produce enough grain for meat production or if vegetarianism or low-meat diets should be encouraged. Putting a tax on livestock products could also reduce consumption, which would help moderate world grain prices (Madeley, 2002:148).

There are also health concerns around intensive meat production systems. Animals kept in close confinement need to be given large amounts of antibiotics (almost half the antibiotics used in the United States are given to farm animals) to keep them healthy, which has led to new, antibiotic-resistant strains of bacteria (Goering *et al*, 1993:24). The use of growth hormones is also worrying for human health, as are general hygiene standards in production facilities and slaughterhouses (Goering *et al*, 1993:26,27). The manure from factory farms cannot be used for fertiliser because of its high salt content and large quantities of sewage need to be disposed of, often polluting water (Goering, 1993:28).

4.1.7 Trade and Growing Crops for Export

As agriculture becomes a globalised industry, there has been a “dramatic increase in ‘food miles’ (McMichael, 2006:179). The transport of food relies on increasingly expensive fossil fuels and contributes to global warming (McMichael, 2006:179; Madeley, 2002:117).

Trade in agricultural products began in earnest during colonialism, but then increased rapidly in the last quarter of the 1900s due to successive rounds of trade liberalisation and the increasing integration of the world economy under globalisation (Madeley, 2002:115).

Agriculture operates within a highly regulated and politicised context. States intervene to promote certain sectors and, especially in the North, to provide subsidies or

artificially higher prices for agricultural production. Bowler mentions that these subsidies are “excessive” and have “unsustainable financial costs” for the state (Bowler, 2002:206). Lampkin says that “subsidised overproduction in Europe has brought about unendurable financial strain and political embarrassment” (1999:6).

As discussed previously, SAPs have forced many countries of the South to promote their export sectors, often at the cost of domestic food production, and open their markets to free trade with countries from the North (McMichael, 2006:174). The World Bank and IMF persuaded developing countries to promote their export sectors on the premise that export earnings would lead to economic growth which would ultimately benefit the poor (Madeley, 2002:117). “At least in Sub-Saharan Africa this has not materialised” – in fact, income per head in Africa grew by a third from 1960 and 1980, and once SAPs started in the 1980s, income per head fell by a quarter (Madeley, 2002:17).

Madeley points out that, although growing food for export takes land away for domestic food production, it can be justified if it yields good cash income (Madeley, 2002:23). However, because of the subsidised prices which farmers of the North obtain for their produce, and because world prices for many of the export crops of the South have reached “historically low levels” (Madeley, 2002:24) of late, farmers of the South cannot compete and make their farms financially viable. Many, in fact, are being forced off their land (McMichael, 2006:175) and this is leading to further concentration by “the remaining, larger, more successful businesses” (Bowler, 2002:206). Perhaps more importantly for small farmers and their families, growing crops for exports means they grow less food for their own consumption. If the prices they obtain for the export crops are poor, they cannot afford to buy a wide enough variety of foods for nutritional security or perhaps not even enough food to prevent hunger (Madeley, 2002:24).

Despite the negative consequences of the SAPs for many developing country small farmers and the lack of success in assisting the hungry, “trade continues to dominate the international economy, even more so since the advent of the World Trade Organisation [WTO] in 1995” (Madeley, 2002:118). After the Uruguay Round of

trade talks which ended in 1993, industrialised countries who gave their farmers high levels of protection before 1993 were allowed to continue with those levels, but developing countries were prevented from increasing their support levels (Madeley, 2002:119). The “evidence is that trade liberalisation had led to an influx of cheap food imports into the developing world, which is putting farmers out of business” and studies of the effects on communities are highly consistent (Madeley, 2002:120). A study from Kenya, for example, says that “liberalised trade, including WTO trade agreements, benefits only the rich while the majority of the poor do not benefit but are instead made more vulnerable to food insecurity” (Madeley, 2002:120). Goering *et al* agree that the benefits of trade go to the powerful, and that growing crops for export “depresses local food production and leaves people dependent on market forces beyond their control” (1993:40).

It is important to recognise that it is companies who conduct the majority of trade, not governments themselves. TNCs dominate developing country agriculture due to their size and power: “seventy percent of international trade is between TNCs” (Madeley, 2002:121). The power of these TNCs also allows them to have a large influence on the terms on which they trade, they had major influence in setting up the WTO and in some cases helped draft the wording of agreements (Madeley, 2002:121; Goering *et al*, 1993:34). Large vertically integrated corporations now “monopolise almost every aspect of farm production and distribution, from seeds, fertilisers and equipment, to processing, transporting and marketing. Four biotech companies own 44 percent of patents on the world’s most important food crops” (Madeley, 2002:121). Paul and Wahlberg also highlight the power of TNCs in shaping government policies on trade and note that many seem to have greatly benefited from the global food crisis in 2008; Cargill’s profits rose 86 percent and Bunge’s 2000 percent in the quarter ending February 2008 (2008:7). These large TNCs do not promote self-sufficiency in farming in developing countries; this would take control of the food chain away from the corporations. Instead, they promote their products and services and talk of the benefit of expanded trade (Madeley, 2002:123). Growing transportation and marketing networks are disempowering individual farmers and making farmers subject to decisions taken off the farm and over which they have no say (Goering *et al*, 1993:6).

Patents on seeds pose a threat to small-scale farmers and food security. The TNCs argue that they need patents on seeds in order to justify their investment in plant breeding. Developing country farmers have nurtured and bred indigenous varieties of seeds for thousands of years, sharing seeds freely with each other. However, these farmers have never received any financial compensation for the breeding they performed before the TNCs began to 'improve' them (Goering *et al*, 1993:9,44). Some countries like India have laws which prevent patents on life "on the grounds that socially valuable products ought not to be privatised or priced out of reach of the general public" (Madeley, 2002:124). But the WTO agreement on Trade-Related Intellectual Property Rights (TRIPs) "grants corporations the right to protect their 'intellectual property' in all member countries of the WTO" which effectively overrides national laws (Madeley, 2002:124). Many of the corporations which own patents on seeds specifically breed the seeds to require chemical inputs which they also manufacture. This means that seeds are not being bred with the interests of small farmers or consumers in mind, but rather with the aim of maximising the profit which can be extracted from the process (Goering *et al*, 1993:9).

The focus on international trade is particularly worrisome in light of the dual challenges of peak oil and climate change. More free trade means more petrol and oil will be consumed and more roads built; increasing the amount of transport will worsen environmental problems and further "the breakdown of rural communities and local economies" (Goering *et al*, 1993:42).

4.1.8 Reliance on Fossil Fuels

It should be clear from some of the previous points that modern agriculture is heavily dependent on fossil fuels; for the production of fertilisers and pesticides, working machinery and moving inputs and produce around the globe. Goering *et al* say that the massive increases in food output in the last century have only been possible due to the exploitation of cheap fossil fuels, especially petrol (1993:32). The amount of energy used to produce one hectare of maize increased by a factor of eight during the 20th century. Looked at in another way, the energy contained in the nitrogen fertiliser applied to a hectare of maize in 1983 is greater than all the energy used to produce that same hectare in 1945 (Goering *et al*, 1993:32). But it is unlikely that fossil fuels

will remain cheap, Paul and Wahlberg say that a recent World Bank report on the 2008 food price crisis blames 20 percent of food price increases on “dramatic input price hikes” (2008:7).

It is clear from the discussion in section 3.3 that this reliance on fossil fuels is not sustainable. It is very likely that the price of fossil fuels will continue to rise, as supplies dwindle. But aside from the concerns over the supply and price of fossil fuels in the future, there are major environmental problems with its use: “acid rain, water pollution, habitat loss and global climate change” (Goering *et al*, 1993:33). These environmental problems should be incorporated into the costs of using fossil fuels, and hence the costs of modern agriculture; currently, these costs are not reflected in prices paid along the value chain “but is instead put on credit for future generations to pay” (Goering *et al*, 1993:34). Human society needs to base its decisions on the full costs in order to make the most sustainable decisions.

4.1.9 Conclusion

It is clear from the discussion above that the current form of agriculture is highly unsustainable for small-scale farmers. However, a full conclusion will not be entered into here, but rather after a discussion of the Indian and African experiences of the GR. The full conclusion regarding the sustainability of the GR for small-scale farmers (research objective i.) can be found in section 4.4.

4.2 INDIA’S EXPERIENCE OF THE GREEN REVOLUTION

4.2.1 Introduction

Most of the points made in the previous section become much clearer when seen in the context of an example; that of India’s experience of the GR. This section looks the elements of the GR as they have impacted India, which serves the dual purpose of reinforcing the previous section with a concrete example and introducing the interviews done in India through background contextualisation.

As was mentioned earlier, India benefited enormously from the GR in terms of spectacular gains in yields. However, many authors now suggest that the GR has taken a serious toll on ecological conditions and that yields have been falling in some areas in recent years (Pretty *et al*, 1995; Singh, 2000; Ghosh 2004; Thakur and Sharma, 2005). This viewpoint is denied by others who feel that the GR is still the best solution and that genetically modified seeds should be added to the package of inputs (Asia Pacific Biotech News, 2006). There seems to be agreement that the GR is not always successful in every situation (Baker & Jewitt, 2007) and that yields vary according to how the package has been applied. For example, in dryland areas where irrigation is not possible, yields are often a lot lower. Also many small-scale farmers cannot afford to implement the whole package of GR inputs and so their yields are often below what they were promised (Pretty *et al*, 1995). A study by the International Labour Organisation found that, despite the achievement of higher per capita cereal yields and Gross National Product in South Asia during the 1960s and 70s, rural poverty increased (Goering *et al*, 1993:40).

The GR was most successful in the north and north-western states of India such as Punjab, Haryana and western Uttar Pradesh (Rao, 2002; Heitzman & Worden, 1995). This was due to the fact that the HYVs required certain inputs and conditions in order to be successful. These conditions included “assured supplies of water and the means to control it, large inputs of fertilisers and adequate farm credit” (Heitzman & Worden, 1995). It is clear that good road infrastructure and market links were also prerequisites; “in a remote region, not only is it difficult for new knowledge and technology to diffuse, but increased production has little or no rewarding outlet” (Goldman & Smith, 1995:258). In states like Andhra Pradesh and Tamil Nadu, where these conditions could not be met, “results were limited or negligible, leading to considerable variation in crop yields within these states” (Heitzman & Worden, 1995). As will be discussed later, this created sizeable regional disparities in food production levels and general prosperity (Heitzman & Worden, 1995; Rao, 2002; Ghosh, 2004; Baker & Jewitt, 2007). “This geographic unevenness has important, though also largely unexplored, implications for food security issues” (Goldman & Smith, 1995:244).

4.2.2 An Agricultural Transformation

Goldman and Smith argue convincingly that the GR was more than just the introduction of the new high-yielding varieties (HYVs) of seeds. They say it was, in fact, an agricultural transformation; a “broad set of changes that fundamentally altered most aspects of the local agricultural economy” (Goldman & Smith, 1995:243). In this section, I will examine the major changes which the GR caused in the states where it was adopted:

4.2.2.1 High-yielding Varieties

The HYVs that were introduced to India around 1965 were mainly rice, wheat and other grains. These were the two main crops which had been developed in the breeding stations in Mexico and the Philippines (Heitzman & Worden, 1995). The area under HYVs grew spectacularly fast; from 1.9 million hectares in 1960 to 43.1 million hectares by 1980 (Heitzman & Worden, 1995). Wheat made the biggest impact with almost three quarters of all land sown under wheat being HYVs (Heitzman & Worden, 1995).

In a study done by Baker and Jewitt in villages in western Uttar Pradesh in 2003, they found that local varieties of crops had been completely replaced by HYVs. There had also been a change of crops cultivated; for example, maize had been completely replaced by rice. The authors say this is due to the increasing demand worldwide for basmati-type rice and because the HYVs made rice more productive than maize. All in all, it is more profitable to grow rice (Baker & Jewitt, 2007:321,323). Singh points out that “people prefer high-yielding and more remunerative crops like wheat and rice” (Singh, 2000:102).

While the spectacular yield increases provided by the HYVs cannot be disputed, there is today concern over their dominance to the exclusion of traditional varieties of crops. This will be discussed in section 4.2.3.1.

4.2.2.2 Irrigation

One of the major impacts of the introduction of HYVs was “the expansion of irrigation” (Goldman & Smith, 1995:246). In most areas of India, annual rainfall

occurs only during two or three months of the year, making irrigation crucial “to achieving high and reliable crop yields” (Goldman & Smith, 1995:246). The government invested heavily in irrigation facilities; in the state of Haryana, almost 95 percent of the area under rice-wheat is irrigated (Singh, 2000:200). India has invested more money in water control than any other agricultural activity (Huang, Pray and Rozelle, 2002:679).

4.2.2.3 Fertiliser Use

As fertiliser use is only effective when combined with irrigation, “the expansion of irrigation helped encourage fertiliser use, which increased 300 percent over the period” (Goldman & Smith, 1995:246). As with irrigation, the Indian government intervened to facilitate increased access to fertilisers by forming a cooperative system in 1967 which supplied fertilisers to farmers on credit (Goldman & Smith, 1995:246). Ghosh adds that the government’s support was not limited to the provision of credit, they also had active demonstrations and invited “private and commercial initiative to build up a vibrant market” (Ghosh, 2004:151).

4.2.2.4 Infrastructure

As mentioned earlier, good roads were a prerequisite for the GR to occur successfully. However, the government assisted with improving the roads and “transportation linkages grew dramatically” (Goldman & Smith, 1995:247). The World Bank WDR 2008 reports that in South Asia, 55 percent of farmers live within an hour of the nearest market (and only five percent of farmers need to travel more than five hours) (IBRD, 2007:54).

4.2.2.5 Mechanisation

“Mechanisation on a broad scale was one of the major aspects of change” (Goldman & Smith, 1995:246). Not only was irrigation mechanised through the introduction of mechanised pumps (with fuel and electricity often subsidised by the government), but cultivation and other tasks were too. Bullocks were replaced by tractors as “tractor ownership increased significantly and tractor use increased by an even greater degree through rental” (Goldman & Smith, 1995:247).

4.2.2.6 Conclusion

It can be concluded that the GR in India was indeed an agricultural transformation. It involved massive and mutually reinforcing changes to all aspects of the agricultural economy and life in villages in India.

4.2.3 Problems Associated with the Green Revolution in India

Despite the many successes of the GR in India, this country also has some of the world's most vocal critics. These critics believe that the GR is "unsustainable for future agricultural development in India both on account of its ecological implications and the burden on the budget" (Ghosh, 2004:149). Vandana Shiva claims that Punjab (one of the provinces of India with the highest GR outputs) "has been left with diseased soils, pest-infested crops, waterlogged deserts and indebted and discontented farmers" (Shiva, 1991:12). An article in *Appropriate Technology* highlights recent high levels of debt and farmer suicides in India (Rao, 2002:10). Indeed, "figures show that more than 166 000 farmers have killed themselves since 1997 – a death almost every half hour" (India digs deep, 2008:33). This has prompted the Indian government to write off loans to farmers in recent budgets, although there are critics who question the long-term effectiveness of such measures (PC's last oomph, 2008; Jerath, 2008). In this section, various problems which have been linked to the GR in India will be discussed in further detail.

4.2.3.1 Changes in Cropping Patterns

As mentioned earlier, the introduction of HYV crops led to a change in cropping patterns and "disappearance of local varieties of rice and wheat" (Rao, 2002:10). The farmers in the villages reviewed by Baker and Jewitt, "when asked whether anyone grew ancient varieties which predated HYVs, the answer was firmly 'no', in all the villages visited" (Baker & Jewitt, 2007:321).

One of the major implications of the focus on HYV grains has been the neglect of pulses and coarse grains. These are the main source of protein for vegetarians and the "staple diet of the poor" (Heitzman & Worden, 1995) who make up 40 percent of India's population (Rao, 2002:11). The area under pulses has not increased and production is at 15 million tons per annum when 25 million are needed (Rao,

2002:11). Baker and Jewitt found that farmers in all villages “lamented the reduction in production of pulses, and particularly gram [lentils etc]” (Baker & Jewitt, 2007:323). The land they farmed was now almost exclusively sown to rice and wheat. The farmers had noticed “deterioration in the quality of their diet, and of their physical strength, with the loss of peas, beans and gram” (Baker & Jewitt, 2007:323). The introduction of HYVs could be said to have caused a reduction in nutritional security for some farmers. Associated with this neglect of pulses and coarse grains was a general neglect of “dryland farming” which “sustains a large segment of the poor and marginalised farmers” (Rao, 2002:11) in India.

A major ecological concern about the changes in cropping patterns brought about by the GR is related to a loss of biodiversity (Rao, 2002:10). A task team at the Indian Council of Agricultural Research (ICAR) commissioned by the Government of India found that the “narrow genetic base on which high-yielding varieties are based has created an alarming uniformity, causing vulnerability to pests and diseases” (Rao, 2002:10). In contrast, Baker and Jewitt’s research is decidedly in favour of the GR on the whole and they report that the farmers they interviewed say that number of HYVs available offer them “such a choice of characteristics that the *deshi* [traditional] varieties to which we were referring had been virtually forgotten”; indeed, Baker and Jewitt claim that breeding programmes have “succeeded in widening the genetic base of the HYVs” (Baker & Jewitt, 2007:321).

Another ecological concern with the change in cropping patterns has to do with the intensive and monocropped nature of the GR crops. The same Government-appointed ICAR task team warns that “the intensive cropping pattern in India’s green revolution states... is causing a perceptible hydrological and soil imbalance which in tandem with drastic unforeseen climatic changes could lower agricultural yields in the years ahead” (Rao, 2002:10). The fact that wheat and rice are grown in rotation without any leguminous crops has led to decreased levels of soil nutrients and lower water tables (Rao, 2002:10; Singh, 2000:100).

4.2.3.2 Depletion of Groundwater

As mentioned above, the intensive cropping patterns of the GR have led to lower ground water levels. Another contributing factor are the extensive irrigation systems needed for fertiliser-fed GR crops. Singh says that many areas in “rice-wheat growing area of Haryana show a water table decline in the range 3-10m” (Singh, 2000:100). Tilman *et al* list India as a region (among China and Bangladesh) where overpumping of groundwater is a serious concern (2002:674).

4.2.3.3 Ecological Degradation

In recent years, there has been growing awareness that excessive use of fertilisers and pesticides causes pollution as nitrates and phosphates contaminate water which seeps into rivers (Singh, 2000; Ghosh, 2004, Thakur and Sharma, 2005). In fact, Singh found that in Haryana province, which has the highest level of fertiliser use in India, nitrates had accumulated to toxic levels in the groundwater (Singh, 2000:101).

Singh (2000), Ghosh (2004) and Thakur and Sharma (2005) all say that chemical fertilisers, essential for GR farming, deplete soil organic matter, decrease micronutrient levels and hence reduce soil quality and long-term productivity. Ghosh goes further to add that depletion of soil quality in this manner makes further use of fertilisers less effective (Ghosh, 2004:151).

4.2.3.4 Reliance on Fossil Fuels

It should also be noted that fertilisers and pesticides are derived largely from petrochemicals and as such “the dependence of Indian agriculture on chemical fertiliser for high crop yields implies a basic reliance on exhaustible fossil fuels with chances of pollution at the production stage” (Ghosh, 2004:149). This becomes more serious in light of global warming, the rapidly rising cost of oil and peak oil predictions.

4.2.3.5 Human Health Concerns

There has also been concern amongst consumers over the health risks imposed by consuming produce which may contain pesticide residues. In developed countries the

organic produce market is growing rapidly. Ghosh says that in India there is now an “emerging market for food with minimal chemical residue” (Ghosh, 2004:151).

Although Baker and Jewitt are convinced of the success of the GR in the area of their study (western Uttar Pradesh), they reluctantly mention “an awareness among the farming communities of problems linked to the sustained use of the technology. These must be mentioned though space does not allow their discussion in full” (2007:336). The communities raised concerns over the appearance of previously unknown illnesses “such as stress, strokes, heart disease and ‘mystery illnesses’, particularly of children. These were attributed to the poisoning of water supplies by overuse of chemical fertilisers, insecticides and pesticides. More research is necessary, however, to establish the validity of such perceived links” (Baker & Jewitt, 2007:336).

4.2.3.6 Regional Disparities

Due to the fact that the GR was more successful in some areas than others, it “created wide regional and interstate disparities” (Heitzman & Worden, 1995). Baker and Jewitt point out that the GR could never have had equally distributed benefits as it was introduced into a country which already had “significant socioeconomic inequalities” (Baker & Jewitt, 2007:324). Goldman and Smith counter that it was the exacerbation of existing inequalities and the creation of new regional disparities which has “been one of the main negative social impacts of the Green Revolution period in Asia” (Goldman & Smith, 1995:260). Shiva says that the Ford and Rockefeller Foundation programmes which implemented the GR in India never tried to promote the importance of agriculture in all regions, but “showed favouritism to specially selected areas for agricultural development, to which material and financial resources of the entire country were diverted” (Shiva, 1991:36).

Goldman and Smith go on to say that areas which do not take part in or benefit from transformations such as the GR may actually cause serious challenges “for the political and social fabric of the country as a whole” (Goldman & Smith, 1995:260). This is because these areas will be poorer, more vulnerable to natural disasters, have food security issues and be at risk of having their natural resources appropriated by more prosperous areas (Goldman & Smith, 1995:260).

4.2.3.7 Debt and Suicides

As has been mentioned previously, the Indian government supported the GR through subsidies to farmers for inputs such as fertilisers and electricity. Baker and Jewitt explain how, in recent years, the government has reduced state control on crop marketing and reduced subsidies on agricultural inputs (Baker & Jewitt, 2007:319). Ghosh says that this removal of state protection has led to the GR “running out of steam” (Ghosh, 2000:151).

This removal of state support, coupled with “the rising cost of inputs and lower prices for food grains has also led to an alarming degree of indebtedness and suicide” (Rao, 2002:10) among farmers in India. The rate of indebtedness in farmer households in India averages 48.6 percent, but is as high as 64.4 percent in certain areas like Kerala (Jeromi, 2007:255). Suicide rates among farmers in rural India have reached alarming proportions; crop failure and high levels of indebtedness were found to be the “main and causative factors” (Rao, 2003:396) for the suicides. The government has agreed, in their March 2008 budget, to write off outstanding loans, mainly to small farmers. Many critics of this policy argue that this is merely a populist measure, designed to win votes ahead of the upcoming elections (PC’s last oomph, 2008:11). These critics say that more structural support needs to be given as loans cannot continue to be written off. “‘It is irresponsible economics. To revive agriculture you need to build canals, roads and warehouses, not indulge in populist sops,’ said Mohan Guruswamy, director of the Centre for Policy Studies, a Delhi economic think tank. ‘Every government will now look at writing off loans to win votes. The neglect has to be stopped, but not like this.’” (India digs deep, 2008:33).

Although Baker and Jewitt feel that any effects that the removal of government support for agriculture may have on farmers “are independent of GR technology” (Baker & Jewitt, 2007:319), other authors disagree. Ghosh argues that certain aspects of GR technology are clearly a burden on the government and that “it is becoming clear that agriculture cannot rely on intensive fertiliser use for future development” (Ghosh, 2004:151). He says that further growth in agriculture cannot rely on “excessively fertiliser demanding technology” like the GR without higher costs, falling yields, growing poverty and further ecological damage (Ghosh, 2004:151). He

and Singh feel that more economically viable and ecologically sustainable alternatives need to be found. Rao suggests policy measures which the Indian government could take to deal with the problem of farmer suicides, including organic farming (Rao, 2003:396). Jeromi suggests that, aside from reforms to credit-granting policies and import and export protection, the government needs to consider long-term ways to improve yields and reduce costs of production (Jeromi, 2007:174).

4.2.3.8 Falling Yields

In recent years, wheat and rice yields have been static or declining. The farmers who Baker and Jewitt interviewed in Uttar Pradesh expressed deep concern that wheat yields had been static since the 1980s (Baker & Jewitt, 2007:324). The ICAR government task team found yields of rice and wheat have been declining in Punjab and Haryana provinces and warn that this “may continue unless immediate and serious remedial measures are initiated” (Rao, 2002:10).

Baker and Jewitt say that the yield problem may be caused by excessive use of chemical inputs which has reduced soil fertility and organic matter (Baker & Jewitt, 2007:330). Singh (2000), Ghosh (2004) and Thakur and Sharma (2005) are in no doubt – they all say that the use of chemical inputs is definitely the cause of falling yields. The ICAR task team says falling yields are due to the intensive cropping patterns of the GR which have disturbed water tables and soil quality (Rao, 2002:10). ICAR warns too that climate change could further reduce yields in the years ahead.

Shiva cites examples from Punjab, where 64 percent of all crop loans were used to finance the purchase of fertilisers (Shiva, 1995:111). But, despite initial years of bumper harvests in the state, “crop failures at a large number of sites were reported, despite liberal applications of NPK [nitrogen phosphorous potassium] fertilisers” (Shiva, 1995:114). Shiva says the crop failures were due to micronutrient deficiencies (e.g. zinc, iron, manganese) in the soil caused by the hungry high-yielding varieties (Shiva, 1995:114). Because organic manure, as used in traditional methods, contains these micronutrients, deficiencies such as this did not used to occur. Traditional NPK fertilisers do not contain them. Shiva says that this is one of the main reasons why yields are “fluctuating and even declining in most districts in Punjab, in spite of

increasing levels of fertiliser application” (Shiva, 1995:116). Huang, Pray and Rozelle say that productivity in wheat-rice systems in Punjab is falling because organic matter in the soil is decreasing and groundwater is becoming increasingly saline (2002:679).

4.2.4 Conclusion

It is clear that the GR raised agricultural output levels significantly since 1965 in India. It was indeed an agricultural transformation, permanently altering the agricultural landscape and life in the villages. However, it is evident too that there are many concerns over the long-term ecological and economic sustainability of the GR. It is clear that some alternatives or adjustments to GR technologies and methods need to be found in order to reverse declining yields and ecological damage and feed India’s growing population into the future.

4.3 AN AFRICAN EXPERIENCE OF THE GREEN REVOLUTION

A MPhil thesis completed in 2007 gives a pertinent example of how farmers in Swaziland feel about modern versus traditional farming methods. Certain aspects of the thesis are related here as they show clearly the similarities to Indian small-scale farmers’ experience of the GR.

In his study of traditional indigenous agriculture in Swaziland, Dlamini (2007) asked respondents what they felt the advantages and disadvantages of modern agricultural methods were. The respondents (rural farmers over the age of 50) said that modern agriculture has the advantages of mechanisation which allows tasks to be completed faster, monocropping which gives a high yield of a single crop and modern crop varieties which mature faster than the indigenous varieties and therefore avoid the reliance on the unreliable rains at the end of the season. They said the disadvantages were monocropping as this means you have less food available; the need to purchase seeds, fertilisers and pesticides from off the farm; the high cost of tractor hire and inputs; the destruction of the soil due to using fertilisers and pesticides; the many pests and diseases associated with modern agriculture and that the modern varieties of crops are not enjoyed as much as the traditional varieties (the taste is not as good and they spoil easily) (Dlamini, 2007:70-72).

The farmers surveyed placed more value on traditional, indigenous methods than modern methods based mainly on the cost of inputs and the amount of food produced by the system. However, the disadvantages they saw in their indigenous methods point to factors from modern farming which could be incorporated into indigenous systems, such as mechanising certain tasks to save time and labour efforts (Dlamini, 2007:96).

Dlamini also learned that modern farming methods were first introduced to the Swazi rural people in the 1960s. The respondents identified the education system and agricultural extension workers as the key players in bringing this information to them. One respondent recalled how, in 1965, extension workers came to the village and showed them how to plant hybrid seeds and apply fertilisers. The villagers were told that the hybrid varieties would give higher yields. One villager told Dlamini, ““As a result of the influence from agricultural extension workers our farming methods changed and this was the beginning of hunger”” (Dlamini, 2007:85).

Dlamini goes on to state that: “most indigenous farmers practicing traditional agriculture cannot afford to purchase modern agricultural technologies in adequate amount such as farm inputs and farm machinery” (Dlamini, 2007:89). The promotion of hybrid seeds and fertilisers have replaced traditional practices such as using kraal manure and indigenous seeds and this has led to food insecurity as the people cannot afford to buy inputs (Dlamini, 2007:98). He states unequivocally that modern agriculture has “not been successful in feeding the poor in Swaziland. Modern agriculture should complement rather than compete with indigenous agriculture” (Dlamini, 2007:99). He says that, since most of the food insecure are located in developing countries that have limited national budgets to spend on modern agriculture, “agricultural research should therefore be contextualised into local ecological and social systems” (Dlamini, 2007:90). He feels affordable and ecologically sound practices such as the use of kraal manure, fallowing and range management should be promoted; research efforts should focus on traditional methods which were effective (Dlamini, 2007:90).

4.4 CONCLUSIONS ON THE SUSTAINABILITY OF GREEN REVOLUTION FARMING METHODS

From the literature review, it is clear that there are serious issues regarding the sustainability of the GR, both at the global level and at the individual small-scale farmer level. A summary is provided here for clarity.

4.4.1 Global Level

Table 3: Global Level Sustainability of GR Farming Methods

Criteria for Sustainability at Global Level	GR Methods
Promote or enhance ecosystems	No, damages
Low emissions of GHGs	No, excessive emissions
Do not rely heavily on fossil fuels	No, heavy reliance
Promote urban resilience	No, promotes urbanisation
Promotes equality	No, worsens inequality
Protects future generations' needs	No, disadvantages them

The criteria developed in section 3.4.1 on what would make farming practices sustainable on a global level are assessed here. Firstly, it is clear that GR farming methods have damaged ecosystems. The high-response varieties of seeds have reduced agrobiodiversity globally, making humanity reliant on a small number of crops. Reducing the number of crops planted and using monocropping techniques has destroyed habitats for many other plants, insects and animals. The chemically derived pesticides and fertilisers used have caused pollution of water and land – through their production (emission of greenhouse gases) and their use. Secondly, GR farming methods clearly also contribute to global warming through their heavy reliance on fossil fuels from production of pesticides and fertilisers through to shipping which results in large emissions of GHGs. This heavy reliance on fossil fuels can also be seen to have global economic consequences as fossil fuels get more expensive and perhaps eventually run out; food will get increasingly expensive. Thirdly, the GR farming methods favour larger-scale farmers and have resulted in reduced numbers of small-scale farmers in the developed world. Fourthly, the GR has worsened inequality. This has been through trade and subsidy regimes which have been shown to have negative impacts on small-scale farmers in the poorest countries and through

the GR's neglect of certain regions and crops which have worsened regional disparities. Lastly, due to the damage to ecosystems, the contribution to global warming, the excessive use of water and the loss of biodiversity, it is clear that GR farming methods have resulted in a threat to the ability of future generations to meet their own needs.

4.4.2 Small-scale Farmer Level

Table 4: Farmer Level Sustainability of GR Farming Methods

Criteria for Sustainability at Small-scale Farmer Level	GR Methods
Enhances global assets	No
Enhances local assets	No
Net beneficial impacts on other livelihoods	Generally, no
Improves ability to cope with stress and shocks	No
Allows farmer to take advantage of changes in surroundings	No
Provides for future generations	No

The criteria developed in section 3.4.2 around sustainability at the level of the individual small-scale farmer are used here to assess the information on GR farming methods. The first is that farming methods need to maintain or enhance global and local assets. It was shown in the previous section that GR farming methods have serious negative impacts on global assets (such as soil health, biodiversity, the climate system, water etc). At the local or farm level, there are negative impacts too. Chemical fertiliser use can cause a loss of soil fertility and organic matter over time, as well as polluting water sources. Pesticides can also disturb the balance of farm ecosystems, by killing pest predators and making pests immune to their use. The use of machinery can result in soil compaction on the farm, reducing water holding capacity and soil fertility.

The second criterion was that farming methods should have net positive impacts on other livelihoods. It is clear that the use of GR farming practices (with their negative environmental impacts) has reduced the ability of future generations to meet their own needs – this relates to the fifth criterion which says that sustainable farming methods should provide for future generations. But the way the GR farming methods have been implemented (i.e. through government policies, trade regimes etc) can also be

seen to cause a negative impact for other livelihoods. For example, when government and funder programmes pushed the GR in India in certain regions above others, the livelihoods of farmers in the neglected areas were disadvantaged. Another example is that the actions of TNCs may result in higher profits for their owners, but have had negative impacts on many small-scale farmers in developing countries, who have to pay for seeds, fertilisers and pesticides, thereby increasing their costs and reducing their self-reliance.

The third criterion is that farming methods are sustainable if they improve a farmer's ability to avoid or cope with stresses and shocks. The fact that GR farming methods rely so heavily on external inputs means that it makes farmers reliant on seeds, fertilisers and pesticides. The farmers have no ability to control the prices of such goods and when prices rise it means the farmers have to cope with the increased input costs, although the price they sell produce for may not be rising simultaneously. The fact that many of these inputs are derived from fossil fuels means that they are likely to become more expensive as oil prices rise as we move towards peak oil. The use of fertilisers and pesticides has been shown to damage ecosystems through pollution of water and reduction of soil fertility. This impacts small-scale farmers directly through the inability to continue to use their land in the future for growing crops; this is a gradual stress which can affect the ability of the farmer to continue to derive a livelihood from his land. The handling of pesticides is also a health risk for farmers, endangering their health and increasing healthcare costs.

Governments often intervened in the past, as in India, to subsidise the cost of such inputs, but it is clear that this is not an economically sustainable option in the long-run for governments. And when these subsidies are removed, small farmers cannot afford the inputs. They often take out loans to buy the inputs, but if the crop fails, the farmers are left with debts they cannot afford to repay. The need to take out debt in order to purchase inputs exposes farmers to further stresses and shocks: interest rate increases, the implications of defaulting etc. The farmer suicides in India are stark evidence of farmers exposed to such high stress levels that they choose to take their own lives.

The hybrid seeds which are a feature of GR farming do not produce the high yields promised unless all the inputs they require are provided in the correct amounts. Therefore, small farmers may not benefit from them if they cannot afford the inputs, or if they do not have access to irrigation. These seeds also need to be purchased each year, which means that farmers cannot save seeds and costs.

Monocropping has been shown to be ecologically unsustainable – it replaced traditional mixed cropping systems which provided pest protection, maintenance of soil fertility and varied outputs required on the farm free of charge. Monocropping requires large amounts of fertilisers and pesticides to grow crops. This ecological unsustainability of monocropping also has negative livelihood impacts on small-scale farmers too, through the need for increased use of inputs in order to maintain the productivity of the system. The practice of monocropping and the promotion of a limited number of varieties of crops is also unsustainable for these farmers as it removed their traditional practice of growing a variety of crops for food, fuel and fibre needs. Now many of these needs have to be purchased in the marketplace instead, increasing exposure to price fluctuations. Poorer farmers may also not purchase as large a variety of foods as were traditionally grown and consumed, reducing their nutritional security.

The fourth criterion is that farming practices which are sustainable enable farmers to take advantage of changes in their surroundings. It has been shown in the discussion thus far that GR farming methods generally lock farmers into a system of farming where they need to purchase inputs; if the price they receive for their produce falls, the farmers usually cannot adapt or reduce their costs. The scientific approach of the GR has reduced the self-reliance and confidence of small-scale farmers. High-technology approaches replaced traditional farming systems and removed farmers' knowledge and ability to make decisions on their land.

Although trade may seem to exist separately from farming methods, it does not. The authors cited in the preceding section make it clear that certain farming methods have been promoted by international organisations and governments. The fact that many developing countries were forced to promote their export sectors and open their

markets for trading has influenced small-scale farmers, most often negatively. And the TNCs, who control most trade between countries and influence trade policies, also control GR technologies (seeds, fertilisers and pesticides). It is clear that small-scale farmers have often been forced into accepting certain GR farming methods and trading regimes which were not beneficial to them.

4.4.3 Conclusion

Thus, it seems that GR farming methods and the current trade and policy regime surrounding them have not been conducive to sustainable livelihoods for small-scale farmers, nor are these methods sustainable on a global level. If there are farming methods which can offer comparable yields to GR methods, with better sustainability credentials, then these are the methods which should be promoted to small-scale farmers. The next section will examine proposed alternative farming methods in more detail.

CHAPTER FIVE: SUSTAINABLE AGRICULTURE – A LITERATURE REVIEW

5.1 ALTERNATIVE FARMING METHODS

At this stage of the literature review, GR or modern agriculture has been discussed, particularly the sustainability thereof. It is now necessary to explore the alternative approaches which are suggested in the literature in order to answer research objective ii. (identify alternative farming methods which may be more sustainable for small-scale farmers in developing countries). Unlike modern agriculture, the so-called ‘sustainable’ agricultural models consist of a wide range of techniques which vary from place to place (Goering *et al*, 1993:64). There are many names which sound similar: organic, biological, ecological, regenerative, LEI. Luckily, most forms of sustainable agriculture share similar principles and practices (Lampkin, 1999:4; Goering *et al*, 1993:64) and this section will focus on what these common principles and practices are. The basic premise of sustainable agriculture is to farm in ways that do not damage “environmental goods and services” (Pretty *et al*, 2006:1114) while increasing productivity. This section will begin with an analysis of the major components that make up what is referred to as ‘sustainable agriculture’. The discussion in 3.4 of what constitutes ‘sustainability’ at the global level and at the level of an individual small-scale farmer, will be used as a framework against which these major components are assessed.

5.1.1 Philosophy

Sustainable agriculture has a very different philosophy to that employed in modern agriculture. As mentioned previously, modern agriculture uses a scientific reductionist approach to “dominate” nature (Lampkin, 1999:4). Sustainable agriculture, on the other hand, seeks to “work with natural systems” (Lampkin, 1999:4). Nature cannot be viewed as separate components which can be controlled, it is very complex and individual solutions are needed rather than standardised approaches (Goering *et al*, 1993:52). Sustainable agricultural methods try to adapt to and work with the surrounding ecosystem of which they are a part (Goering *et al*, 1993:54) – there is a clear focus on adapting farming methods to the specific site (Goering *et al*, 1993:64).

The aim is to create a system that will “optimise productivity in the long-term rather than maximise it in the short-term” (Madeley, 2002:26) through achieving yields and production levels which are sustainable and consistent in the long run (Thakur and Sharma, 2005:212).

A further important feature of most forms of sustainable agriculture is that farmers consider themselves part of a wider social and ecological system. Farmers and scientists should not be specialists but rather generalists who contemplate the full range of social, environmental and economic implications when making decisions or designing solutions (Goering *et al*, 1993:52). Another feature which is prevalent among sustainable agriculture proponents is the need to develop locally sourced and sold agriculture. This will not only reduce “food miles” (McMichael, 2006:185) and hence use of oil and carbon dioxide emissions, it would also allow consumers to consumer fresher, healthier food (Goering *et al*, 1993:53) and to reconnect with local suppliers and keep money circulating within the local economy.

Another important aspect of the philosophy has to do with respect for traditional farming methods. Goering *et al* point out that modern agriculture as it exists today has only been around for about 40 years, whereas traditional farming methods have existed for generations: “these traditional systems are, in fact, the only time-tested models of sustainable agriculture” (Goering *et al*, 1993:54). This knowledge is to be respected and valued because it offers “an extensive realm of accumulated practical knowledge... that is needed if sustainability and development goals are to be reached” (IAASTD, 2008b:20).

5.1.2 Low External Inputs

Another major feature of sustainable agriculture systems is that they promote a LEI approach – the polar opposite of current agriculture which uses a HEI model. This means that, instead of buying seed, fertilisers and pesticides, farmers attempt to use natural processes and farm- or locally-sourced inputs to achieve the same effect.

An LEI approach makes sense for resource-poor farmers as “it involves lower economic risk than comparative interventions based on purchased inputs” (Halweil,

2006:21). Using purchased inputs makes farmers dependent on external resources whose price and availability is beyond their control (Pretty *et al*, 1995:131; Goering *et al*, 1993:52). This aspect of sustainable agriculture was what prompted my interest in this thesis topic, and was largely validated by the experience of the Indian farmers interviewed. More detail on this in Chapter Four.

LEI also means that the agriculture will use less fossil fuel inputs (Bowler, 2002:209) and more “locally-available nutrient and energy sources” (Goering *et al*, 1993:57).

5.1.2.1 Weed and Pest Management Strategies

Goering *et al* point out that modern farming has disturbed ecological balance to the point that when most farmers attempt to convert to organic methods and stop their use of herbicides on weeds, weeds often overwhelm their crops. Once the balance of the ecosystem is restored, weeds are usually manageable. Organic farmers recognise that weeds can bring benefits too – as habitats for natural predators and as nutrients to be ploughed back into the soil (Goering *et al*, 1993:70).

An LEI or sustainable approach to pests makes use of the principles of “predation, competition and parasitism” (Pretty *et al*, 1995:132). For example, farmers attempt to encourage predators of pests e.g. birds, spiders, or plant a diversity of crops to limit susceptibility. Intercropping can also protect companion plants against predators and affect shade and air currents which limits pests (Goering *et al*, 1993:70, Shiva, 1995:93). Mechanical methods can be useful for certain pests. Where pesticides are used they are very low toxicity and applied sparingly; many plant extracts are used, for example extracts from the neem tree are used in Asia and Africa. These natural pest repellent sprays have no harmful effects on humans or animals and usually contain a variety of active ingredients so pests do not develop resistance (Goering *et al*, 1993:70). The ultimate goal is to reduce “pest populations to economically acceptable levels” while still being “sustainable and non-polluting” (Pretty *et al*, 1995:132). Indeed, Shiva says that the mindset among chemical farmers of being ‘at war’ with pests is completely unnecessary, because the ecology of crops contains a built in pest control mechanism (1995:97). This occurs “partly by ensuring balanced pest-predator relationships through crop diversity and partly by building up resistance

in plants. Organic manuring is now being shown to be critical to such a building up of resistance” (Shiva, 1995:97). Tilman *et al* agree that the need to keep breeding plants to resist disease or develop new pesticides can be “reduced by crop rotation and the use of spatial or temporal crop diversity” (2002:674); this indicates Tilman *et al*’s middle ground stance on sustainable agriculture which does not exclude but rather limits the use of crop breeding and chemical inputs.

5.1.2.2 Nutrient Provision Strategies

Nutrients always need to be returned to the soil after crops have been removed, as well as to replace nutrients lost through erosion and other natural processes. Chemical fertilisers are expensive and produced in a very energy-intensive way. Farmers who cannot afford them or wish to avoid their use can find a number of natural alternatives; these include livestock manure, compost and legumes for nitrogen fixing (Pretty *et al*, 1995:133). Tilman *et al* argue that the use of animal manure can help to reduce dependence on synthetic fertilisers and can provide an efficient solution when animals are part of the farm system (2002:675).

However, not all proponents of sustainable agriculture feel that there needs to be a complete avoidance of chemical fertilisers; instead, they propose the use of ‘precision agriculture’ which uses much smaller doses of fertilisers, applied at specific times in the growth cycle and at or near plant roots (Tilman *et al*, 2002:673). Tilman *et al* admit that precision agriculture has so far only been used in large-scale farming systems, but argue that it is possible for small-scale farmers “given the use of the appropriate diagnostic tools” (2002:673). It seems a fairly complicated, high technology approach, and its ease of transfer to small-scale, rural farmers seems doubtful.

Preventing soil erosion and water run-off are also methods which can conserve and retain nutrients on the farm (Pretty *et al*, 1995:133). Various methods exist, such as the building of bunds, contour planting and using mulches (Pretty *et al*, 1995:134).

5.1.2.3 Self-reliance

Sustainable agriculture also seeks to reduce the dependency of farmers on external knowledge. It seeks to “make better use of the knowledge and skills of farmers, so improving their self-reliance” (Pretty *et al*, 2001:11). There is often a focus on building social capital – which includes people’s abilities to work together to solve common problems such as watershed management (Pretty *et al*, 2001:11). The IAASTD says focussing on local or traditional knowledge can reduce “the reliance of agriculture and the food chain on fossil fuels for agrochemicals, machinery, transport and distribution” (IAASTD, 2008a:34). There is also an understanding that sustainable agricultural practices must be relevant to local constraints and values and, by implication, region and culture specific (Tilman *et al*, 2002:672).

5.1.3 Intercropping and Biodiversity

Intercropping (also known as mixed cropping) has a “long and successful history” (Madeley, 2002:26). Madeley mentions that resource-poor farmers down the centuries knew that cropping patterns “had to be in balance with nature and not denude the soil’s nutrients” (Madeley, 2002:26). They evolved complex cropping systems based on their needs and the specifics of their site in order to: minimise pests, cope with harsh weather, provide insurance against crop failure, reduce soil erosion and moisture loss, provide the correct nutrients and utilise resources such as sun and water efficiently (Madeley, 2002:26,27).

Intercropping and also rotating crops sequentially is efficient because it allows for the most intensive use of a piece of land which gives higher total production levels (Goering *et al*, 1993:68). As mentioned above, it mitigates against pests and crop failure, which “provides a continuous and varied food supply” (Goering *et al*, 1993:55). For farmers who are not producing food only for subsistence, crop rotation allows nutrient levels to be maintained in the soil.

Biodiversity conservation is currently a major issue worldwide and many conservationists propose concentrating available conservation resources on identified “biodiversity hotspots” (Myers, 2000:853). However, many disagree with this viewpoint. Badgley, quoted in an interview by Halweil, maintains that we need to

encourage agricultural practices which promote and protect biodiversity: “if we simply try to maintain biodiversity in islands around the world, we will lose most of it” (Halweil, 2006:20). Shiva agrees that the hotspots approach to biodiversity is “myopic” (Shiva, 1995:44), she says that agricultural and other forms of “production based on uniformity... become the primary threat to biodiversity conservation and sustainability” (Shiva, 1995:47). The importance of maintaining biodiversity and diversity in agricultural production is that it will lead to sustainability of ecological systems because it “offers the multiplicity of interactions which can heal ecological disturbance to the part of the system” (Shiva, 1995:53). Monocultures do not exist anywhere in nature. Sustainable agriculture understands this and seeks to reflect the diversity found in nature which provides “stability and security” (Goering *et al*, 1993:52).

5.1.4 Developing the Soil

There is a major focus in sustainable agriculture on maintaining the health of the soil. While this may also be seen in modern agriculture, the difference here is that sustainable agriculture views soil as a living system. It sees “soil, plant, animal and man” as essentially linked (Lampkin, 1999:5). This goes back to the philosophy described in 5.1, where nature is viewed as a complete system where “everything affects everything else” (Lampkin, 1999:5).

The protection of soil is fundamental and achieved through “preservation of soil structure, earthworms, micro organisms and larger insects” (Lampkin, 1999:7) and reduction of soil erosion (Pretty and Hine, 2001:19). Farmers attempt to create ideal conditions in the soil to encourage the micro organisms which make nutrients available to the plants, such as *rhizobia* bacteria which fix nitrogen (Goering *et al*, 1993:65). It can be seen that, while sustainable farming is based largely upon traditional methods of farming, it has also learnt much from the scientific advances of modern agricultural research (Lampkin, 1999:3).

It is vital for farmers to return nutrients to the soil once crops are removed. In sustainable agricultural systems, this is achieved through crop residues, animal manure, human waste, weeds and waste from the farm and planting leguminous crops

for nitrogen-fixing (Goering *et al*, 1993:65, Pretty and Hine, 2001:19). Adding organic matter to the soil not only returns nutrients but also aerates the soil, improves its structure, prevents wind and water erosion, regulates pH and moisture content, and nurtures beneficial organisms (e.g. earthworms) (Goering *et al*, 1993:66). A Swedish study which compared the effects of chemical versus organic fertilisers over 18 years concluded that the organic fertilisers gave soil better structure, had a greater 'enlivening' effect and produced crops of better quality (higher protein levels, storage life and taste) (Goering *et al*, 1993:67). Thakur and Sharma say that a focus on improving the health and fertility of soil through organic methods will ensure that the farming system can sustain consistently high yields and production (2005:212).

Pretty and Hine advised that sustainable agriculture can promote the creation of a significant public good through improving soil quality and organic content (2001:19). Their updated study (Pretty *et al*, 2006) estimated the amount of carbon sequestered by the sustainable agriculture projects reviewed, and found it to be significant. They concluded that carbon sequestration could be a potential income source for rural farmers through carbon trading schemes (Pretty *et al*, 2006:1117).

5.1.5 Avoiding Chemical Inputs

While not all the approaches which fall under the umbrella of sustainable agriculture strictly prohibit the use of synthetically derived fertilisers and pesticides, most at least severely limit their use. This is because sustainable agriculture seeks to reduce pollution (Lampkin, 1999:4) and to reduce risks to human health. There is evidence that organic produce has improved vitamin content, longer shelf life (Lampkin, 1999:7; Goering *et al*, 1993:75) and less pesticide residues than other produce (Halweil, 2006:23; Goering *et al*, 1993:75). Demand for food which is fresher and chemical-free is strong among consumers in developed countries who are concerned about their health (Goering *et al*, 1993:79).

5.1.6 Use of Open-pollinated Seeds

Many forms of sustainable agriculture do still use hybrid seeds. However, local or traditional (non-hybrid) seeds provide farmers with the security of being able to save their seed year after year, reducing their dependence on outside markets (Goering *et*

al, 1993:68). Where a farmer cannot afford the inputs required for hybrid seeds to perform at their optimum level, local varieties may prove to be more successful in terms of yields.

5.1.7 Conclusion

In conclusion then, one can see the major principles and practices promoted by most forms of sustainable agriculture are vastly in contrast to those of modern agriculture. A full conclusion in answer to research objective ii. will be given in section 5.3, after a discussion in the following section of whether sustainable agriculture can produce enough food to feed the world population.

5.2 CAN SUSTAINABLE AGRICULTURE PRODUCE ENOUGH FOOD?

A common theme which recurs in the literature is the question of feeding the world population. McMichael believes that we produce enough food to feed the global population but the reason that more than 800 million people go hungry everyday is because of the unequal distribution of food (McMichael, 2006:170, also Paul and Wahlberg, 2008:2, Pretty and Hine, 2001:9). An objection which is often raised with regard to sustainable agriculture is that it cannot produce enough food to feed the world population. Debate has raged for decades on this topic, with GR advocates arguing “that a more intensified version of green-revolution agriculture represents our only hope of feeding the world” (Badgley, 2006:86). Biotechnology or genetic modification has been touted in recent years as the solution for the hungry in developing countries: “new technology will be their salvation, freeing them from obsolete, low-yielding and more costly¹⁶ production technology” (Borlaug, 2000:490). The reasons given for this viewpoint are that organic agriculture cannot produce high enough yields, that a worldwide shift to organic agriculture would require more land and that there are not enough organic fertilisers to regenerate the soil (without taking over more land to grow the crops used for fertilisers) (Badgley, 2006:87). I feel the growing body of evidence which refutes this objection is worth discussing at this stage.

¹⁶ Borlaug does not explain what he means by ‘more costly’.

It is important to note firstly that areas under GR farming practices are experiencing falling yields (Pretty *et al*, 1995:130; Huang, Pray and Rozelle, 2002:679; Thakur and Sharma, 2005:206). This means that more inputs of fertilisers and pesticides are needed to maintain output levels. Pretty *et al* say this indicates that “many HEI systems are at or above sustainable levels of production” (Pretty *et al*, 1995:130).

Goering *et al* say that “recent studies of peasant agriculture in Brazil, Chile, Colombia, Ecuador and Guatemala have shown small farms to be three to fourteen times more productive per acre than large farms” and that “the greater productivity of small farms has been confirmed by others, including the World Bank” (1993:61). Shiva points out that yields and productivity mean different things to small farmers and to large farmers and corporates. She says that small farmers who grow a variety of crops on one piece of land will have lower yields as measured by large farmers, but the overall yields of mixed crops have more value to them (Shiva, 1995:50).

Madeley says that growing numbers of small-scale farmers are showing that the future of farming lies with organic and semi-organic methods. There is now a large amount of evidence that it is possible to substantially increase yields, even in marginal lands, through low-input farming methods (Madeley, 2002:44). Madeley cites the work of Pretty and Hine (2001) who attempted the first ever large-scale audit of sustainable agriculture initiatives in developing countries. This work was updated in Pretty *et al* (2006). They reviewed 286 projects in 57 countries (the physical extent of these 286 projects make up 3 percent of total cultivated area in developing countries) which showed average yield increases of 79 percent since the adoption of sustainable agricultural methods (although yield increases were substantially higher in rainfed agriculture than irrigated land), with significant water use efficiency gains and decreased use of pesticides (Pretty *et al*, 2006:1114).

Most of the projects reviewed used IPM which seeks to make the farm ecosystem resilient to pest attacks, disease and weeds through diversity, and only uses pesticides when absolutely necessary (Pretty *et al*, 2006:1114). The authors conclude that IPM in these projects is proving that pesticide use can be decreased without sacrificing yields (Pretty *et al*, 2006:1117). The projects also used integrated nutrient

management to limit the amount of fertiliser which needs to be brought in from off the farm by focussing on nitrogen fixing on the farm and erosion control (Pretty *et al*, 2006:1115). These methods, while more affordable for small-scale farmers, also protect and restore natural resources; “it explodes the myth that chemical fertiliser is needed to feed the world” (Madeley, 2002:44). This new GR is still to make a breakthrough “in the minds of many policymakers and agricultural advisors, who cling to the belief that the chemical route is the best way forward” (Madeley, 2002:41).

Pretty and Hine (2001) reported that there had not been substantial increases in the amount of food sold to external markets from the successful sustainable agriculture projects reviewed. They say that this is due to the fact that the rural people consumed the extra produce themselves, as they are highly food insecure, and experienced direct benefits in terms of their health (Pretty and Hine, 2001:16).

Goering *et al* also cite a report on alternative agriculture conducted by the National Academy of Science in the United States (“one of the most prestigious research bodies in the United States” (Goering *et al*, 1993:74)). This study reviewed farmers using alternatives to high-input, modern agriculture in the United States and found that farmers using alternatives were achieving yields per hectare comparable to modern farmers, with much lower adverse environmental impacts and lower production costs (Goering *et al*, 1993:74). The study found that these farmers were achieving these results without relying on state support financially or in terms of scientific research. It recommended that “wider adoption of proven alternative systems would result in even greater economic benefits to farmers and environmental gains to the nation” (Goering *et al*, 1993:74).

A recent Indian study (commissioned by the Indian Council for Agricultural Research) found that, not only did organic farming methods increase yields over time, but also that net income from organic farming could be two to three times higher than under chemical methods, before any price premiums received, due to lower costs of production (Thakur and Sharma, 2005:210). The study was carried out over five years with over 100 small-scale farmers in Himachal Pradesh, with half the farmers using

high-input, chemical methods and the other half low-input, organic methods. The results showed that the yields, total production, income and profits increased under the organic system, while yields and incomes fell under the chemical system (Thakur and Sharma, 2005:210). They concluded that organic systems produce higher and more sustainable outputs, with lower costs and energy usage; they recommended that the Indian government should redirect agricultural policy to boost organic farming on a large-scale (Thakur and Sharma, 2005:218).

Recent highly-regarded scientific studies have shown that a complete conversion to organic farming worldwide would produce an equal amount of, if not more, food. Badgley *et al's* 2006 research concluded that a worldwide shift to organic farming could produce more food than is currently produced with GR methods, and potentially enough to feed the growing world population, without increasing the agricultural land base (Badgley *et al*, 2006:86). Interestingly, they found that yields would increase more in developing countries than in developed countries (Badgley *et al*, 2006:91). But the authors feel that the yield increases in developed countries may be understated by their model, due to the fact that soils in developed countries are more degraded due to years of fertiliser and pesticide use, and yields may increase after a few years under organic methods (Badgley *et al*, 2006:92). They also found that the use of leguminous cover crops, between normal cropping periods, could provide more nitrogen than is currently used in synthetic fertilisers “and achieve yields equivalent to those of high-yielding conventionally grown crops” (Badgley *et al*, 2006:92) without requiring more land.

However, Badgley *et al* (2006:86) repeat the point made by other authors that, even if food production in developing countries increased, “nearly a billion people remained hungry, because any surpluses were simply exported to areas that could best afford it” (Halweil, 2006:21). Clearly, increasing food supply may help to reduce some hunger and poverty, but cannot eliminate it entirely without reforms to the food system as a whole. Pretty *et al* say that “what is important is who produces the food, has access to the technology and knowledge to produce it, and has the purchasing power to acquire it” (Pretty *et al*, 2006:1114). This shows once again the need to consider the political and economic power structures in which any type of agriculture are enmeshed.

Because, even if sustainable agriculture can match the yields of modern agriculture, it still cannot promise to feed the world within a global economic system which favours the interests of those with the greatest market power (Patel, 2008).

A discussion of the changes needed to political and economic structures in order to move towards a more sustainable agricultural system globally is included in section 8.5.2.

5.3 CONCLUSIONS ON THE SUSTAINABILITY OF ALTERNATIVE FARMING METHODS

From the literature reviewed, it is clear that alternative farming methods exist which are more sustainable than GR farming methods. A summary is provided here, which addresses research objective ii. (determine whether there are alternative farming methods which may be more sustainable for small-scale farmers in developing countries).

5.3.1 Global Level

Table 5: Global Level Sustainability of Alternative Farming Methods

Criteria for Sustainability at Global Level	Alternative Methods
Promote or enhance ecosystems	Yes
Low emissions of GHGs	Yes, reduced
Do not rely heavily on fossil fuels	Yes, reduced reliance
Promote urban resilience	Possible
Promotes equality	Possible
Protects future generations' needs	Yes

The criteria developed in section 3.4.1 on what would make farming practices sustainable on a global level are assessed here. Sustainable agricultural practices firstly aim not to damage and even aim to enhance environmental goods and services. They also aim to work with ecosystems, not to dominate them. The complete abstinence from or lower use of chemically-derived fertilisers and pesticides lowers pollution levels and maintains soil fertility. It also means that alternative farming methods do not rely as heavily on fossil fuels and therefore result in lower emissions

of greenhouse gases which can mitigate global warming. Some alternative methods can also sequester carbon dioxide. The use of mixed cropping rather than monocropping means that greater biodiversity can be promoted on farms, protecting and enhancing ecosystems. Although not all alternative methods increase the demand for farm labour, there are authors (Pretty and Hine, 2001:17) who feel that the positive benefits of sustainable agriculture could mean rural areas become more attractive places to live, resulting in reverse migration from urban to rural areas. At the very least, small-scale farmers who are able to farm successfully using these alternative methods are less likely to leave rural areas and contribute to the problem of slums. The ecosystem services which can be protected and enhanced through alternative farming methods can help to ensure the earth's carrying capacity is sustained into the future.

5.3.2 Small-scale Farmer Level

Table 6: Farmer Level Sustainability of Alternative Farming Methods

Criteria for Sustainability at Small-scale Farmer Level	Alternative Methods
Enhances global assets	Yes
Enhances local assets	Yes
Net beneficial impacts on other livelihoods	Yes
Improves ability to cope with stress and shocks	Yes
Allows farmer to take advantage of changes in surroundings	Yes
Provides for future generations	Yes

The criteria developed in section 3.4.2 around sustainability at the level of the individual small-scale farmer are used here to assess the alternative farming methods. The first is that farming methods need to maintain or enhance global and local assets. Global assets were discussed in the previous section above. Since alternative methods usually involve a philosophy of working with nature and considering the wider implications of one's actions, there is an in-built consideration for the local natural resource base. The reduction or complete avoidance of chemical inputs protects soil fertility, reduces pollution and promotes biodiversity which all in turn promote better and more reliable yields.

The second criterion stated that sustainable farming methods provide net benefits to other livelihoods. The use of alternative farming methods, with their emphasis on protecting the environment, can help to maintain the ability of future generations to meet their own needs – this relates to the fifth criterion which says that sustainable farming methods should provide for future generations. If small-scale farmers were to reduce their use of purchased seeds, fertilisers and pesticides, it may mean that the profits of the companies which manufacture and sell these products would fall. This could be seen to be a negative impact on the livelihoods of the employees and shareholders of such companies. However, I would argue that the net gain to the small-scale farmer would be considerably more valuable than the loss to the TNC. For example, if a small-scale farming family in India were to adopt sustainable methods, reduce their costs, grow a wider variety of foods, increase their nutritional security, this may be the difference between life and death for them. For the comparatively wealthy employees and shareholders of a large TNC to lose their jobs or reduce their wealth, this would probably not translate into a life or death situation for them. Another argument which could be made against sustainable agricultural methods is that they would result in lower food output levels worldwide, which would threaten the food security of many who live in urban areas. This is the viewpoint of those who promote further high technology solutions (Borlaug, 2000; Trewevas, 2002; Huang, Pray and Rozelle, 2002). It also seems to be the view of the World Bank, who prescribes that the most efficient producers must prevail, that small-scale farmers must leave farming if they cannot compete. But the discussion in section 5.2 above hopefully shows that there is growing evidence that alternative farming methods can produce enough food, although there are still issues around its distribution.

The third criterion stated that sustainable farming methods are those that improve the ability of small-scale farmers to avoid or cope with stresses and shocks. Many aspects of the alternative farming methods increase the ability of the farmer to avoid shocks and stresses in the first place. For example, the use of less external inputs and more on-farm derived inputs reduces the farmer's need to purchase these from the market, thereby reducing his costs. These alternative farming methods alone cannot guarantee good income though, as this depends on the price obtained for the produce which is influenced by political and institutional factors surrounding markets and trade. But

these alternative methods can at least provide a much lower cost base and less economic risk or requirements for credit. They can also guarantee high and sustainable yields, through their protection and regeneration of the farm's soils and ecosystems. The focus of these alternative methods on mixed cropping can also contribute to food security for the farmers, in providing them with a wider variety of crop outputs, and reduce the risk of crop failures. The reduced or eliminated use of pesticides means that the farmer's health is protected, which can also reduce the need for healthcare expenditure.

The fourth criterion is that sustainable farming methods should enable the farmer to take advantage of changes in his surroundings. It is clear that the alternative approaches reviewed place much emphasis on farmer self-reliance and innovation. This allows farmers to grow in confidence regarding their knowledge and ability in farming and to plant crops which meet their needs and preferences. The farmers are not subject to prices for inputs which are beyond their control.

5.3.3 Conclusion

This section has made it clear that viable farming methods exist as an alternative to GR farming methods. Not only are these alternative methods more sustainable on a global level, but they improve sustainable livelihoods for small-scale farmers.

It also becomes clear from the literature review, and particularly section 5.2, that asking small-scale farmers to farm using these alternative methods does not require asking them sacrifice yields. In fact, asking small-scale farmers to farm in ways which promote long-term sustainability for the good of mankind is actually in these farmers' best interests in the short-term too: providing higher yields, lower costs and less damage to the ecosystems which support them.

CHAPTER SIX: GREEN REVOLUTION IN AFRICA?

6.1 INTRODUCTION

This section aims to introduce the proposed GR for Africa, its major proponents and elements and includes the viewpoint of civil society critics. This section serves as an introduction to AGRA, but it will only be analysed at the end of the thesis once the findings from India have been used to illustrate the conclusions made.

6.2 ALLIANCE FOR A GREEN REVOLUTION IN AFRICA

One of the largest proponents of a GR in Africa is an organisation called the Alliance for a Green Revolution in Africa (AGRA). AGRA was formed in 2006 with funding from the Rockefeller Foundation and the Bill and Melinda Gates' Foundation. It is currently chaired by Kofi Annan, former Secretary-General of the United Nations (AGRA, 2008a). Its main aim is to lift millions of African small-scale farmers and their families out of poverty by increasing the productivity of farming systems (Tonniessen *et al*, 2008:242).

AGRA has a comprehensive approach with interventions planned across the agricultural value chain. The aim is to meet both on- and off-farm challenges: “these challenges involve access to farmer inputs: high quality seeds, organic and mineral fertiliser, and systems of reliable water management. They also involve access to ‘output’ markets—to the crop storage, processing, transport, and finance that ultimately allow small-scale farmers to sell their harvests and make a profit” (AGRA, 2008a).

AGRA’s planned timeline for initiatives is as follows (please see next page):

Table 7: AGRA Timetable

2006	Developing new varieties of local crops. Agricultural education programmes.
2007	Soil fertility programme.
2008	Water management programme.
2009	Improve crop storage, financing, market information, transport. Also advocate for policies which support small-scale farmers.

(AGRA, 2008a)

The AGRA website praises the success of the first GR “in India, much of Asia, and Latin America” (AGRA, 2008a) for doubling agricultural production, saving millions of lives and setting the stage for the economic progress seen in the past few decades. AGRA then acknowledges two shortcomings of this GR: that it may have worsened inequities in these regions and “misuse of fertiliser and irrigation resulted in environmental damage” (AGRA, 2008a). No mention is made of the financial burden of GR inputs on farmers, debt levels, suicides nor the long-term economic unsustainability for farmers of environmental damage.

AGRA says its approach is “both pro-poor and pro-environment. Increased productivity on small-scale farms can simultaneously support agricultural growth and enhance the environment: rebuilding depleted, erosion-prone soil; conserving crop biodiversity; making wise use of limited water; and sparing vast expanses of forest and savannah from cultivation. Indeed, to be sustainable, agricultural development must protect the natural resource base that farmers—and all of society—depend upon” (AGRA, 2008a). It is difficult to assess just by viewing their own website whether AGRA truly values long-term environmental sustainability or whether this is just lip-service. More information will have to be sought on the actual programmes being implemented and what AGRA’s critics have to say (if there are any). Unfortunately, AGRA is such a new institution with very few of its overall plans implemented yet, that it will be difficult to get hold of any independent evaluations of AGRA programmes.

AGRA's approach is based on a theory of change which they refer to as "market-led technology adoption" (Tonniessen *et al*, 2008:236). There are three basic parts to this approach which are listed here as they provide a good starting point for a discussion of what I consider the main pro's and con's:

1. To help farmers increase the yield potential of their fields by enhancing soil productivity through innovative farming practices that supply adequate plant nutrients, improve the land's water-holding capacity, and are labour saving
2. To help farmers realise a higher proportion of their farms' potential yield by planting more resilient varieties of Africa's staple food crops that significantly reduce losses and increase the stability of yields while meeting human nutritional needs and consumer preferences
3. Helping to build and make more equitable both the input markets that can deliver better seeds, small fertiliser packets, and other inputs to farmers, and the output markets that enable farmers to convert surplus production into profits and to generate greater income from cash crops and livestock

(Tonniessen *et al*, 2008:236)

While these goals sound very comprehensive and worthwhile, I worry about the introduction of technologies which are unaffordable to farmers when there are much less costly alternatives that are just as productive.

In terms of initiatives already underway, AGRA programmes have already released hundreds of improved crop varieties that have better disease and pest resistance and improved drought tolerance. In addition, AGRA is currently training African scientists in crop breeding; funding crop breeding programmes and setting up African-owned, local seed companies to sell and distribute the seed (Tonniessen *et al*:2008:236-237). Although AGRA expressly states on its website that they are not currently using or promoting the use of genetic modification in the breeding of crops. However, they may consider it in the future. Section 6.4 contains the reaction of certain AGRA critics to this approach to GM.

AGRA is also planning a major Soil Health Initiative using Integrated Soil Fertility Management (ISFM) (AGRA, 2008c). They say that Africa's soils are very degraded and that the traditional method of allowing land to lie fallow for several years between planting cycles is disappearing due to rapid population growth. This means that the nutrients removed from the soil when plants are harvested are not being replaced and that African farmers are literally "mining the soil" (AGRA, 2008c). Soil mining means the soil is less productive and so yields fall. It also results in a loss of organic matter in the soil which reduces its fertility (AGRA, 2008c). AGRA says that ISFM is a broad approach which considers the individual situation of the farm: the complexities of its soils, the decision-making of the farmer and his access to inputs and knowledge.

AGRA quotes research which shows that the highest and most sustainable increases in productivity come from using a mixture of fertiliser and organic inputs. AGRA defines fertilisers as "concentrated chemical forms of plant nutrients" (AGRA, 2008c) and organic inputs as "manure, crop residues and compost" (AGRA, 2008c). Interestingly, they then acknowledge that chemical fertilisers are too expensive for small-scale farmers: "there is no doubt that fertiliser application alone can create big increases in yield, but with a low efficiency that has proved to be too expensive for poor farmers and is environmentally unsustainable" (AGRA, 2008c). Furthermore, they recommend the use of methods of increasing organic matter in soils recommended by "low-input organic systems... Such low-input organic systems each have advantages, but none has proven sustainable or sufficiently attractive to become widely adopted by farmers" (AGRA, 2008c). No mention is made of what grounds were used to disregard these systems on the AGRA website¹⁷ but in another article accessible on their site, which seems to be an assessment of AGRA, it is said that organic methods are too labour-intensive for the yield increase achieved. These authors continue to say that organic methods are only worthwhile for farmers if they receive some form of subsidy or guaranteed higher selling price (Tonniessen *et al*, 2008:237). Tonniessen *et al* argue that adding a small amount of chemical fertiliser

¹⁷ I tried to contact AGRA twice via the email address on their website (once in August and again in October). In my emails I asked them to explain what grounds were used to make the claim that no organic methods had proven "sustainable or sufficiently attractive" to be widely adopted by farmers. I also asked them to explain what they meant by these terms. I never received any reply.

(in conjunction with the organic methods) increases output sufficiently to warrant the extra labour required. AGRA is funding projects which will sell smaller packets of fertiliser that farmers can afford, but Tonniessen *et al* say that these small amounts of fertiliser also do not increase productivity to warrant their high cost and so subsidies are needed for fertiliser too. So, in Malawi and Kenya, AGRA “is experimenting with ‘market smart’ subsidies that stimulate demand for fertiliser and seed from private markets by providing farmers with targeted vouchers redeemable at local shops to help cover the cost of specific inputs” (Tonniessen *et al*, 2008:237). There is no mention made of who is paying for these subsidies (governments or AGRA and its funders?), nor about how farmers are expected to afford fertilisers when subsidies end, nor about the potential impact of peak oil and rising oil prices on fertiliser costs.

Further to their aim of reducing the cost of fertiliser and making it more accessible to small-scale farmers, AGRA helped to organise the African Fertiliser Summit which was held in 2006 (more detail of this given below).

AGRA claims to be a direct response to the call by African leaders for the desperate need to boost agricultural development. “In particular, AGRA responds to and strongly endorses the African Union’s (AU’s) Comprehensive Africa Agriculture Development Programme (CAADP). Developed in 2002 by the AU’s New Partnership for Africa’s Development, CAADP presents a powerful vision for change and commits to seeking a 6 percent annual growth in food production by 2015” (AGRA, 2008a).

The African Fertiliser Summit was held in Abuja, Nigeria in June 2006, organised by the AU and NEPAD (New Partnership for Africa’s Development), the economic development programme of the AU. It was attended by heads of state of African countries, farmers’ organisations, fertiliser companies and development organisations (IFAD, 2008). They met to agree on ways to ramp up fertiliser use in Africa and start a GR for Africa. After the summit, the Abuja Declaration on Fertiliser for African Green Revolution was released. In it, African leaders declared fertiliser (both inorganic and organic) “‘a strategic commodity without borders’ and resolved that

‘the African Union Member States will accelerate the timely access of farmers to fertilisers’” (IFAD, 2008). They proposed to do so through:

- Eliminating tariffs and taxes on fertiliser and its raw materials
- Developing agro-dealer networks
- Using ‘smart subsidies’ to make fertiliser cheaper for small-scale farmers
- Removal of trade barriers for fertilisers
- Increasing local fertiliser production
- Establishment of an Africa Fertiliser Development Financing Mechanism by the African Development Bank

(IFAD, 2008)

Clearly removing taxes and tariffs on fertilisers and providing subsidies will mean a decrease in revenue and an increase in spending for African governments. Dorward, Hazell and Poulton (2008) note that input subsidies were very effective in Asia in the 1960s and 70s during the GR there. However, input subsidies became unpopular during the 1980s and 90s in Africa as they were regarded as being inefficient and a drain on fiscal resources. But, as evidenced above, there has been a surge of interest in the reintroduction of input subsidies in Africa. Dorward, Hazell and Poulton highlight some of the potential pitfalls of subsidies:

- Costs can be difficult to control (especially for general subsidies)
- Subsidies are hard to phase out due to political pressure
- Targeting the recipients can be ineffective
- May cause unwanted behaviour (e.g. farmers favour input-intensive methods over employment-generating labour-intensive methods)
- Market distortions may inhibit industry growth and lead to corruption

(Dorward, Hazell and Poulton, 2008:1-2)

However, Dorward, Hazell and Poulton say that subsidies during the Asian GR were a major factor for its success and should be implemented in Africa. They caution that conditions in Africa now are different; new subsidy designs are needed but should be quickly addressed as there is significant pressure on governments to start introducing subsidies (Dorward, Hazell and Poulton, 2008:3).

6.3 OTHER SUPPORTERS OF A GREEN REVOLUTION FOR AFRICA

AGRA and the AU are not the only players in the drive for a GR in Africa. The Food and Agriculture Organisation (FAO) held a high-level summit on World Food Security in June 2008 where world leaders met to discuss the food price crisis (FAO, 2008). At this summit, AGRA signed an agreement with the Rome-based UN agencies, the FAO, International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP). Their aim was to increase agricultural production in the high rainfall areas of Africa in order to address the food crisis immediately, as other initiatives underway are much longer-term projects (FAO, 2008).

Another group who are involved called themselves 'Public-Private Partnership for an African Green Revolution' (PPP-AGR). They

are composed of "Yara International, the world's leading supplier of mineral fertilisers, in close co-operation with the financial group Rabobank, the financing agency Norfund and the development agency NORAD" (Yara International, 2008a). Yara International does not only supply mineral fertilisers, they also manufacture large amounts of chemically-synthesised nitrogen fertilisers: "Yara International ASA is a global chemical company that converts energy and nitrogen from the air into essential products for farmers and industrial customers" (Yara International, 2008b). Yara International also runs a philanthropic organisation called the Yara Foundation, which was formed in 2005 and is "an expression of the company's commitment to implementing and inspiring corporate actions in support of the Millennium Development Goals and a Green Revolution in Africa" (Daño, 2008:19).

Yara International

The Third World Network, which has done an in-depth study of all the parties involved in the calls for a GR in Africa, reports the following: "The Yara Foundation has been awarding the Yara Prize for a Green Revolution in Africa since 2005 to commend outstanding efforts to increase food production and availability... This award, which comes with a US\$200 000 prize, went to Ethiopian President Meles Zenawi in 2005" (Daño, 2008:20). However, the award to Zenawi sparked widespread criticism by various parties who said Ethiopia has a "dire food security and rural poverty situation" (Daño, 2008:20). Also, Zenawi has been widely criticised within his own country for "corruption, political manipulation and acts of repression" (Daño, 2008:20).

Furthermore, a Norwegian civil society watchdog, Norwatch, revealed that "Yara International won major fertiliser contracts in Ethiopia worth €12 million three months after the Yara Foundation bestowed the prize on Zenawi. The fertilisers were sold to two government-controlled cooperatives which had earlier been reported to have forced poor farmers to buy fertilisers on credit and which were closely associated with powerful political parties that used fertiliser distribution as a tool to suppress opposition" (Daño, 2008:20)

The PPP aims to help Africa achieve its MDG of halving poverty and hunger, through:

- Establishing a global private-public partnership to increase agricultural productivity and improve food security in Africa, contributing to an African GR.
- Inspiring private sector players to join the partnership and take an active role in improving overall productivity of African agriculture, with special emphasis on small-scale farmers, particularly women.
- Encouraging public sector bodies to align with the private sector in the achievement of these goals.

(Yara International, 2008a)

While these sound like laudable goals, the fact that one of the world's largest fertiliser companies is on board makes one question whether their motives are pure philanthropy or profit-driven. Clearly they may have a conflict of interest if someone suggests that mineral fertiliser may not be the best option.

6.4 CRITICS OF AGRA

Two major critics of AGRA are the Third World Network (TWN) and GRAIN, both internationally respected and active NGOs. GRAIN specifically promotes sustainable management and use of agricultural biodiversity, through people's control over genetic resources and local knowledge. TWN is an international network of organisations and individuals who aim to promote the interests of the Third World and promote development which is environmentally sustainable and achieves a fairer distribution of resources. GRAIN says that AGRA's attempt to bring the GR to Africa will be no more successful than any previous project which has attempted to do the same in Africa.

The original GR had much the same mission as AGRA, to reduce hunger through international agricultural research and development of new 'improved' crop varieties. But, as the literature review of this thesis has shown, "these varieties only produced

the desired 'high-yielding' results if there was irrigation, mechanisation, and plenty of chemical fertilisers (the real key) and pesticides” (GRAIN, 2007:1). TWN’s opinion on the first GR in Asia is that “chemical-based agricultural inputs promoted as means of increasing productivity have buried farmers in debt and resulted in negative environmental consequences” (Daño, 2008:57). GRAIN says that, despite large international funding and efforts to introduce improved varieties into Africa during the original GR, these varieties never took root because they were not accepted by African farmers and consumers and because the GR approach was so alien to peasant farming systems, which use a holistic approach, combined with livestock, and considered wider social and environmental effects (GRAIN, 2007:2). TWN agrees with this, stating that TNCs who were selling hybrid seeds, chemical pesticides and fertilisers did not make much profit in Africa, “mainly because African farmers were poorer, the basic infrastructure was mostly absent, and Africa’s farming systems and conditions were much more diverse” (Daño, 2008:3).

The GR for Africa is the same formula used in Asia: “a technology package for agriculture involving the use of external inputs, massive agricultural infrastructure and modern seeds” (Daño, 2008:1). TWN says that AGRA will rely on public-private partnerships to ensure farmers buy the inputs for the “input dependent farming systems being promoted” (Daño, 2008:12). TWN highlights the active work being done by the Rockefeller Foundation and its associates in “promoting private sector interest in Africa’s fledgling seed industry” (Daño, 2008:40). At a conference in 2007, a Rockefeller official “appealed to his audience to utilise the AGRA donations from the Rockefeller and Gates Foundations for training and assisting agro-dealers in order to ‘fight starvation and famine’” (Daño, 2008:40). But it is not only seed companies who are being called on to capitalise on the GR for Africa, TWN says the fertiliser industry is also one of the most active business sectors which has been called on to join the GR for Africa and is “eyeing handsome profits in the package” (Daño, 2008:41). GRAIN warns that the massive plant breeding programmes are using AGRA’s large political influence to persuade African governments to fast track its seeds to market without adequate local testing, which means small farmers have an increased risk of crop failure (GRAIN, 2007:2).

GRAIN also criticises AGRA's proposed establishment of agro-dealer networks to get the seeds, along with fertilisers and pesticides, to the farmers. AGRA is funding private seed companies but GRAIN warns that the World Bank and Rockefeller Foundation have not succeeded in the past with these kinds of initiatives which "have so far been limited by the stubborn resilience of traditional seed systems that have always supplied African farmers with high-quality, affordable, locally adapted and culturally acceptable seeds" (GRAIN, 2007:3). GRAIN is scathing: "The logic here is staggering. The idea is to fund public breeders to develop new varieties (as the private sector does not want to do this), to fund private companies to sell these to farmers, and to provide credit to farmers for the purchase of these seeds, because otherwise they cannot afford them. AGRA is all about creating an effective demand for its own product, prescribing a model of development that is not able to survive on its own" (GRAIN, 2007:3).

GRAIN cites the example of Kenya, to show how AGRA's 'market-smart subsidies' work in practice. Farmers have been receiving US\$92 to purchase fertilisers, seeds and pesticides. In order to make sure farmers are consistent in their purchases (to keep the agro-dealer network alive), farmers are told they must join groups and a village co-ordinator ensures their crops are sold and the money earned is used to buy inputs for the next season (farmers are required to pay the co-ordinator) (GRAIN, 2007:3). GRAIN laments the lack of choice farmers have about what crops to grow or which inputs to use, the loss of their traditional knowledge which is not applicable in this situation and their lack of ability to respond to changes in their environment (GRAIN, 2007:3). Importantly, GRAIN questions what will happen to farmers once donor subsidies stop – the farmers will be left with degraded soils and no way to purchase inputs, "the old Green Revolution game continues" (GRAIN, 2007:3).

GRAIN is also concerned that AGRA is paving the way for agribusiness and large-scale farming. It quotes the Director of one of AGRA's partners (the International Institute of Tropical Agriculture (IITA) in Nigeria) as saying "there is a need to encourage farmers to go on large-scale farming instead of subsistence agriculture" (GRAIN, 2007:4). GRAIN says IITA has developed cassava varieties but these are not well-suited to small-scale farmers and uptake has been very low among African

farmers (GRAIN, 2007:4). TWN is convinced that AGRA's ulterior motive is the neo-liberal economic push to integrate Africa into the world market economy by creating markets for agricultural inputs and products, all in the name of freeing poor African farmers from the clutches of hunger and poverty" (Daño, 2008:56). TWN warns that the arrangements being formed in Africa between large philanthropic organisations, business and government provide perfect cover for corporate interests and that "the profit motive of transnational corporations like Monsanto and Syngenta fits perfectly into the conceptual mode provided by strategic philanthropy" (Daño, 2008:55). TWN also warns that "the close links of the Rockefeller Foundation with the fossil fuel industry, for example, cannot be simply detached from the active effort to enliven the fertiliser industry in Africa, but need critical examination" (Daño, 2008:55).

Although AGRA has said it is not including GM technologies in its crop breeding programmes, GRAIN says this is hard to believe and TWN is convinced that AGRA will introduce GM crops. Recent AGRA conferences included many presentations on GM research and many of the funders behind AGRA are openly in favour of GM (GRAIN, 2007:5). In fact, the Rockefeller Foundation itself has invested large amounts of money in helping African countries put in place biosafety regulations and facilities for testing GM crops and foods, as well as establishing a large number of African facilities focussed on biotechnology (Daño, 2008:12). Gary Toenniessen, who wrote the article quoted from the AGRA website in the previous section, is "a veteran in the [Rockefeller] organisation and its current Director of Food Security. Toenniessen is the brains behind the Rice Biotechnology Programme on which the Foundation has already invested a staggering amount of some US\$100 million since its inception in 1984" (Daño, 2008:12). GRAIN feels AGRA is waiting until it has established infrastructure and faster mechanisms for getting seeds to market (GRAIN, 2007:5). TWN says that, "duplicating the example set in Asia, the Rockefeller Foundation's admission into Africa is akin to that of a 'Trojan Horse' paving the way for entry by transnational agrochemical, fertiliser and agricultural biotechnology companies to peddle their wares" (Daño, 2008:1).

TWN agrees with GRAIN that a GR model will not be successful this time around either. The reasons they give are:

- Africa has diverse farming systems where a one-size-fits-all approach will not work
- Africa's farmers have limited access to food and basic needs and this will "present a challenge to the market-oriented approach to agriculture"
- Asia's success in the original GR was largely due to government subsidies which encouraged farmers to move to monocultures and growing crops for export. But "the current international trade regime and pressures from creditors would make it impossible for Africa to follow the same pattern today. The international market is now much more restrictive to trade from poor countries that have no chance of competing with the heavily subsidised commodities of rich countries"

(Daño, 2008:4):

GRAIN feels Africa should be focused on food sovereignty, not growing crops for trade, especially with the threat of climate change (GRAIN, 2007:5). TWN agrees that food sovereignty and self-sufficiency should be the primary goals in Africa and that the high-input GR model is not the only option for Africa (Daño, 2008:56 and 58). TWN says further that civil society should focus on "providing locally available, environmentally sustainable, socially acceptable and culturally sensitive alternatives based on equity and justice" (Daño, 2008:2).

6.5 CONCLUSION

In conclusion then, it is clear to see that there are massive institutional and governmental bodies behind the call for a GR in Africa. Finding out exactly what such a GR entails is difficult just from reading the websites of those promoting their projects. As mentioned above, it is still very early in this whole process to find good evaluations of work already done by organisations like AGRA. But there are critics who seem to have valid points. Regardless of the assumed introduction of GM to the AGRA package, it becomes immediately apparent, based on the experience of India

and the literature, that the industrialisation of African small-scale agriculture proposed by AGRA has the potential to be disastrous for small-scale farmers. A full discussion of this and other points related to AGRA will be given in section 8.4, after the findings from India are presented.

CHAPTER SEVEN: INDIA FARMER FINDINGS AND DISCUSSION

7.1 INTRODUCTION

This section begins with an overview of Dharamitra, the NGO in India which was responsible for introducing the low-input farming methods to the farmers interviewed. This overview was prepared from Dharamitra publications, interviews with Dr Tarak Kate and my own observations while in India. This serves to set the background for the farmer interviews and observations gathered in India. Next, the findings from the interviews are related and discussed. Findings are grouped around the main questions asked during the interview, related to the farmers' reasons for wanting to convert to organic farming, the changes in his yields since conversion, the changes in his net profit since conversion, his debt levels before and after conversion and his feelings about success as a farmer. These findings are related to research objective iii: Illustrate the findings of research objectives i. and ii.¹⁸ with the personal experience of six small-scale Indian farmers who have converted from GR methods to LEI methods. The findings will be used to present the experience of the farmers in order to compare them to the findings from the literature in Chapter Two.

7.2 DHARAMITRA

7.2.1 A History of Dharamitra

Dharamitra was formed in 1991 by Dr Tarak Kate. I came into contact with Dr Kate at a module I attended at the Sustainability Institute in Stellenbosch. Dr Kate met Professor Mark Swilling, who runs the MPhil programme I am doing, through the Ashoka fellowship. Ashoka is an organisation which honours and supports social entrepreneurship, it was founded in 1980 and in 2006 had a budget of \$30 million (Ashoka, 2008). Dr Kate was elected as an Ashoka fellow in 1993 because of the work he had done in founding Dharamitra.

¹⁸ Research Objectives:

- i. From the literature, assess the sustainability of GR farming practices, particularly for small-scale farmers in developing countries
- ii. From the literature, identify alternative farming methods which may be more sustainable for small-scale farmers in developing countries

Whilst studying for his PhD in botany, Dr Kate became involved with student organisations which were concerned about the upliftment of the poor. He says that this interaction changed the course of his life and after graduating he went to work for the Centre of Science for Villages in Wardha. He worked there for 14 years, from 1980 until 1994. He founded Dharamitra with friends and fellow scientists in 1991, also in Wardha, and went on to become the managing director full-time in 1994. Dharamitra consisted of a multidisciplinary team of scientists focussed on the development of eco-friendly technologies relevant to rural areas. The focus was not only on sustainable agriculture but also included organic recycling, watershed management, renewable and alternative energy sources, use of waste biomass and development of produce processing facilities.

Dr Kate says that he became aware of the “fallacy of the Green Revolution” (Kate, 2008) – that the costly inputs were causing farmers to take on debt and that their soil fertility and yields were decreasing. As a scientist and concerned citizen, he started to look for alternatives. Initially he came across the book *One Straw Revolution* by Masanobu Fukuoka; this concept of farming in harmony with nature and inputs derived from the farm fascinated him. Then he came across permaculture and went on a course with Bill Mollison, the founder of permaculture. Dr Kate also discovered local farmers who claimed they had been tending their land without chemicals for 10 to 15 years and their productivity was almost at par with neighbouring chemical farmers but with a very low cost of production and hence much higher net profit. One thing they told Dr Kate which impressed him was that they sleep well at night; “no farmer can claim that in India now” (Kate, 2008). These were the same farmers who were pioneers of the GR, acclaimed by the government for their high yields. But “they were first to realise the fallacy [of the GR]” (Kate, 2008). They tried to reinvigorate their original or traditional methods which they had been using before the GR. They developed their own systems – this is why Dr Kate calls them the innovative farmers. As a scientist, he wanted to learn their systems and understand why their productivity was high. He learnt that they were using locally available bio-resources. Dr Kate decided to test these methods on his own, so he purchased a piece of land, just less than 1ha, and tried the techniques he had been shown. Once he had hands-on experience, he wanted to interact with farmers and take this package of low-input

techniques to them. He worked in one village with 25 farmers and they were converted to non-chemical farming within two years (they all started with one acre of their land and slowly they converted all their land). This is the work for which he was awarded the Ashoka Fellowship in 1994. Once he had built his confidence by working with this group of farmers, Dharamitra entered its first official phase of introducing these techniques to farmers in 1997, starting with 400 farmers in Ghantanjee district. By 2008, Dharamitra's techniques have spread to over 1000 farmers in the district.

The reason why Dharamitra chose the Ghantanjee area of Yeotmal district to start their work with farmers was because this was the area in which farmer suicides in Maharashtra state were the highest. Poverty is rife in this area and suicides had been occurring for many years. Dr Kate says that the suicides became particularly bad about six years ago because of factors like the influence of the World Trade Organisation (cotton mill owners had access to very cheap cotton available from the United States due to the high subsidies given to American farmers), the cost of production went up for Indian farmers (cost of seeds, fertilisers etc), the need for large amounts of pesticide on cotton (cotton uses almost 50 percent of pesticides countrywide in India but pests are still an issue), the monsoon rains have become quite erratic in recent years (not falling within the regular cycle), credit has also been an issue (when crops fail, small farmers cannot repay banks and have to go to private moneylenders who charge up to 60 percent interest), also soil fertility has become lower due to sustained chemical use. Another reason for choosing this area was because there were already grassroots organisations active in the district who could introduce Dharamitra to the farmers.

Dharamitra's work has drawn the attention of the state government of Maharashtra, which had been completely perplexed by the problem of farmer suicides and was not sure how to solve the problem. Dr Kate mentioned that he started an organisation of organic farmers some years ago; these innovative farmers were doing so well that the state agricultural department heard about them and sent agricultural officers to the farms (Kate, 2008). The state employees were impressed by what they saw: lower costs of production, improved quality of soils and no need for loans. The Minister of Agriculture came to visit the farms too. The state government was convinced that

organic farming was the solution which could lower the cost of farming for small and marginal farmers. They resolved that 100 000 ha of land in the state should be brought under organic farming. However, the state government did not have any knowledge or capacity to institute organic farming. For this reason, they decided to seek out NGOs such as Dharamitra which have been doing successful work in converting small farmers to organic methods. The government now gives NGOs, such as Dharamitra, money in order to train people in their methods, so that the knowledge can be spread by these people to farmers in other areas. Dr Kate says the state government views Dharamitra as a resource centre on sustainable agriculture and watershed management.

The national government has also recognised the value of organic farming; it has identified NGOs with a good track record in each state and given the NGOs the funds and responsibility to convert 1ha per farmer to organic farming. Dharamitra, which has been identified as a Service Provider Agency for Wardha and Yeotmal districts, has been given funds to work with 1500 farmers (i.e. 1500 ha). Dr Kate mentioned that the movement towards organic farming has always been driven by the farmers, not the government. Groups of farmers and state level NGOs formed the Organic Farmers' Association of India, and there are independent organic farmer associations in every state which have organised themselves to obtain certification and sell the produce to Europe. The organic movement is spreading mainly informally through farmers themselves. The Indian national government is influenced by a strong fertiliser and pesticide lobby, and for this reason, is not formally taking a position against chemical farming. Dr Kate says that there is a “universal logic of all scientists” (Kate, 2008) that chemical fertilisers are the only way to keep soils productive and that organic farming cannot feed a growing global population; but these scientists are ignoring what is happening on the ground, they have a “block in their mindset” (Kate, 2008). Dr Kate is also concerned about companies like Monsanto which are trying to popularise GM seeds in India. They have been promoting Bt cotton and are now trying to introduce Bt brinjal. Dr Kate says that GM seeds will mean that the “sovereignty over seeds will be lost” (Kate, 2008), along with gene and crop diversity. He questions the logic of focussing on GM when oil prices are rising, in a country like India which needs to import 70 percent of its fossil fuel

requirements and is losing foreign exchange. Dr Kate fears that Indian farmers will become the “slaves of these companies” (Kate, 2008).

Dharamitra put together a report on the work done in the Yeotmal district called *A Ray of Hope: A Study of Impact of Adoption of Sustainable Agricultural Practices by Resource Poor Farmers*. This report was produced by Dharamitra for internal use and for its funders and will be used for further insight into the experience of the small-scale farmers in the area who converted to organic methods. This document is clearly at risk of being biased as it was produced by Dharamitra about their own work. However, there is much at stake in the debate of organic versus chemical methods, and Dharamitra would be risking their reputation and future funding streams if anything in this report were found to be false or misleading and could not be backed up or substantiated through thoroughly researched and verifiable data. I therefore felt I could trust this document as being reliable. Unfortunately, Dharamitra does not have any published documents about their work. Dr Kate expressed his dismay at this situation but says that Dharamitra has never had the capacity to produce comprehensive reports about its work (Kate, 2008). He is hoping to retire as Managing Director soon and to spend time publishing their findings and experience for others to learn from (Kate, 2008).

Three other Dharamitra staff were instrumental in the interviewing process we undertook. The first is Shamika Mone, a Masters’ graduate in biodiversity, who joined Dharamitra recently as a research student to work on her PhD (comparing the biodiversity of chemical and organic farming). She had the best English skills and was sent with us as our translator for the interviews. The next was Mr Madhukar Kombe who is the Project Co-ordinator and runs the Dharamitra field office at Ghantanjee. He has a degree in agriculture and has been working in organic agriculture for eight years. His role is to organise training, monitor the five motivators, collect and compile field data and provide field guidance to the farmers. He was present at all of the interviews too. The other staff member present at many of the interviews was Sucheta Ingole. She is the co-ordinator of the women’s activities, responsible for the micro-credit system, the grain and seed banks and the nutritional garden programme. Two

motivators were often present at the interviews (according to which village we were in); their names are Maroti Karadbhuje and Pramod Sontakke.

7.2.2 Dharamitra's Approach

Dharamitra initially collaborated with other NGOs who were active in the area and used them to organise the initial meetings and introductions to the farmers. One of the key factors in the approach was to select motivators from the village youth, who were trained in farming practices, how to organise meetings and collect data. The next major factor was the formation of Farmers' Study Groups (FSGs). These were very successful as they allowed for the introduction of the techniques with discussion among the farmers. They also assisted the motivators in building relationships with the farmers. Exposure visits were another major element in Dharamitra's approach. Groups of farmers were taken to visit innovative farmers who were farming successfully with organic methods. Dr Kate feels that this focus on farmer-to-farmer learning was one of the keys to Dharamitra's success (Kate, 2008). He feels that farmers really trust and value each other's experience, as well as physically seeing successful farms for themselves. I asked him why he thinks farmers are so easily influenced by agri-business sales representatives who visit their farms. He replied that farmers have lost their confidence – with the GR, they accepted scientific, high-tech solutions which they often did not understand. They were told that their traditional methods which had worked for centuries were backward. But after decades of the GR their yields were falling and they were stuck in debt. Dr Kate says that, the farmers are so confused and desperate, that if anyone promises them a bumper crop, they will jump at the opportunity.

Dharamitra conducted a socioeconomic survey of the farmers who were part of the programme in 2005 and 2006. At this stage there were 507 farming families who took part from the 19 villages. Almost every family except two live below the poverty line – meaning they did not have enough food to meet their basic nutritional requirements. Land title was jointly held by husbands and wives in most cases, as gender equity in this regard is traditionally observed by the tribal communities to which they belong. The average family income was Rs. 23 307 per annum (about R4 600); made up of mostly farm income, some wages and income from livestock. Their average annual

expenditure was Rs. 31 692 (about R6 300), so they are spending far more than they are earning. These expenses were mainly farming inputs, food and health expenses. Most of these families borrowed money from banks or community moneylenders to meet certain expenses.

Aside from the farming interventions which are the focus of this thesis, Dharamitra also undertook several other programmes. These included a focus on the women: encouraging and training them in growing vegetable gardens at home for added nutritional security, training them in income generation activities (such as paper making and food processing), training in seed storage and germination tests, setting up of grain banks to help the poorest families, setting up village level micro-credit organisations to lend money to farmers and households at better interest rates than banks and community moneylenders and cultural programmes to allow for socialising and building relationships in the villages. Dharamitra has helped to facilitate the selling of processed products in the cities. This aspect of the operations is to be expanded in the future. All of these interventions are very important, but not the focus of this thesis, so they are mentioned here merely for completeness.

Dharamitra first began introducing its package of low cost agricultural practices (see table 8 below) between 1997 and 2000. By 2006, there were 751 farmers who were part of the programme. Not all of them have converted all their land to organic though; many are trying out the organic methods on a portion of their land only. Of the 751 farmers, 33 percent of their total land is under organic methods (Dharamitra, 2007:21).

The farming techniques which Dharamitra introduced are based on locally available resources which aim to improve the soil and crop productivity (Dharamitra, 2007:24) with the main objective being to lower the cost of production. This is a fundamentally different approach to those which focus only on yield or output maximisation. The Dharamitra focus was on longer-term financial and ecological sustainability for these farmers: lowering their costs of production, assisting them to get out of debt and to improve the long-term health of their soil. This approach can be seen to be one of long-term optimisation. A list is given below of the 17 techniques, as well as their

relative popularity among the farmers. A brief description of each technique is given in Appendix B.

Table 8: Dharamitra Low-Cost Techniques

	Technique	Uptake Among Farmers
1	<i>In situ</i> composting of weeds	75%
2	Agro-waste utilisation on the farm or composting	70%
3	Mixed cropping patterns	67%
4	Deep hoeing	66%
5	Preparation of compost and vermi-compost	64%
6	Sowing across the slope	58%
7	Seed germination testing	56%
8	Seed treatment (cattle dung, urine and ant hill soil)	47%
9	Use of bird perches	42%
10	Adoption of gap filling management	41%
11	Contour bunding	36%
12	Use of cattle urine and neem spray	35%
13	Tree planting on farm bunds	27%
14	Use of trap crops	22%
15	Use of <i>Sanjeevak</i>	14%
16	Use of vermi-wash	4%
17	Establishment of farm ponds	2%

(Dharamitra, 2007:25)

Of the 715 farmers, 28 percent used less than six techniques, 56 percent adopted between six and ten techniques and 16 percent adopted more than ten. It was also shown that the more techniques adopted, the higher the net income per acre achieved (Dharamitra, 2007:47).

Soil analysis was also undertaken. Samples were brought in from land tended organically for at least two years, and compared to land nearby which had been left under chemical methods. The organic soil showed improved pH, higher organic carbon content, higher total nitrogen content, higher microbial levels and improved water holding capacity.

By the end of the first three years of the programme, yields under the organic system were equal to or marginally lower than those under chemical methods. However, the

net income for organic crops was high due to the reduction in the cost of production. This was even true during the first year of conversion; although yields were as much as 20 percent lower than chemical methods at that stage, the net income was still higher. This is clearly an important achievement and demonstrates that small-scale farmers can benefit immediately by switching to organic methods. Dharamitra is proud of its achievements, in particular the fact that, since they began work in the region, there have been no farmer suicides at all.

7.2.3 Dharamitra's Plans for the Future

Dharamitra currently has 30 employees and three offices: head office in Wardha, field office in Ghantanjee and an office in Amraodi where the focus is on watershed management activities. Dharamitra's plans for the future in the Ghantanjee district are to further organise the women's micro-credit system. These systems have been created in order to help the villagers help themselves and to avoid using community moneylenders who charge excessive interest rates. A micro-credit system is a group of men or women who contribute Rs.20 (about R4) per month, which is kept in the group bank account. The group then decides which members to grant loans to and what interest rate to charge. The earnings from interest are divided among the group. If the group is run successfully for a year, the bank may agree to lend money to the group, which the group then lends on to members. Dr Kate says that women's groups are usually better than men, with a 100 percent pay back rate (Kate, 2008). The micro-credit system is not only an economic activity but also helps the women to gain confidence; in this sense it is a tool for social integration and empowerment (Kate, 2008). In the future, Dharamitra plans to involve the women and youth in processing and value addition of primary produce. The idea is to set up small rural enterprises with their own brand names that can capture a local and wider niche market for organic food, herbs and medicinal plants (Kate, 2008). The plans for the farmers in the future are two-fold: in the villages already covered under the project, to cover a larger number of farmers and to fully convert farmers who are only partially organic at present; and to reach villages not yet covered through training and resource materials so other interested parties can spread Dharamitra's techniques for them (Kate, 2008).

7.3 DESCRIPTION OF INTERVIEWEES

As described in Chapter Two, six farmers were interviewed from the district of Ghantanjee. Since two of the farmers had the same first name and two had the same surname, they will be referred to as Farmer 1, Farmer 2 etc. in the order in which they were interviewed.

Table 9: Farmer Key

Farmer	Name and Surname	Village	Date Interviewed
1	Bhimarao Kharatade	Chincholi	20 February 2008
2	Ramesh Kharatade	Chincholi	20 February 2008
3	Bhimarao Chincholkr	Pangadi	20 February 2008
4	Chandra Shekhernibude	Sayatkharda	21 February 2008
5	Maruti Zhade	Shiroli	22 February 2008
6	Jayawant Milmile	Shiroli	22 February 2008

The first two farmers interviewed were from the same village. Although they have the same surnames, we were told they are not directly related. Farmer 3 and 4 were from different villages and Farmers 5 and 6 were from the same village. The farmers from the same villages were present during each other's interviews and often contributed to each other's answers. Farmer 1 was the only farmer whose wife was present at the interview and who contributed to the answers. From all of the farmers we met while in India, we knew that this was a very rare occurrence. When wives were present, they usually stayed in the kitchen of the home and did not speak a word unless we directly asked to speak to them.

Figure 4: Farmer 1 (Bhimarao Kharatade with wife and son)



Table 10 is presented below with a summary of the answers they gave to the main questions asked during the interview. Where only a question mark is present in the block, it means that this question was not put to the farmer during the interview.

Table 10: Overview of Interview Findings

	1. Bhimarao Kharatade	2. Ramesh Kharatade	3. Bhimarao Chincholkr	4. Chandra Shekhernibude	5. Maruti Zhade	6. Jayawant Milmile*
Organic or Chemical	100% organic	100% organic	80% organic	100% organic	50% organic	100% chemical
No. of Years Organic	5	5	5	4	5	2
Size of Land (acres)	13	6	10 (8 organic, 2 chemical)	7.5	6 (3 organic, 3 chemical)	2
Reasons for Going Organic	Soil quality was poor, disease and pests were rife	Chemical farming was too costly and time-consuming	To reduce his expenditure and efforts in the field	The soil quality was bad and yields were falling	To reduce costs	To reduce costs
Reasons for Staying Partly Chemical	n/a	n/a	Fear of not using chemicals on wheat, now feels this was mistake.	n/a	Needs higher yields on chemical side to pay off debts	Yields too low on organic
No. of Dharamitra Techniques Used	13	9	11	13	9	n/a
Loans in Past	Yes, many	Yes	Yes	No	Yes	Yes
Source of Loans	?	?	?	n/a	Government bank and community money-lender	Government bank and community money-lender
Debt Level Now	None	Greatly reduced	None	None	High	High
Yield Level Now	?	Lower than chemical	Higher than chemical	Higher than chemical	On organic side, almost as high as chemical	Higher than when previously chemical
Net Profit	Higher than chemical	Higher than chemical	Higher than chemical	Higher than chemical	Higher on organic side	High??

* = Jayawant Milmile converted to organic five years ago, after two years on organic methods, he went back to full chemical farming.

As can be seen from the table, Farmers 1, 2 and 4 were already fully engaged in organic farming methods. Farmer 3 added chemicals¹⁹ to his wheat this year; he said this was because he was frightened that if he did not add chemicals then the wheat would not grow properly. He said that he now thinks this was a mistake and he will stop the use of chemicals next year. Farmer 5 was using organic methods on only half his farm and Farmer 6 had tried organic methods for two years, but three years ago he reverted to full chemical methods.

7.4 REASONS FOR CONVERTING TO ORGANIC

The main reason given for conversion was that chemical methods were too expensive and the farmers hoped to reduce their costs by using organic methods. Interestingly, the farmers who seemed to be doing the best under organic methods now, Farmers 1 and 4, were motivated to change because their soil quality was poor and they felt that organic methods could restore it; Farmer 1 said: “With chemicals, the structure of the soil was lost. My yields of cotton were reduced and pests and disease were very severe. There was no use of spraying. So I shifted to organic”. Another reason cited by two farmers was that chemical methods were too time-consuming. None of the farmers interviewed cited a concern for the broader environment as a reason for changing to organic methods.

7.5 CHANGES IN YIELDS SINCE CONVERSION

It was my understanding prior to interviewing farmers that yields sometimes fall initially when conversion from chemical to organic methods occurs. This could be a factor which may make farmers reluctant or unwilling to change. The question was thus posed as to whether they were worried that their yields would fall when they converted. Farmer 6 was not asked this question. The only farmer who said he was worried about falling yields was Farmer 3, he said that the fact that his expenditure fell with his yields made it okay. Farmer 1 and 2 both said they were not worried about falling yields as they knew their expenditure would decrease. Farmer 4 said he

¹⁹ It should be noted that the term ‘chemicals’ was used by the translator to mean either pesticides or fertilisers or both. All Dharamitra staff refer to GR farming methods as ‘chemical farming’.

was not worried because he knew yields would fall initially but then his soil health would increase. Farmer 5 said only that he was not worried because he knew that the yields would fall, he accepted that.

It is worth at this point explaining more about Farmers 5 and 6. We interviewed them in their village of Shirol, one after the other. We had asked before this visit to speak to two farmers: one who was trying organic methods but struggling and one who was a fully chemical farmer. I realised later during the proceedings who the chemical farmer was that we were supposed to interview. He left before it was time to speak to him. I asked Shamika if he had been scared off by our questions, but she said he had probably left to drink alcohol and would not be in a state to speak to us later. Alcohol has been a major problem in the rural areas and was banned in the district of Wardha where we spent a lot of our time. It was not banned in Ghantanjee. At this point, it was decided that we should interview Farmer 6 instead, as he was also fully chemical. Both Farmer 5 and 6 seemed to me to be shy and withdrawn and often allowed the other men and farmers present to speak over them or answer questions for them. I often had to push Shamika to tell me what the farmer's answer was, to distinguish it from the group's answer. It seemed too that the chemical farmer who left to go drinking was highly regarded by the other farmers because he had the highest yields in the area. I asked Dr Kate later whether my sense that these farmers allowed others to speak for them indicated a lower social status; he said that socially, in the caste system, they may be at a lower level. For this reason, they "don't speak, their voice is very low. Other people dominate them" (Kate, 2008).

There seemed to be much pride attached to growing Bt cotton; Dharamitra staff explained to us later that many farmers see Bt cotton as modern. Dr Kate confirmed too that there is a sense of "being at the forefront" (Kate, 2008) when using GM seeds.

Farmer 1 said his yields now, after five years of organic methods, were good. Farmer 2 said his yields were down after five years of organic, especially cotton yields, but he has no water source on his land. Farmers 3 and 4 both said their yields now, after five years of organic, are higher than they ever were while farming chemically. Farmer 5

says his yields on the organic side are now the same as they were under chemical farming but it took three years to reach that level.

Farmer 6 says his chemical yields are higher than they ever were. He also said that his organic yields were not high enough during the two years he was organic. His yields are higher now because he is adding more fertilisers and pesticides than he did previously. I asked how he can afford more chemical inputs now, since he said that the original reason he changed to organic was to decrease his costs. When Shamika translated the question, Mr Kombe and some of the others laughed. The farmer answered that his expenditure is more now, but his yields have gone up so he can afford to spend more. I then asked “So, have his net profits actually gone up then, if he earns more but spends more?” The farmer’s answer to this question unleashed a loud and passionate conversation amongst the others. Shamika whispered to me that it seems like he has never calculated anything but he is saying net profit is more on chemical. She told me that Mr. Kombe asked the farmer how he knew this was the case, if he had never written anything down or calculated it. My impression was that this farmer was solely focussed on obtaining high yields and did not seem to understand that high yields do not automatically mean good profits if your costs and debt needs have increased too. Mr Kombe also expressed concern over whether the farmer would be able to sustain these high yields over time. The situation of Farmer 6 is further discussed in the following section.

7.6 CHANGES IN NET PROFIT

In South Africa, organic farming has very different connotations to that in the area of India we visited. Organic farming in South Africa is usually associated with expensive certification and produce which is charged at a premium. The farmers were therefore asked if they were certified organic and whether they were receiving a higher price for their produce. All the farmers were selling their produce in the closest town, transporting it there by bullock cart. All sold their produce as conventional produce and did not receive any premium for being organic. Farmers 1 – 4 were all about to receive a group certification through an organisation called NOKA. NOKA is an organic certifying agency in Pune, Maharashtra. Dr Kate says that NOKA has come

up with a “novel certification scheme” (Kate, 2008) which will certify a group of 50 to 100 farmers under one group certificate so that the cost of certification can be shared among them. Dr Kate mentioned that the national government assists with the costs of the certification through their ‘Central Government Organic Farming Promotion Programme’. The government pays Dharamitra Rs.100 per farmer per year and Dharamitra pays NOKA, the farmers do not pay for the certification themselves, yet (Kate, 2008). The aim of NOKA’s certification for small and marginal organic farmers was to have certified produce available for sale within India and was not meant to meet international standards for export (Kate, 2008). In order to check that certification standards are being maintained, NOKA does random sampling of the farms once a year and relies heavily on the integrity of the NGO that standards are being met across the farms.

Once many of these farmers are certified, there are buyers who are keen to start buying the produce. Farmer 1 mentioned that he already has an organisation which wants all his non-cotton produce and another which wants his cotton. They will pay about ten percent higher prices than he receives selling his produce as conventional produce in the local village market. Farmer 1 mentioned that these buyers will come and collect the produce from the farms. Farmers 2, 3 and 4 also mentioned the possibility of selling their produce to these buyers for a ten percent premium. This would not only mean higher income for the farmers, but also save them the journey to the market. Dr Kate mentioned that Dharamitra does not want to get too involved in the marketing and sales of the produce; they want farmers to make their own choices. However, Dharamitra is trying to help the farmers to improve their negotiation skills with buyers (Kate, 2008).

Despite the fact that none of them currently earn a premium for their produce, Farmers 1 to 4 all had higher net profit. Farmer 1 went so far as to say that he had no net profit while farming chemically. Farmer 5 seemed to have no understanding of the concept of net profit. Shamika told me that he kept answering that the yields were the same on the chemical and organic sides of his land. She said the Dharamitra staff tried asking the questions in different ways. They eventually had to explain to him that

although his yields are almost the same, the costs are a lot lower on the organic half, so his net profit would be higher.

Figure 5: Farmer 5 (Maruti Zhade, bottom left, seated)



Both Farmer 5 and 6 seemed confused about the concept of net profit. Both expressed pride in having high yields, but Mr Kombe spent a lot of time telling them that yields mean nothing if your expenditure is high. I was struck by the irrationality displayed by these two farmers: they wanted higher yields above all else. Both of them had high levels of debt, but didn't seem to understand that even if their yields fell, if their expenditure fell accordingly, they could still make a higher profit. Dr Kate told me that many farmers like this do not calculate profit and instead are convinced that they are doing well through having high yields (Kate, 2008). Dharamitra's motivators do keep records of the farmers' costs and income levels though, so I asked Dr Kate why they do not show such workings to the farmers in order to prove the point about lower net profit under chemical farming. Dr Kate expressed regret about this (Kate, 2008). He said he had hoped to have some computer software developed which would make it easy to input and maintain financial data for the farmers; but since Dharamitra's methods changed several times over the course of the project, this did not happen. He explained that the Dharamitra office at Ghantanjee is maintained by Mr Kombe, who is in his sixties, and has no desire to start learning about computers. The motivators bring in the data, which gets written up by hand onto paper files. Often, this recording

happens long after the season has passed. Dr Kate says that, under the national government programme, which is sponsoring Dharamitra to convert 1ha per farmer to organic methods, they are required to maintain a booklet for each farmer on costs and income. This can then be shown to the farmer to prove to him that he makes a higher profit on the organic hectare of his farm. Dr Kate did admit though that some farmers may still psychologically want to have a higher yield to feel fully successful (Kate, 2008).

Dharamitra's publication, *A Ray of Hope*, does not include any statistics on the average percentage increase in net income for the farmers in the group. However, an older Dharamitra publication, published around 2001, when the package was first being introduced to a smaller group of farmers, shows average increases in net income as being around 32 percent per acre (Dharamitra, 2002). This figure does not take into account interest payments which would have been made to banks or moneylenders under the chemical system. In 1999, a 32 percent increase in income was only equivalent to about Rs. 286 (Dharamitra, 2002). At 2008 exchange rates, this is only about R57. It is clear that these farmers are very poor to begin with.

7.7 DEBT LEVELS

Farmers 1 and 3 both said that they used to have debt when doing chemical farming but since changing to organic they have no debt. Farmer 3 added that you can only do chemical farming if you have debt. Farmer 2 (who has no water source on his land) said he used to have problems with debt but he has greatly reduced his debt since conversion. Farmer 4 claims he has never had to take a loan (his reason for going organic was to improve the quality of his soil). Farmer 5 says he still has debt and that is why he still has half his farm under chemical farming. He said that he would like to be 100 percent organic one day, but he can only do this when his debt finishes; he needs to keep his yields high to pay off his debt. Shamika told me that, after the farmer had made this comment, Mr Kombe told him that he will never get rid of his debt while he is still using chemicals. Farmer 5 told me that he took loans from the government bank, but when his debt was too high, they refused to lend any more to him and so he borrowed from a moneylender in his community. Dr Kate told me that

the government banks typically charge around 18 percent interest per annum, while community lenders charge around 60 percent (Kate, 2008). Farmer 6 told me that he borrows from both the government bank and community moneylenders. Shamika commented that he seems very happy about this situation; that he does not seem to understand the repercussions of debt.

7.8 FEELINGS AROUND SUCCESS

At first, I wanted to ask all the farmers if they feel they are successful. I was hoping that their answers would reflect to me what they interpreted 'successful' to mean. It turned out though that this word is not easy to translate into Marathi (the local language). I tried to adapt the question during later interviews by asking the farmers who they felt was the most successful farmer in their area.

Farmer 1 unequivocally answered "There's no question that I'm not successful, I'm fully successful and satisfied". We were introduced to Farmer 2 as a '100 percent organic farmer who is struggling'. In light of this, I adjusted the question to "You mentioned before we started that he feels he is still struggling or he still has some challenges to overcome. Can he tell me what those are?" Shamika related that the farmer says his cotton production is less than those using chemicals. He needs to get a higher price for it so this will be remedied once he is certified. Here is a copy of the transcript from the interview with Farmer 3 (grammar errors are due to copying what Shamika said verbatim):

- Candice Can he tell me who is the most successful farmer in his area?
 [This question seems to be confusing, Sucheta takes over asking]
- Shamika He didn't answer when I asked who is most successful. Then Sucheta asked him who produces more. Then he said that since the last few years his production is increasing, and it will increase slowly. Then another farmer added that he [Farmer 3] is the only one who has highest production in his area.
- Candice Does he consider himself a successful farmer now?

- Shamika Yes, he is happy that he is a successful farmer. [At this point the farmer seemed to get very emotional, almost crying].
- Candice Does he feel like he is still facing any challenges with his farm?
- Shamika He says there are no more challenges. We tried asking him in different ways, but he just said how organic has helped him.

Figure 6: Farmer 4 (Chandra Shekernibude, centre, with Katlego Moloto, on left, and Dharamitra Motivator on right)



Farmer 4 has apparently won state awards for his farm. He was a very self-assured individual who is clearly used to being interviewed and well-respected in the village. Here is an excerpt from the transcript of his interview:

- Candice How would he identify a successful farmer? What makes a farmer successful? [When asking Shamika to ask him – I asked her to prompt him by asking – is it the highest yield, high profits, is it better soils, lower costs? There was quite a long discussion which Sucheta was involved in]
- Shamika He says a successful farmer will have good yields, and it also depends on what quality soils he has, and what kinds of seeds he has sown. If

someone has better soils, seeds and yields than him, then he will consider them more successful than him.

Candice Does he consider himself successful?

Shamika Yes. The motivator asked him why he considers himself a successful person, and the farmer said that in the first year he had decreased production and it increased year by year. Now it has doubled. So he feels he is successful because his net profit has increased and there is no expenditure.

Farmer 5 is clearly still struggling with debt, so the question was not put to him about whether he considers himself successful. He was asked who he thinks is the most successful farmer in his area. He answered that this would be the farmer with the highest production. He then identified a farmer present who has the highest production (this was the same chemical farmer mentioned above who left during the proceedings). I found this very interesting because it is clear that Farmer 5 feels yields are the most important factor in one's success as a farmer, with little regard for profit margins. The interview with Farmer 6 happened after the chemical farmer had left. I decided to ask the question again to see if I would get a different answer. Farmer 6 said it would be the farmer with more land and money and the highest yields. He said there is no one in his area like that. I then asked if he considers himself more successful now than when he was organic. He said yes, he thinks he is successful. Shamika told me that Mr Kombe then challenged the farmer – asking him if he would still be able to say he is successful in two years' time. Mr Kombe told the farmer he will be giving completely opposite answers.

7.9 OTHER BENEFITS OF ORGANIC

This question was meant to uncover other benefits farmers felt were achieved through converting to organic farming. The question was phrased as: in what other ways has your life improved since you changed to organic farming? Farmer 6 was not asked this question since he is farming chemically. Farmers 1, 2 and 3 all mentioned that they feel their health has improved now that they have stopped using chemicals and eat organic food. Farmer 5 said that he thinks that the chemicals and Bt that he uses

have a bad effect on his health. Farmer 1 and his wife said that they did not get sick when a recent outbreak of chicken guinea hit the village and they attribute this to organic farming. From the internet, I noted that chicken guinea is a fever which affects the joints and is transmitted by mosquito.

Farmer 2 and 3 both said that organic farming has reduced the time they spend farming. Farmer 3 said that his efforts in the field have been reduced by 50 percent and he has more spare time for himself.

Farmers 1, 2, 3 and 4 all said the quality of their soil had improved. Farmer 2 added that his soil has increased water holding capacity which is important as he has no irrigation.

Farmer 3 mentioned the fact that he now has more cattle as a benefit. He went from one cow to two bulls, two cows, one buffalo and one goat. Shamika apologised for this saying that this answer was not relevant to the question. I feel it must be important to him – cattle give urine and dung for fertilising the soil, milk, draught power on the farm and transport. There may also be prestige attached to owning cattle; Dr Kate confirmed this when I asked him about it (Kate, 2008). Clearly the farmer now had enough extra profit to purchase more cattle, and this was perceived as a benefit by him.

Although none of the farmers mentioned this in answer to this question, it is clear that those farmers who will be certified will benefit from even higher net profit, as well as saving time in not transporting their produce to the market.

7.10 EXTRA INFORMATION

During the interview process, I had the benefit of the other Masters' student on the research trip, Katlego Moloto, asking her questions after me. Katlego was focussed on soil quality and her questions focussed on the differences in soil quality under chemical and organic farming. However, it seems her questions uncovered extra information which is relevant to my study. This is included here.

Farmer 1:

His farm is sloped with medium and shallow soils. He has prepared bunds to prevent soil erosion and control slopes. He has four bullocks and five cows and uses all this dung in the field. Once he converted to organic, his soil became softer after a year. When asked why he thinks chemical fertilisers didn't work, the farmer said there were no bio-organisms in the soil to help him. He has a well for irrigation with an electric motor. There is a channel along his field but it often dries up. He spends less time in the field than he did when chemical farming. He uses less water now than when he was chemical. He uses local varieties of seeds, not hybrid seeds; so the size of produce is smaller, but yield is higher. Dharamitra visits every week or two to give him advice and also take him to see other farmers which helps him a lot.

Mr Kombe then read out some information which the motivator gave him:

Over the 12 months of 2007, Farmer 1's expenses were Rs. 40 500 and his income was Rs. 164 500. The expenses include seeds and labour (sowing, weeding, harvesting, and threshing). However, both of these are theoretical and not cash costs. The seeds he has saved himself and the labour is provided by his family. Essentially his profit is Rs. 164 500 (about R32 900).

Farmer 2:

He has medium and shallow soils, with little slope, and he uses bunds to prevent soil erosion. While doing chemical farming, he spent a lot more time in the field, adding fertilisers and pesticides at specific times. With organic farming, there is not the requirement to do things at very specific times, there is more leeway with timings. He does not use sanjeevak (the cattle urine-dung mixture) because he does not have a water source on his field. He has four bulls and two cows. His produce under organic is about the same size as it was under chemical but it weighs more. When he was using chemicals his soil was hard, but now it is softer and he thinks it is more fertile.

Farmer 3:

He has medium and shallow soils with slight slopes in some areas. When borrowing money from the bank in the past, he had to use his land as collateral. He says that, even though his produce may be slightly smaller than under chemical, it weighs more.

He and the other farmers present are totally convinced that by eating organic produce they will not get any disease and will stay healthier. Shamika added: “they are also reading some religious things and so they think that organic is more helpful in its religious aspect, and so it’s helping them to have good health” [sic]. The conversation diverged to the farmers telling us about an activist doctor from Ghandi’s ashram who tells the people to only eat organic food because of its health aspects. This same doctor also tells them that they should only eat indigenous, local food to be self-sufficient. No other NGOs or government officials have visited this farmer promoting organic farming, but many seed company staff visit and try to sell him seeds. He tells them that he has his own indigenous seed and he doesn’t want to take their seeds. He says the seed company people tell him, you are the only one saying this, there are many other people buying these seeds. The farmer told us that he is the one who protested against these seeds; his main reason for not buying the seeds is economic. The farmer seemed very passionate about this topic. Another farmer added that he used to grow cotton from seeds bought from these companies and his yields were good; but when he calculated the economics of his production, he realised he was making a loss. So he stopped growing cotton and when seed company agents came and tried to sell him cotton, he refused. During an informal discussion with the farmers after the interview, one of the other farmers in the group added that he is happy today because of organic farming. If he were not farming organically, he would not be so happy.

Farmer 4:

He has slight slope on his land and medium black soils. He has four bullocks and seven cows. He has a well and uses sprinkler irrigation. When he initially converted to organic farming, he experienced pest problems, but he used a neem spray on the pests and after two years, he no longer has pest problems. He would have converted to organic even without Dharamitra’s intervention because he went to visit a farmer who had won a government award and was using organic methods.

Farmer 5:

He has undulating land with heavy and medium black soils. He has five cows, two calves and two bullocks. The soil under organic is softer than the soil under chemical.

He is growing mainly cotton on the chemical side (intercropped with pigeon pea) and on the organic side he grows green and black gram intercropped with sorghum.

Farmer 6:

He has black, heavy soils with no slopes. He has two bullocks and uses their dung on his land. It seems most of the farmers use dung on their land – whether chemical or organic. The farmer says he uses cow dung because it prevents the shedding of flowers of Bt Cotton. To maintain his yields, he needs to increase the amount of fertilisers and pesticides he uses every year.

7.11 FOOD SECURITY VERSUS CASH CROPS

Most of the farmers (except Farmer 4) were asked if they fed their families from their farms. This was an attempt to find out whether farmers were growing cash crops or farming on a subsistence basis. Farmer 1 and 2 both said they keep what their family needs before selling the excess to the market. Farmer 3 said he is completely reliant on his farm for his household's food needs and only buys in sugar, oil and other things which are not possible to grow on his land. Farmer 5 can only feed his family for four months of the year from his land, the rest of the year they buy from the market. Farmer 6 does not feed his family from his land at all. Although Farmer 6 only has two acres, which may explain his answer, Farmer 5 has six acres, the same amount as Farmer 2 who feeds his family from his land. I wondered whether Farmer 5 and 6, the two farmers who seemed to value yields over net profit, possibly did not understand the benefit of food security from their land and instead chose to pursue a cash income from growing cash crops. While not enough questions were asked to validate this assumption on my part, it does seem to be a difference in attitude between Farmers 1 to 4 and Farmers 5 and 6. It also shows the importance of Dharamitra's interventions aimed at the women, promoting nutritional kitchen gardens. These can then be relied upon if a cash crop farmer has a crop failure or market prices drop drastically.

7.12 OTHER FARMERS' ADOPTION

Given the supposed success achieved by Dharamitra's farmers in converting to organic, I wondered why all farmers had not converted. I posed this question to Farmers 1 to 4. Farmer 1 said that other farmers lack the confidence to change and some do not think that organic farming is the only solution to whatever problems one faces. He says some farmers are trying to convert, they understand the benefits but they will get convinced slowly. Farmer 2 said he thinks other farmers are not convinced that they will get high enough production. Since many of them are already in debt, they are not prepared to face any more reduction in yields. He knows some who have started converting one or two acres. Farmer 3 said some of his neighbours have started converting because they can see that organic farming requires less time in the field and no loans. Farmer 4 said that other farmers he knows are starting to convert one or two acres on their land.

7.13 INTERPRETATION OF FINDINGS

Based on the 6 farmer interviews, as well as other informal farm visits in Wardha and the results presented in Dharamitra's report, I have to conclude that many small-scale farmers in these districts are farming successfully with lower input farming methods.

It was clear that the farmers interviewed found that the GR or chemical farming methods resulted in high costs, often leading them to take out loans from banks or community money lenders. One of the main reasons cited for wanting to convert to organic methods was to lower their production costs.

However, it was also apparent that the farmers found their soil to be less fertile under chemical methods. Some cited this as their reason for converting to organic. Even those who did not cite this as a reason to change found their soil softer and more fertile under organic methods. Another issue which came up in the farmer interviews was that pesticides were no longer effective against pests.

Every farmer interviewed said his costs under organic farming were much lower and most had eliminated their debt or at least reduced its levels. It was clear from the interviews and *A Ray of Hope*, that debt levels among these farmers were rife before the introduction of organic methods. All farmers, whether they understood the concept or not, had increased their net profit from farming due to the reduction in costs.

It was also clear that the farmers did experience some fall in yields after conversion, but it seemed that Dharamitra had prepared them for this and most of them were willing to sacrifice yields knowing that their costs would fall at the same time. It was clear too that those farmers who had been organic for three to five years were finding their yields could be higher than they ever had been under chemical methods. Clearly, from the farmers' comments about why other farmers aren't converting, not all farmers are willing to sacrifice yields.

This led me to ask Dr Kate in a later interview with him what the usual challenges are in convincing farmers to change to organic methods. Dr Kate says the main challenge is market pressure (Kate, 2008). There are large advertising campaigns by agribusiness who have substantial budgets and send sales staff out to the farms. This influences the farmers (Kate, 2008). Small farmers also look at bigger farmers to see what they are doing; the small farmers are "followers" (Kate, 2008). Because many of the larger farmers can afford the chemical inputs, they have not converted to organic farming. However, Dr Kate says the main reason farmers are unwilling to make the change to organic is because they have low risk-taking capacity – for marginal farmers such as these, who are dependent on their land for income and food for their families, if they lose one crop, they lose everything (Kate, 2008).

Farmer 5 and 6 represented well the fear Dr Kate speaks about with falling yields. They may also represent the fact that human beings are not always completely rational. It seemed to me that these farmers value high yields above profitability; whether this relates to a lack of understanding about the concept of net profit or rather some kind of status issues among their peers, I am not sure. I asked Dr Kate why a farmer, such as Farmer 5, is convinced that he has to keep half his land under chemical farming in order to pay off his debt. Surely, if the expenditure falls so

drastically, even if the yields fall, the farmer should have a higher net profit and be able to repay his debts? Dr Kate repeated his point about the farmers having lost their confidence and being afraid of losing their crop. He said that their confidence needs to be built slowly, so that is why Dharamitra asks them just to convert a small part of their land to organic to prove its effectiveness (Kate, 2008). Dr Kate is of the opinion that it is possible for a farmer to convert all his land to organic at once and still be able to repay his debts (Kate, 2008), but Dharamitra takes a gradual approach, to build farmers' confidence.

It was interesting that the farmers' felt that chemical farming inputs damaged their health and that consuming organically grown produce was better for them as they would have had no scientific evidence to base this on, just feeling and personal experience

Lastly, I found it interesting that the farmers had been approached by NOKA to join the group certification scheme. There is clearly demand within India for organic produce as most of the farmers had already been approached by buyers who wanted to purchase their produce. This will have double benefits for the farmers, giving them a higher price for their produce and also through collecting their produce and thereby reducing the amount of travel they need to do to take their crops to market. However, it was clear that these farmers did not need the higher prices in order to make a living from organic farming, their costs were already reduced, they were free of debt and their net profit was higher. At the moment, these farmers' pesticide-free food is going into the village market along with conventional produce. Once the buyer starts buying directly from the farmers, the village markets will be left with mostly chemically-farmed produce available for sale. This is essentially the export on nutrients from the local area to other wealthier buyers elsewhere. While the farmers' families will at least be consuming the healthier organic produce, local buyers will likely experience rising prices and poorer quality produce.

CHAPTER EIGHT: CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

In this section, all the literature reviewed is summarised according to the research objectives in order to demonstrate how the objectives have been fulfilled by the study.

Section 8.2 will summarise the results which address objective i.: from the literature, assess the sustainability of GR farming practices, particularly for small-scale farmers in developing countries, illustrated with the personal experiences of the small-scale farmers interviewed (objective iii.).

Section 8.3 will summarise the findings related to objective ii.: from the literature, identify alternative farming methods which may be more sustainable for small-scale farmers in developing countries, again using the personal experiences of the farmers to illustrate findings from the literature (objective iii.).

Section 8.4 will address objective iv.: determine whether the findings from the literature and/or the personal experience of these farmers suggest the need for further primary research in response to the drive for a GR in Africa.

Section 8.5 will cover policy and other recommendations which can be made from this study.

And finally, Section 8.6 will give some concluding reflections on the research.

8.2 THE SUSTAINABILITY OF GREEN REVOLUTION FARMING METHODS

8.2.1 Refining the Research Objective

Research objective i. was fairly broad: to assess the sustainability of GR farming practices, particularly for small-scale farmers in developing countries. In section 3.4, an attempt was made to focus the objective by defining what was meant by

‘sustainability’ through a discussion of SD and the seven important documents, as well as the SLA. This discussion of sustainability concluded that there are two levels of sustainability: those which impact directly upon the livelihood of the small-scale farmer and those which can be considered broader sustainability issues which affect the human population as a whole. The literature clearly showed a planet in distress, where “business as usual is no longer an option” (IAASTD, 2008b:4). In the past it was often the opinion of development economists and proponents of the ‘crisis of justice’ that developing countries had the right to choose the easiest path to development, even if that involved environmental damage. But the literature shows clearly (Sachs, 1999; MA, 2005; IPCC, 2007; UNDP, 1998; Daly and Goodland, 1996) that the planet cannot support this and that developing countries need to “leapfrog to growth patterns that are pro-environment, preserving natural resources and creating less pollution and waste” (UNDP, 1998:7). In other words, broader sustainability issues actually cannot be viewed separately from those which impact the individual small-scale farmer directly.

Using these conclusions as a type of framework against which to assess GR farming methods, the literature cited and the personal experience of the farmers interviewed showed clearly that GR farming methods are unsustainable, both at individual level and more broadly. The main reasons why it is unsustainable are discussed below, first at the global level and then at the level of the individual small-scale farmer.

8.2.2 Unsustainability at a Global Level

In the introduction to this thesis it was stipulated that the focus of the research was on farming methods, viewed separately from the food system as a whole. This was an attempt to limit the scope of the research somewhat, trying to exclude potentially large debates around trade systems and government policies. But it became clear during the thesis that GR farming methods cannot be separated from the broader food system as a whole because the GR has been promoted and implemented around the world as a result of political and business decisions and trading regimes. It was necessary during the thesis to engage with certain issues in the food system because they impact small-scale farmers directly and they also heavily influence the sustainability effects of GR farming. However, it has also been shown in the thesis

that small-scale farmers can change to farming methods which are more sustainable for them, independently of reforms to trade and government policies.

On the broadest level, something is sustainable if it can be maintained indefinitely. However, sustainable development goes a step further to say that true sustainability involves people being able to meet their own needs, without limiting future generations from meeting their needs (WCED, 1987). It also implies some form of intra-generational equity, meaning that there should at least be fairness in people's access to goods and services with which to improve their lives.

The interviews with small-scale farmers did not reveal many insights into these broader impacts of the GR. This is partly because the farmers were interviewed very early on during the research period of this thesis, before I developed these criteria, and partly because such high-level impacts are often not directly felt by individual farmers. The literature illustrates that GR farming methods met most of the criteria developed in section 3.4. Firstly, it is clear that GR farming methods have damaged ecosystems through a loss of crop biodiversity, destruction of habitats through monocropping and pesticide use, pollution of water and land from pesticide and fertiliser use, damage to the climatic system from GHG emissions and a reduction of soil fertility from fertiliser use. The interviews with the six Indian farmers did illustrate that they had experienced a loss of soil fertility using GR methods, with some farmers citing this as the reason they wanted to convert to organic methods.

Secondly, GR farming methods have contributed to global warming through the use of pesticides and fertilisers (fossil fuels are used in their production), mechanisation and transport (of inputs and mainly the trade of foodstuffs).

Thirdly, GR farming methods have resulted in reduced numbers of small-scale farmers, mainly in the developed world. This is because GR farming methods favour large-scale farmers, who have the economies of scale necessary to afford expensive inputs and meet the requirements of international trade. Pushing small-scale farmers out of farming, and often to urban areas is highly unsustainable given the challenges facing humanity in terms of urbanisation and the growth of slums.

Fourthly, the GR has worsened inequality in certain regions. This is due to the negative impacts the current trade and subsidy regimes have had on small-scale farmers in the poorest countries. The literature indicated clearly the power of a small number of TNCs over the food system and the fact that small-scale farmers are almost always net losers under trade liberalisation, a policy pushed by TNCs and the World Bank, IMF and WTO. Inequality has also resulted from the GR's focus on certain crops and favourable areas, worsening regional disparities and diverting resources to these areas. The Indian farmers interviewed were in an area which was not focussed on during the original GR. Even to this day, very few agricultural extension officers ever visit the farms.

8.2.3 Unsustainability at the Level of the Farmer

This section is well illustrated by the experience of the Indian farmers. Before Dharamitra intervened to introduce organic LEI farming methods to these farmers, their livelihoods were extremely unsustainable. The use of GR farming methods was not only causing harm to the global resource base, but also their own natural resources. Most of the farmers in the region were living in poverty, without enough food to meet their nutritional requirements, many of them in debt and the rate of suicide in the area was extremely high.

The first criterion used to assess whether farming methods contribute to sustainable livelihoods is that the methods should maintain or enhance global and local assets. It was shown in the previous section that GR farming methods have serious negative impacts on global assets (such as soil health, biodiversity, the climate system, water etc). At the local or farm level, negative impacts were identified too. Chemical fertiliser use can cause a loss of soil fertility and organic matter over time, as well as polluting water sources. The Indian farmers illustrated the point about soil fertility, as did interviews with Dr Kate who cited this as a problem in the district in general. Pesticides can also disturb the balance of farm ecosystems, by killing pest predators and making pests immune to their use. A few of the Indian farmers had experienced this, saying that pesticides were no longer effective in killing pests. The use of

machinery can result in soil compaction on the farm, reducing water holding capacity and soil fertility.

The second criterion was that farming methods should have net positive impacts on other livelihoods. It is clear that the use of GR farming practices (with their negative environmental impacts) has reduced the ability of future generations to meet their own needs – this relates to the fifth criterion which says that sustainable farming methods should provide for future generations. But the way the GR farming methods have been implemented (i.e. through government policies, trade regimes etc) can also be seen to cause a negative impact for other livelihoods. The interviews with the Indian farmers did not ask questions related to this point, although Dr Kate mentioned an example in an interview. He said that one of the reasons the suicide rate in the region had become particularly severe six years ago was due to the influence of the WTO, which had allowed cheaper subsidised cotton from the United States into India, undercutting the local farmers.

The third criterion is that farming methods are sustainable if they improve a farmer's ability to avoid or cope with stresses and shocks. The fact that GR farming methods rely so heavily on external inputs means that it makes farmers reliant on seeds, fertilisers and pesticides. The farmers have no ability to control the prices of such goods and when prices rise it means the farmers have to cope with the increased input costs, although the price they sell produce for may not be rising simultaneously. This was one of the points most clearly illustrated by the Indian farmers. Almost all of them decided to try LEI methods because they wanted to reduce their farming input costs. The problem of unaffordable inputs is rife in the area we visited in India, and this is one of the reasons for the high suicide rate. Farmers need to take out loans in order to afford the inputs for the season, but if something goes wrong and the crop is lost, the farmer cannot afford to repay the debt. The fact that many of these inputs are derived from fossil fuels means that they are likely to become more expensive as oil prices rise as we move towards peak oil.

The use of fertilisers and pesticides has been shown to damage ecosystems through pollution of water and reduction of soil fertility. This impacts small-scale farmers

directly through the inability to continue to use their land in the future for growing crops; this is a gradual stress which can affect the ability of the farmer to continue to derive a livelihood from his land. The Indian farmers who mentioned that their soil fertility had decreased under GR farming methods, although they did not say it, were clearly worried that the reduction in soil fertility would lead to lower yields over time. The health risks of handling pesticides is also a risk for farmers, endangering their health and possibly increasing healthcare costs. Although none of the farmers interviewed mentioned being directly poisoned, some expressed concern over their health from using pesticides and also from eating food grown with chemicals.

Monocropping has been shown to be ecologically unsustainable – it replaced traditional mixed cropping systems which provided pest protection, maintenance of soil fertility and varied outputs required on the farm free of charge. Monocropping requires large amounts of fertilisers and pesticides to grow crops. This ecological unsustainability of monocropping also has negative livelihood impacts on small-scale farmers too, through the need for increased use of inputs in order to maintain the productivity of the system. The practice of monocropping and the promotion of a limited number of varieties of crops is also unsustainable for these farmers as it removed their traditional practice of growing a variety of crops for food, fuel and fibre needs. Now many of these needs have to be purchased in the marketplace instead, increasing exposure to price fluctuations. Poorer farmers may also not purchase as large a variety of foods as were traditionally grown and consumed, reducing their nutritional security. Unfortunately, no questions were posed to the farmers in India about the variety of crops they had grown under GR methods compared to organic methods. However, there was an interesting distinction between the Farmers 1 – 4, who were largely providing for their families from their farms under organic methods, and Farmers 5 and 6, who were using 50 and 100 percent chemical methods, who were not growing much food for their families. Another point which was clear from speaking to Farmers 5 and 6 was their focus on yields, above all other considerations. This speaks to Shiva's point about the productivity of a farming system which should be viewed as the total outputs (not just yields but all food, fodder and fuel) of the farm less its total inputs. The focus of Farmers 5 and 6 solely on yields perhaps indicates a mindset of GR farming which is not helpful to them.

The fourth criterion is that farming practices which are sustainable enable farmers to take advantage of changes in their surroundings. It has been shown in the discussion thus far that GR farming methods generally lock farmers into a system of farming where they need to purchase inputs for farming; if the price they receive for their produce falls, the farmers usually cannot adapt or reduce their costs. The scientific approach of the GR has reduced the self-reliance and confidence of small-scale farmers. High-technology approaches replaced traditional farming systems and removed farmers' knowledge and ability to make decisions on their land. The Indian farmers commented on this loss of confidence when asked why other farmers were not converting to organic methods: they said that many farmers are too scared to risk any further drop in yields, even if there was a promise of reduced costs and that the yields would recover in the future. Farmer 5 said he could not convert to organic methods fully because he still needed to pay off his debt. Dr Kate commented often on this loss of confidence among farmers. It is clear that GR farming methods have, in these cases, reduced farmers' willingness and ability to experiment and adjust their methods. Many are trapped in a debt spiral and have seen suicide as the only way out. Clearly, farming methods which result in such a situation are not sustainable.

8.2.4 Conclusion

The interviews with the farmers in India have illustrated very clearly the conclusions drawn in section 4.4, namely that GR farming methods have negative impacts for sustainable livelihoods for small-scale farmers in developing countries. Although the interviews with the Indian farmers could not add much to the discussion on the global sustainability impacts of GR farming methods, the conclusion remains that GR farming methods have had a negative impact on global sustainability, especially in terms of the ability of future generations to meet their needs.

8.3 MORE SUSTAINABLE ALTERNATIVE FARMING METHODS

8.3.1 Refining the Research Objective

Research objective ii. was to identify more sustainable farming methods from the literature. Because there are such a large number of alternative farming systems, the approach taken was to limit the discussion to the major principles and practices which

these systems have in common. The research objective was further refined by using the discussion of sustainability in section 3.4 in the same way it was used for research objective i.

8.3.2 Sustainability at a Global Level

Firstly, alternative farming methods have a philosophy of working with natural systems and promise better maintenance and even enhancement of the ecosystems on which humans rely. The reduction or cessation of the use of pesticides and fertilisers reduces pollution of groundwater and maintains or enhances soil fertility. The Indian farmers interviewed confirmed that their soil was softer and more fertile, some indicated that their soil had increased waterholding capacity. Lower demand for fertilisers and pesticides also means less fossil fuels are used, thereby limiting the emission of GHGs and mitigating global warming. The literature also pointed out the ability of alternative farming methods to sequester carbon. These alternative methods focus on intercropping which means a higher level of on-farm biodiversity is promoted.

Some of the criteria identified in section 3.4 that make farming methods unsustainable at a global level cannot be answered merely by a conversion to alternative farming methods. At this point the distinction between farming methods and the food system as a whole becomes important. While individual farmers can choose farming methods which are more sustainable for themselves and the planet, the food system as a whole requires major reforms in order to become more sustainable. In other words, even if small-scale farmers in developing countries shifted to organic methods but the trade and government policy regimes remained the same, the food system as a whole would remain unsustainable in terms of being heavily reliant on fossil fuels to transport food, contributing the global warming from this transport and through the impact of unfair trade policies on the poor. This issue of what types of reforms are needed and how they could be initiated is discussed in more detail in section 8.5.

8.3.3 Sustainability at the Level of the Farmer

The first criterion for farmer-level sustainability in farming methods is that global and local natural resources must be maintained. The global level was discussed in the

previous section. At a local level, alternative farming methods encourage practices like intercropping, lower or no use of chemical inputs and a focus on soil health. These practices promote the protection of the natural resources on the farm: promoting soil health, limiting pollution and promoting biodiversity to provide pest and disease resistance. The farmers in India indicated that their soils felt softer, which many interpreted to mean more fertile, under organic methods. Some felt that pests and disease were under control.

The second criterion stated that sustainable farming methods provide net benefits to other livelihoods. The use of alternative farming methods, with their emphasis on protecting the environment, can help to maintain the ability of future generations to meet their own needs – this relates to the fifth criterion which says that sustainable farming methods should provide for future generations. Possible criticisms against alternative farming methods on this criterion were discussed in section 5.3.

The third criterion stated that sustainable farming methods are those that improve the resilience of small-scale farmers (i.e. their ability to avoid or cope with stresses and shocks). Many aspects of the alternative farming methods increase the ability of the farmer to avoid shocks and stresses in the first place. One of the key principles of alternative farming methods is a focus on a LEI approach; this is in direct contrast to the GR methods. It means that farmers can reduce their costs and become more self-reliant on inputs from their own farm. The farmers in India confirmed that their costs were lower than they had been while using GR methods and that not needing to purchase inputs externally had freed them from the risk of taking on debt. There is also a lower risk of the inputs used under these systems becoming more expensive as with fossil-fuel based inputs. These alternative farming methods alone cannot guarantee good income though, as this depends on the price obtained for the produce which is influenced by political and institutional factors surrounding markets and trade. But these alternative methods can at least provide a much lower cost base and less economic risk or requirements for credit. The farmers interviewed mentioned that, with a group organic certification, they had been offered a ten percent higher price for their crops. While the sustainability of this could be questioned (in terms of global warming and undermining of local food security) if the crops are being

exported, it is important to note that the farmers had already increased their income from farming just by reducing their costs.

Alternative farming methods can also guarantee high and sustainable yields, through their protection and regeneration of the farm's soils and ecosystems. The Indian farmers indicated that their yields were close to the yields they had obtained under GR methods or, in some cases, even higher. The focus of these alternative methods on mixed cropping can also contribute to food security for the farmers, in providing them with a wider variety of crop outputs, and reduce the risk of crop failures. The reduced or eliminated use of pesticides means that the farmer and surrounding community's health is protected, which can also reduce the need for healthcare expenditure. The Indian farmers felt that they were healthier and better able to resist disease through the avoidance of pesticide use and the consumption of organic food.

The fourth criterion is that sustainable farming methods should enable the farmer to take advantage of changes in his surroundings. It is clear that the alternative approaches reviewed place much emphasis on farmer self-reliance and innovation. This allows farmers to grow in confidence about their knowledge and ability in farming and to plant crops which meet their needs and preferences.

It also becomes clear from the literature review, and particularly section 5.2, that asking small-scale farmers to farm using these alternative methods does not require asking them to sacrifice yields. In fact, asking small-scale farmers to farm in ways which promote long-term global sustainability is actually in these farmers' best interests too: providing higher yields, lower costs and less damage to the ecosystems which support them. Although this question was not put directly to the farmers in India, it seemed to me that Farmers 1 to 4, who were using almost exclusively organic methods, were much more confident than Farmers 5 and 6. The fact that Dharamitra can report no farmer suicides among the farmers who joined their group reflects the fact that the farmers no longer feel hopeless about their lives. Also, one of the farmers present during Farmer 3's interview made it clear that he could only call himself happy because he was farming organically. Dr Kate's comment about the innovative

farmers who told him they could sleep at night also reflects more contentment and confidence from organic methods.

8.3.4 Conclusion

The interviews with the Indian farmers has highlighted the conclusion drawn in section 5.3, that there are alternative farming methods which can contribute positively to sustainable livelihoods for small-scale farmers in developing countries. These LEI and organic methods have the added benefit of contributing to global sustainability. However, further reforms would be needed to the global food system in order to really achieve sustainability. This is discussed in section 8.5.2.

8.4 RESPONSE TO THE GREEN REVOLUTION FOR AFRICA

This section seeks to address objective iv.: determine whether the findings from the literature and/or the personal experience of these farmers suggest the need for further primary research in response to the drive for a GR in Africa. It is clear from the literature that GR farming methods are unsustainable for small-scale farmers. However, 'GR' may have different meanings to different groups, it has no set or standard definition. So it is important to identify which unsustainable elements of the GR (as understood by this thesis) are present in the GR for Africa (as presented by AGRA). This section will draw on the initial literature review on the proposed GR for Africa presented in Chapter Six.

The most obvious element of AGRA's approach which may be regarded as unsustainable for small-scale farmers is the need for external inputs. One of AGRA's main goals is to increase farmer access to high-quality seeds and organic, mineral and chemical fertilisers. It is one of the main findings of this thesis that LEI technologies are the most sustainable option for small-scale farmers.

AGRA maintains that Africa needs improved varieties of its staple crops, that traditional seeds are not productive enough or resistant to droughts or pests. But in the first GR these improved varieties were highly unsustainable in that they required very specific conditions in order to produce the higher yields they promised. If one of the

required inputs was missing, or not at the optimum level, yields were no better than those for traditional varieties. GRAIN warns of this issue too. Another issue with these types of seeds is that they need to be purchased again every year, which means more outlay for farmers.

It is unclear whether AGRA will promote a variety of crops to be grown on each farm or the monoculture approach present in the previous GR. If a monoculture approach is promoted, the attendant issues highlighted in the thesis around the ecological unsustainability of monocultures (loss of biodiversity, higher pest and disease and greater risk of crop failure) as well decreased nutritional security are likely to occur. GRAIN's example of the Kenyan farmers already involved with AGRA highlights that the farmers have little choice about what crops they grow, with maize being the crop for which they receive subsidies and for which there is a market.

AGRA says it will focus on Integrated Soil Fertility Management (ISFM). While some aspects of this approach sound very good, like the fact that this approach considers the specific situation and soils of each farm, no mention is made of how AGRA could implement a project this large, specifically tailored to every farmer. AGRA goes on to claim that the highest and most sustainable yields come from using a mixture of organic and chemical fertilisers (no mention is made of what AGRA means by 'sustainable'). AGRA says that while certain low-input organic methods can help to increase soil fertility "none has proven sustainable or sufficiently attractive to become widely adopted by farmers" (AGRA, 2008c). No indication is given of what grounds were used to disregard these systems on the AGRA website, but in another article accessible on their site, it is said that organic methods are too labour-intensive for the yield increase achieved. This directly contradicts the experience of the Indian farmers interviewed, many of whom said that low input, organic farming methods had greatly reduced the amount of time they had to spend in the field. Perhaps AGRA means that, compared to traditional farming methods, organic methods require more labour. But the Indian farmers' experience would indicate that the use of fertilisers and pesticides, which need to be delivered at exact times, require even more labour intensity. The issue of labour is an interesting one. AGRA refers often to the fact that it aims to introduce technologies which are labour-

saving. But in a continent like Africa, with massive unemployment, should the focus not be on job creation? An earlier discussion in this thesis (section 3.2) around the issue of people leaving agriculture and rural areas for urban areas highlighted the wisdom of promoting such an approach in Africa where there is an “absence of clear employment prospects” (Havenik *et al*, 2007:62) outside agriculture.

The statement by AGRA regarding low-input organic methods not being “sustainable” or “sufficiently attractive” contradicts the findings of this thesis and the experience of the Indian farmers. Dharamitra has found growing numbers of farmers who are eager to try their low input methods and the farmers interviewed were obtaining high yields, lower costs and increased income from these low input methods. It also contradicts the findings of Pretty and Hine (2001) who reviewed hundreds of sustainable agriculture projects in developing countries and found them to have increased yields and food security. AGRA goes on to explain that farmers need chemical fertilisers and that subsidies are needed to help them purchase these. No mention is made of the fact that chemical fertilisers are heavily dependent on fossil fuels, whose price is likely to rise in the future.

GRAIN is critical of AGRA for introducing a model of development which is not sustainable or able to survive on its own: AGRA is funding seed breeding, then funding private seed companies to sell the seed to farmers and also providing subsidies and credit to farmers so that they can afford to buy the seed and fertilisers. What happens when AGRA stops these subsidies? Would African governments be able to afford to take over the payment of such subsidies? The experience of India shows that when the Indian government removed subsidies for inputs for GR methods, small-scale farmers could not afford them and needed to take on debt. Why is AGRA introducing a model which requires funding at each and every step of the process when models exist worldwide (like Dharamitra) where farmers can farm without the need for these external inputs? The Dharamitra story and other examples from the literature show clearly that sustainable, LEI methods exist which can produce yields as high as chemical methods.

This seems to confirm GRAIN and TWN's concerns that AGRA is paving the way for the entry of agri-business and large-scale farming in Africa. Why else would they encourage the reliance of small-scale farmers on external input markets when this is not necessary for them to increase the productivity of their farms? AGRA clearly states that its approach is one of market-led technology adoption. This corresponds with the World Bank's approach in *Agriculture for Development*, which stipulates that agricultural development should be led by market actors, with the state playing only a facilitating role. No mention is made by AGRA of the need for sustainable livelihoods and it is questionable as to whether market-led approaches would be concerned with or capable of engendering sustainable livelihoods.

Another concern with AGRA's market-driven approach, which is heavily subsidised at present, is that it is unlikely that African governments would be able to continue with this level of financial support if AGRA steps out later. It is much more likely that agri-business will fill the gap and turn the system into a profitable one for themselves. The involvement of Yara International, the biggest chemical fertiliser company in the world, in promoting a GR for Africa seems to highlight the fact that chemical fertilisers are being favoured in an approach which is not the most sustainable one for small-scale farmers. The IAASTD warns of the dangers of the private sector being involved in funding research; it recommends that public-private partnerships be closely monitored by government, universities and research institutions to ensure that conflicts of interest are avoided and sustainability goals are not compromised by private sector funding (IAASTD, 2008a:13). There is no indication that African governments have the will or capacity to monitor public-private partnerships in this manner.

Another part of AGRA's approach is to develop the output markets and infrastructure needed to allow farmers to sell surplus crops and make a profit. This highlights a point made in the *Agriculture for Development* and a crucial difference between India and Africa: access to markets. In India, the government invested heavily in road infrastructure during the original GR, which is reflected in the fact that in South Asia only five percent of the population live more than five hours from the nearest market, while in Africa 30 percent live more than five hours from the nearest market (IBRD,

2007:54). The experience of the farmers interviewed in India showed that, although they live in a fairly remote area, none of them has to travel excessive distances to reach the nearest town to sell their produce. It is clear that AGRA could bring benefits to Africa by improving road and market infrastructure, but it must also be remembered that Africa has much lower population densities than India. AGRA professes that one of its goals is to make output markets more equitable. While AGRA may be able to assist in providing better access to markets, it seems unlikely that AGRA could influence the prices which farmers receive for their produce, which are presently determined by international trading agreements, TNCs and government policies.

The example given by GRAIN of Kenyan farmers already involved in an AGRA programme which provides them with cash to purchase inputs highlights that the approach seriously threatens sustainable livelihoods. GRAIN laments the lack of choice farmers have about what crops to grow or which inputs to use, the loss of their traditional knowledge which is not applicable in this situation and their lack of ability to respond to changes in their environment (GRAIN, 2007:3). Importantly, GRAIN questions what will happen to farmers once donor subsidies stop – the farmers will be left with degraded soils and no way to purchase inputs, “the old Green Revolution game continues” (GRAIN, 2007:3). Sustainable livelihoods require farmers to have the ability to respond to changes in their surroundings, the ability to innovate and experiment, self-confidence and self-reliance. It seems this example of AGRA’s principles in practice is rather promoting reliance on external inputs and technological knowledge. In a recent debate about AGRA (which included Gary Toenniessen from AGRA and Roy Steiner from the Gates Foundation), food security activists on the panel challenged AGRA for wanting to introduce technological solutions to African farmers (Moss, 2007). They cited the evidence of agroecological solutions which could provide higher yields; these solutions are much closer to the methods already used by farmers which are not reliant on high technology and purchased inputs (Moss, 2007). Toenniessen’s response was that the Rockefeller Foundation supports many such agroecological approaches but that they are “unsustainable” (Moss, 2007). He also said that widespread adoption of agroecological techniques is not possible without chemical fertilisers because “all those techniques involve significant extra

labour, and the return to farmers is not high enough” (Moss, 2007). The activists strongly disagreed with this statement, saying that the successful agroecological projects in Africa should be scaled up rather than introducing AGRA’s approach. One of the activists from Mali claimed that “80 percent of Mali rural producers are organised and have said no to AGRA at the World Social Forum and the Forum for Food Sovereignty” (Moss, 2007).

TWN highlights key principles which it feels need to underlie any agricultural development plans for Africa (Daño, 2008:57). I include these here as I feel they summarise the points made so far in this section. The key principles are:

- Agricultural development policies need to be “defined and implemented by Africans” – world history shows outside interventions are bound to fail (unlike AGRA which has not been conceived nor designed from within Africa).
- Small-scale farmers should be leading the ‘revolution’ because “solutions to the agricultural problems of Africa lie in the hands of African farmers, who must be empowered to mobilise and organise themselves to come up with collective solutions that address their specific needs and situations” (TWN suggests alliances between communities, civil society and agricultural research institutions).
- Structural changes are key. Access to productive assets like land and water need to be dealt with at the beginning of “any agricultural revolution, instead of being left to market forces”.
- Agriculture (soil and plant health and biodiversity) needs to be viewed as a living system and solutions need to be based on the health of the whole system, and the traditional knowledge of farmers.
- “Agricultural development projects must first and foremost address the challenges of food security at the household level, instead of being designed as market-oriented. Poor farmers should be supported in ensuring food self-sufficiency at the farm level through integrated farming and livestock production using readily available resources and based on traditional knowledge systems. Local and domestic trade in farm surplus

should be given priority over the international market, and indigenous crops should be promoted”.

- The basic needs of the poor must be met by government, not through reliance on the private sector. These needs for healthcare, education and shelter must “not wait until after the poor have increased their income from production of cash crops, but should instead be a prerequisite for the poor to become productive citizens”.
- Africa’s resources should be harnessed for the benefit of Africans, especially through the use of “traditional knowledge systems, most of which have been under-utilised”.

(Adapted from Daño, 2008:57-58)

Based on these points, I would warn that AGRA’s approach is not in the best interests of small-scale farmers in Africa. The main reason is that it will result in dependence on outside inputs which is both unnecessary and economically unsustainable for them. There are clearly very successful LEI technologies available which are more in the interests of the farmer. I feel too that there is a definite need for further research around AGRA. I would recommend further reviews by independent bodies of the impact of AGRA’s programmes on small-scale farmers. There is also a need to document the impacts of organic or LEI methods which have been implemented already in Africa. This would allow a comparison of the two, to see which is delivering real value to the creation of sustainable livelihoods for small-scale farmers in Africa.

8.5 RECOMMENDATIONS

As previously stated, this thesis has tried to deal with farming methods as separate from the food system as a whole. In this section, an attempt will once again be made to distinguish between the two. This serves to highlight a point made previously, that small-scale farmers can convert to farming methods which are more sustainable for them, independently of reforms to trade and government policies. These two points will be dealt with separately.

8.5.1 Changing to Sustainable Farming Methods

Badgley *et al* make it clear that the debate about whether organic farming can feed the world should end, because “it can, both locally and globally” (Badgley *et al*, 2006:94). They feel that energy should rather be focussed on how to promote the spread of organic farming (Badgley *et al*, 2006:94).

Small-scale farmers can change to lower-input, more sustainable farming methods independently of changes or reforms to trade or political systems and policies. This clearly requires some form of information dissemination as many small-scale farmers live in remote areas and are not exposed to traditional media. From the farmer interviews and experience with Dharamitra, it is apparent that NGOs or similar grassroots organisations can be highly effective in introducing LEI farming methods to small-scale farmers.

Following their review of successful sustainable agriculture projects in developing countries, Pretty and Hine (2001) concluded that key factors in the success of sustainable agricultural projects were that they:

- Used appropriate technology, adapted by farmers’ own experimentation
- A participatory learning approach between farmers
- Involved the project working well with external agencies
- Made use of existing working relationships between projects/NGOs
- Capitalised on existing social capital in rural areas

(Pretty and Hine, 2001:16)

These factors were present in Dharamitra’s approach. Dharamitra used other organisations’ relationships in order to gain an introduction to the farmers. The key element of Dharamitra’s success was to form Farmer Study Groups and organise exposure visits. Pretty and Hine agree that “participatory approaches and social learning will increase farmer innovation and the likelihood that the technologies will be maintained” (2001:18). Increasing farmers’ confidence to experiment and innovate is crucial with organic and LEI methods as these approaches require adaptation to the specific situation of each farm and farmer. Dharamitra has also tried to build social

capital in the rural areas it operated in: organising micro-credit systems, grain banks, seed banks, women's self-help groups etc.

There should also be better sharing of knowledge and ideas between NGOs who are doing work on sustainable agricultural alternatives. Dharamitra has never published any of its work, and if I had not come into contact with Dr Kate through the Sustainability Institute, I would not have heard of the successful work they are doing. There are very likely many other NGOs like Dharamitra whose work could be shared for the benefit of others. This raises an issue already highlighted in the thesis: the problem of knowledge and where it sits. The IAASTD has acknowledged that some interpretations of AKST were promoted more heavily than others, forcing formal AKST down certain paths and neglecting other scientifically sound options along the way. Some of the other interpretations which have been sidelined include "traditional knowledge or civil society experience [which] may be better able to contribute to poverty reduction, social inclusion, equity and multifunctional outcomes" (IAASTD, 2008a:13). This is certainly my belief after my interaction with Dharamitra.

These recommendations have been made assuming that no changes are made to government policy or trade regimes; the next section will deal with what kind of changes could be made to facilitate a large-scale global shift to more sustainable agriculture.

8.5.2 Changing Political and Economic Structures

It is my belief at the conclusion of this research, that "it's time to recognise that the agro-industrial approach has *already* failed us" (Paul and Wahlberg, 2008:8). I agree fully with Pretty and Hine that "sustainable agriculture can be complementary for rural people's livelihoods. It can deliver increases in food production at relatively low cost, plus contribute to other important functions. Were these approaches to be widely adopted, they would make a significant impact on rural people's livelihoods, as well as on local and regional food security" (Pretty and Hine, 2001:22).

This thesis has also highlighted the problems with trade policies and the power of TNCs over the agricultural value chain. Reforms are clearly needed here to make the

entire food system more sustainable. McMichael paints a bleak picture of the possibility of reforming world agriculture, and Paul and Wahlberg agree that the current industrial model of agriculture is “deeply entrenched in political systems, global corporate interests and embedded farming practices” (2008:8). McMichael says “the entrenched power of the agribusiness complex... is unmistakably strong” (2006:185) and “threatens to appropriate alternative technologies from organic foods to biofuels – that are needed for a democratic and ecologically sustainable agriculture” (McMichael, 2006:185). Pretty and Hine say that a shift to sustainable agriculture globally would mean a limited role for agri-business, “who would not be predicted to accept such market losses lightly” (Pretty and Hine, 2001:20). Both Shiva and McMichael talk about the need for food sovereignty and self-reliance in farming for the poor. Shiva talks about the need for valuing diversity in production and the danger of allowing patents on seeds and other life forms. She says that this undermines the self-reliance of small farmers and needs to be changed (Shiva, 1995:48).

McMichael, writing from a pro-poor perspective, has three suggestions for moving towards a “post-capitalist agriculture” (McMichael, 2006:186). These are:

- Raising public awareness – of ecological footprints and the impacts of the current agricultural regime on society, health and the environment.
- Mobilising poor farmers around their rights and fair trade.
- Monopolising on the collapse of the current agriculture (i.e. food health scares, water shortages, climate change, peak oil etc) to suggest alternative agricultures.

(McMichael, 2006:186)

It is clear that McMichael feels that changes need to be driven by public pressure on politicians and TNCs and that he does not have much faith in changes being initiated by government or business. Goering *et al* agree that currently it is farmers and consumers who are “showing their distrust of industrial agriculture” (1993:82), while governments and public institutions still lag a long way behind – funding for sustainable agriculture is still only a small percentage of national research budgets (Goering *et al*, 1993:83). Pretty and Hine point out that the technologies of sustainable

agriculture are now proven, but that without more effort to support sustainable agriculture at national policy level, it is unlikely that this type of agriculture will spread (2001:22).

Goering *et al* say that there is a need to educate people, especially those in the developing world, about the negatives of industrial agriculture. They feel that the vested interests of TNCs and governments ensure that only one side of the story is told: “namely, that chemical agriculture can vastly increase yields and, therefore, wealth” (Goering *et al*, 1993:87). Growing cash crops for export is promoted to people who cannot meet their own basic needs (Goering *et al*, 1993:87). Goering *et al* argue that people in developing countries need to be educated about the full implications and long-term effects of industrial agricultural policies recommended by overseas development agencies, TNCs (especially agricultural chemical companies) and governments so that they can make their own decisions (Goering *et al*, 1993:88). There is a need too for information on the long-term impacts of inappropriate development projects and the “dangers of moving away from a subsistence economy” (Goering *et al*, 1993:88).

This is in contrast to Bowler, who talks about the “positive role that the state can play in the regulation of agriculture” (Bowler, 2002:211). He mentions the need for legislation to prevent environmental pollution and to promote sustainable farming practices (Bowler, 2002:211). But he acknowledges that, to date, no country has “forced a full internalisation of the environmental costs on the farming community” (Bowler, 2002:211). This approach would be useful because it would force farmers who are causing pollution and producing excessive carbon dioxide emissions to pay for this; this would encourage them to switch to more sustainable methods.

Bowler also mentions that states could remove “perverse subsidies that encourage productivist agriculture” (Bowler, 2002:211), which is echoed by the IAASTD (2008a:33). Goering *et al* go further, calling for the removal of subsidies which “encourage agribusiness and vast trading networks at the expense of small farmers producing for local markets” (Goering *et al*, 1993:90). This would help farmers of the South to compete on a fairer world market or to produce profitably for their local

market. Tilman *et al* argue that the massive subsidies of the OECD countries should be redirected to support sustainable practices (2002:675).

To promote organic agriculture on a large-scale, there would need to be economic incentives to encourage farmers to switch to organic methods, as well as the need for funding for on-farm research, regional information exchanges between farmers and the removal of funding for industrial agricultural systems (Goering *et al*, 1993:90). The IAASTD strongly urges the use of payment and reward mechanisms for agriculture to either dissuade farmers from using environmentally damaging practices or reward them for using regenerative methods (IAASTD, 2008a:32). This can also be a way of providing a reliable additional income stream for small-scale farmers.

Tilman *et al* argue that the current paradigm, where science is developed at a high level and disseminated to farmers, needs to be shifted to an active dialogue between farmers and scientists (2002:675). The IAASTD agrees, recommending that the less powerful need to be able to participate in decision making in agriculture, through mechanisms like farmer field schools and farmer-scientist research groups (IAASTD, 2008a:22). There is a need to strengthen public support of farmer organisations and community approaches to natural resource management (e.g. local seed systems) (IAASTD, 2008a:23). The success of Dharamitra's farmer study groups underscores this point; but the recommendation that scientists should be closer to farmers is an important one to overcome the problem of science being disconnected from the needs of farmers on the ground and of science not considering the whole range of outcomes of its proposals.

To summarise then, I agree with McMichael that change is most likely to come from the public putting pressure on their governments and the companies they buy from. By raising awareness and educating people about the need for a more sustainable agriculture, governments and companies will eventually feel the need to change in order to maintain support and profits. However, if we were living in an ideal world, I would recommend the following:

- Punitive and reward-based financial mechanisms to encourage farmers to change to more sustainable farming methods (e.g. fines on GHG emissions and pesticide use, tax incentives for organic farmers)
- Removal of subsidies which encourage increased agricultural output at the expense of ecosystem services
- Government policies which support sustainable agriculture, like funding for research into agroecological approaches
- Limits to the power of TNCs, with certain functions taken over by public bodies
- Trade regimes which provide protection to developing countries
- The promotion of a strong domestic food growing programme, less emphasis on growing crops for export

In the meantime, sustainable agriculture initiatives need to continue to develop as they have been, with the help of NGOs and grassroots organisations. This will both help small-scale farmers who are living in poverty and food insecurity to farm with lower costs and more reliable yields. It will also mean that, when public pressure demands a change, there are viable working models and frameworks to use as examples.

8.6 CONCLUDING REFLECTIONS ON THE RESEARCH

At the outset of this research, the aim was to investigate whether the experience of small-scale farmers in India could reveal any insight into the proposed GR for Africa. A SD and SLA framework was used to assess the sustainability of GR farming methods for small-scale farmers in developing countries (based on literature and interviews with farmers in India). This assessment revealed there are serious sustainability issues caused by GR farming methods, both at a global level and at the level of the small-scale farmer.

The thesis clearly showed agriculture facing the challenge of needing to feed a growing population but within major constraints such as damaged ecosystems, global warming, water shortages and growing poverty. While proponents of GR methods suggest further scientific advancement and the addition of GM crops to the toolkit, the

findings of this thesis show that these are unsustainable and, more importantly, unnecessary. The experience of the Indian farmers interviewed confirmed recent scientific studies which show that organic, LEI methods can produce just as much food as GR methods, but with better environmental credentials and livelihood impacts.

Groups like the World Bank and AGRA feel the solution to poverty is to incorporate small-scale farmers into global trade markets. But the thesis presented evidence which shows that this is unlikely to reduce poverty as small-scale farmers are often losers in trade liberalisation. Also, it seems unlikely that massive trade in foodstuffs will be feasible in the future due to the rising costs of fossil fuels and the growing impact of climate change.

In India, Dharamitra noted that, even though the conversion to organic, LEI methods had increased yields, reduced costs and improved income levels for the farmers, many still had income levels which were too low to meet their livelihood needs. Many of these farmers still grew cash crops, such as cotton and soya, for sale in the market. Dharamitra's recommendation sums up my feelings at the conclusion of this research about what kind of farming methods should be promoted to small-scale farmers:

“For a more balanced and sustainable agriculture in the future, a proper perspective needs to be developed with respect to the choice of crops and to meet the objective of development of a self-reliant, ecologically sound and economically viable agricultural system. In this regard, the real stress in agriculture needs to be shifted from market-oriented agriculture to needs-based agriculture if the production system is to really help the poor farmers” (Dharamitra, 2002).

This is one of the main reasons that I feel the AGRA approach for a GR in Africa is not in the best interests of poor, small-scale farmers. It will make them reliant on expensive external inputs, possibly damage the long-term health of their farms and definitely shift their focus away from meeting their own food needs to growing crops for the market. The farmers of Africa need to be empowered to farm without reliance

on external inputs, in ways which promote the long-term ecological sustainability of their land, and which meet all their needs for food, fuel and fibre first, before surpluses or cash crops are grown for the market.

CHAPTER NINE: EPILOGUE

9.1 INTERNATIONAL ECONOMIC CRISIS AND OIL PRICES

During the latter half of the preparation of this thesis (August 2008 – October 2008), a global financial crisis has engulfed most countries in the world. This epilogue will not attempt to enter a debate or discussion on the causes or implications of the crisis. It is just meant to explain the reasons for the sudden drop in the oil price (see section 3.3.5), which seems to contradict statements made in this thesis to the effect that oil prices will continue to rise in the future as we move towards peak oil.

The main reasons given in the international media for the fall in oil prices relate to a reduction in demand for oil in developed countries, as they enter recession; the recent strengthening of the dollar relative to other currencies and the removal of funds from commodity markets as investors look for more stable places for their money (Economist Intelligence Unit ViewsWire, 2008). The Organisation of Petroleum Exporting Countries (OPEC) has scheduled an emergency meeting for 18 November 2008, when it is expected that they will order a reduction in production levels, in order to combat the current oversupply of petroleum due to contracted demand (Economist Intelligence Unit ViewsWire, 2008). Thus, in my opinion, the current oil price drop is unlikely to continue in the short-term as OPEC restricts production, and oil prices are likely to rise in the long-term once the recession is over and demand recovers and as we move towards peak oil.

9.2 ORGANIC AGRICULTURE AND FOOD SECURITY IN AFRICA

In the week before this thesis was due, the United Nations released a report on the potential of organic agriculture²⁰ for improving food security in Africa. Although it was too late to incorporate it into the thesis, I wanted to include it as a footnote, as the report confirms many of the findings of the thesis.

²⁰ This report defines organic agriculture as holistic farming system which uses agroecosystem management rather than external inputs.

The study was based on organic agriculture projects in East Africa since 2004 supported by the United Nations Environment Programme (UNEP) and United Nations Conference on Trade and Development (UNCTAD) Capacity-building Task Force on Trade, Environment and Development. The report feels its findings are relevant to the rest of Africa and other developing countries.

The report highlights the concern over food security, especially in Africa, as the number of hungry people in the world has been increasing every year since 1996 (UNEP UNCTAD, 2008:iii). One of the main findings of the report is that “organic agriculture can be more conducive to food security in Africa than most conventional production systems, and that it is more likely to be sustainable in the long-term” (UNEP UNCTAD, 2008:iii). The report also criticises the calls for redoubling efforts to spread modern agriculture, saying this type of agriculture has not led to major reductions in hunger and poverty in most developing countries (UNEP UNCTAD, 2008:vii).

Below is an overview of the major findings of the report. It is clear how closely they correlate with the findings of this thesis, which used the literature and the experience of Indian farmers to predict what the negative impacts of GR farming would be in Africa and how organic, LEI methods would better serve sustainability at the global and small-scale farmer level in Africa. These findings also echo the experience of the small-scale farmers interviewed in India. It was found that organic agriculture:

- Builds up stocks of natural, social and economic resources, thereby reducing factors which lead to food insecurity
- Gave higher yields than traditional agriculture and equal yields to HEI systems
- Increased food availability, which lead to household food security for farmers
- Allowed farmers to earn income from selling surpluses in the market
- Provided organic produce to the wider community
- Allowed more people to become involved in agriculture when previously it was too expensive for them to farm (using HEI methods)
- Improved soil fertility (increased organic matter and water holding capacity), water supply, flood control and biodiversity

- Resulted in farming systems which were more diverse and resistant to stress
- Strengthened social capital
- Gave farmers the ability to adapt their farming methods in order to better cope with environmental and external stress
- Increased farmer household income through the ability of the farmer to save (through not having to buy synthetic fertilisers and pesticides), extra income from selling surpluses and obtaining premium prices for organic produce
- Was less dependent on energy and external inputs (which was deemed important given the recent price increases of energy and these inputs)
- Was making a significant contribution to the reduction of poverty and food insecurity and the improvement of rural livelihoods

(UNEP UNCTAD, 2008:vii-x)

In conclusion, it was gratifying to read this report at the culmination of my research process and to see evidence of working organic, LEI systems in Africa which are improving livelihoods for small-scale farmers.

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APPENDIX A

EXAMPLE OF FARMER INTERVIEW QUESTIONS

Please note that these questions were adapted during the interviews and not all questions were asked to each farmer.

1. How long has he been farming?
2. How big is his land?
3. What crops does he grow?
4. How long ago did he start farming organically?
5. Why did he decide to start farming this way?
6. How did he hear about Dharamitra?
7. Please ask him to tell me about the conversion to organic farming – was he worried yields would fall initially?
8. How long did it take for him to become convinced that organic farming could work?
9. How many of Dharamitra's techniques did he adopt?
10. Have his yields improved?
11. Are the yields better or worse now than they were under chemical methods?
12. What costs does he have now compared to chemical farming?
13. Has his net profit improved?
14. Where does he sell his crop?
15. Is he certified organic?
16. Does he receive a higher price for his organic produce?
17. Does he have any debt related to his farm?
18. Did he used to have debt when farming chemically?
19. Has he reduced his debt now?
20. Are there any other benefits from converting to organic?
21. Why does he think chemical farming did not work for him?
22. If organic is working for him, why does he think all farmers do not change to organic too?
23. Who is the most successful farmer in his area? Why?
24. Does he consider himself successful?
25. If not, what challenges does he still need to overcome?

APPENDIX B

DESCRIPTION OF DHARAMITRA'S LOW-COST TECHNIQUES

	Technique	Description
1	<i>In situ</i> composting of weeds	Pulling out weeds and folding them into the soil where they stand to return nutrients to the soil
2	Agro-waste utilisation on the farm or composting	This is to replace the burning of plant waste (a common practice) which could be composted instead
3	Mixed cropping patterns	This takes advantage of different heights of plants (for shade and maximising space), allowing plants to provide pest control and share nutrients
4	Deep hoeing	This practice loosens and aerates soil (especially useful if soils are compacted or clayey)
5	Preparation of compost and vermi-compost	Vermi-compost is made by feeding organic waste to worms. Both of these are low-cost methods of providing nutrients to soil and plants
6	Sowing across the slope	This prevents erosion and loss of topsoil
7	Seed germination testing	This reduces the number of unresponsive seeds sown
8	Seed treatment (cattle dung, urine and ant hill soil)	This is a germination and growth promoter
9	Use of bird perches	This will attract more birds to the farm which are useful in pest removal
10	Adoption of gap filling management	This involves planting between rows of other crops which provides mulch to protect soil from the sun, wind and rain
11	Contour bunding	This involves building raised mounds along contours to capture runoff and prevent erosion
12	Use of cattle urine and neem spray	This is an effective pest control
13	Tree planting on farm bunds	Planting trees not only provides habitat for birds, but also means that soil is protected from erosion and the tree brings minerals and nutrients from deep layers of soil to the surface
14	Use of trap crops	These crops 'trap' or attract pests away from more important or vulnerable plants

15	Use of <i>Sanjeevak</i>	Sanjeevak is a fermented mixture of cattle dung, urine and molasses which is a very effective source of nutrients for plants
16	Use of vermi-wash	Vermi-wash is the liquid which drains out of a worm composting container and is also a very powerful fertiliser
17	Establishment of farm ponds	Ponds allow for the capture and storage of run-off water