

Exploring expansive learning in sustainable agriculture:

A case study of commercial sugarcane farmers and extensionists in
KwaZulu-Natal Midlands and South Coast

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ABSTRACT

Sugarcane production in South Africa is at a crossroads. Internationally, the South African sugarcane industry is a small player. But within South Africa it remains a significant commodity supporting a substantial number of livelihoods. Sugarcane agriculture has a significant impact on South Africa's environment. The industry thus bears a large measure of responsibility to contain that impact. It is under pressure to conform to national legislation and international standards of sustainable production, whilst big players like Coca-Cola have indicated the sector needs to 'green up' or potentially face loss of sales. One response to this has been the industry's development and adoption of the Sustainable Sugarcane Farm Management System (SUSFARMS) as a sustainability decision support tool for sugarcane growers.

The implementation of SUSFARMS however demands an unprecedented level of integrated action on the part of competing actors in the value chain. Key among these are the cane farmers, the South African Sugar Association (SASA), millers, and the South African Sugar Research Institute (SASRI) – the latter two being the dominant players in sugarcane extension. SASA's and SASRI's traditional top-down technology transfer approach was considered in this study as unlikely to achieve the learning and collaboration required to successfully achieve broad scale use of the SUSFARMS tool and implementation of both social and environmental sustainability practice.

To begin the learning and collaborative process, this study examined the professional learning needed to foster multiagency partnerships supporting sustainability practices among SASRI extension specialists and large-scale commercial sugarcane growers in the Midlands and South Coast regions of South Africa's KwaZulu-Natal province.

This research explored whether sugarcane farmers and extensionists can be supported through interventionist research to identify and address inhibiting factors relating to sustainability, learning and understandings of SUSFARMS. Inhibiting factors are most likely to be related to tensions and contradictions of cultural and historical origin within activity systems. For this reason, the epistemological framework for the research was provided by cultural historical activity theory (CHAT) and the theory of expansive learning. CHAT supported the research process to surface and identify tensions and contradictions related to SUSFARMS. Once

surfaced these tensions and contradictions were examined and probed for their root causes and possible solutions proposed.

Expansive social learning theory and CHAT was used in the study to explore the processes by which growers and extension staff foster learning in settings where knowledge and practice are not necessarily stable, well-defined or understood. A key element was the capacity of professionals working in multiagency settings to recognise and engage with disputed knowledge and distributed expertise in complex workplace settings. Workshops modelled on Engeström's (1996) 'Change Laboratory' examined data from 17 semi-structured interviews with growers, extension specialists and industry managers selected by purposive sampling. The interviews and workshops were used to surface tensions and contradictions regarding sustainability practices - particularly those relating to SUSFARMS - which were used to support expansive social learning, allowing participants to deepen their understanding and learning of workplace practice, and to formulate proposed solutions.

The first part of the study found: no formal learning plan for growers and extension staff exists; participation from growers in formal learning opportunities is weak; lack of quantifiable cost-benefit evidence hinders grower and extension support of SUSFARMS; strategic leadership from industry is not evident to people on the ground; and scope, structure and budget hampers extension's impact. The second part of the study found four different ways sugarcane farmers and extensionists learn: learning from a more knowledgeable other; learning from peers; learning through observation and learning through practice and experimentation. These framings of learning suggest multiple ways in which farmers and extensionists interact and experience the world around them. They also suggest avenues of focus for strengthening industry extension approach.

Ultimately six Model Solutions were developed: Clarify with stakeholders SASA's position and methodology regarding SUSFARMS and on-farm sustainability; ensure communication and dialogue occur with stakeholders; identify and respond to grower and extension staff knowledge needs; strengthen informal grower and extension learning using expansive social learning processes; strengthen organisational learning through formal learning plans; and prioritise action research that strengthens grower, extension and researcher networking and understanding and

develops quantifiable evidence relevant to on-farm SUSFARMS use and the implementation of on-farm sustainability practices.

The study concludes with providing recommendations for agencies such as SASA and SASRI on their extension approach when introducing new technologies such as SUSFARMS in complex and often competing multiagency settings. The study suggests that SASRI, at institutional and farmer-interface level, should play close attention to understanding how their client farmers learn and ensure their systems and field officers have the relevant capacity and skills to engage farmers in the required collaborative learning.

DECLARATION

I hereby declare that the work presented here, apart from the assistance received as reported in the acknowledgement and in the appropriate places in the text, represents the original work of the author.

I declare that the dissertation that I am hereby submitting to the University of KwaZulu-Natal for M. Agric degree is my own work and that I have never before submitted it to any other tertiary institution for any degree.

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Dr. S. Worth

Date:_____

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DEDICATION

This dissertation is dedicated to my wife for her patience and unstinting faith in me over the years it took to complete this dissertation.

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LIST OF ABBREVIATIONS

BMPs	Better Management Practices
CHAT	Cultural Historical Activity Theory
CL	Change Laboratory
COO	Chief Operating Officer
DWR	Developmental work research
FF	Farmer First
FPR	Farmer Participatory Research
FSC	Forestry Stewardship Council
FSRE	Farming Systems Research and Extension
LEC	Local Environmental committee
MWP	Mondi Wetlands Programme
NCT	Natal Cooperative Timbers
PCL&I	People centred learning and innovation
RD&E	Research, Development and Extension
SA Canegrowers	South African Canegrowers
SASA	South African Sugar Association
SASRI	South African Sugarcane Research Institute
SCCs	Soil Conservation Committees
ToT	Transfer of Technology
WESSA	Wildlife and Environment Society of South Africa

PREFACE

The reason for conducting this research into workplace learning in sustainable agriculture came about primarily as a result of professional circumstances and personal interest. I began with the Sustainable Sugarcane Initiative work in 2002 and am currently still involved there. The present work still involves engaging sugarcane farmers on implementing sustainable environmental practices and catchment stewardship, but now includes millers and supply chain actors and forms part of WWF's broader regional and global work on freshwater stewardship and sustainable agro-commodity supply chains.

At the time of this research the Sustainable Sugarcane Initiative fell under the Mondi Wetlands (MWP), a joint initiative between the conservation NGO the Wildlife and Environment Society of South Africa (WESSA) and WWF. Prior to working for the MWP I worked for the Department of Water Affairs and preceding this, for the Department of Agriculture. My undergraduate studies were in nature conservation after which I spent a year as a cadet ranger for the then Natal Parks Board.

While at WESSA I attended on a short course at Rhodes University on the practice and theory of environmental education, the ethics and power dynamics, the politics of knowledge, the theory of social change and the role of expansive learning in facilitating voluntary change in environmental practice. Coupled to this was my experience in working with sugarcane farmers and extensionists and plantation forester practitioners for more than 10 years to implement better catchment and wetland management practices. During my interactions with farmers and agricultural extension practitioners they often spoke of the supposed reluctance of farmers to change, particularly when it came to sustainable farming practices. My curiosity about ways to strengthen sustainability praxis amongst extensionists and farmers, together with a love of farming and a belief that agriculture and nature conservation are co-dependant and mutually beneficial provided the motivation for this study.

The research was also inspired by other researchers such as the study by Mukute (2010) entitled; *Exploring and expanding learning processes in sustainable agriculture workplace contexts* and the study by Lindley entitled; *Exploring if expansive social learning processes can strengthen wetland understanding and management*. Other researchers such as Downsborough (2007) looked at the learning processes in farming communities of practice, but there was little emphasis

on how the learning expands beyond the communities of practice. Masara (2010) looked how social and expansive learning processes develops and supports farmers in transitioning to commercial beekeeping. These studies reveal the potential of expansive and social learning approaches in supporting learning and change over a range of land tenure, farming systems and institutional settings. These contexts however are quite dissimilar to the sugar sector which is uniquely structured and governed by its own Act, subject to trade controls and comprised of thousands of individual farmers, six milling companies with a well-established centralised and sophisticated research and extension service administered by the South African Sugar Association on behalf of its farmer and miller members. This variation in context provided an opportunity to explore expansive and social learning in a unique space.

CHAPTER 1 INTRODUCTION

1.1 Overview of the chapter

This chapter provides a brief orientation and introduction to the study. It provides a brief introduction and background to the study. It then outlines the research question and goals of the research. It also discusses the context within which this research was conducted. The chapter then moves on to introduce the reader to the general structure and organisation of the research report, giving a brief outline of the focus of the chapters that make up the study.

1.2 Introduction and background

This study explores the concept of expansive and social learning in the context of implementing sustainable farming practices among sugarcane farmers and extension workers in KwaZulu-Natal. The research was, in part, inspired by research such as Mukute's (2010) study: *Exploring and expanding learning processes in sustainable agriculture workplace contexts* and Lindley's (2007) study: *Exploring if expansive social learning processes can strengthen wetland understanding and management*. While some research such as Downsborough (2007) had explored the learning processes in farming communities of practice, there was little investigation into how the learning expands beyond these communities of practice.

As is discussed in greater detail in Chapter 2, expansive learning theory is an emergent arena of research exploring adaptation and change in complex socio-ecological systems (Engeström, 1987; Mukute, 2009; Mukute and Lotz-Sisitka, 2012; Van Bommel *et al.*, 2009). It argues that when whole collective activity systems (such as the sugarcane farmers and extension workers included in this study) need to be redefined, or are facing uncertain change, traditional modes of learning containing predefined solutions are not enough, as no one can envisage exactly what needs to be learned. In an expansive learning approach the processes of designing, testing and implementing of a new activity, and the acquisition of the knowledge and skills it requires are interwoven.

The participants in this study faced exactly this challenge. The collective activity systems of the farmers and extensionists needed to be redefined because of the increasing demands emanating from environmental law and policy and growing

pressure from society to adopt 'environmentally friendly' production and post-harvest practices. It was not possible to pre-determine what needed to be learned. It was relatively new territory for farmers and extensionists alike. There were established patterns of production, extension provision and extension-farmer engagements. All of these patterns needed to be examined and redefined. In an effort to avoid simply repeating the standard engagement protocols to 'figure out what to do', employing the principles, concepts and methods of expansive learning emerged as a possibility – giving rise to this research.

A preliminary exploratory review of literature found that expansive learning puts importance on: participants as learners; transformation and creation of culture; horizontal learning between people; and the formation of theoretical concepts (Engeström, 2010). It also found that in expansive learning, "learners learn something that is not yet there", that "they construct a new object and concept for their collective activity", and finally "implement this new object and concept in practice" (Engeström, 2010, p. 74). This appeared to fit the context of this study in which sugarcane farmers and extension workers were learning how to use Sustainable Sugarcane Farm Management System, otherwise known as SUSFARMS (discussed in more detail in section 1.5.5), as a mediating tool in achieving sustainable agriculture.

1.3 Research question and goals

This research is guided by the central question of whether cultural historical activity theory and the expansive learning cycle can strengthen sugarcane farmer and extensionist learning and practice?

The main aim of the research was to gain a deeper understanding of the ways in commercial sugarcane farmers and extensionist learn and what the main hurdles to sustainability learning and practice are. It was also to explore whether cultural historical activity theory and expansive learning could strengthen sustainability learning and practice. In order to help achieve this aim and address the research question two research goals were generated:

- How do farmers and extension specialists learn about sustainable sugarcane agriculture?

- What tensions and contradictions do sugarcane farmers and extensionists face in their workplace in relation to SUSFARMS and sustainable agriculture learning and practice?

1.4 Regional context of the research

1.5 Bio-geographic profile

The farmers and extensionists who participated in this research live and work in the sugarcane growing regions of Midlands North, Midlands South (Eston) and South Coast (Sezela) in the South African province of KwaZulu-Natal (KZN). The region stretches from an altitude of approximately 900 meters above sea level in the upland Midlands North region, dropping steeply to sea level over a relatively short distance of 110km (Figure 1.1). The landscape is rugged, comprising flat plateaux regions alternating with steep escarpments and deeply dissecting dry and hot river valleys. As a result the region has a wide range of vegetation types from dry Valley Bushveld to coastal forest, Ngongoni Veld and Natal Mist-belt grassland in the midlands. Inland of this, leading up to the Drakensberg, are the high rainfall Sourveld grassland areas. The coastal forest and warmer inland grassland areas have for many years been devoted to sugarcane production to the extent that the natural vegetation is listed as endangered or vulnerable (Driver *et al.*, 2011; DWAF, 2004). Likewise, rivers along the eastern sea board of the province are classified as vulnerable or endangered as a result of intensive agriculture and urban settlements (Driver *et al.*, 2011).

The region is water stressed with demand outstripping available supply in most river catchments (DWAF, 2004). The uMngeni River is the main water supply for the cities of Pietermaritzburg and Durban which, combined, are geographically one of the largest metropolitan areas in the country. To augment water supply, water is transferred through the Mearns-Springrove transfer scheme into the uMngeni system. Invasive alien plant species are a significant problem in the greater uMngeni catchments consuming a significant amount (estimated 14 million m³ /annum) of available water.

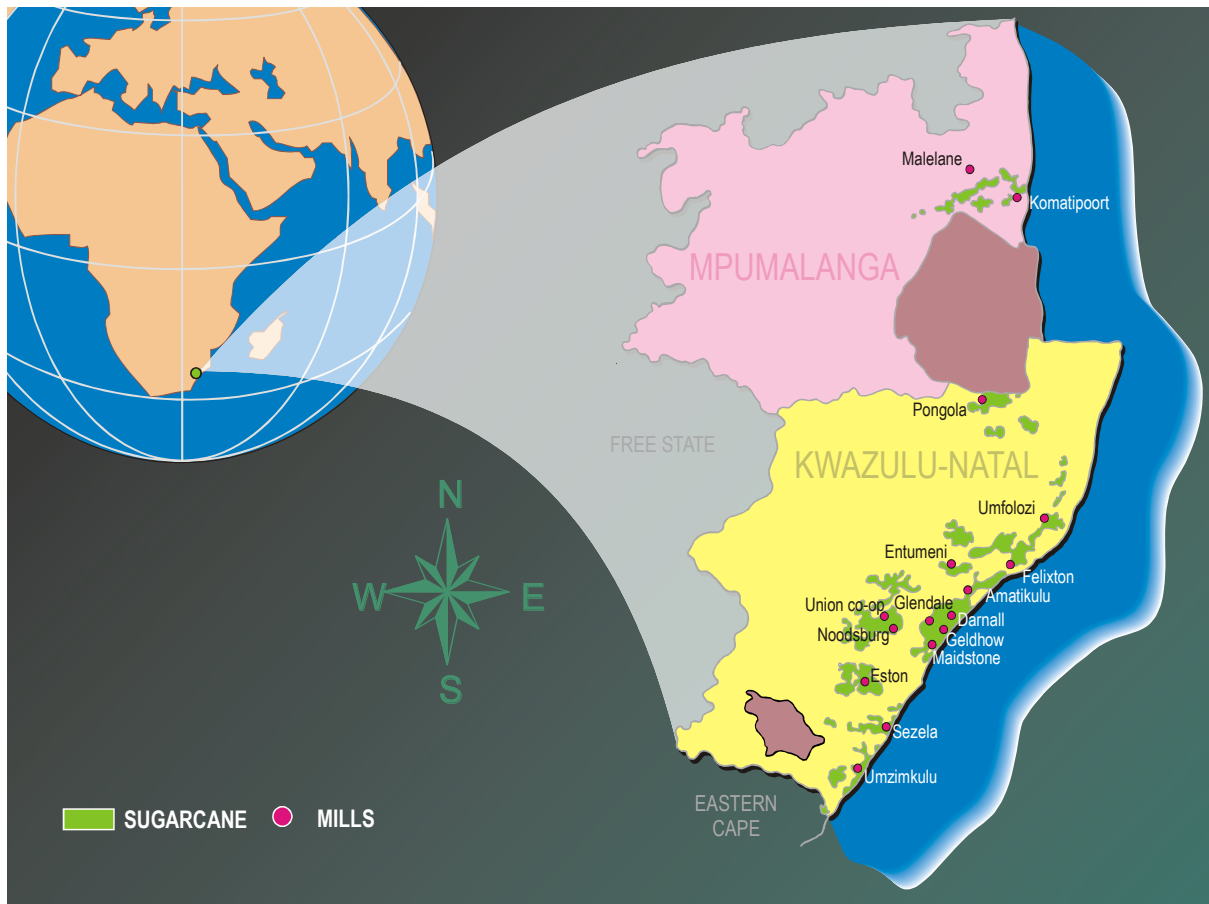


Figure 1.1: Location of sugarcane agriculture in South Africa

(Source: SASA, n.d.)

1.6 Institutional context and arrangements of the sugar industry

The study region is situated within a number of wider socio-economic and political contexts where numerous interactions across a variety of institutions are at play. From an environmental perspective the Water Act, Conservation of Agricultural Resources Act and National Environmental Management Act have the largest bearing on individual farmers and the industry at large.

The South African Sugar Association (SASA) is the institutional home of the sugar industry in the country. It is a partnership between cane farmers and the South African Sugar Millers Association Limited (SASMAL). This partnership is mandated by the Sugar Act which also governs the division of costs and proceeds and trade tariffs that prevent cheaper sugar from being imported into the local market. In addition to broad governance and marketing functions, SASA also provides specialists services in logistics, research, marketing, administration and extension for

farmers. As a result, farmers are removed from the responsibilities of marketing and distributing their product and are responsible only for producing and transporting their sugarcane to the mill.

The South African sugar industry ranks in the top 15 out of approximately 120 sugar producing countries worldwide on a cost competitive basis. From 60% to 75% of the sugar on average is marketed in the Southern African Customs Union (SACU). The remainder is exported to markets in Africa, Asia and the USA. Six milling companies with 14 sugar mills are supplied from sugarcane grown in KwaZulu-Natal and Mpumalanga. There are approximately 24 000 cane farmers of which approximately 1400 are large-scale farmers on freehold land who produce 84% of the crop on roughly 400 000ha. Milling companies produce 8% whilst the remaining production of cane is supplied by small-scale farmers on Tribal Authority land (Mandla, 2012; South African Sugar Association, n.d.).

The South African Cane Growers Association (CANEGROWERS) administers the interests of independent farmers who are members through 26 farmers groups. In each mill area farmers are represented by a Local Grower Council from which members can be elected onto the CANEGROWERS Executive Committee. One of the main aims of CANEGROWERS is to ensure that farmers receive fair value for their sugarcane.

1.7 Social and economic context

The region in which sugar is grown is economically important as an industrial and administrative hub for the province. About 12% of the Gross Domestic Product (GDP) of South Africa originates from the region, making the region the fourth largest contributor in terms of National Gross Geographic Product (DWAf, 2004). The sugar industry creates approximately 79 000 direct jobs, which represents over 11% of the total agricultural workforce in South Africa (SASA, n.d.). Indirect employment is estimated at 350 000 jobs. Approximately one million people or 2% of South Africa's population depend on the sugar industry for a living (SASA, n.d.).

1.8 Conservation in the sugarcane sector

On-farm environmental management is the responsibility of the individual farmer. Each of the 26 Farmers Associations has an elected Environmental Committee

which provides guidance and advice to the local Growers Council and to individual farmers. SASA provides support to Environmental Committees through its Natural Resource Manager. Environmental matters at the industry level are dealt with through the SASA Environmental Committee which provides guidance and input into SASA Council on environmental matters. In 2002, SASA published the Standards and Guidelines for Conservation and Environmental Management in the South African Sugar Industry which became the basis for the revised and more detailed SUSFARMS (discussed in the following section).

1.9 How the study is situated

As was noted in the previous section, the MWP, with funding from WWF, began working in 2002 with representatives of Noodsberg Canegrowers, a group of 180 sugarcane farmers in the KwaZulu-Natal midlands, to develop and implement a holistic and sound approach to sugarcane agriculture based on the three interlinking spheres of sustainability: social, environmental and economic better practice. Through a process of desktop research and a series of facilitated stakeholder workshops, the environmental impacts of sugarcane farming were scoped and the existing industry Standards and Guidelines for Conservation and Environmental Management were reviewed and strengthened. These were then collated into the user-friendly SUSFARMS tool for farmers and extensionists.

The SUSFARMS tool was designed to guide and strengthen farm production efficiencies while reducing the impact of farming on biodiversity and ecosystems and ensuring legal compliance. It also serves as a useful learning tool for farmers and extensions workers. It includes a farm appraisal check sheet which farmers and extension staff can use to assess, track and report on farm sustainability performance. Amongst the environmental sustainability practices included in the tool are delineation of wetlands and riparian zones and the creating of associated buffers, alien invasive plant control, soil and water conservation, integrated pest management and the setting aside of biodiversity hot spot areas.

Over time the MWP partnership with the farmer group has grown to include the neighbouring farmers of UCL Company (Pty) Ltd, Eston and the milling company Illovo Sugar Ltd. In 2009, SASA endorsed SUSFARMS as their primary sustainability management tool for farmers. A key challenge that came with this endorsement was

how to provide farmers and extension staff with the skills to understand and use the tool and thereby align the industry with global sustainable reporting and certification trends.

1.10 An emerging context

Traditional approaches to agriculture and agricultural development and extension have focused on minimizing uncertainty and risk to achieve more sustained yields. However, the focus has typically been on engineering and technological approaches where people and their actions are seen as decoupled from the biosphere. Agricultural extension models have long been grounded in a teaching and information transfer model in which these engineering and technologies are passed or 'transferred' from research scientists via extensionists to farmers. History has shown us however that these approaches have mostly met with limited success as they treated education and extension as a technique to change others' behaviour (Downsborough, 2007).

In realisation of these limitations of technology transfer approaches, an emerging trend within agricultural extension and environmental learning is a shift towards being more participatory. In this approach to extension the focus is on co-engaging people in an activity or discussion that facilitates learning. Instead of trying to change behaviour, emphasis is placed on working with people in a particular and relevant context (such as on their farm on a specific topic) to facilitate learning and understanding (Babikwa, 2004; Downsborough, 2007; Mukute, 2010; Scoones and Thompson, 2009, 1994).

In parallel to the emerging trends within agricultural extension the notion of corporate sustainability and social responsibility is increasingly occupying a place of importance in the discourse surrounding business (Gray, 2005). As this discourse gains traction, organisations are seeking ways to measure and manage their interactions with suppliers, investors and civil society. Recent examples of this are the announcements by the Coca-Cola Company (Swindall, 2014), SABMiller (Guzman, 2014) and Unilever (King *et al.*, 2010) of their sustainability codes and targets relating to agricultural produce and water use, and the engagement of SABMiller with WWF Midlands sugarcane growers and Illovo Sugar Ltd on

developing a joint programme of work to support sustainability practices in their sugar supply chain in South Africa.

In 2007 Coca Cola signed a Conservation Partnership with WWF which includes to improving water use efficiencies in its agricultural supply chain, starting with sugar (Sapa-AP, 2007) and recently announced targets to procure by 2020 all their agricultural products from sustainable and responsible producers (Swindall, 2014).

In 2008, Bonsucro, a global multi-stakeholder non-profit organisation dedicated to reducing the environmental and social impacts of sugarcane production, was established and became the first global metric standard for sugarcane. The major industrial buyers of sugar in South Africa - The Coca-Cola Company, SAB Miller and Unilever - are members and are engaging with WWF, Illovo Sugar Ltd and the Midlands growers to develop joint activities towards supporting sustainable and responsible production of sugarcane. NGOs such as WWF together with Business, farmers and millers are thus currently facing rapid change and are exploring collaborative ventures to support new ways of agriculture and extension practice.

This study focuses on contributing new knowledge on how developmental work, research and expansive learning can support sustainable agriculture learning and practice amongst commercial sugarcane farmers and extensionists. Such knowledge would be useful in designing and implementing sustainable agriculture learning and extension programmes which seek to address the emerging demands from business, civil society and regulators for evidence based responsible social and environmental practice.

1.11 Overview of the chapters

Chapter 2 provides insights into the literature that has been used to guide interpretations in the research. The chapter starts with an overview of risk society to locate the study within the broad global context. It then moves onto the often contested notions of sustainability and sustainable development and the role of biodiversity in supporting human well-being. It then looks at the importance of agriculture in its role of supporting human growth and development and agricultural extension. It then moves onto cultural historical activity theory, the numerous and varied conceptualisations of learning before honing in more closely on expansive learning and how it links with agricultural extension.

Chapter 3 discusses the methodology and methods that were used in the research. The research worked with cultural historical activity theory and the theory of expansive learning as a theoretical framework and as a means to interpret and describe the farmer and extension workplace activity and learning.

Chapter 4 presents the data from the research processes, namely the interviews and outcomes of the change laboratory workshops. The chapter tracks the developments that took place during the study from the interviews to the outcomes of the workshops. Quotations were used as a means to let the voices of the farmers be heard and to assist in writing as closely to the data as possible.

Chapter 5 engages with the data. Six analytical statements were formulated from the data and are posed as statements around which discussion is then presented.

Chapter 6 provides a summary of the main findings of the research and makes recommendations. It then discusses and suggests some broader implications of the research findings for extension practice in the South African sugar industry. Finally it provides critical reflections of the study and some limitations before finishing off with recommendations and conclusions.

CHAPTER 2 REVIEW OF THE LITERATURE

2.1 Introduction

I have seen how the earth's lungs – the forests – have been decimated; its skin – the soil – is getting drier and more reliant on chemicals; the pressure on the earth's arteries – the rivers – are higher owing to blocking dams and clogging pollution. Our energy reserves – coal and oil – are being run down faster than ever...The carbon fuelled, capital driven economic growth that seemed a brilliant idea at the time [in the late eighteenth century] has expanded across the globe with barely any consideration for the finiteness of the earth's resources (Watts, 2010, part 8266 of 10873).

This chapter sets out the context within which the study was conceptualised. Its main proposition is that we are living in a risk society, which requires new ways of knowing and doing should society choose to continue prospering as it is. The chapter discusses how the epistemology of knowledge has shaped how society views the natural environment and how in turn this has shaped our approaches to knowledge, research and science. The chapter briefly looks at the various ways in which sustainability is conceptualised and then examines biodiversity as one of the underlying pillars of sustainability and human well-being and what this means for agriculture. The concept of agriculture and the important role it has played in the history of economic development is briefly discussed, together with agricultural risks and uncertainties and the notion of sustainability in agriculture. The history and typologies of agricultural extension are then examined followed by a discussion on what constitutes learning, and in turn this is followed by the linking of agricultural extension, as a framework for facilitating farmer learning, to the theory of expansive learning.

2.2 Risk society

Nature has become integrated into every facet of the modern industrialised economy as all manufactured products ultimately come from natural systems (Beck, 1992). For this reason man and nature are today increasingly seen as a connected and embedded socio-ecological system characterised by webs of complex interactions and uncertainty (Beck, 1992; Liu *et al.*, 2007). Many authors suggest the notion of risk society is an appropriate framing for building understanding of the dynamic and complex relationship between society and the natural environment (Beck, 2009, 1992; Benn *et al.*, 2009; Borne, 2009; Cohen, 1997; Mukute, 2010).

One of the central themes of risk society theory is the coupling of society to the environment. The view of man-nature connectedness is a relatively recent development in Western thinking (Benn *et al.*, 2009). Earlier Western society viewed man and nature as decoupled entities (Beck, 1992) with the Church holding authority over all. Western ontology at the time thus tended to frame nature as a given, as being disconnected from society and a force to be subdued (Beck, 1992).

These views had a significant influence on the birth of modern science. During the fourteenth century, resistance grew against the blind faith in doctrines, religious dogma and the exaggerated belief in human reasoning which had dominated Western thinking since the Middle Ages. Scholars of the time began arguing that the study of natural phenomena must be grounded on observation and experiment to provide empirically measurable evidence. This movement ultimately gave rise to the ascendancy of mathematics in understanding and explaining natural phenomena which has dominated science and research ever since (Janse van Rensburg, 2001).

By the 1600s the emergent discipline of natural science had developed exacting empirical-analytical research methods to describe natural processes; facts were observed and measured and relationships explored using reasoning (often mathematically using statistics) to come to a defensible conclusion (Janse van Rensburg, 2001). Objectivity and the conceptual separation of facts from theory and values were seen as important attributes. In order to achieve this, however, problems needed to be broken down or reduced into their smallest elements, leading to an oversimplification of complex interactions and reality. This empiricist approach to science became known as the Cartesian worldview. Over time this ideology spread around the world through processes ranging from colonisation, missionary education and agricultural extension, and came to dominate contemporary Western thinking and learning approaches (Janse van Rensburg, 2001).

The empiricist approach to science had significant benefits for Western society. It opened the door for a technological revolution. Mankind started to intervene and control nature on a scale never seen before, which ultimately gave rise to the Industrial Revolution with its unprecedented living standard improvements and technological innovations. As this modern material and economic progress was founded within the positivist Cartesian worldview, it encouraged the man-nature disconnect and consumptive use of natural capital without due consideration of how

the natural system worked, its tipping points and its capacity for resilience or renewal. Ecological deterioration was accepted as an inevitable by-product of industrialisation and an unavoidable cost in the process of economic development and improved living conditions (Cohen, 1997). Any evidence indicating overexploitation of natural resources was either consciously removed, disregarded or misunderstood (Smyth, 2006). Society thus moved in pre-modernity times from viewing risks as being unavoidable natural hazards, to the risk society of today where 'manufactured risks' of climate change, pollution and resource scarcity dominate (Beck, 1992).

In order to manage manufactured risk, industrial society devised a system of rules and placed the responsibility for them in the hands of institutions (Benn *et al.*, 2009). These traditional methods of control and 'normal-science' approaches are however increasingly being rendered ineffectual (Beck, 2009). Authors such as Pretty (1995, p1247) argue that "the dominant scientific paradigm of positivism has served us well over three to four centuries, but is not well suited to contexts where uncertainties are high, and problems are open to interpretation". Where past knowledge, solutions and approaches to learning are no longer suitable, learning approaches that create a more reflexive, resilient, flexible, adaptive, and, ultimately, more sustainable world are required (Wals *et al.*, 2009). The challenge lies in how this learning for sustainability can be brought about. Mukute (2010), in his study to explore and expand farmer learning, suggests expansive learning as a suitable approach (discussed in more detail in section 2.9 of this chapter).

2.3 Sustainability and sustainable development

2.3.1 Sustainability and sustainable development as a contested term

Sustainability and the notion of sustainable development is a complex and often contested concept (Blackmore, 2007). There is no uniform understanding on what sustainability or sustainable development means (Wals, 2007). To some, it implies persistence and the capacity of something to continue for a long time. To others, it implies resilience and the capacity to bounce back after unexpected difficulties; or that developmental activities simply take account of the environment. With regard to the environment, sustainability is commonly seen to mean not damaging nor

degrading natural resources (Pretty in Mukute, 2010). However the very term 'environment' is in itself problematic as there is still widespread confusion as to what this term means or encompasses. Smyth (2006 pp248-249) suggests that:

Our environment is the totality of what we live in, natural or constructed, spatial, social and temporal. It is an extension of ourselves, its health requiring the same care as our own health. Because we share it with other people its care is a shared responsibility. The parts that are familiar and significant to us connect by many complex links to unfamiliar systems, and to a global environment which includes the significant worlds of people and other organisms unknown.

The most widely used definition of sustainable development comes from the United Nations World Commission on Environment and Development (1987, par 15) which sees the aim of sustainable development as seeking to ensure that:

...needs of the present generation are met without compromising those of future generations in a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspiration.

Perhaps the most appropriate definition for the context of this study is that of Lotz-Sisitka's (in (Mukute, 2010 p22) who suggests sustainable development "practices take full account of the economy-environment-society nexus in development interventions and initiatives (e.g. production processes) that are oriented towards ecological sustainability, social justice, and a more benign economic system".

2.3.2 Conceptualisations of sustainability and sustainable development

Sustainable development has been graphically represented in a number of ways. Most logic models link environmental (i.e. bio-physical) problems to that of social problems in the sense of a coupled destructive relationship. (Hattingh, 2004) argues that this becomes problematic as social problems, because of their immediacy, become fore-grounded and dealt with first, while the bio-physical problems are moved to the background to be dealt with later. The classic representation of this framing is found in the Venn diagram of three overlapping circles where each circle respectively represents the sphere of the economy, the socio-political aspects and the environment. Where these circles overlap is considered the sustainable development domain (Figure 2.1).

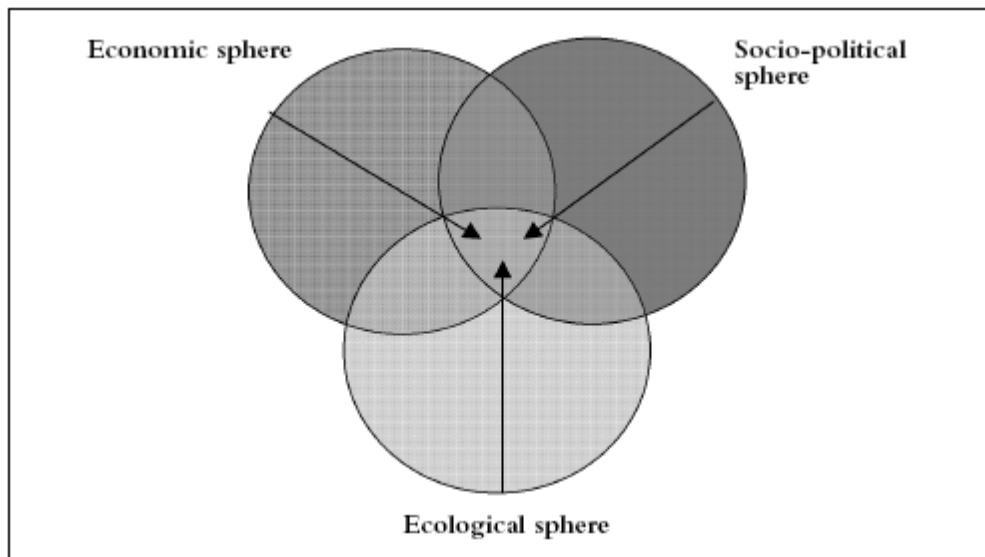


Figure 2.1: The classic representation of sustainable development

(Source: Hattingh, 2004)

Another common representation of sustainable development is the three pillars model where the environmental, socio-political and economic dimensions are represented as separate pillars atop a foundation of technology and governance (Hattingh, 2004). It has been argued however that these two depictions of

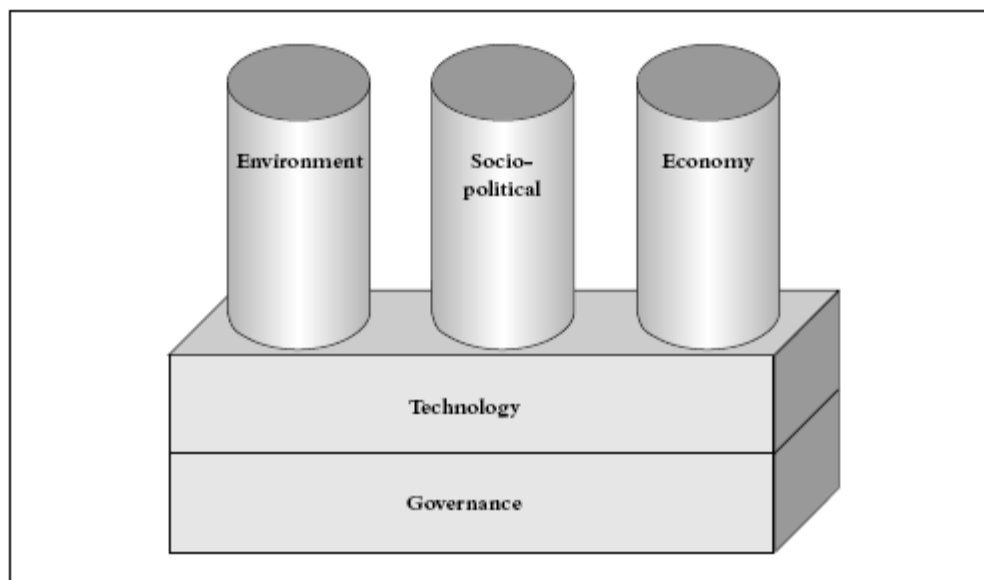


Figure 2.2: The three pillars model representation of sustainable development

(Source: Hattingh 2004)

sustainable development are not as ideologically neutral as they appear. Hattingh (2004) points out that both the overlapping circles and the three pillars model

disregard how the economic, social and political spheres interact, affect or depend on one another. He posits that the three circles or pillars model locks us into the language and practice of mitigating inevitable social and environmental costs related to economic and human development, and that the model is embedded in conventional instrumental rationality that is not strong enough to resist the current exploitation of the bio-physical environment leading to the environmental problems we face today.

As a solution Hattingh (2004) puts forward an alternative notion of sustainable development where the ecological, socio-political and economic spheres are embedded within one another and underpinned by governance, Hattingh, (2004). This image implies that these activities are interconnected, embedded and nested and that activities in one sphere will have an impact on another. It suggests preventing impacts instead of mitigation and introduces the notion of non-negotiable

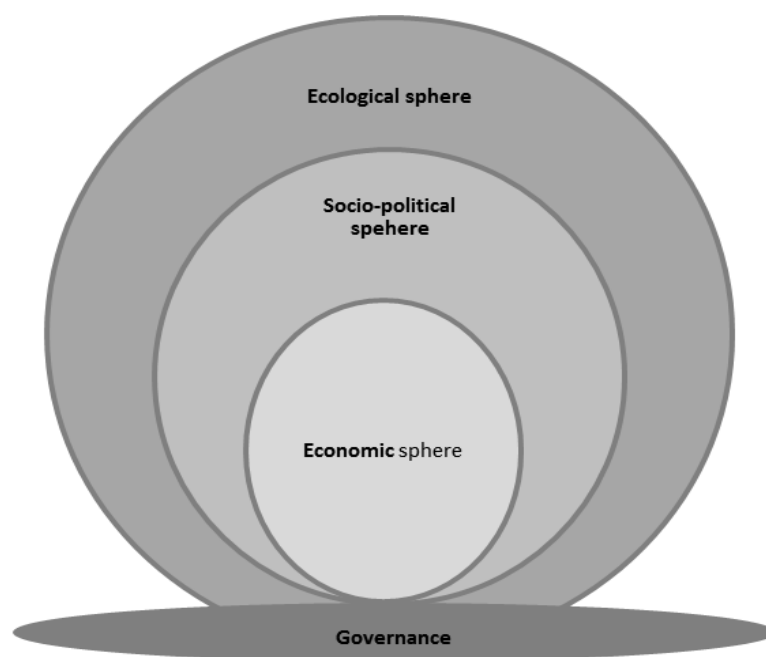


Figure 2.3 Portraying sustainable development in terms of three embedded spheres.

(Source: Department of Environmental Affairs, 2011; Hattingh, 2004; Steffen et al., 2011)

thresholds in the social and environmental spheres underpinned by precaution and safe minimum standards. In this study Hattingh's (2004) depiction of the nested spheres of sustainability is considered most relevant.

2.4 The role of biodiversity in supporting human well-being

Biodiversity, in essence, is the assortment of species, genes and ecosystems found on land, in freshwater and in the oceans. Collectively biodiversity helps drive and maintain Earth's life-support systems on which human society depends (Biggs *et al.*, 2006; Folke *et al.*, 1993; Rockström *et al.*, 2009; Steffen *et al.*, 2011). There is growing concern, however, over the rate and extent of world-wide ecosystem degradation as a result of this human activity. It has been calculated that these changes have resulted in the boundaries of three of the nine interlinked planetary systems important for ecosystem health and human wellbeing (climate change, nitrogen cycle and biodiversity loss) having been overstepped, with potentially harmful results (Rockström *et al.*, 2009b). The drivers of environmental change are multidimensional, complex and interconnected and are projected to intensify as the human population grows and per capita consumption increases. Some of these drivers are briefly discussed below.

Growth: Between 1960 and 2000 world population doubled to 6 billion people and the global economy increased more than six fold, driving significant demand for regulating and supporting ecosystem services. The growing demand for these ecosystem services was met both by consuming an increasing amount of available supply (for example, diverting more water for irrigation or capturing more fish from the sea) and by raising the production of some services, such as crops and livestock. Over this period food production increased by roughly two-and-a half times, water use doubled, wood harvests for pulp and paper production tripled, installed hydropower capacity doubled, and timber production increased by more than half in order to meet demand (Millennium Ecosystem Assessment, 2005).

Ecological Economics: Globalisation, capitalism and the market economy - as the dominant global economic model - largely excludes or externalises environmental impact and costs in production processes and foregrounds individual wealth over collective well-being. The primary contradiction in capitalism is that between the use value and exchange value of commodities (Engeström, 2001). This has resulted in failure to account for the full suite of production costs and little to no recognition of the broader economic values of ecosystems and biodiversity to society (Sukhdev *et al.*, 2010).

Land use practices: Agriculture is the dominant use of land globally, covering 24% of the Earth's land surface. Together with urban development and the spread of invasive species, it is recognised as exerting the most significant effect on biodiversity loss and ecosystem degradation (Biggs *et al.*, 2006). The rise of agriculture to dominance happened recently and quickly with more land being converted to crop production in the 30 years after 1950 than between 1700 and 1850. Agriculture also impacts on freshwater. Sixty (60) to 70% of available water locally and globally is used for irrigation with large impoundments needed to store water for irrigation and flood control, negatively affecting downstream river flow and habitat characteristics (Grimmond, 2010).

Knowledge: A large part of the reason for the loss of biodiversity is that contemporary human society does not – or consciously chooses not to - recognise the interdependence of the social-ecological system and the role species and ecological infrastructure play in supporting human well-being (Carpenter *et al.*, 2012; Folke *et al.*, 1993).

Drivers of biodiversity loss and ecosystem change are multi-dimensional and complex interactions between economic, political, socio-cultural and legal factors. Traditional science, research and educational orientations have not prepared society well for dealing with the complexities of socio-ecological systems, including in agricultural settings. What scholars and practitioners are suggesting rather are “post-normal’ scientific practices that “deal with not only the consequences of human activity, but human activity itself” (Woodhill and Roling 2001, p46) and which recognise and engage plural ways of knowing and doing through approaches that facilitate change-oriented learning in educational and extension settings (Mukute and Lotz-Sisitka, 2012; Scoones and Thompson, 2009; Smyth, 2006).

2.5 Agriculture and its role in supporting human well-being

2.5.1 A Brief history of agriculture

Humans have been farming for around 12 000 years. For most of this time the production and consumption of food has been intimately connected to culture and society (Pretty, 2002). Over time there have been long periods of stability as well as

periods of rapid change which have resulted in fundamental shifts in how people thought about and practised farming.

One of the most important of these shifts came with the advent of modern high intensity agriculture and the Green Revolution of the 1960's and 1970's that followed. The Green Revolution developed in response to the growing food needs from an ever-expanding and more affluent human population and to the dwindling availability of fertile land. To achieve greater yields per hectare, modern agriculture employs intensive mono-cropping and animal husbandry techniques that are heavily reliant on external inputs such as artificial fertilisers and irrigated water, as well as on specialised technologies and credit facilities (Mukute, 2010; Pretty, 1995). Modern agriculture tends to fore-ground economic goals over the social and ecological dimensions of agriculture and is dominated by management approaches that favour reductionist or mechanistic thinking which sees farming in isolation rather than nested within a complex socio-ecological system (Mukute, 2010; Whiteside, 1998). There is no doubt however that the benefits of the Green Revolution and modern agriculture have been immense; the doubling of global cereal production in the past 40 years, increased global per capita food supply, reduced hunger and improved nutrition (Tilman *et al.*, 2002). However, there are challenges in dealing with the social and ecological consequences modern day agriculture brings.

2.5.2 The concept of agriculture

Modern day agriculture (depicted in Figure 2.4) encompasses the science, technology and business involved in intensive plant cultivation and livestock husbandry for human use and includes the associated activities of financing, processing, marketing, distribution of products and farm production supply which in turn are nested within the sociological, political, environmental and cultural context of the food and fibre system (Yunlong and Smit in Mukute, 2010). The biophysical component provides renewable and non-renewable natural resources that are used in agricultural activities. The key concern of agriculture is profitability by keeping, and enhancing, the productive potential of the biophysical environment. The socio-political component influences agriculture because it is the human element - policies, cultures, beliefs and traditions - that shape the manner in which agriculture is pursued (Yunlong and Smit, 1994 in Mukute, 2010). The techno-economic

component of agriculture is concerned with and affects the feasibility and viability of agricultural activities (input, labour and transport costs, availability and accessibility of technology, prices of agricultural commodities).

Roling and Jiggins (1998) suggest that agriculture exists within a knowledge system where stable actor networks support agricultural innovation and learning. They note that these knowledge systems are located within a coherent epistemology and typically comprise researchers, extensionists and farmers.

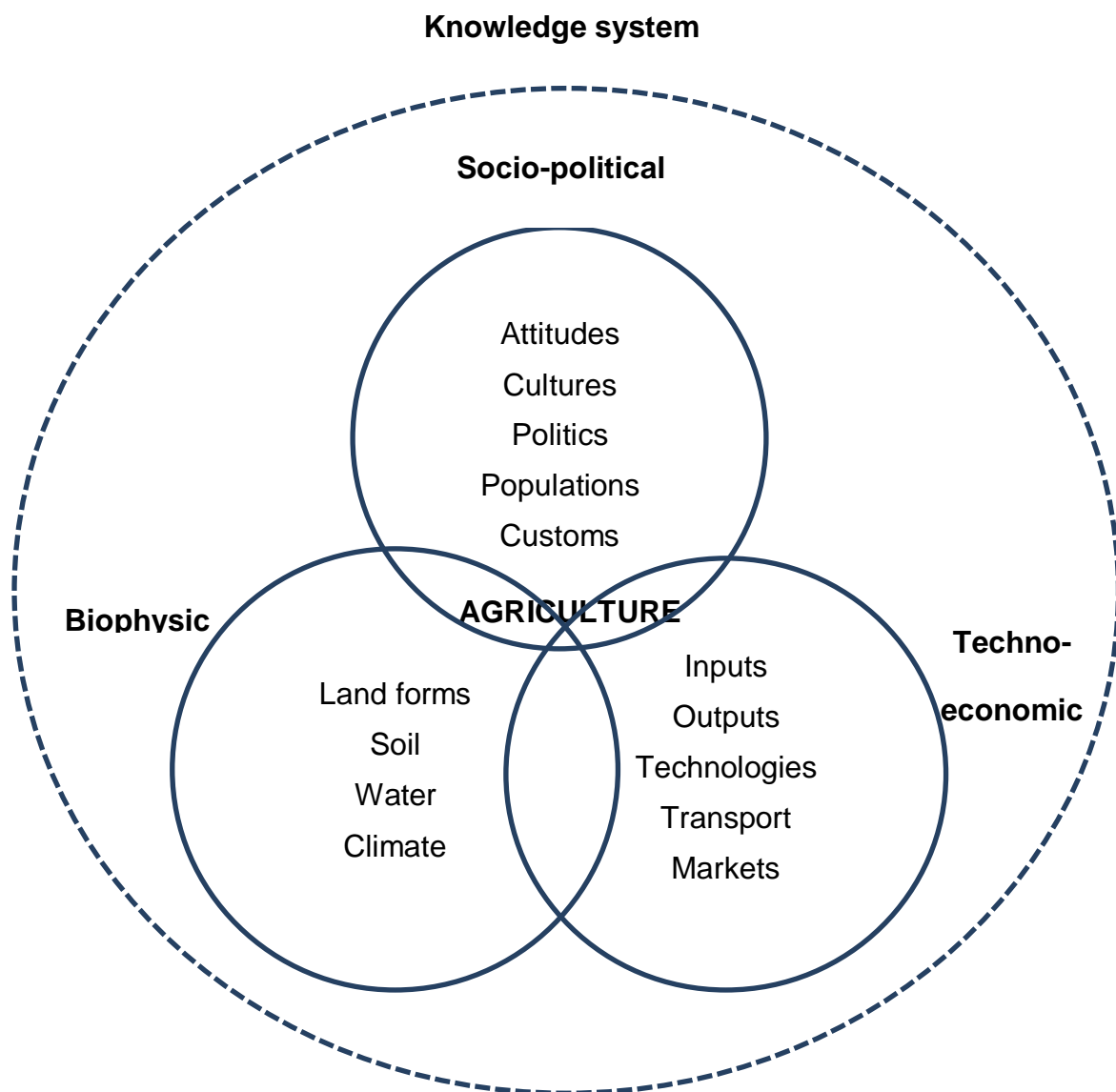


Figure 2.4: Depiction of modern-day agriculture and its context

(Source: adapted from Yunlong and Smit in Mukute, 2010 and Rolling & Jiggins 1998)

The framing of agriculture in the above-mentioned manner is useful and relevant to this study in that the interplay and relationships between the above-mentioned components create the broader context which effects the distribution of influences, benefits and incomes from sugarcane farming (Yunlong and Smit, 1994 in Mukute, 2010).

2.5.3 Agricultural issues, risks and uncertainties globally and in South Africa

The increasing human ecological footprint on the earth (currently standing at 80% of the planet's terrestrial area) is straining existing supplies of arable land, clean water, energy and other resources (Rockström *et al.*, 2009). Crop yields are increasingly uncertain due to the vagaries of climate change, steadily rising input costs and a globalised economy where commodity prices are subject to downward pressure from cheaper imports (Sanderson *et al.* in Jackson *et al.*, 2007). Pimbert (2009, p5) notes that “business as usual is not an option” and that:

Agriculture has a footprint on all of the big environmental issues, so as the world considers climate change, biodiversity [loss], land degradation, water quality issues, etc. they must also consider agriculture which lies at the centre of these issues and poses some uncomfortable challenges that need to be faced. We've got to make sure the footprint of agriculture on climate change is lessened; we have to make sure that we don't degrade our soil, we don't degrade the water, and we don't have adverse effects on biodiversity.

In suggesting solutions, Pimbert (2009, p6) calls for farming and knowledge systems that “establish more socially and ecologically resilient systems whilst maintaining current levels of productivity and profitability of farmers”.

2.5.4 Sustainability as an approach to agriculture

Modern intensive agriculture has been widely criticised as being environmentally detrimental and nonviable (Cai and Smit, 1994a; Pretty, 1995; Dragun *et al.*, 1999 cited in Shi, 2002). In response to these criticisms sustainable agriculture approaches are gaining prominence (Hansen, 1996) as they attempt to address the criticisms against modern agriculture whilst mitigating environmental degradation and climate change threats on food security and ecosystem resilience (Shi, 2002).

Despite general consensus on the importance and relevance of sustainability and its desirability as a goal of agriculture, there exists a wide variation in how the notion is conceptualised. Mandla (2012) regards agricultural systems to be sustainable if they are economically viable, environmentally safe and socially fair. Pretty and Howes (in Webster, 1997) suggest that agricultural sustainability encompasses a whole-farm management perspective so as to conserve soil, waste, energy and biological resources. Tilman *et al.* (2002, p672) offer another viewpoint in suggesting that

“sustainability [in an agricultural context] implies both high yields that can be maintained in the face of major shocks as well as agricultural practices that have acceptable environmental impacts”. Mukute (2010), drawing on the view of the World Commission on Environmental Development, adds a further angle by suggesting that sustainable agriculture falls within the broader concept of sustainable development where the needs of the present generation are met without compromising those of future generations.

Sustainable agriculture can also be conceptualised from a production point of view. The United Nations Conference on Environment and Development cited in Shi (2002) sees sustainable agriculture in terms of emphasising the need to enhance agricultural productivity in a manner that provides affordable, efficient and healthy diets to all at the lowest environmental cost. It notes, however, that “[n]o single blueprint of sustainability will be found, as economic and social systems and ecological conditions differ widely among countries” (Shi, 2002, p360).

Hansen (1996, p10, p119), in a comprehensive review of the concept of agricultural sustainability, suggests two broad interpretations of agricultural sustainability that are perhaps most useful to this study. The first interpretation is that of ‘system-describing’ which interprets agricultural sustainability either as an ability to fulfil a diverse set of goals, or as an ability to continue. The second interpretation sees agricultural sustainability as a ‘goal-prescribing’ characterisation which interprets sustainability as an ideological or management approach to agriculture as a response to concerns about negative impacts of agriculture and which motivates for the adoption of alternative approaches.

Hansen and Pretty (1996; 1995) argue that the variety of ideologies around sustainable agriculture and the way that resource-conserving technologies and practices are developed by scientists in isolation from farmers results in few farmers adopting new sustainable practices without considerable adjustment on their part. As a result, approaches which consider the needs and goals of farmers and society and which view farming as complex and unpredictable socio-ecological systems where sustainability approaches are not prescribed but embrace uncertainty, multiple sources of knowledge and promote a learning rather than teaching approach are increasingly being called for (Hansen, 1996; Pretty, 1995).

2.6 Agricultural extension

2.6.1 History of agricultural extension and research

Agricultural extension work has a venerable, although largely unrecorded, history that has adapted and changed over nearly four thousand years (Garforth and Jones, 1997). The first evidence of dissemination of agricultural information comes from Mesopotamia and China around 1800 B.C. Modern forms of Western agricultural extension and research can be traced back to the Renaissance Period when European society transformed from its medieval feudal form into recognisably modern social systems. In the early eighteenth century, clergymen, schoolteachers and progressive landowners and farmers began bringing up-to-date agricultural knowledge to farmers, either individually or through early agricultural associations. By the 1820s, most of the elements for creating modern forms of agricultural extension were in place in Europe and the technology spread in the later nineteenth century to the United States, Australia and Japan (Garforth and Jones, 1997). Some scholars regard agricultural extension as a significant social innovation and an important force in social change because it helped drive production surpluses and population growth and enabled people to move from subsistence lifestyles towards more industrious activity.

The modern extension service as we know it today came into existence in response to the outbreak of potato blight in Europe in 1845 and the widespread economic hardship of the 'potato famine' in Ireland (Garforth and Jones, 1997). Trained extensionists were recruited to offer farmers information and guidance in overcoming the blight through better husbandry and adapting to new circumstances (Bembridge, 1991). In many colonial African territories, missionaries often undertook agricultural education activities as colonial government interaction with agriculture was minimal before 1914 because early departments of agriculture were largely involved only in administrative duties (Garforth and Jones, 1997).

As extension organisations grew in the early twentieth century from small scale haphazard activities towards more formalised endeavours, they inevitably became more bureaucratic, hierarchical and diversified. In the less developed countries, extension models have tended to emulate those of the industrialised countries, focusing on agricultural (mainly food) production to support rural livelihoods, with

varying degrees of success (Bembridge, 1991). Among large-scale commercial farmers of the North - and increasingly in some Southern Hemisphere countries - the focus is somewhat different. In these regions economic returns and livelihoods are threatened by surplus production and environmental degradation associated with intensive production methods. In response agricultural extension services are evolving to include stronger emphasis on both social dimensions and environmental considerations in their activities (Garforth and Jones, 1997).

In South Africa agricultural extension for the commercial farming sector became official in 1924 when the Division of Agricultural Education and Extension was formed and then the first 10 extension workers were appointed in 1925. The extension service was loosely modelled on the American system where extension workers were based at agricultural colleges and received guidance and training from college specialists. Extension methods of the time in South Africa included the showing of American educational films, lectures and demonstrations to farmers. Demonstrations based on the 'seeing is believing' principle were also used with general success in stimulating farmers to adopt new methods (Bembridge, 1991). It was only in 1959 that the first formal course in agricultural extension was offered in the country by the University of Pretoria (Bembridge, 1991).

2.6.2 Typologies of agricultural extension

The term "extension" has a wide variety of meanings with no single agreed definition. However, in broad terms, conventional agricultural extension can be understood as the production and exchange of knowledge which seeks to enlarge and improve the abilities of farmers to adopt more appropriate and often new practices in adjusting to changing conditions and societal needs (Cornwall *et al.*, 1994; Garforth and Jones, 1997). Extension is usually carried out for a particular reason by people who make methodological choices based on their understanding of knowledge and learning. The literature on extensions reveals a range of extension typologies which can be ascribed to differences in the underlying epistemologies of extension and the role it plays in rural development, science and how people learn (Roling and Wagemakers, 2001).

Duvel (2003, p13) argues that there is no singular 'best extension approach', but rather a range of approaches with varying epistemologies that may be more or less

suited to a specific learning context. Duvel places extension approaches into two broad groups. The first group are those that are essentially production-technology or technology-transfer centric. These approaches tend to be centralised, top-down and blueprint in nature. The second group are those that are essentially problem solving and participatory in orientation with guiding principles that include empowering farmers in a manner where scientists are not seen as outsiders, but where various forms of knowledge are engaged jointly and participatively to solve context-specific issues in long term processes. This framing generally corresponds with the framings of Cornwall *et al.* (1994), Mukute (2010), Scoones and Thompson (1994) and Whiteside (1998) (summarised in Table 2.1). Although these authors' framings of extension were developed in the context of small-scale farmers, they arguably apply equally to industrial agriculture, such as commercial sugarcane farming (Chambers, 1994).

In Southern Africa the progression and evolution of approaches to agricultural extension have broadly followed the rest of the world (Mukute, 2010; Whiteside, 1998). In South Africa the dominant approaches to agricultural extension are Transfer of Technology, Farming Systems, Train and Visit, and the Farmer First Approach (Mukute, 2011; Whiteside, 1998; Worth, 2006). They are briefly discussed below and outlined in Table 2.1.

2.6.2.1 Transfer of Technology

The most widely held view on the role of extension is to transfer and disseminate ready-made knowledge from researchers to farmers via extension workers who act as intermediaries in the process. Transfer of Technology (ToT) is consistent with the linear or positivist epistemology that currently dominates extension theory and practice and is conceptually based on reductionist thinking where complex issues are broken down into simplified components (Bembridge, 1991; Leeuwis, 2004; Roling and Wagemakers, 2001). It seeks to improve productivity using prescriptive top-down technology with success measured by the rate of adoption. The main thrust of ToT is to change farmer behaviour. Farmers are not viewed as innovators but as either progressive adopters of information or laggards, their role being to learn, adopt and conform. The research and extension process is supply-driven where the assumption is that technologies developed at research stations are appropriate for individual farmers. Extension methods include farm visits,

demonstrations, group training sessions and extension articles in farmer correspondence media. Sustainability, institutions and politics are not considered elements. In South Africa the ToT approach to agricultural extension is long standing, where success is measured by the rate of adoption of new technologies to improve production (Worth, 2006). The ToT approach however is considered mostly unsuccessful in accommodating the situated knowledge of farmers and the wide ranging agro-ecological and social conditions and complexity of modern agricultural production systems (Mukute, 2010).

2.6.2.2 Farming Systems Research and Extension

Farming Systems Research and Extension (FSRE) emerged in the 1970s as a result of the failure of the Green Revolution in Africa and the inadequacies of the prevailing ToT mode (Cornwall *et al.*, 1994; Whiteside, 1998). FSRE recognises that constraints at the farm level limited the adoption of new technologies from outside. It profiles the agro-ecological context over the traditional yield optimisation focus and recognises agriculture as a complex activity in which all important variables must be considered. For this reason it calls for a multi-disciplinary approach to problem analyses, technology design, experimentation and evaluation. Research and extension activities in FSRE are informed by farmer needs rather than researcher preconceptions and thus researchers and extensionists are encouraged to work together with farmers to design, test and refine agricultural technologies to suit local conditions. A number of methods have been developed to support the implementation of FSRE where farmers are included in research and experimentation trials. The more inclusive approach of FSRE has resulted in better appreciation of farmer contexts and abilities and the complexity of farming systems. However it remains an approach with a technology bias at the expense of the social dimension where social scientists are hardly involved.

Table 2.1: Approaches in agricultural research, development and extension

	Technology transfer	Farming Systems Research	Farmer First/Farmer Participatory research	People-centred innovation and learning
Era	Long history, central since 1960s	1970s-1980s	From 1990s	2000s
Mental model of activities	Supply through pipeline	Learn through survey	Collaborate in research	Innovation network centred on co- development; involving multi-stakeholder processes and messy partnerships
Farmers seen by scientists as:	Progressive adopters and laggards	Objects of study and sources of information	Colleagues	Partners, collaborators, entrepreneurs, innovators; organised group setting the agenda, “the boss”
Scientists as seen by farmers	Not seen – only see extension workers	Used our land, asked us questions	Friendly consumers of our time	One of many sources of ideas
Knowledge and disciplines	Single discipline driven (breeding)	Inter-disciplinary (plus economics)	Inter-disciplinary (more, plus farmer experts)	Extra/trans-disciplinary – holistic, multiple culturally rooted practices
Farmers’ roles	Learn, adopt and conform	Provide information for scientists	Diagnose, experiment, test, adapt	Empowered, co-generators of knowledge and innovation; negotiators
Scope	Technology packages	Modified packages to overcome constraints	Joint production of knowledge	Social networks of innovators; shared learning and change; politics of demand
Drivers	Supply push from research	Scientists’ need to learn about farmer	Demand pull from farmers	Responsiveness to changing contexts: markets, globalisation, climate change, organised farmers, power and politics

		conditions and needs		
Key changes Sought	Farmer behaviour	Scientists knowledge	Scientist-farmer relationships	Institutional, professional and personal change; opening space for innovation
Intended Outcome	Technology transfer and uptake	Technology produced with better fit to the farming systems	Co-evolved technology with better fit to livelihood systems	Capacities to innovate, learn and change
Institutions and politics	Technology transfer as independent: assumed away	Ignored, black box	Acknowledged but sometimes naïve populism	Central dimensions of change
Sustainability	Undefined	Important	Explicit	Championed – and multidimensional, normative and political
Innovators	Scientists	Scientists adapt packages	Farmers and scientists together	Multiple actors, learning alliances

(Source: Mukute, 2010; Scoones and Thompson, 2009, p. 6)

2.6.2.3 Farmer first or Farmer Participatory Research

Farmer First (FF) or Farmer Participatory Research (FPR) approaches evolved from the growing realisation of the shortcomings of prescriptive top-down approaches that do not consider farmer and agro-ecological complexities. The approach is more inter-disciplinary and recognises farmers and scientists as experts and innovators. Social scientists are also included in the joint production of knowledge with farmers. Sustainability is more explicit while institutions and politics are treated as important, albeit naively so. Whiteside (1998) points out that the approach has a number of key concepts:

- Farmers are knowledgeable, especially about local conditions. This knowledge evolves over time and is made up of home-grown technical knowledge and more recent knowledge obtained from a number of sources.
- Farmers are mostly rational, responding in their own best interests to the diverse physical, economic and social environments in which they operate. However, this rationality is exercised within a specific social and cultural context.
- Farmers need an enabling environment, including resources, information, security and power.
- Participation by farmers in the process of identifying and overcoming problems is essential.
- Barriers to adoption from scientists, extensionists and farmers can be expected because of its divergence from traditional extension approaches.

Within FF/FPR approaches there are a number of sub-approaches drawing on applied anthropology where the importance of local knowledge, values, behaviours and perspectives are fore-grounded. These include: Participatory Learning and Action, Participatory Technology Development, and Farmer Field Schools all of which have different emphases, as described by Mukute (2011):

Participatory Learning: the Participatory Learning approach is based on the cycle of theory which informs action which in turn informs theory. People learn from interaction with others and from experiencing new situations. In this sub-approach the extension worker role is to:

- Provide training of farmers in specific research topics;

- Conduct regular reviews of research priorities with farmers;
- Stimulate and support farmer to farmer learning programmes; and
- Facilitating the scaling up of good practice.

Participatory Technology Development (PTD): This sub-approach seeks to:

- Build on local knowledge and skills;
- Ensure participation of farmers in decision-making to increase their technical capacity and technology choices; and
- Strengthen local institutions.

The advantages of PTD are that it builds trust between farmers and outsiders, taps farmers' potential to innovate, strengthens linkages between outside and situated knowledge sources, and builds farmer resilience under current risk society conditions.

Farmer Field Schools (FFS): a common approach developed in Asia that was later introduced into Southern Africa. The main characteristics are:

- Farmers are regarded as experts and learn as they farm, conducting their own experiments and studies in the field;
- Extension workers serve a facilitation and not a teaching role;
- Scientists and extension workers or subject matter specialists work with, instead of lecturing to, farmers;
- Learning curriculums are holistic and cover agriculture, economics, ecology, sociology and education;
- Training follows the seasonal cycle;
- Learning materials are learner generated; and
- There is farmer interaction through regular farmer group meetings.

Traditional information transmission and farmer participatory approaches in agricultural research and extension have been credited with improving the relevance and uptake of research results and improving agronomic yields (Scoones and Thompson, 2009). However, the approaches have limitations in that they mostly neglect structural, contextual and historical aspects and provide inadequate connection between basic and adaptive research (Mukute, 2011). As a result, such approaches to research and learning tend to reproduce and not transform

entrenched practice and reduce the range of choices for thinking and practicing in new ways to address emerging challenges. As a result agricultural extension and education practice is beginning to explore process- and learning-driven approaches (Mukute, 2011, 2010; Mukute and Lotz-Sisitka, 2012). An example is People Centred Learning and Innovation which is discussed in more detail below.

2.6.2.4 People Centred Learning and Innovation

People Centred Learning and Innovation (PCLI) is a relatively new extension approach situated within social learning (Mukute, 2011). PCLI eschews the epistemologically dominant extension paradigm of diffusion of innovation and allows for the formation of innovation networks centred on co-development involving multiple stakeholder processes and ‘messy’ partnerships with the intended outcomes of improved capacities to innovate, learn and change. Sustainability is championed and it is viewed as multi-dimensional, normative and political. Scientists are viewed by farmers as one of many sources of ideas and knowledge. Farmers in turn are viewed by scientists as being partners, collaborators and innovators who help set the research and practice agenda. The important features of PCLI are its group and collective approach, and the recognition that agriculture is multi-dimensional in covering the economic, social and ecological spheres. It engages policy, institutions and structures that have a bearing on knowledge generation and use and it embraces the multi-voicedness of agriculture. The scope of PCLI tends to be wider and beyond the farm gate to include multi-functional agriculture, livelihoods, food systems and value chains over long time frames across multiple scales from global to local. Sustainability, particularly as it relates to the environment and livelihoods, is considered a critical issue (Mukute, 2010).

2.7 Cultural Historical Activity Theory

Cultural Historical Activity Theory (CHAT) forms the epistemological framing for this study. CHAT suggests that learning takes place through collective activities that are purposefully directed around a common object. CHAT draws on established systems based principles, but takes a radically different approach. It is based on the proposition that learning is a social and cultural process that draws on historical achievements (Mukute and Lotz-Sisitka, 2012) and more purposefully incorporates the interactions of learners with elements of their social and biophysical environment

(Krasny and Roth, 2010). The focus for activity theory is on activity systems consisting of changes that come about in learners, social communities, objects, and tools as they interact over time. Thus, activity theory incorporates complexity, change, and adaptation or expansion over time within a particular learning, practice, or social ecological system (Krasny and Roth, 2010).

Traditional systems-based thinking developed by biologists, physicists and engineers is constructed essentially on simplified or idealised models of how the physical world behaves. In contrast, CHAT was developed by cognitive psychologists who argued that if the way we gain insights of the real world is essentially a cognitive rather than a physical process, then systems models should be based on the understanding of these cognitive processes. These cognitive 'mental models' look rather at how we develop understandings of the real world, draw meanings from these understandings, create learning from those meanings and are motivated to respond to those, instead of attempting to model how the world actually works in a physical or biological sense (Capper and Williams, 2004). A CHAT based enquiry according to Capper and Williams (2004) is therefore comprised of three elements:

- A systems component that helps to construct meanings from situations.
- A learning component as a way of learning from those meanings.
- A developmental component that allows for the expansion of those meanings towards action.

CHAT can be understood through five principles described below:

The *first principle* is that a collective, artefact-mediated and object-oriented activity system, seen in its network of relations to other activity systems, is the prime unit of analysis. This means that the motive for the individual or group of people (such as sugarcane farmers) to participate in, for example, the practice of sustainable farming, can only be fully understood if interpreted in relation to other activity systems influencing their activity system (Engeström, 2001; Masara, 2010).

The *second principle* is the multi-voicedness of activity systems. An activity system is made up of a many individuals and communities that have multiple points of view, traditions and interests. The division of labour in an activity creates different positions for people who in turn pose their own diverse histories, and the activity system itself has multiple layers and strands of history embedded within its rules, objects and

conventions. The multi-voicedness is multiplied in networks of interacting activity systems. It is a source of trouble and a source of innovation, demanding actions of translation and negotiation (Engeström, 2001; Masara, 2010).

The *third principle* is historicity. Activity systems take shape and get transformed over lengthy periods of time and need to be considered not only in terms of the local history of the activity system and its objects, but also in the history of the theoretical ideas and tools that shaped the activity (Engeström, 2001; Masara, 2010).

The *fourth principle* is the central role of Contradictions as sources of change and development. Contradictions are not the same as problems or conflicts but are historically accumulating structural tensions within and between activity systems (Engeström, 2011). When an activity system adopts a new element from the outside (for example, a new tool such as SUSFARMS or a new object such as sustainable farming practices), it can lead to aggravated Secondary Contradictions where some old elements (for example, the Rules or the Division of labour) collide with the new ones. Such Contradictions not only generate disturbances and conflicts, but also opportunities for innovation to change the activity. There are four levels of Contradictions (Table 2.2): primary, secondary, tertiary and quaternary (Masara, 2010; Mukute, 2010). A Primary contradiction happens within elements such as the artefacts or the rules; a Secondary Contradiction occurs when there is tension between one element and another in the activity system; a Tertiary Contradiction happens when the old activity system clashes with a more advanced activity system; while a Quaternary Contradiction occurs when the central activity clashes with any of its neighbouring activity systems (Engeström, 2001; Masara, 2010).

Table 2.2: Levels of Contradiction

Level of Contradiction	Explanation
Primary	Contradictions are within the elements of the central activity system, such as the mediating artefacts or the rules
Secondary	Contradictions occur when there is tension between one element and another in a central activity system
Tertiary	Contradictions happen when the object/motive of a dominant or old form of the central activity system clashes with the object/motive of a culturally more advanced form of the central activity system
Quaternary	Contradictions are contradictions between the central activity system and its neighbouring or related activity systems

(Adapted from Masara, 2010; Mukute, 2010)

The *fifth principle* asserts the possibility of expansive transformations in activity systems. Activity systems move through relatively long cycles of qualitative transformations. As the Contradictions of an activity system are surfaced, some individual participants begin to question and diverge from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort that embraces a radically wider horizon of possibilities, termed expansive transformation, from where the concept of expansive learning has been drawn.

2.7.1 Activity systems as units of analysis

The anatomy of an activity system is commonly depicted by Vygotsky's triangular model (Figure 2.5) developed in the late 1920s and further enhanced by Engeström (1987). This conceptualisation of activity systems sees the Object as the crucial factor that gives direction, purpose and identity to an activity. Engeström sees such activity systems as units of analysis characterised by flux, movement and systemic change which mark a capacity to learn (Edwards, 2005a). An activity system is made up of the following elements ((Engeström, 1999; Mukute, 2010):

Subject: Individual or group of people whose agency is chosen as a point of view in the analysis of the activity system.

Object: Raw material or problem space being worked on, a horizon never fully reached.

Outcome: Desired result of working on the object.

Tools: Conceptual and material artefacts for understanding or transforming the object (carrying culture, history, skill and knowledge involved in developing them).

Community: Group of people who share the same Object.

Division of labour: Horizontal and vertical allocation of responsibility which mediates relationship between the Community and the Object.

Rules: Mediate the interaction between the Subject and the Community, as well as between the Subject and the Object.

2.7.2 Generations of Activity Theory

Activity theory's first iteration centred on Vygotsky's idea of cultural mediation of actions commonly expressed using the triangle with Subject, Object and Mediating artefact at each point **Error! Reference source not found..** In the context of agriculture this can be illustrated by a farmer (Subject) using a tractor and plough (Mediating artefact or Tool) as a means of producing a crop (Object or Goal). Vygotsky's insertion of cultural artefacts into human actions was revolutionary in that the basic unit of analysis overcame the split between the Cartesian conceptual separation of fact from theory and values. In other words, it was argued that the individual could not be understood without their cultural context, and society could not be understood without the agency of individuals who use and produce the artefacts. The limitation of the first generation activity theory however was that the unit of analysis was focused on the individual (Engeström, 2001). This was overcome by second generation activity theory developed by Leont'ev who sought to overcome the Cartesian split between individual and society through including the social elements of Community, Rules and Division of labour (Engeström, 1987), thus recognising that there are other activity system stakeholders (such as - in the farming context - consumers, regulators or input suppliers). This expansion of the basic Vygotskian triangle was an important development as it brought the interrelations between individual and community into focus (Mukute, 2010) and emphasised the importance of analysing their interactions with each other.

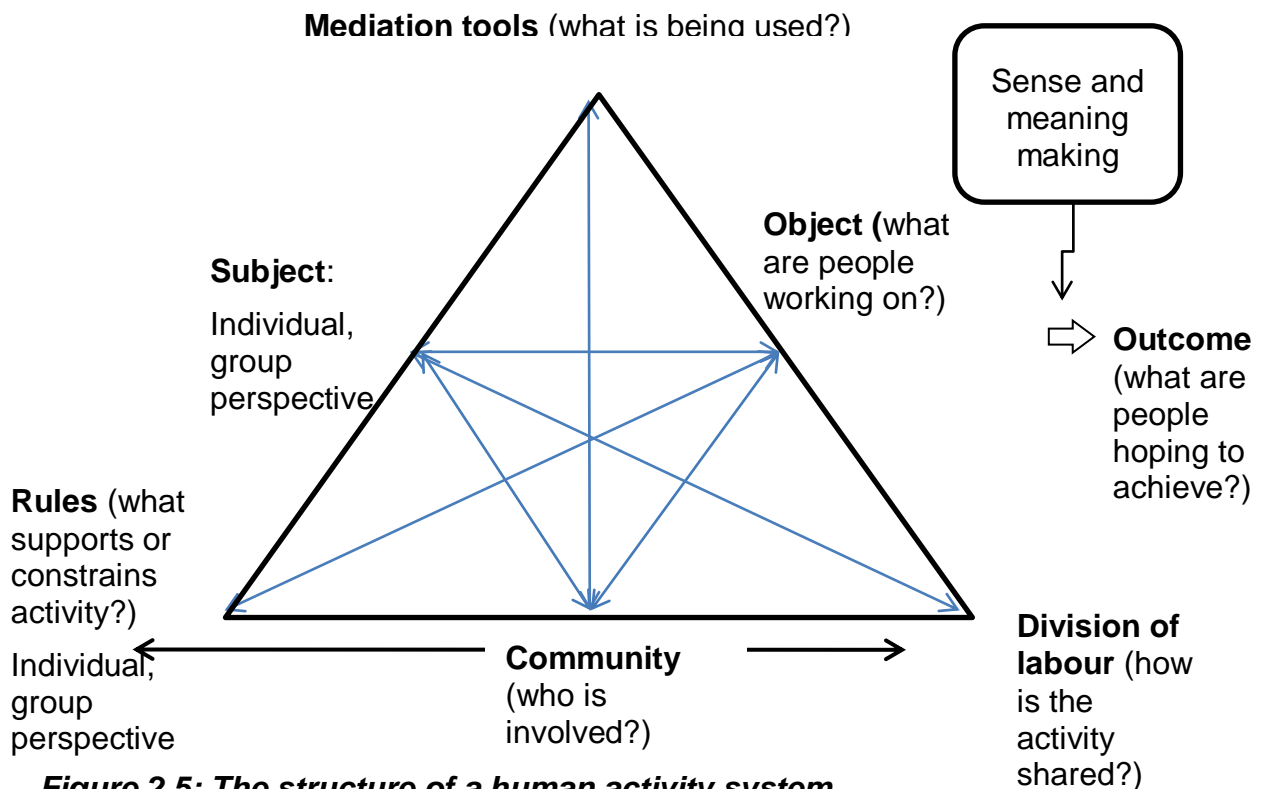


Figure 2.5: The structure of a human activity system

(Source: Engeström, 2001)

Contemporary work with activity theory has focused on expanding the basic activity system. In third generation activity theory, actors belonging to different activity systems work together towards a shared Object which they construct collectively (Engeström, 2001). It is in this conceptualisation of CHAT that boundary crossing occurs as the actors from the different activity systems, after jointly developing their shared Object, cross into unfamiliar territory as they develop new solutions with people who may have different perspectives and backgrounds.

This study used third generation CHAT to explore the object-oriented cooperative activity systems of the sugarcane farmers and extension workers using Engeström's Change Laboratory workshop methodology (Engeström, 2001). The Change Laboratory is a formative intervention method for developing work activities by the practitioners in collaboration with researcher-interventionists. It is also a tool kit for envisioning, designing, and experimenting with new forms of work and a social setting in which this can be done. A Change Laboratory intervention is typically conducted in a pilot unit of an activity that is in need of a major transformation. The practitioners and managers of the unit typically work intensively together with a small

group of researcher-interventionists in five to twelve successive Change Laboratory sessions to analyse and specify the challenges of developing the activity and creating a new model for it. A number of follow-up sessions are typically carried out after the initial experimentation and implementation of the new model some months later (Virkkunen and Newnham, 2013). For the purposes of this study only three Laboratory sessions were run and no follow-up sessions were held.

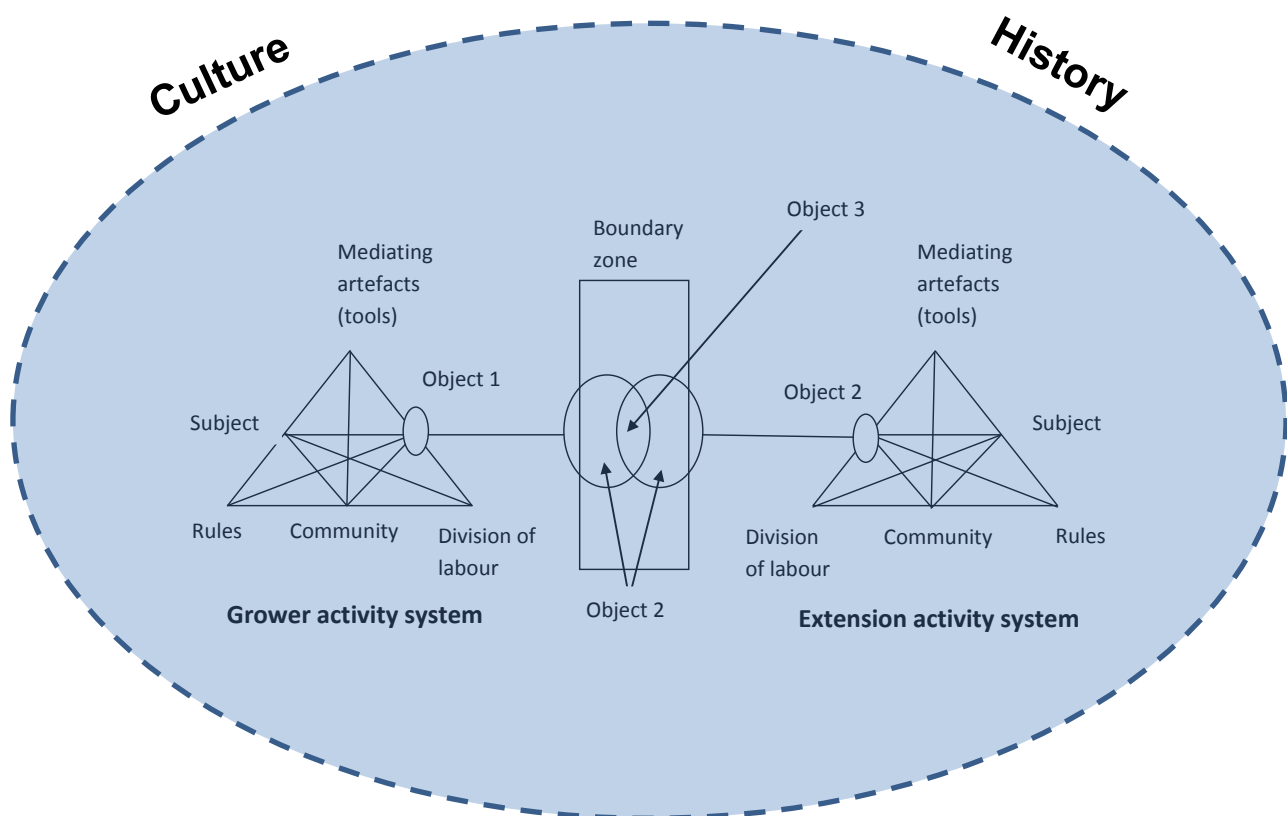


Figure 2.6: Two intercepting activity systems in third generation activity theory.

(Source: Engeström, 2001)

In laboratory sessions mirror data containing contradictions from ethnographic data is used to trigger learning and development processes along the expansive learning cycle (discussed further in section 2.9 and Chapter 3).

2.8 Conceptualisations of learning

The practice of extension in broad terms - and specifically the emerging extension practice of People Centred Learning and Innovation - is broadly situated within learning theory. This section looks at what is understood by the term learning and how it relates to agricultural extension.

Learning has become an important aspect of sustainability thinking and practice. However, there is no widely accepted definition of learning (Illeris, 2009). According to Lave and Wenger (in Arnseth, 2008, p291) learning is not merely situated in practice – it is an integral part of generative social practice in the lived-in world”.

Illeris (2009) suggests that traditionally learning was understood as the acquisition of knowledge and skills, but that today the term covers emotional, social and societal dimensions. He explains learning as “any process...that leads to permanent capacity change and which is not solely due to biological maturation or ageing” (Usher, 2009, p7). He further notes that:

I have deliberately chosen this very open formulation because the concept of learning includes a very extensive and complicated set of processes, and a comprehensive understanding is not only a matter of the nature of the learning process itself. It must also include all the conditions that influence and are influenced by this process.

Illeris (2009) goes on to say that all learning essentially comprises two different types of process. The first is an external interaction between the learner and his or her social, cultural and material environment, and an internal psychological process of acquisition and elaboration in which new impulses are connected with the results of prior learning. The second process involves three learning dimensions: the cognitive dimension of knowledge and skills, the emotional dimension of feelings and motivation, and the social dimension of communication and cooperation — all of which are embedded in a societally situated context, which resonates with CHAT (Engeström, 2011; Mukute and Lotz-Sisitka, 2012).

Another conceptualisation of learning is that of Edwards (2005b, p50) who sees learning in part as being “deeply cognitive” and “embodying within-person changes which modify the way in which a person interprets and may act on the world”. This resonates in part with Vygotsky’s seminal point (on which CHAT is in part based) that learning is not only a cognitive phenomenon but also a socio-cultural one. Vygotsky suggests that learning involves participation in social practice defined by

dynamic transformations, change, and interrelationships with other social systems (Edwards in Mukute, 2010).

What the above-mentioned conceptualisations of learning do not mention explicitly is that most standard theories of learning tend to focus on learners or organisations acquiring reasonably defined and stable knowledge which is transmitted to others via a more learned individual. The assumption here is that the knowledge context is stable and that the transmission of information results in a lasting change in behaviour (Engeström, 2001). What traditional theories of learning mostly fail to recognise is that when learning takes place it often involves knowledge that is not stable or known beforehand, originating instead from new forms of activity (Engeström, 2001; Warmington *et al.*, 2005).

These theories, though, also often fail to explain how these new forms of activity are created. While the literature in environmental management, agricultural extension and sustainable agriculture commonly refers to the need for learning or learning processes, the conceptualisation of learning and the link to learning theories is often weak (Engeström in Illeris, 2009; Stagl, 2007). As discussed previously, a range of learning approaches is practiced in South Africa within agricultural extension from transmissive top-down approaches to bottom-up approaches that emphasise the importance of co-developing knowledge and technologies. A key challenge has been to find a bridging theory between the top-down and participatory agricultural learning approaches (Leeuwis, 2004; Mukute and Lotz-Sisitka, 2012). Mukute and Lotz-Sisitka (2012) in their work exploring farmer learning in Southern Africa suggest that CHAT provides this bridging theory as it provides tools for working with contradictions (explained in more detail below) and because of its assumptions about knowledge and learning.

Lave and Wenger (1991, in Edwards, 2005c) suggested three approaches to supporting learning within CHAT: scaffolding interpretation, where a more knowledgeable other assists the learner to move to a new understanding; cultural interpretation, which is concerned with addressing the difference between everyday experiences and scientific understandings using instruction; and the collectivist/societal interpretation, which refers to the difference between “current understandings and new forms of collectively generated solutions to the contradictions embedded in the current understandings” (Edwards, 2005c, p4).

Scaffolding and cultural interpretations of learning are concerned with internalization of the culture in which people are found using mediation tools. The collectivist/societal interpretation of learning is concerned with dealing with new problems thus emphasising externalisation and contestation of the object, and allowing people to see new problems and develop new solutions. This view of learning fits well with Engeström's idea of expansive learning, which is more open-ended and allows for the generation of new understandings for new problems. For Engeström, systems such as those of the sugarcane farmer and extensionist are seen as open-ended learning zones distinguished by their capacity to reveal and work on contradictions, between, for example, object and tool or in interpretations of the object (Edwards, 2005c).

2.9 Expansive learning

Expansive learning theory is an emergent and promising arena of research towards facilitating adaptation and change in complex socio-ecological systems (Engeström, 1987; Mukute, 2009; Mukute and Lotz-Sisitka, 2012; Van Bommel *et al.*, 2009). When whole collective activity systems (such as sugarcane farmers and extension workers) need to be redefined, or are facing uncertain change, traditional modes of learning containing predefined solutions are not enough, as nobody can envisage exactly what needs to be learned. In an expansive learning approach the designing, testing and implementing of a new activity, and the acquisition of the knowledge and skills it requires are interwoven. Engeström and Sannino (2010, p7) explain that:

Expansive learning leads to the formation of a new, expanded object and pattern of activity oriented to the object. This involves the formation of a theoretical concept of the new activity, based on grasping and modelling the initial simple relationship, the 'germ cell' that gives rise to the new activity and generates its diverse concrete manifestations. The formation of an expanded object and corresponding new pattern of activity requires and brings about collective and distributed agency, questioning and breaking away from the constraints of the existing activity.... In other words, the 'what' of expansive learning consists of a triplet: expanded pattern of activity, corresponding theoretical concept, and new type of agency.

In essence, the theory of expansive learning puts importance on participants as learners; transformation and creation of culture; horizontal learning between people; and the formation of theoretical concepts (Engeström, 2010). For this reason, the theory of expansive learning relies on its own metaphor: expansion, the core idea of

which is qualitatively different from both acquisition and participation approaches to learning. In expansive learning , “learners learn something that is not yet there...they construct a new object and concept for their collective activity and implement this new object and concept in practice” (Engeström, 2010, p74). This pertains, in the context of this study, to sugarcane farmers and extension workers learning how to use SUSFARMS as a mediating tool in achieving sustainable agriculture.

In a typical expansive learning cycle (Figure 2.7) moving from the abstract to the tangible is achieved through specific learning actions which can be described as follows (Engeström, 2001, 2000; Engeström and Sannino, 2010; Masara, 2010):

1. *Questioning*: examining aspects of accepted practice and existing wisdom, such as group beliefs, values, attitudes and multiple perspectives which are interrogated, accepted or rejected.
2. *Analysing the situation*: a probing of the cultural and historical origin of current practice leading towards more detailed and better articulated questioning of existing practices, whilst surfacing causal or explanatory mechanisms. This can be done through explaining the situation by tracing its origin and evolution or through explaining the current problematic situation by constructing a picture of its inner systemic relations.
3. *Modelling of new solutions and alternative ways of working and learning*: this action involves constructing an explicit, simplified model of the new idea that explains and offers potential solutions to the problem situation.
4. *Examining the new model*: experimenting with the new model to fully grasp its dynamics, potentials and limitations.
5. *Implementing the new model*: practical application of the new or proposed solutions through activities such as pilot projects.
6. *Reflecting on the process*: being conscious of the solutions and learning of activities and pilot projects

7. *Consolidating the new practice*: merging the new practice into a new stable form of practice.

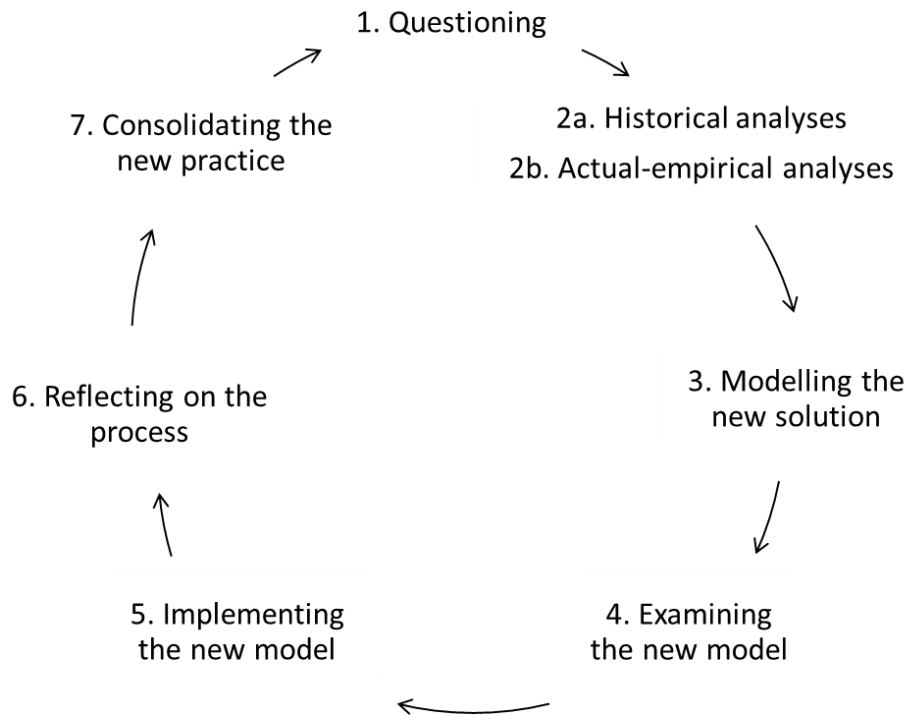


Figure 2.7: Expansive cycle of learning actions

(Source: Engeström 2000)

A critique of Engeström's work on expansive learning is that the focus is on systems rather than individuals. Despite this, however, the approach helps us conceptualise how to construct new ways of understanding familiar objects (Edwards, 2005a). Due to the scope and limited time, this study dealt only with the first three learning actions of questioning, analysing the situation and modelling of the new solutions and alternative ways of working and learning.

2.10 Linking agricultural extension to expansive learning

Duvel (2003, p21), in arguing for an appropriate extension approach for agriculture and rural development in South Africa, noted that the challenge for the extension profession in the risk society of today is to identify problems and solutions and adapt to local and changing contexts and farmer circumstances reflexively. He notes that

this requires “the proper understanding of the principles of behaviour change and the ability - with the help of useful and appropriate theories – to effectively intervene”.

How one ‘effectively intervenes’ is however open to interpretation. Pretty (1994) offers a potential solution by suggesting that extension practitioners move from a teaching- to a learning-centric style where the focus is less on content and more on the ‘how’ of learning and with whom learning occurs. In this vein, Wals argues that sustainability education “should bring about a closer link between sustainability problems that are faced by particular communities and focussing analyses of these by means of interdisciplinary, comprehensive approaches which permit proper understanding of sustainability problems” (2007, p36). Wals goes further by arguing that the basic aim of education for sustainability is to help support individuals and communities to understand the complex nature of natural and built environments and to obtain the necessary skills, knowledge and attitudes to anticipate and solve problems responsibly. One form of education for sustainability is the learning of sustainable agriculture. Mukute (2010) in his study on learning in sustainable agricultural workplace contexts, argued that expansive learning processes enable sustainable agricultural learning.

2.11 Conclusion

From the above discussions it is evident that in the past two decades there has been significant change in thinking and approaches relating to agricultural extension and learning. The drivers of this new era include risks associated with climate change and globalisation which require new ways of working and reflexive responses. Coupled to this is the growing trend towards efficiency, accountability and transparency in market chains and production processes. Chambers (in Scoones and Thompson, 2009), in describing the epistemic evolution of agricultural research, innovation and extension, suggests that contemporary practice is moving beyond the reductionist focus on production and productivity towards embracing complexity, uncertainty, multiple worldviews and innovation approaches. Furthermore, the author suggests that this new orientation is underpinned by relationships, networks and partnerships which recognise political dimensions, power, trust, transparency and accountability. Significant in this change is the emergence of social learning approaches where the focus is not just with traditional capacity building, but with soft

skills, values and reflexivity and the politics of knowledge. Emerging extension approaches such as PCLI that facilitate co-development and adaptation of knowledge and opening up spaces for innovation for change are being explored. Whereas the traditional technology transfer approach to extension would largely have taken place within the field or pasture, the Farmer First evolution in extension has expanded the focus to encompass nearby communities and landscapes beyond the farm boundary. In the post-modern PCLI extension approach, the scope extends to include policy makers, the market place and associated value chain (Mukute, 2010). What matters now is how people gain access to, acquire, and process information towards the co-construction of action with the idea of enhancing reflexivity in a risk society. In answering this challenge this study draws on CHAT and Engeström's expansive learning cycle using Change Laboratory workshops to explore how sugarcane farmers and extension workers learn and practice sustainable agriculture, the hurdles to sustainable practice they face during their everyday activities, and what potential solutions there are to overcome these hurdles, in a context of change-oriented learning.

CHAPTER 3 THEORETICAL FRAMEWORK, METHODOLOGY AND METHODS

3.1. Introduction

This chapter describes the methodological framework of the study and the specific methods used for data generation and analyses. As outlined in Chapter 1 and discussed in a theoretical context in Chapter 2, sustainability is the overarching context of the study – specifically sustainable sugarcane production through the implementation of SUSFARMS. To effectively carry out the research, it was necessary to identify a theoretical approach to the study as well as research methods that could adequately explore the farmer-extension issues related to implementing sustainable practices as intended by the SUSFARMS framework.

This chapter will first discuss the theoretical framing of the research approach by looking at critical realism, Cultural Historical Activity Theory (CHAT) as it is applied as a research tool and, for ease of reference, a brief summary of the conceptualisations of learning. The chapter then discusses the research process and the case study research approach. Because of the complexity and iterative nature of the data collection process, the chapter discusses this in some detail. The chapter then concludes with a brief discussion of validity, reliability, ethics and reflexivity.

In keeping with the intention of participatory methods, the primary data collection methods used with farmers and extensionists not only generated data for this study, but also generated data that was immediately of value to the participants. The processes followed left the participants with greater insight into their individual and collective situations relative to the issues of sustainability, learning and their perceptions and understandings of SUSFARMS.

3.2. Theoretical framing of the research approach

3.2.1. Critical realism

Critiques of social phenomena are contentious because of deep-seated disagreement over the nature of meaning and truth. Gaining consensus on what constitutes problems and solutions and whether they are 'real' or fallible is therefore difficult (Sayer, 2000). With this in mind critical realism, as a philosophy of the social sciences, was felt to provide a suitable theoretical framework for this study. It posits

that our understanding of the natural and social world is both fallible and provisional as our experiences of the world are both theory-laden and open to refinement (Mukute, 2010; Sayer, 2000). Critical realism thus allows for an explanatory critique with ontological depth that probes beyond the apparent and the observed to the causal mechanisms that are often invisible in the workplace or everyday life. Critical realism thus allows for a 'realist' view of the world at the same time as acknowledging the relativity of experience and suggests that reality can only be changed rationally if it is interpreted adequately (Huckle, 2004).

Huckle (2004, p7) suggests that applying a critical realism lens to sustainability education allows for:

- Experiences to be probed to liberate knowledge of deeper realities (structures, processes and events);
- Revealing structures and processes that produce and reproduce powerful interests that prevent people from realising their potential;
- Exposing knowledge or ideology that sustains such interests; and
- Reflecting and acting on alternative structures, processes and knowledge which allow a greater degree of self-determination and democracy.

Using a critical realist lens in this study thus enabled greater depth when probing and attempting to understand causal and structural mechanisms relating to learning and practice of sugarcane farmers and extension workers in the context of SUSFARMS and sustainable farming. It also aligns well with the systemic approach of CHAT which was the primary research tool used in this study.

3.2.2. Cultural Historical Activity Theory (CHAT)

CHAT is discussed in depth in Chapter 2; however, for ease of reference it is summarised here and its use as a research tool explained.

This research explored whether a number of sugarcane farmers and extensionists can be supported through interventionist research to identify and address inhibiting factors relating to sustainability, learning and understandings of SUSFARMS. According to Engeström (2001, 2000, 1987) and Daniels (2006) inhibiting factors are most likely to be related to Tensions and Contradictions of cultural and historical origin within activity systems. For this reason, the epistemological framework for the

research was provided by Engeström's cultural historical activity theory (Engeström, 2001, 2000, 1987) and the theory of expansive learning (Engeström, 2001; Engeström and Sannino, 2010). CHAT supported the research process to surface and identify Tensions and Contradictions related to SUSFARMS. Once surfaced these Tensions and Contradictions were examined and probed for their root causes and historicity following steps one to three of Engeström's expansive learning cycle (Engeström, 2001; Engeström and Sannino, 2010). The expansive learning cycle, as a transformative methodology, involves another three steps (examining and implementing new models and alternative ways of working, learning and reflecting, and consolidating on the process and outcomes). These steps were beyond the scope of the study and therefore were not applied in the research process.

3.2.3. Conceptualisations of learning

The various conceptualisations of learning are discussed in depth in Chapter 2. For ease of reference it is summarised here and its relevance to the research project explained.

Learning has become an important aspect of sustainability thinking and practice and is integral to environmental education and extension practice. However, there is no widely accepted definition of learning (Illeris, 2009). Some authors see learning as the acquisition of knowledge and skills whilst others see it in broader terms as any process that leads to permanent capacity change which is not linked to age or experience (Illeris, 2009).

As is mentioned in Chapter 2, a range of learning approaches is practised in South Africa within agricultural extension, with the transmission of information approach being dominant (Worth, 2006). In this approach the assumptions are that the knowledge context is stable and reasonably defined; that the knowledge comes from a teacher or extensionist who knows what needs to be learned; and that the transmission of information results in a lasting change in behaviour. Engeström however argues against these assumptions. He posits that much of the learning in the workplace is learning knowledge that is not stable or known beforehand and thus cannot be transferred successfully by more knowledgeable others. He suggests that learning occurs as new forms of activity are being co-created by drawing on multiple, divergent and external knowledge sources. Engeström puts forward that his theory of

expansive learning is a bridging theory between the traditional transmissive top-down learning approaches and participatory bottom-up approaches which emphasise the importance of co-developing knowledge and technologies (Leeuwis, 2004; Mukute and Lotz-Sisitka, 2012), especially in situations where prior knowledge may not currently exist. Engeström suggests the expansive learning cycle as a methodology for both empirically researching and bringing about individual and collective learning. The theory of expansive learning and the expansive learning cycle were chosen for this research because new forms of activity and learning are required by farmers and extensionists in order to understand and apply SUSFARMS in their workplaces.

3.3. Research process

3.3.1. Negotiating access and choosing study sites

Maxwell (1998) suggested that research design decisions are ultimately effected by the complex and changeable relationships a researcher has with people in a study. For social studies, especially ones employing a critical realism approach, the research process involves 'getting into' a social setting and 'getting on' with the subjects (Mukute, 2010). The researcher in this study had been working with farmer and extension individuals and industry representatives from the South African Sugar Association for 10 years prior to the study, which allowed for the building of trust. Respecting local customs, listening and observing with an open mind and keeping promises were key concepts that were used during the study to ensure trust and participant involvement were sustained.

The study area and sample population were selected by non-probability purposive sampling (Leedy and Ormrod, 2005). To facilitate use of the CHAT approach, which was new to all the participants and to the South African Sugarcane Research Institute (SASRI), the study area was purposely chosen so that there was a greater probability that the farmer participants selected would have similar issues related to the implementation of SUSFARMS. The aim in using this approach was to ensure that the widest and most diverse cross-section, particularly of farmer participants, was included in the study while ensuring the range of issues was manageable and not excessively divergent. It was anticipated that, after the research project had been

concluded, in addition to the data, information and recommendations generated by the study, SASRI would be in a position to replicate the learning process in other areas – again drawing on groupings of farmers facing similar issues.

Permission to conduct the research was first obtained from the South African Sugar Association (SASA). Discussions with the SASRI Extension Manager were then held to identify extension regions in the province of KwaZulu-Natal, South Africa, from which to invite farmer and extensionist participants. The four extension regions identified were: Midlands North and South, Sezela and Umzimkulu. The regions were selected for their close proximity to one another, their similarities in production systems (i.e. mostly non-irrigated sugarcane) and their range and history of engagement with sustainability practices and the SUSFARMS tool.

Participating extensionists were those currently working in the four regions selected for the study. In all five extensionists were identified. An email that briefly described the study and invited the individual to participate was sent to each extensionist by the researcher. Each extensionist together with the SASRI Extension Manager was then contacted by phone by the researcher when any questions about the study were discussed. Through this process, the five extensionists and their manager agreed to participate together in the study. To implement the purposive sampling for selecting farmer participants, the extensionists who confirmed their participation, were asked to invite two growers from their region to join the study. Dates for researcher interviews were mediated through the extensionists in each region, after which the researcher liaised directly with the farmer to finalise a convenient time and venue for the interview. Ultimately, nine farmers were identified, of whom nine participated in the interviews and eight in the follow-up workshops.

3.4. Research methods

The research questions and the epistemological perspective of the study guided the choice of a theoretical framework which drew on CHAT and Developmental Work Research Methodology. Primary data collection was undertaken using document reviews, semi-structured interviews, analytical memos, observation and Change Laboratory workshop sessions (after Engeström, 1987). The Change Laboratories also served as an instrument for agency building and expansive learning. Inductive analysis was used to establish 'what must be the case' as well as enabling theory-

reality congruence (Mukute and Lotz-Sisitka, 2012). Commercial (large-scale) sugarcane farming and accompanying sugar industry extension services in the KwaZulu-Natal Midlands acted as research case studies.

Yin (2009) points out that classic experimental research approaches are often pushed beyond their capabilities in many social and behavioural settings where underlying drivers are mostly complex and involve multiple interactions. Using a case study approach in social research is considered to be well suited to these research requirements as the approach accommodates the seeking of detailed information of particular issues being encountered by specific groups of people in complex real life settings (ibid). Case studies are also well suited to ethnographically based 'how' and 'why' research questions - as in the case of this study - and for investigating poorly understood social phenomena in settings where the researcher has little or no control and where the boundaries between phenomena and context are not clearly evident (Leedy, 2001; Yin, 2009).

Case studies also align with CHAT, as the theoretical framework for the study, in that context is valued in a similar manner (Mukute, 2010). Further, Leedy(2001) notes that by engaging with the context of a case the researcher helps those who read the study and draw conclusions about the extent to which its findings might be generalisable to other situations.

Both case study design and CHAT call for units of analyses to be defined. For this study an embedded case study design was chosen (after Yin, 2009) where the farmer and extension activity systems constituted multiple and overlapping units of analyses.

3.4.1. Data collection techniques

The research process was divided into two phases. The first phase focused on exploring how farmer and extension worker practice and learn about sustainable agriculture; as well as focusing on surfacing associated tensions and contradictions. The second phase focused on building understanding of these tensions and contradictions and identifying potential solutions.

3.4.2. Phase one data generation

3.4.2.1. Document review

Reviewing relevant documents is an important aspect of data collection and the research process (Yin, 2009). Sugar Industry policy documents and strategies, training materials, formal reports and newsletters and newspaper articles were reviewed for relevant information during the study. The documents helped provide perspective on how industry and industry stakeholders were engaging with issues pertaining to sustainable production of sugarcane. Data from document analyses was used to augment and triangulate data from interviews and observations.

3.4.2.2. Individual semi-structured interviews

Maxwell (1998, p235) suggests that for qualitative research, purposive sampling is a suitable approach as it allows “particular settings, persons or events [to be] deliberately selected for the important information that they can provide and which cannot be had as well from other choices”. As noted earlier, purposive sampling was well suited for information rich sampling for the purpose of in-depth analysis that helps with illuminating the phenomenon under study (Cohen, Manion and Morrison in Masara, 2010), which— in the case of this study – are barriers to learning and implementing sustainability practices.

Semi-structured interviews were used in the first phase of the study to gather rich ethnographic and empirical evidence for use as mirror data in the second phase of data collection. The value of semi-structured interviewing is in its pursuit of validity over reliability, standardisation and repeatability in order to access more fully the social meanings of the respondent’s world (Bloor and Wood in Mukute, 2010).

The interview questions were guided by a framework structured to explore the various elements of the farmer and extension activity system as they pertained to the learning and practice of sustainable farming (see Figure 2.5 for depiction of a human activity system and Appendix 2a and 2b for the extension and farmer interview framework). In each of the four identified regions, up to two farmers together with the region’s extension specialist were individually interviewed between 8 January and 15 June 2011. Interviews were captured on a digital voice recorder and transcribed into text. As noted earlier, five extension specialists and nine growers were interviewed in

the Midlands and South Coast grower areas (Noodsberg, UCL, Eston, Umzimkulu and Sizela).

3.4.2.3. Observation

Observation helped in accessing what was being done in relation to what people were saying was being done (Bloor and Wood in Mukute, 2010). It provided opportunities to look directly at what was taking place *in situ*, an approach consistent with the practice focus of the research (ibid). Observations were made particularly in relation to farming and extension practice, mostly using photographs to capture key aspects which were stored in a data base for easy retrieval.

3.4.3. Phase one data management and analyses

For this study data management and analyses followed two steps suggested for case study data management and analyses (Leedy, 2001):

Coding and categorising of data: Interviews were captured on a digital voice recorder and transcribed into text as ethnographic data describing the farmers' and extension workers' activity systems. A simple indexing system was developed for linking original source interview data to interview text used in analytical memos. The code was made up of the letter 'e' or 'g' designating whether the person was a grower or extension specialist, followed by a number representing the person. The letter 'i' representing that the data source was an interview was followed by a number representing the transcription page number on which the information occurred.

Identification of patterns: The transcribed text of the interviews was analysed using abductive inference and pattern matching logic with analytical memos to order and make sense of the data (Yin, 2009). Critical issues, troubles and problems from the activity setting were formulated and grouped according to common themes that emerged from the data. These groupings then formed the 'Tensions and Contradictions' which were used as 'mirror data' in the second phase of data collection. An example of a transcribed script and analytical memo is attached in Appendix 1 and Appendix 2c and 2d.

As the research was based on a case study approach, any generalisations made are recognised as being tentative and require further support from other studies (Yin, 2009). Nevertheless they still provide rich information on the range and nature of

issues and processes and actions to be considered in the implementation of SUSFARMS in SASRI's extension programme.

3.4.4. Phase two data generation and analyses

In phase two the research had a deliberately interventionist orientation in line with expansive learning theory's call for formative interventions based on Vygotsky's principle of double stimulation (Engeström and Sannino, 2010). This section first describes Developmental Work Research as an interventionist research methodology. It then goes on to describe Change Laboratory workshops as the specific interventionist tool used in the research and then concludes with a description of how change laboratories were applied in the research process.

3.4.4.1. Developmental work research

Developmental Work Research (DWR) is an interventionist research methodology used for supporting and developing expansive learning when working with CHAT (Warmington *et al.*, 2005). DWR does so through "pushing forward, mediating, recording and analysing cycles of expansive learning in local activity systems" (Engeström, 1987, p7). DWR was used in the study as a framework for promoting new knowledge in which learning was linked with the identification and creation of new forms of activity (Warmington *et al.*, 2005). Mukute (2010) suggests that DWR is a useful methodology for enabling the people-centred learning and innovation extension approach where opportunities for learning is foregrounded over processes involving pre-determined transmission of knowledge. The DWR approach thus enables the development of knowledge and skills which in turn may also change the contexts in which people are working.

DWR enables the researcher to be both researcher and participant. It allows for the researcher to 'intervene' in the study in ways that enable research participants to address some of the contradictions they may be facing in their work place. The methodology is thus emancipatory and transformative in line with the research objective of the study (Mukute, 2010).

The researcher's role in this study was thus primarily to facilitate the process of farmer and extension participants examining their contexts and questioning the way they practiced and learned about sustainable farming and why they tended to get

certain outcomes. The researcher's other main roles were to obtain a systematic view of the farmer and extension activity systems and reflect it back to the participants as mirror data, and make the researcher's participation and knowledge of theoretical tools available for use by participants during the developmental research process. This approach therefore made the research process interactive rather than extractive and created the opportunity for participants to interact with one another and the mirror data rather than just with the researcher (Mukute, 2010). The Change Laboratory is a formative intervention method for developing work activities by the practitioners in collaboration with researcher-interventionists and is described in further detail in the chapter below.

3.4.4.2. Describing Change Laboratory workshops

The Change Laboratory is not only a formative intervention method but also a tool kit for envisioning, designing, and experimenting with new forms of work and a social setting in which this can be done. A Change Laboratory intervention is typically conducted in a pilot unit of an activity that is in need of a major transformation. The practitioners and managers of the unit work intensively together with a small group of researcher-interventionists to analyse and specify the challenges of developing the activity and creating a new model for it. A number of follow-up sessions are typically carried out after the initial experimentation and implementation of the new model some months later (Virkkunen and Newnham, 2013). As mentioned in Chapter 2 for the purposes of this study three Laboratory sessions were run and no follow-up sessions were held.

The Change Laboratory is built on ethnographic data from the activity setting in which it is conducted. Critical incidents, troubles and problems in work practice are recorded and brought into Change Laboratory sessions to serve as first stimuli (figure 3.1). This 'mirror material' is used to stimulate involvement, analysis and collaborative design efforts among the participants (Engeström, 2011). In this process everyday conceptualisations of practice are brought together with scientific, reflexive analysis. To facilitate analysis and resolution of the problems, interventionists typically introduce conceptual tools such as the triangular models of activity systems as second stimulus. Commonly, the conceptual models offered by the interventionists are replaced or combined with mediating conceptualisations and models formulated by the participants. The participants are challenged to use the

mediating second stimulus as an instrument in the design of a new concept for the activity they are trying to transform. Ideally implementation of the designed new solution is initiated while the Change Laboratory sessions are still running, in the form of pilot experiments, leading to a richer and more articulated concept. The expansive learning cycle steps four to seven, as mentioned previously, were beyond the scope of this study and thus not implemented). This means that historical origins of the current problems are surfaced and modelled, and ideas toward a future concept are envisaged (Engeström *et al.*, 1996; Masara, 2010; Mukute, 2010; Virkkunen and Newnham, 2013).



Figure 3.1: Growers and extension staff participating in workshop 1 at SASRI, 28 June 2011

Throughout the process, participants engage with systemic, invisible and underlying issues relating to their activity system (discussed in Chapter 2) which are critically unpacked by reflecting on their root causes and historical development in the work place as well as how they shaped past ideas, actions and tools. Participants are asked to move between the past, the present, and the future in the process which allows for rich discussion by the participants and researcher as the researcher

encourages and facilitates critical probing of the issues with the aim of transforming and expanding knowledge and practice (Engeström and Sannino, 2010; Warmington *et al.*, 2005).

Change Laboratory workshops are effective as 'boundary crossing' opportunities. Representatives from two or more activity systems that are involved in collaboration or partnership are encouraged to interact in a mutual process of problem solving where initially assumed objects and roles may be changed. Boundary crossing can happen vertically through the hierarchy of an organisation or horizontally between people with different knowledge and expertise (Engestrom in Mukute, 2010).

The Change Laboratory thus served as a mediational setting consistent with the theoretical framework and methodology of the study wherein the farmer and extension participants were supported in re-conceptualising and redesigning their practice. In so doing, this 'scientific' approach becomes the tool for shifting both participant and researcher knowledge and allows for the development and expansion of new practices (Warmington *et al.*, 2005).

3.4.4.3. Using Change Laboratory workshops for data generation in the study

The Change Laboratory workshops used in the study followed the typical design where activity systems were brought into the workshops as first stimuli (Engeström, 1987; Engeström and Sannino, 2010), and contradictions and tensions of existing practice were questioned as to their history, root causes and effects. This allowed participants to develop a deeper understanding of their activities and enabled them to reframe and design new forms of activity as potential solutions to the contradictions and tensions encountered.

For this study the farmer and extension activity system were examined in one full day Change Laboratory workshop and two half-day workshops held between June and October 2011. The workshops were split into two sessions. The first session addressed steps 1 and 2 in the expansive learning cycle and formed the first stimulus. Ethnographic mirror data formulated from the interview data, document reviews and observations, was presented to participants by the researcher. The mirror data was comprised of the Contradictions and Tensions found in the workplace and critical depictions of the farmer and extension activity system. The researcher facilitated critical discussion and reflection by participants of current

practice and explored historicity, root causes and influences of the Tensions and Contradictions within the farmer and extension activity system. The mirroring process was used to catalyse interaction with and between the workshop participants and the researcher and the empirical evidence.

In the second workshop session, step three in the expansive learning cycle was followed. This involved modelling of new solutions and alternative ways of working and learning to address the Tensions and Contradictions identified by participants in the first workshop.

The first Change Laboratory workshop was held at the South African Sugarcane Research Institute on 28 June 2011. The second workshop was held at the Eston Country Club in the KwaZulu-Natal Midlands on 5 October 2011 for the Noodsberg and Eston participants. The third workshop was held on 6 October 2011 at the Sezela Country Club on the KwaZulu-Natal South Coast for the Umzimkulu and Sezela participants.

For the first workshop, the research team consisted of one person capturing outcomes of discussions on cards for visual display, a second team member who presented and explained the mirror data and facilitated dialogue, and a third who videotaped the discussions and assisted with note taking. (The videotaped data was not used in the analyses due to time constraints.) The second and third workshops were facilitated by one researcher and were not videotaped.

3.5. Validity and reliability

Maxwell (1998, p243) lists two main threats to research validity and reality. The first is researcher bias and the second is the effect of the researcher on the setting or individuals studied, which he terms 'reactivity'. For this reason interview techniques that ensure both depth and rigour were used, including stating the purpose of the study, asking open-ended questions and cross-checking important issues or suggestions that were being raised by the interviewee. The researcher also remained conscious of his personal values and the institutional setting in which the study was situated (i.e. within a joint venture between the local sugar industry and a conservation NGO). Strategies that helped in validity and reliability employed during the study were (Leedy, 2001; Maxwell, 1998):

- *Intensive and long-term involvement:* At the inception of the study the researcher had been working with sugarcane farmers and extensionists for 10 years (and with some, but not all of the participants). This sustained presence of the researcher in the setting being studied helped minimise or avoid spurious associations and premature theories.
- *Collection of rich data:* Both the long-term involvement and intensive interviews that were transcribed enabled the collection of 'rich' data helping to provide a fuller and more revealing picture of the study setting.
- *Respondent validation:* Conclusions or interpretations were taken back to participants for their feedback and input against their own experiences.
- *Feedback from others:* The opinion of colleagues from the field of study was solicited to determine whether they agreed or disagreed with the researcher's interpretations made from the data.
- *Looking for discrepant evidence and negative cases:* Any conclusions or instances that appeared implausible were rigorously subjected to examination of supporting and discrepant data to assess whether it was more plausible to retain or modify conclusions while being aware of the dangers of ignoring data that do not fit conclusions or personal biases.
- *Triangulation of information:* Information was collected from as diverse a range of individuals and sources as was possible within the boundaries of the study to reduce chance associations and systematic biases.
- *Avoidance of quasi-statistical inferences:* Any quantitative conclusions emerging from data interpretation were checked for quantitative support within the data. Where this was not found, the conclusions were not used or an explanation for the phenomena was given.
- *Comparison:* Whenever implied comparisons appeared in the data or conclusions they were made explicit as a means of surfacing potential biases or as a means of deepening contextual understanding.

3.6. Ethics

As the study was qualitative involving people, the study adhered to the required ethical practices. As required by the University of KwaZulu-Natal, ethical clearance was obtained prior to conducting the study. Most ethical issues in qualitative research fall into one of four categories: protection from harm, informed consent, right to privacy and honesty with professional colleagues (Leedy, 2001; Maxwell, 1998). These ethical requirements were met through sending letters to seek consent for carrying out data collection from the South African Sugarcane Association and the relevant governing institutions at the farmer level for the four extension regions participating in the study. In preparation for interviews, participants were briefed as to the nature of the research, assured of anonymity and given the choice to participate or withdraw at any time – and they signed consent forms. Pseudo ‘names’ in the form of codes were used in feedback sessions and the thesis text to protect the privacy of individuals. Conduct with others and the reporting of findings was undertaken in an honest fashion at all times.

3.7. Reflexivity

As qualitative studies are essentially collaborative constructs between the researcher and their subjects (Richards, 2005), a reflexive research orientation was maintained during the study to encourage introspection and questioning of taken-for-granted knowledge or assumptions by the researcher to ensure awareness of the ways that the researcher may be influencing what was being recorded as data (ibid). Due consideration was also given to the fact that the livelihoods of the interviewed individuals were linked to the phenomena being researched and every effort was made to ensure that the research process did not negatively impact on the individuals or otherwise compromise their livelihoods.

CHAPTER 4 PRESENTATION OF RESEARCH DATA

4.1 Introduction

This chapter presents the farmer and extension activity system as the basis of exploring farmer and extensionist learning and practice in sugarcane agriculture in the case study. It then reports on how farmers and extensionists learn about sustainable agriculture in their workplaces, the Tensions and Contradictions they face and the Model Solutions that were generated out of Change Laboratories.

4.2 Description of extension and farmer activity system

The study worked with the two interacting extension and farmer activity systems within the sugar industry using Engeströms (2001) second generation activity framework (as described in Chapter 2). The **Subjects** were the extension specialists and farmers, either as individuals or as a collective, who were involved in sugarcane production in the Midlands and South Coast region of KwaZulu-Natal.

The farmers and extensionists (subjects) each have an **Object** or the raw material or problem space being worked on. For sugarcane farmers these are typically issues relating to ensuring or improving agronomic yield and efficiencies, such as soil health, pest, disease, weed and alien plant control, labour, harvesting and transport logistics. For extensionists the **Object** relates to supporting farmer learning in relation to the above-mentioned issues and sharing knowledge, facts and technical know-how with farmers.

For extensionists the **Outcome** of their endeavours is more knowledgeable and skilled farmers in relation to sustainable production, good land husbandry, adoption of better management practices and tools such as SUSFARMS. For farmers the **Outcome** of farming sugarcane in a responsible and informed manner is ecological and livelihood resilience enhanced productivity and minimised risk.

Extensionists and farmers typically use as **Mediating tools** and **artefacts** that support their learning and skills development, the SUSFARMS manual, model 'case study' farms, SASRI research outcomes, past experience, informal social learning, official courses and the internet. In addition farmers also use agro-chemicals, fertilisers, agro-machinery, look-and-learn farm visits, SASRI research visits, SASRI

research bulletins and senior certificate course, as well as the SASRI extension specialists.

Both farmers' and extensionists' workplaces exist within a broader industry and societal context in which **Rules** govern everyday practice. These rules range from climatic conditions to government environmental and labour legislation. Industry levies, division of proceeds and mill supply agreement rules also hold sway for farmers.

Farmers interact within similar **Communities** that include fellow farmers and extension colleagues, industry and miller colleagues, the Departments of Agriculture and Labour, the Local Grower Committee and Pest and Disease officer, SASRI research scientists and provincial and non-government conservation organisations.

In terms of **Division of labour**, farmers rely on employees for land preparation, planting, harvesting, alien plant control, weeding, cane loading and transport; industry extension services and researchers for technology development and advice; and SASA and external conservation stakeholders for ecological advice. Extensionists depend on the SA Canegrower regional manager to provide business and financial advice; SASRI researchers for technical advice; and SASA and external provincial conservation department, WWF and WESSA for conservation and environmental advice. Figure 4.1 and Figure 4.2 provide representations of the grower and extension activity systems without details of history, culture, contradictions, or boundary-crossing based on second generation CHAT (Engeström, 2001).

Mediating tools: SUSFARMS manual, model 'case study' farms, SASRI research outcomes, past experience, informal social learning, official courses and the internet.

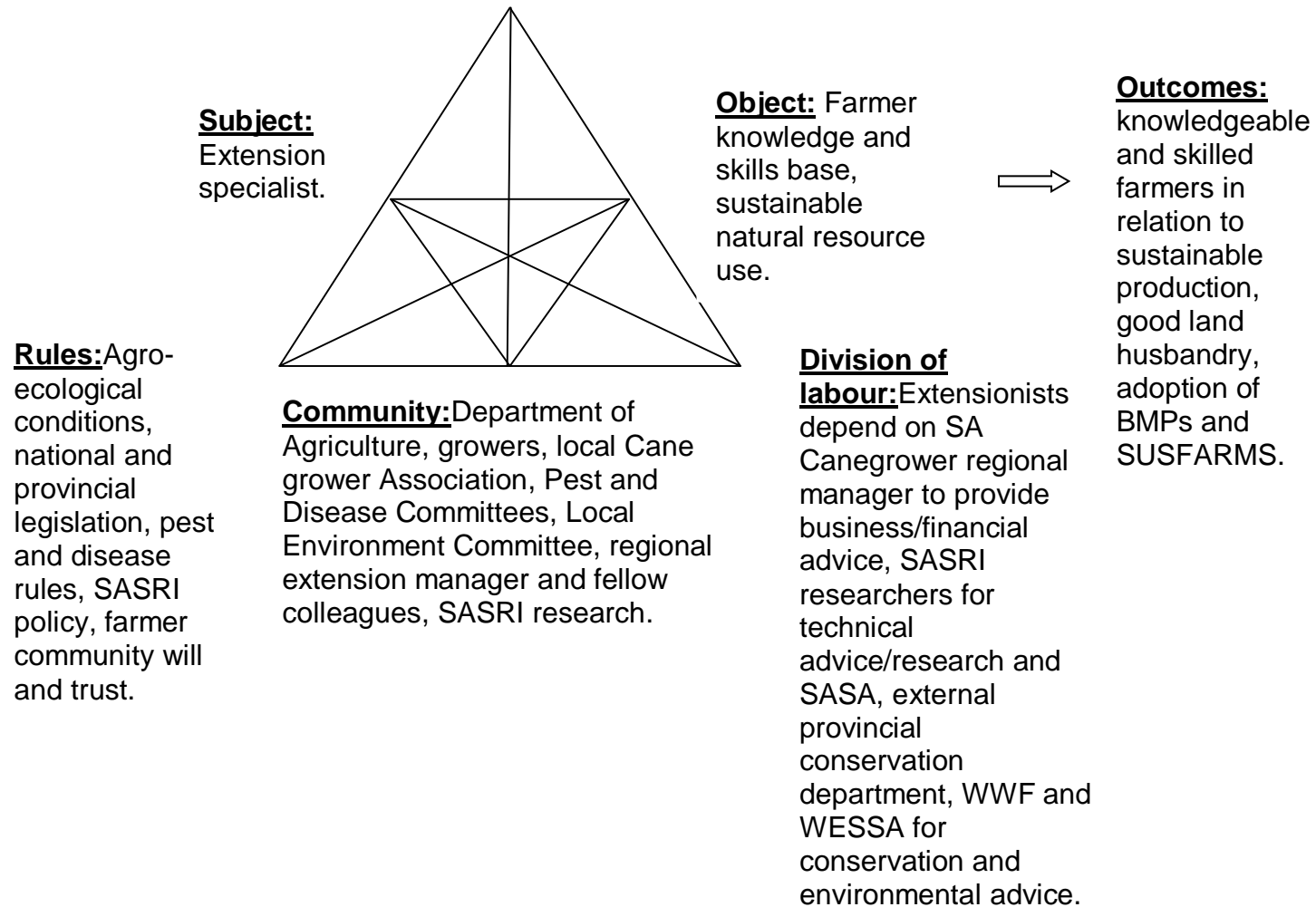


Figure 4.1: Elements of a second generation extensionist activity system

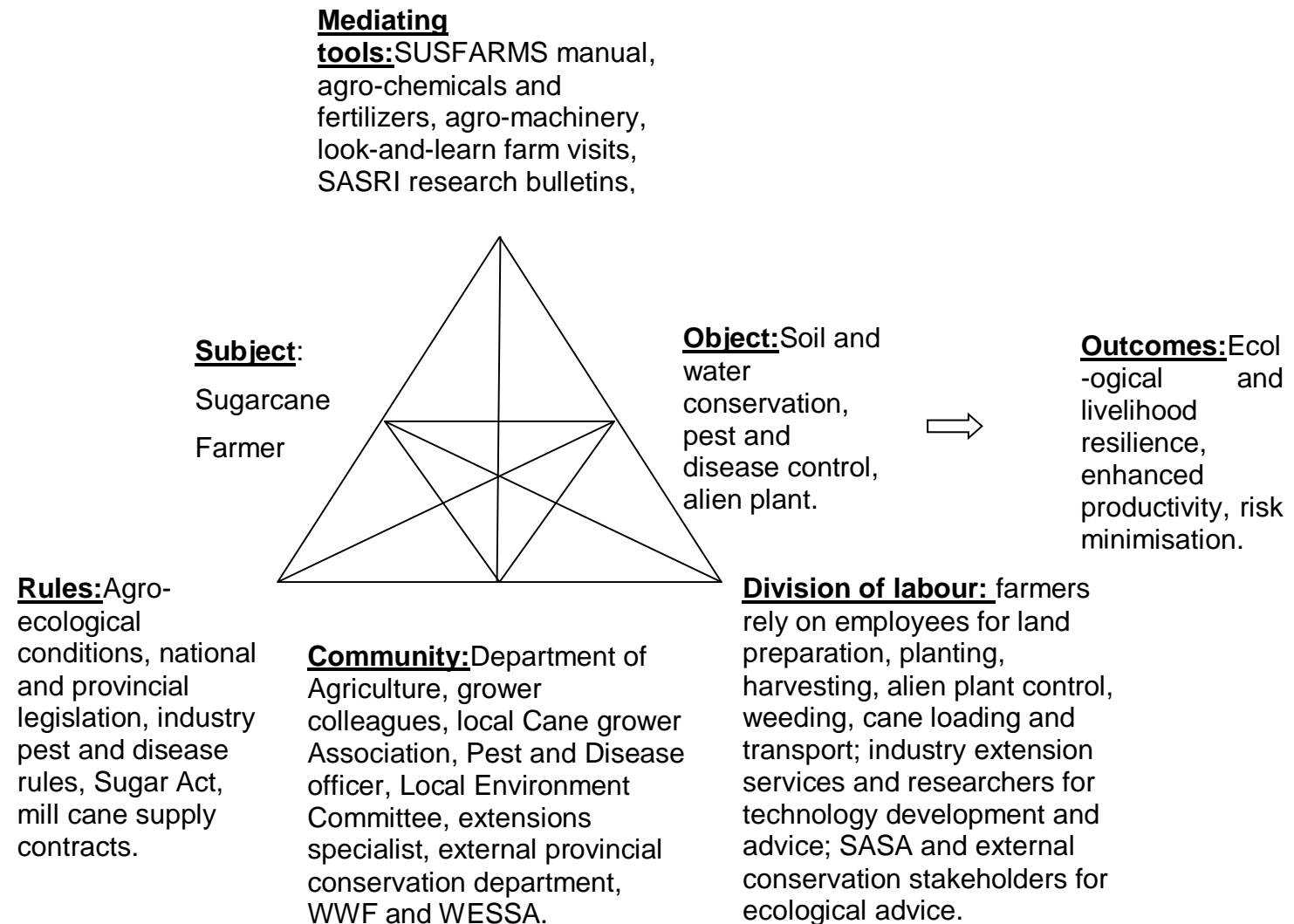


Figure 4.2: Elements of a second generation farmer activity system

4.3 How farmers and extensionists are learning about sustainable agriculture

In this section, farmer and extensionist learning is described. It addresses the first research goal of exploring how farmers and extensionists learn about sustainable agriculture. As discussed in Chapter 3, individual semi-structured interviews exploring farmer and extension work-place practices were conducted. These interviews were recorded and transcribed. The transcribed interviews provided data that helped illustrate how farmers and extensionists were learning about sustainable agriculture in their respective workplaces.

In the interviews farmers were asked how they learn about sustainable agricultural practice. Mukute (2010) identified several ways in which learning occurs amongst farmers in an agricultural setting, namely: learning from more knowledgeable others, learning from peers, learning through observation and learning through practice and experimenting. These framings of Mukute were used as a lens when analysing the interview data to identify whether farmers and extensionists in this study were learning in a similar fashion despite being in radically different contexts. That is large-scale industrial sugarcane agriculture as opposed to the small-scale (i.e. less than one hectare) food security or micro-enterprise farming named in Mukute's study.

It must be noted that some statements used to support the way of learning in this section do not align comfortably with the theoretical framing. It may be argued that this underscores the dynamic nature of learning in that a specific instance of learning may be conceptually seen as being horizontal or vertical or may be expert-to-less-expert in knowledge flow or may occur during peer to peer dialogue or interaction. The very richness of the participants' statements however suggests a more dynamic nature to learning that is not easily captured by rigid theoretical constructs; it may be that in a conversation with a more knowledgeable person, that person hits a point at which the less knowledgeable becomes the more knowledgeable one. This dynamism is recognised by this study, together with the practical limits of unpacking the complexities of learning within the scope of this study. For this reason, and for the convenience of reporting, the general framings of Mukute have thus been adhered to.

4.3.1 Learning from a more knowledgeable other through mediating tools that link personal knowledge to scientific knowledge

4.3.1.1 Farmers

Learning from others occurs when information is exchanged between people, generally in a one-way flow from the more knowledgeable person to the less knowledgeable. This type of learning is termed vertical learning and takes place typically when farmers learn from extensionists. It is often associated with the acquisition of formal knowledge from western science (Mukute, 2010). The extensionist, as the 'expert' leads the farmer to new understandings using the tools he has chosen for the session. This is illustrated by Farmer 1 in the study when discussing how he learnt about soil conservation practices from his local government extension worker:

Farmer 1: I had no knowledge of soil conservation structures, obviously coming from a technical background, so I had to get assistance on that from the government extension officer at the time... who was quite environmentally conscious.

This sentiment was echoed by other farmers in their interviews (Farmers 3, 5, 7 and 8) who, in the absence of suitable government extension workers, engaged instead with their local industry extension worker as mentioned by Farmer 8 in his response:

Researcher: if you need to find out more about sustainability practices, who do you speak to?

Farmer 8: If I want to know something, I do it through [my extension officer], and if I need information, [he] will get it for me.

Another way in which vertical learning occurs among these farmers is when they engage with scientists at the South African Sugarcane Research Institute (SASRI). SASRI provides a network of scientists that are available to assist extension workers and their growers through activities such as formal presentations of research results and field trials at farmer field days. As illustrated below, some farmers, but not all, draw on this outside knowledge when needed:

Researcher:: Are there any other networks of people who you engage with on your farm activities, if you want to find out more?

Farmer 5: it is basically just the experiment station, we don't use anybody else.

One farmer mentioned that both he and his son had attended a formal industry course, another way in which vertical learning occurs amongst farmers (Farmer 8).

The above examples indicate that the farmers are learning through actively networking with more knowledgeable others within their community, either from within the sugar industry, or externally.

4.3.1.2 Extensionists

The conversations below illustrate how extensionists describe how they too learn from more knowledgeable others. In some cases the knowledgeable person can be a SASRI scientist or a more senior colleague:

*Extensionist 3: I go straight to **SASRI**...Up until now I don't think I have ever had an issue that couldn't be answered by someone at SASRI. It has never happened.*

*Extensionist 4:...It depends on what I was trying to focus on, maybe **SASRI** could help me out, if it's something to do with that I would fall back on one of our specialists or scientists. To just give you an example...of how to peg a cane [contour]...I go to someone, such as my **extension manager**, who has done it before,I use **internet** if it [the topic] became very broad.*

The use of the internet mentioned by extensionist 4 above illustrates the use of a mediating tool to support learning.

In contrast to the traditional definition of learning from more knowledgeable others where the extensionist, as the 'expert', typically leads the farmer to new understandings, some extensionists spoke about how they gained knowledge through talking with their growers and visiting their farms, which stimulated dialogue and experience sharing:

*Extensionist 1: Myself, personally, obviously through experience coming into contact with other **growers** that have adopted them and say, yes they have worked for me in this way and then I can use that experience to pass on to other growers, and myself, to go and experience first-hand the best management practice, and also from communications from SASRI.*

*Extensionist 4: And in some ways one also learns quite a bit by Interacting with the **growers** by having one on one interaction.*

*Extensionist 6: So what I do, as much as possible I **listen to people**...it's from talking with the **study group** that has recently come back from New Zealand,...a whole bunch of **growers**, and saying so what did you learn, tell me what happened, what was the best thing, so I am pulling information out of these guys.*

The above statements suggest that the traditional construct of vertical learning, such as when knowledge flows from a more knowledgeable person to a less knowledgeable person, is not necessarily limited to a top-down flow of knowledge,

but rather that the knowledge flow can reverse in that the knowledgeable other can become the learner, and vice versa, in a dynamic interchange.

4.3.2 Learning from peers

4.3.2.1 Farmers

Learning from peers formed the core of responses from farmers in their interview discussions on how they learn. This type of learning happens as farmers interact with fellow farmers in what Mukute (2010, p187) terms “horizontal learning”. This is where learning occurs through passing on of knowledge between individuals or between peers. This is evident from the following conversations drawn from the farmer interviews:

*Farmer 1: Farming is a lonely job so I wouldn't say farmers are reluctant to [learn] – farmers often [pursue learning], they get to the pub and that's where **a lot of information gets swapped** on [cane] varieties... I have tried this and it works...”*

*Farmer 3: the guys that you are farming with... I wouldn't see every day, but you see quite regularly, you pick up things, they pick up things elsewhere and **the guys bring information back and guys are happy to discuss** what they have learnt, what they are doing and what they are not doing.*

*Farmer 7: We meet every morning...seven of the ten or twelve farmers meet for coffee at 7.30 to 8 a.m. discussing anything that is going. We **talk about anything** and there is a huge melting pot of information there...there is a lot of transfer of information and unity and planning and emphasis and idea shifts and we have roaring arguments, but it's all good!*

Some farmers mentioned the Mediating tools which facilitated their learning such as study groups, conservancy meetings, conservation days and (the now defunct) soil conservation committees as opportunities for interaction and learning from each other:

*Farmer 3: My uncle fortunately sits on **environmental committees** so we **get information** about what you should and shouldn't be able to do with regards to machinery, wetlands and that sort of stuff.*

*Farmer 4: I am involved with **conservancies** and a lot goes around that, I mean there is the biodiversity forum at Durban, I go to that, I don't know, there's a whole lot, anything around that I am keen on I attend.*

*Farmer 5: They [**soil conservation committees**], were very active. They used to have soil courses in the area, which we would attend, they would have farm visits too which we would attend.*

*The guys also have a **study group**, currently in the area. But I won't say it is predominantly for the younger chaps like my sons here, but it is mostly the younger guys who are on that.*

4.3.2.2 Extensionists

From the interview conversations, evidence of horizontal peer-to-peer learning on environmental sustainability issues was not overtly evident. Many of the conversations illustrated learning from peers, but contained an element of vertical learning as mostly others with more experience were involved, such as SASRI scientists, or more experienced colleagues, as illustrated below using a response shared earlier:

Extensionist 4: Depends on what I was trying to focus, maybe SASRI could help me out, if it's something to do with that I would fall back on one of our specialists or scientists. If, to just give you an example, of how to peg cane field contours...I would go to someone who has done it before, like Extensionist e5 or e2. I would use internet if it [the subject] became very broad.

Some extensionists struggled to answer how they learned - and responded instead to the question of learning about sustainability practices by explaining learning opportunities that they had organised for farmers, such as study groups or field trips, as one extensionist mentioned below:

Extensionist 3: Through study groups. That is what is very active in this area. I have study groups. We try to have one every month at a different farm.

In this instance it could be argued that Extensionist 3 is viewing the learning as occurring between farmers and himself on an equal level, as peers. It could also be argued however that during the interchange of experiences the learning flows both horizontally and vertically in both directions between growers and extensionist. This, again, highlights the dynamic nature of learning mentioned earlier in this section.

4.3.3 Learning through observation

4.3.3.1 Farmers and extensionists

A common form of learning was that of an individual farmer observing the practice of another farmer, most often as Farmer 3 notes “Guys like to see what other people are doing”. In the quotes below from the interviews, farmers illustrate this point as they describe how they learn through seeing other farmers practice:

*Farmer 1: I attended a lot of **field days** [held by Natal Cooperative Timbers forestry extension], here on this farm, because I also grow timber. Pannar used to have information days, pasture days, all that, so we stayed up to speed...*

*Farmer 2: When we **go to each other's farms**, and look and learn and encourage. There is not enough of that.*

*Farmer 5: Yes, we used to do **farm visits and go and have a look** at guys, what they were doing, particularly some of the younger growers, yes it was valuable because we used to go together with a chap from NCS and the chaps from the Department of Agriculture.*

*Farmer 8: You can **always learn by visiting another farm**, I certainly find that, even if its' not sugar, if it is a dairy farm, there is always something you can learn...*

As illustrated by the above quotes, farmers indicate the value of seeing other farmers practise and that this occurs not only amongst sugarcane farmers, but also in other agricultural contexts such as plantation timber and dairy. This illustrates how farmers draw on knowledge outside of their industry context. Drawing on distributed knowledge is recognised as supporting social-ecological resilience practice Extensionists

Learning also occurs when extension workers visit farmers in their area, usually on the invitation of the farmer to discuss an issue he needs advice on. This allows for the extensionists to experience first-hand the practices and issues the farmers are dealing with, as illustrated in the responses below:

*Extensionist 2: Mainly **by visiting growers** and I see that when they are planting they are not minimum tilling.*

*Extensionist 7: The amount of times I see my growers, when I see my growers I look for a new excuse at the end of the day because there are a lot of guys that don't want you there. So that excuse **gets me on the farm**, and I drive around the farm, and as soon as you start doing that, then you will be surprised how many growers will suddenly talk about everything and anything. They want to show you their farm. I would say about ninety percent of the growers want to show you their farm. They are proud of their farms; they have worked on these things.*

4.3.4 Learning through practice and experimentation

4.3.4.1 Farmers and extensionists

Another commonly found form of learning involved learning through practice and experimentation. This is when the individual uses knowledge that has been appropriated and internalised, and then externalises it by working on a particular

problem or issue, as illustrated by the conversations below concerning soil and water conservation planning:

Farmer 1: ...you can skip and bypass a lot of things people have tried and don't work, ask 40 different farmers how do you kill cane, and you get 40 different answers. [There are] different ways to do it [farm sugarcane], so from that, you model your own; find ways to suit what you have. You get this deluge of information. You have got to sift through it and find out what works.

Farmer 1: So he [the extensionist] would come and plan and... do the whole layout; and when I had done a few of those I could see the cost benefit of having a decent waterway with grass and the road next to it.

Farmer 6: We...redo the water ways, plant up instant grass on the whole water way and then we will start pegging the contours ..., put a crest road and all that sort of stuff in. That is just from experience that I have gained over the years.

Extensionist 2: So that's my background, and I suppose that's where I have got all the experience on environmental things, especially in the farm planning department because it's all about surface water management and farm planning.

Mukute (2010) notes that learning through practice and experimentation means applying what might have been learnt elsewhere as well as experimenting with new ideas that may improve practice. He notes that this and requires using internalised conceptual tools to work on understanding new situations. In other words, the farmers are working reflexively which is recognised as a key component of expansive learning (Mukute and Lotz-Sisitka, 2012).

4.4 Summary of how farmers and extensionists learn

Farmers involved in the case study typically learn from each other (horizontal learning) and from practice and experimentation and to a lesser extent from more experienced others, such as their extension officers or industry scientists (vertical learning). Farmer learning from each other takes place when farmers exchange advice, experiences and insights during meetings, field days, study group tours and informal gatherings that allow for interaction, networking and observation of farmer practice. To a lesser extent farmers learn from more structured or step-wise interventions during formal engagements with their extensionists or during formal courses. Another way farmers learn is through practice and experimentation where new knowledge is tested and adjusted to their farming context. Vertical learning is how most extensionists learn, particularly from more experienced peers or industry

scientists or through formal learning opportunities such as courses. The nature of farmer and extensionist learning suggests that knowledge which flows between individuals can occur dynamically, moving back and forth between them, both horizontally and vertically, making the identification of typologies of learning as suggested by Mukute's framings at times problematic and less than ideal.

4.5 Surfacing of Tensions and Contradictions in the farmer and extension activity system

This section addresses the second research question on barriers and contradictions in farmer and extensionist learning processes and prepares the ground for the next chapter. As discussed in Chapter 2, Contradictions and Tensions are fundamental concepts in Activity Theory and serve as key mechanisms for change-oriented learning (Capper and Williams, 2004; Warmington *et al.*, 2005). As Mukute (2010, p221) points out "contradictions are potentially fruitful for the growing of the practices under discussion and the learning of subjects in those activity systems". As outlined in Chapter 3, the Contradictions and Tensions that are discussed in this section were drawn from the inductive analyses of transcribed interview data gathered during the first phase of data generation. They were subjected to iterative refinement by participants in three Change Laboratory workshops. These refined Contradictions and Tensions represent the results sought by the research, while the initial Contradictions and Tensions were simply a step in this direction. In this section the refined Contradictions and Tensions are explained, together with their type (or level, as outlined in Chapter 2, Table 2.2) and quotes from the interview data are given to elucidate the Contradiction. In the next section the refinement of the Contradictions and Tensions using the Change Laboratories is explained in more detail.

4.5.1 Contradiction 1: Between the expectations on extension staff to improve and support sustainability practices and no formal or informal learning plan or structure and materials in place to strengthen learning.

Many of the participants spoke of the expectations on extension staff by farmers and other industry stakeholders to support and improve sustainability practices. However, no formal or informal learning plan and materials are in place to support the learning.

This is a Secondary Contradiction where there is tension between the extension activity system Object and its Mediating artefacts.

Two Tensions emerged from the extension specialist interview data that contributed towards the contradiction. The first Tension was that it is *a challenge for the extension services to maintain and strengthen their skills base*. Some extensionists spoke about how identifying and gaining consensus as to the diverse skills training needs of extension staff is challenging (e5i5). They also mentioned how extension work requires people with a specific suite of diverse skills and experience, and that it takes time for extension staff to learn the range of skills required for the job. They mentioned how difficult it is for the industry to find extension staff who have the appropriate skills and knowledge (e5i5,13, e2i9), as illustrated by the comment below:

Extensionist 5: It's very difficult to find [experienced] extension people in South Africa. If I am a grower, I am paying so many thousands of rand towards an extension service, now I expect to be able to get what I want, because I am paying for it. We need to understand what skills are needed by extension staff and we need to be allowed time to provide for that skills development. You can't, expect anybody straight away to know everything, especially in this world. Skill demands are diverse. What should the extension officer be studying?

In addition to the scarcity of extension skills in the current market place, the concern was expressed that many of the experienced extension staff are not far from retirement age and, because of a skills shortage, they will not be replaced by adequately skilled and experienced people:

Extensionist 2: ...the resource pool of older guys, knowledgeable guys is going and being replaced by a bunch of young guys and there are not many experienced guys left, which is a big problem.

Extensionist 5: So now we have got a problem, a dilemma where in five to ten years' time, our expertise is gone in extension because they are retiring. Now what do we do?

The second Tension highlights that there is *no formalised learning structure or plan that exists to strengthen formal and informal environmental learning for extension*. Extension staff felt that they were required to learn about environmental conservation matters on their own initiative, from colleagues or others they proactively engage with (e4i3), with little to no meaningful support on applied or technical biodiversity issues (e2i7). Of note was a comment from an extension specialist that the approach taken so far in familiarising growers and extension staff with SUSFARMS was

inadequate to build applied competence, with the result that SUSFARMS appeared somewhat overwhelming, as illustrated by the comments below:

Extensionist 3, p6: Basically we have had one talk, one presentation and we have thrown this [SUSFARMS] manual at the grower and told him to go and do a self-audit and phone the extension officer when you are ready. It's overwhelming.

Extensionist 2, p9: I can only speak for myself, we don't get enough training, on any environmental issues, there's not enough dialogue between other environmental groups like KZN Wildlife, like yourselves, we don't talk enough to each other, and we just seem to do our own thing, so that is certainly missing. There is no source of information really; I don't get fed a whole lot of information from SASRI on environmental matters at all.

This Contradiction is depicted in Figure 4.3 which shows the 'contradiction' between the Object and the mediating artefact elements in the extension activity system.

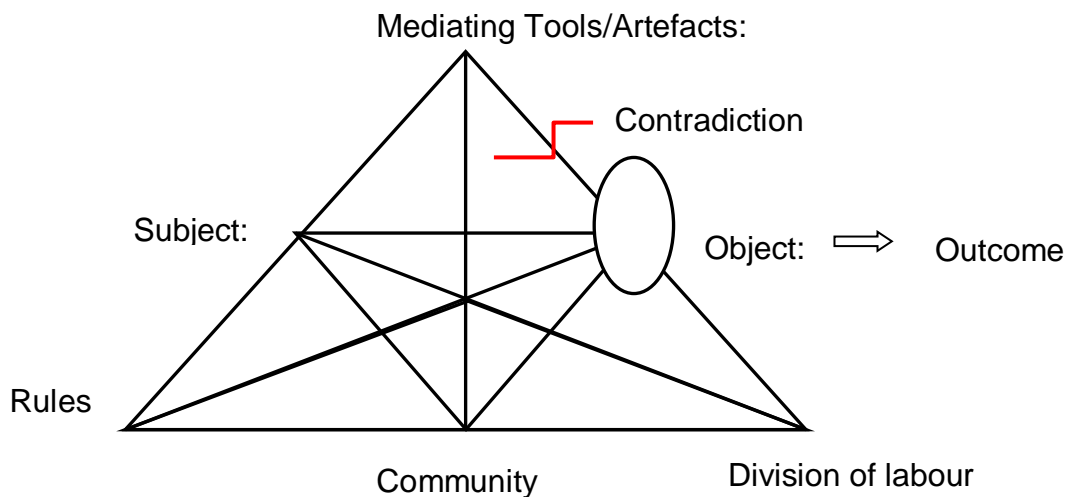


Figure 4.3: Contradiction 1: Secondary Contradiction occurring between the Object and Mediating artefact elements of the extension activity system

4.5.2 Contradiction 2: Between growers wanting more practical learning opportunities and the low attendance of, or participation in, grower days or meetings.

Contradiction 2 is a Primary contradiction within the Subject element of the farmer activity system. Farmers ask for more practical learning opportunities, but respond poorly when such learning opportunities are offered. In other words, what farmers are asking for is not congruent with how they respond to receiving it. Three Tensions emerged from the interview data that contributed towards the formulation of contradiction 2.

The first Tension that *information is not in an easy-to-use form and learning approaches are not meeting grower learning needs* was informed by comments raised by a number of growers and extension specialists. An extensionist pointed out that SASRI research can be presented in too scientific a way for it to be readily interpreted by farmers (e1i4). Another extensionist said that accessing environmental and agronomic BMP information is not easy and therefore constraining (g7i6). Participants also mentioned how the findings of scientific trials undertaken by SASRI are not necessarily believed by growers pointing out that farming realities and contexts often differ from those of scientific trials, as illustrated in the following comments:

Farmer 1, p6: Scientific trials run by SASRI are not easily believed as they are perceived by growers as being site specific and not reflecting reality.

Extensionist 1, p4: SASRI research is often really scientific and not on farming type level, [and] in that case not much of it is of use.

Farmers indicated that they prefer practical and contextually relevant examples or demonstrations of new technologies and will make time for field days accordingly. They also pointed out how growers enjoy participating in practical and applied learning processes (g7i4, e7i6, g4i6, g3i8), as illustrated by the comments below:

Farmer 1, p8: Farmers prefer practical examples of benefits of technology or practices over a fact sheet from SASRI.

Farmer 2, p3 and 4: That's what we always moan to each other about, there is not enough practical field stuff taking place.[Farmers] will make time if they know there is a farm visit, they will make time for that as opposed to coming to a meeting at the office.

The second Tension contributing towards the formulation of Contradiction 2 is that *there is not sufficient time available for formal or informal learning*. The issue of time shortage was raised by many growers and extensionists. Both groups viewed environmental sustainability learning as being 'additional' or over and above what they have to learn, rather than being integral or fundamental components of agronomic learning or knowledge. Both extensionists and farmers indicated that they are heavily committed, with little extra time available (g8i2, g5i3, g1i9, g4i8, e7i9) as illustrated by the following comment:

Farmer 3, p8: Farmers don't like courses, because they have to put aside two or three days and no farmer thinks they have that much time to put away.

For extensionists the pressure of balancing industry commitments with grower demands on their time was mentioned as a key issue, as illustrated by the two comments below:

Extensionist3, p10: I don't spend enough time on the farm with the growers. I spend a lot of time running to SASRI, for advice [and meetings].

Extensionist 4, p7: I have a lot of industry meetings to attend at the same time [as having to be in the field with farmers].

The third Tension contributing towards Contradiction 2 is that *opportunities for formal and informal learning are not being optimised*. Growers felt that study groups, an approach used by extensionists to facilitate farmer learning, are not effective, are not operating well, or have fallen away. Soil Conservation Committees and Local Environmental Committees are also no longer functional or well supported (g5i2, g4i9, g6i6). In addition, study groups are perceived by some to be time and labour intensive and not engaging those that should be attending, as illustrated by farmers in the comments below:

Farmer 4, p8: I don't think you can have a separate study group [for SUSFARMS], there is not the time. And then you have got a new chairman, secretary; all that sort of issues that come up.

Farmer 9, p7: [Study groups are not a good approach] because it will be the same guys who participate... the guys who are open to new things in any case. Those are the easy guys to reach; it is the guys that aren't on board that are the target, but are difficult to reach.

The Contradiction is depicted in Figure 4.4 which shows the 'contradiction' within the Subject element of the farmer activity system

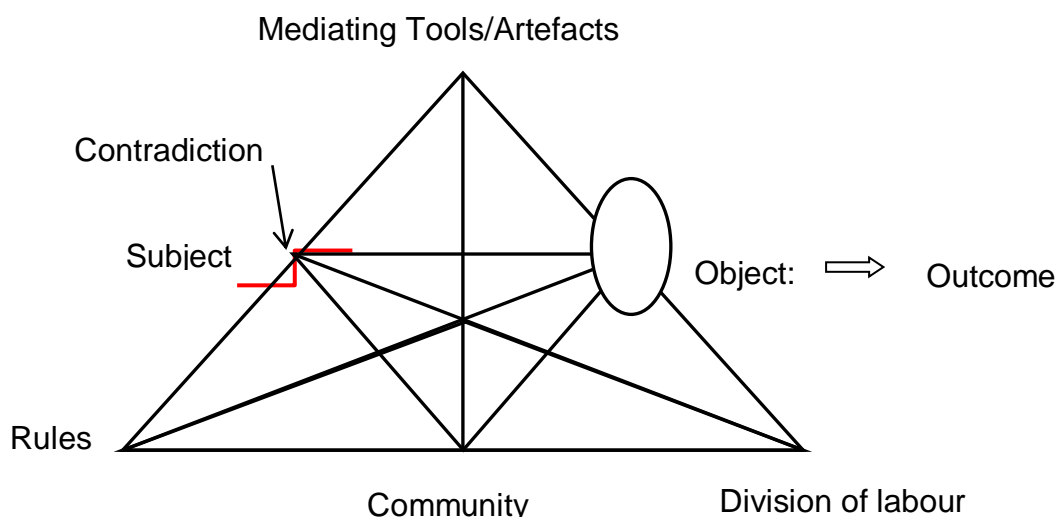


Figure 4.4: Contradiction 2: Primary Contradiction occurring within the Subject element of the farmer activity system.

4.5.3 Contradiction 3: Between SASRI's planned implementation of SUSFARMS and grower need for practical and economic evidence before accepting change

Contradiction 3 is a Quaternary Contradiction between the Mediating tools of the farming and extension activity systems. Two Tensions emerged from the interview data which contributed towards that contradiction that SASRI has a predetermined plan for how it will facilitate farmer learning of the SUSFARMS tool and the resistance of farmers to use SUSFARMS without evidence that it will be beneficial for them.

The first Tension that *farmers have an aversion to administration and paperwork* arose from discussions in the interviews around how farmers are generally resistant to participating in (SUSFARMS) audits and to providing documented evidence of better practice (g5i4, g6i10).

Farmer 5, p4: I think some of them, the minute they hear you have got to do an audit, people seem to get their backs up and they don't want to do it.

Farmer 6, p1: For us as single farmers, we don't have the time to do all that paper work [required by FSC or SUSFARMS].

The underlying aversion to administration and paperwork is illustrated by a farmer and extension specialist who note that growers need convincing of the value of keeping adequate and accurate financial and production records because of the perceived effort that this requires (g7i5, e4i4) which seemingly outweighs the benefits of the action.

The second Tension to emerge from the interview data was that *growers have an entrenched way of thinking and doing which is difficult to change*. This Tension was derived from a range of comments, almost exclusively from extension staff, who noted that most growers are interested in new technology ideas (e4i4) and that implementing sustainability practices is voluntary and requires the willingness of people to participate (e3i4; e7i4). Further, extension staff noted that growers generally do not like being told that they can improve aspects of their farming as it may require a change in established practice (e1i2, e6i1,5, e5i6). Growers and extension staff also noted that there has been a long history of farming sugarcane and extension practice which has resulted in entrenched thinking which is difficult to change (g9i4; e4i4, e5i6,12, e6i1,5). The above points are illustrated by the following comment from an extensionist:

Extensionist 5, p6: a farmer or an extension person out there gets used to something, and the older that person is, and the longer they have been doing it, the harder it is to get them to step out and say actually let me change.

In discussing the factors that influence the use of sustainability practices amongst farmers, one farmer noted that it is how the issue is perceived by a person that is most important:

Farmer 9, 4: It's a mind-set; you must believe that it's the right thing to do.

This sentiment of 'mind-set' was also mentioned by an extensionist who noted that:

Extensionist 5, p5 and p12: A major constraint is change of attitude of people; how do you change someone's mind-set? As I said before, the longer you are in a job, and the older you become, the more static you become. I don't think we have enough younger, more innovative people within the extension fold. How do you keep up with the technology if you have been around so long?

In the comment above the extensionist mentions how entrenched thinking inhibits innovation and change and links new outside knowledge from younger entrants into the extension profession as bringing potential solutions to the issue.

The Contradiction is depicted in Figure 4.5 which shows the 'contradiction' between the mediating tools of the farmer activity system and the mediating of the neighbouring SASRI extension activity system.

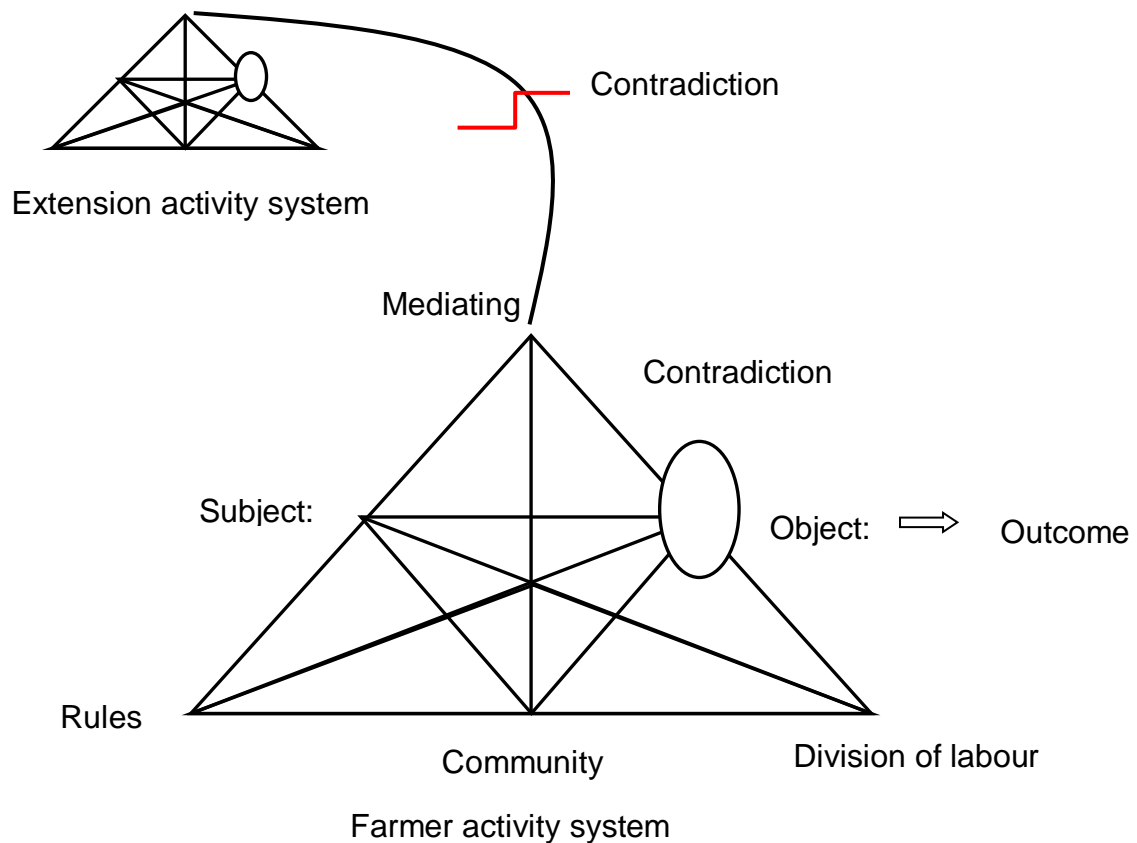


Figure 4.5: Contradiction 3: Quaternary Contradiction between the Mediating tools of the farmer activity system and the Mediating tools of the neighbouring SASRI extension activity system

4.5.4 Contradiction 4: Between the economic benefits of implementing BMPs for farmers and the resource constraints faced by farmers

Contradiction 4 is a Secondary Contradiction occurring within the farmer activity system between its Rules and Outcome elements. The contradiction between the perceived economic benefits of implementing BMPs and the perceived negative risks in changing practices is hampered by the smaller labour force that farmers have available for implementing environmental and agronomic BMPs. Growers nowadays have to deal with equity issues, strict labour legislation, unionisation of workers and the threat of land claims (g5i2, g3i5, g6i9) and have consequently shed labour units who in the past worked on environmental and agronomic issues (g5i6).

Participants also felt that implementing environmental and agronomic BMPs is constrained by negative cost-benefit perceptions. This issue, which elicited the most responses from participants, was the perception of poor returns and high costs of

implementing sustainability practices. Yields are decreasing and input costs are escalating and applying BMPs as a solution is perceived to be prohibitively costly (g8i3, 5, g5i2, 8, g7i2, g2i1, 3, g4i7, e4i3, e3i4, e5i8), especially when margins are small and making a mistake can be very costly for a farmer (e5i8). Farmers expressed a reluctance to spend on BMPs that do not have an obvious or direct financial benefit (g3i3, e1i3) and tend to worry more about their immediate returns than the long term sustainability of their practices, or how their individual practice contributes towards the bigger landscape context, especially when yields and incomes are under negative pressure (g5i5, g7i2, g2i1, g9i4), as illustrated by the comment and Figure 4.6 below:

Farmer 9, p4: If you have got cash flow problems and they [extension] ask you to stick in more in your input costs, for whatever reason, whatever they might be, and you will only get the benefit in year four, five or six; it's a very difficult thing to tell the guy, listen, just bite the bullet now, it will be OK later. There aren't any guarantees but you would presume that you would be better off.

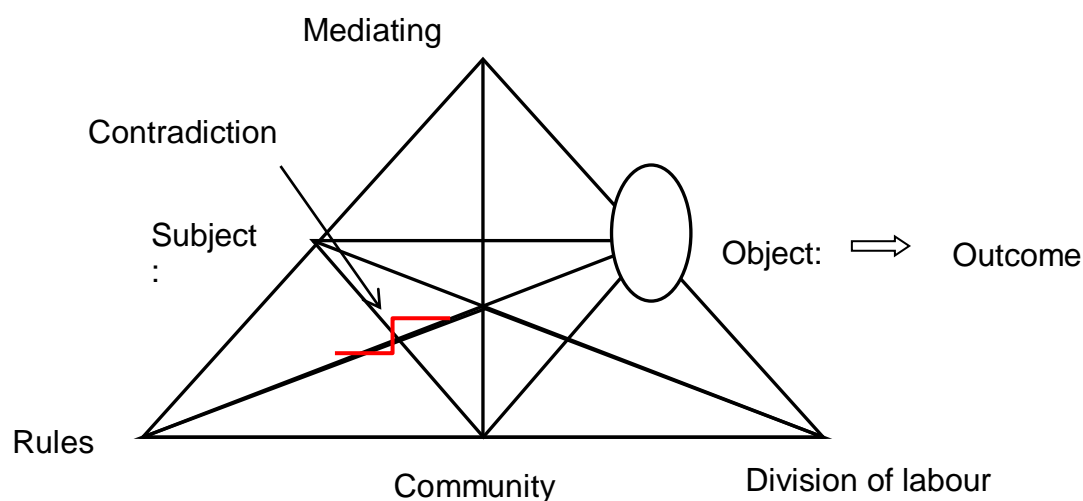


Figure 4.6: Contradiction 4: Secondary Contradiction between the Rules and Outcome elements of the farmer activity system

4.5.5 Contradiction 5: Between SASA's goal of environmental custodianship and the lack of strategic environmental leadership from the industry.

Contradiction 5 is a Secondary Contradiction between the Object and Division of labour elements of the SASA activity system. A Tension expressed by participants was that strategic leadership on environmental issues from top industry structures was not evident to people on the ground (g4i3). The message of environmental

custodianship and support for SUSFARMS and the pressure to implement it has not been received by extension services from top industry structures, but rather from 'outsiders', as one farmer notes:

Farmer 1, p7: 'green messaging' is not received from SASRI. It would be better received by growers if it came from SASRI as opposed to outsiders.

Figure 4.7 depicts the Contradiction between the Mediating tools of the farmer activity system and the Mediating of the neighbouring SASRI extension activity system.

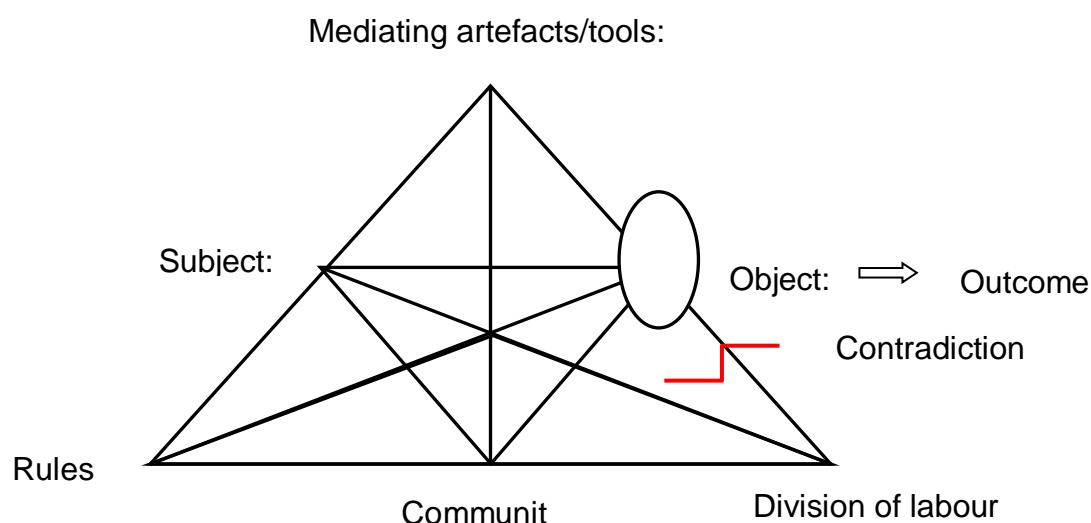


Figure 4.7: Contradiction 5: Secondary Contradiction between the Object and Division of Labour elements of the SASA activity system

4.5.6 Contradiction 6: Between the limitations inherent in the current extension model and grower need for more frequent extension contact.

Contradiction 6 is a Quaternary Contradiction between the extension activity system Rules and the farmer activity system Object. The limitations inherent in the current extension model and grower need for more frequent extension contact was informed by the Tension around the efficacy of industry extension being hampered by skilled staff shortages and structural and budgetary constraints (e5i2, 7, 8). Sugarcane extension is funded through a grower levy, so lower yields mean less income for the extension budget, as one extensionist illustrates:

Extensionist 5, p7: If you are funded through a levy per ton, when you don't get the tons, you don't get the money. Now each year we are not sure of how much money we have got to work with.

In addition to budgetary pressures, the duplication of extension services between milling and SASRI extension operations (e5i13) and the inability of the industry extension services to deal with modern diverse farming operations beyond sugarcane (g5i7), further hampers extension efficacy.

Figure 4.8 below depicts the Contradiction between the extension activity system Rules and the farmer activity system Object.

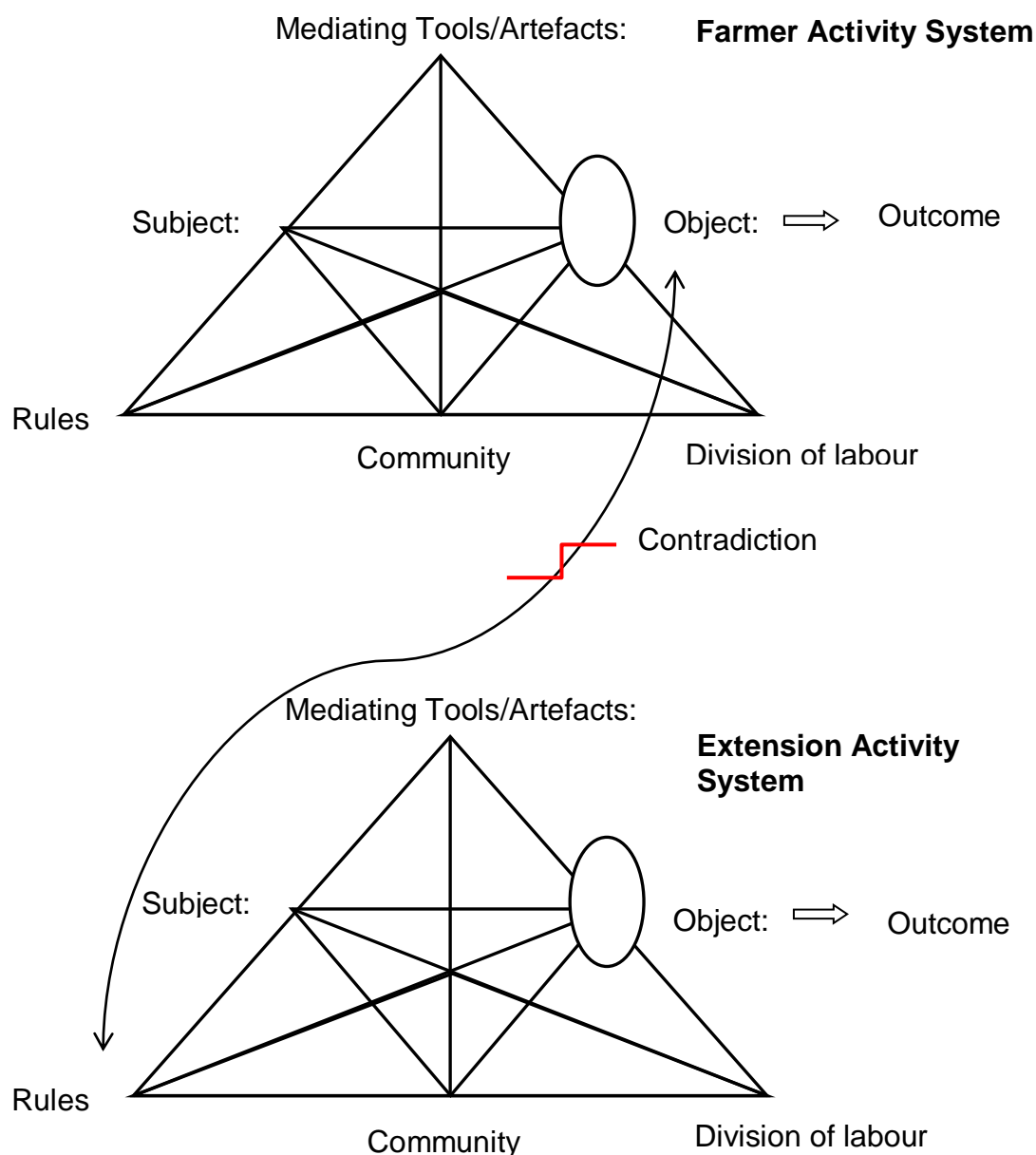


Figure 4.8: Contradiction 6: Quaternary Contradiction between the extension activity system Rules and the farmer activity system Object

4.6 Change Laboratory workshops: deepening the understanding of contradictions and modelling solutions

This section describes how the Change Laboratory workshops were run where the Tensions and Contradictions were interrogated by the participants and refined where necessary, after which proposed (model) solutions were constructed.

As described in Chapter 3, Change Laboratory (CL) workshops are based on the theory of expansive learning and serve as a tool in which potential new ways of working can be constructed (Engeström, 2011, 1987; Virkkunen and Newnham, 2013). During these workshops participants engage with ethnographic data of the activity setting and use conceptual tools (such as the triangular models) and mediating conceptualisations to formulate model workplace solutions. In Change Laboratory interventions the end result of learning is not predetermined by the interventionist researcher. Instead, the outcomes are designed by the participants and researcher as they work out expansive solutions to developmental contradictions in the activity systems (Virkkunen and Newnham, 2013). Change Laboratory sessions are typically conducted in an activity system that is facing major transformation challenges, such as the farmer and extension workplace where industry stakeholders are asking for implementation and validation of sustainability practice, and the sessions often play the role of an independent pilot in a large organisation (Engeström, 2011), as is the case with this study.

For this study three participant Change Laboratory workshops were held between June and October 2011. In the workshops participants engaged with critical incidents, troubles and problems in the work place in the form of the Tensions and Contradictions formulated from interview data which served as the *first stimuli*. Participants examined the Tensions for each Contradiction identified in the mirror data, focusing on their historicity and root causes, together with the problems or difficulties that arise from them. This created the opportunity for the participants to share perspectives and probe the issues more deeply, and allowed for rich discussions and the deepening of individual and collective understanding. The data was presented by the interventionist researcher on large sheets of paper placed on the meeting room wall, in line with Change Laboratory methodology. This served to 'visualise' the data for participants, making for easier engagement and involvement. Insights, suggestions and potential solutions were noted by a scribe and displayed

on the wall in association with existing mirror data categories or in new associations. This way of capturing and displaying the latest thinking and understanding of the group as it was generated by the participants was a refinement to the existing methodology.

The conceptual tools of the triangular models of the farmer and extension activity system were introduced to participants as the *second stimulus*. Participants were challenged to use the mediating second stimulus as an instrument in the design of new concepts for the activity they were trying to transform. In the analyses and design, the participants were asked to move between the past, the present and the future. This allowed for the historical origins of the current problems to be surfaced and examined and ideas for future concepts modelled (Model Solutions). The workshops are described in more detail below.

Table 4.1 shows the reframed Contradictions and Tensions and the Model Solutions

4.6.1 Exploring Contradictions and Tensions and Model Solutions: Change Laboratory workshop 1

Change Laboratory workshop 1 was held at the South African Sugarcane Research Institute on 28 June 2011 for the farmers and extensionists who participated in the interviews. Of the 17 people interviewed, four growers and two extensionists were unable to attend the workshop. Extension management was represented amongst the participants, but no-one from the milling, broader supply chain or South African Sugar Association was invited to attend. As both farmers and extensionists were present, the workshop served as a “boundary crossing laboratory” where participants from the two activity systems were able to share experiences and explore joint solutions and partnerships.

The researcher gave an overview of the six Contradictions and their associated Tensions and introduced the triangle depictions of the farmer and extension activity systems. Participants spent the morning examining and probing this mirror data, using the triangle depictions to assist them in probing their understandings of their activity.

Out of this probing, participants felt that Contradictions 3 and 4 and Tensions F, G and H required reframing to better reflect reality. Contradiction 3's original wording was:

Between SASRI's planned implementation of SUSFARMS and grower/extension staff resistance to change, record keeping and working with/investing in new forms of technologies.

The Contradiction described the resistance that many farmers and extensionists expressed towards SASRI's proposed implementation of SUSFARMS and the SUSFARMS tool because of the additional work burden of record keeping and changes that may be needed to established practice. Participants felt that a reframing was required that captured the need for evidence before accepting change:

Between SASRI's planned implementation of SUSFARMS and grower need for practical and economic evidence before accepting change.

The two Tensions of Contradiction 3 that described growers dislike of paperwork, administration and an entrenched way of thinking and doing was also felt not to be suitable. Participants reframed the Tension instead to better capture the elements of risk and evidence:

Hesitance towards change driven by perceptions of risk which in turn is driven by lack of practical and economic evidence of benefits of BMPs.

Contradiction 4 described the perceived benefits of implementing BMPs versus the perceived time, money and labour resources that farmers felt they would need in order to implement sustainability contained within the SUSFARMS tool:

Between the benefits of implementing BMPs and the resource constraints faced by growers (time, money, labour).

Participants reframed the Tension to better capture the element of risk as a hurdle to change :

Between the economic benefits of implementing BMP s and the perceived risks in changing practices.

The two Tensions from Contradiction 4 describing smaller labour forces and negative cost-benefit perceptions relating to the implementation of sustainability practices were reframed into a more generic Tension very similar to Tension 3:

Implementing environmental and agronomic BMPs is hampered by smaller labour forces and constrained by negative cost-benefit perceptions.

After the interrogation and reframing of the Contradictions and Tensions participants were asked to prioritise which Contradictions and Tensions were most relevant to their workplace and which they felt required further probing to develop mode solutions. Contradictions 1, 2 and 3 were selected by participants for further analysis. Due to the limited time available in the one-day workshop, participants selected Contradiction 3 for further analysis, opting to engage with Contradictions 1 and 2 in follow-on workshops. (The numbering of the Contradictions are the original numbers as presented at the workshop and are therefore not in sequential order. The original numbering is kept to ensure consistency and referencing back to the original transcripts and analytical memos.)

Although Contradictions 3 and 4 overlap, participants felt that by keeping them separate they better represented the respective issues. Contradictions 4, 5 and 6 were not prioritised for further action by participants as they felt that the issues were beyond the scope of the farmer and extension activity systems, as well as beyond the scope of the study. Table 4.1 below summarises the reframed contradictions.

Table 4.1: Workshop 1: Summary of reframed Tensions and Contradictions

	Contradictions identified from interviews	Reframed Contradiction from Workshop #1	Tensions interviews resulted in from that the Contradiction	Reframed Tension from workshop #1
3	Between SASRI's planned implementation of SUSFARMS and grower/extension staff resistance to change , record keeping and working with/investing in new forms of technologies.	Between SASRI's planned implementation of SUSFARMS and grower need for practical and economic evidence before accepting change	F. Growers dislike paperwork and administration: G. Growers have a chosen way of thinking or doing which is difficult to change	Hesitance towards change driven by perceptions of risk which in turn is driven by lack of practical and economic evidence of benefits of BMPs
4	Between the benefits of implementing BMPs and the resource constraints faced by growers (time, money, labour).	Between the <i>economic</i> benefits of implementing BMPs and the <i>perceived risks in changing practices</i>	H. Implementing environmental and agronomic BMPs is hampered by smaller labour forces I. Implementing environmental and agronomic BMPs is constrained by negative cost-benefit perceptions	Implementing BMPs is hampered by uncertainty and risk perceptions

Through the reframing of the Contradictions and Tensions by participants, new insights were generated which led to the modelling of eight potential solutions and 18 actions for Contradiction 3. These are described below in more detail and summarised in Table 4.2.

Table 4.2: Workshop 1: Proposed solutions, actions and responsible parties for Contradiction 3, SASRI on 28 June 2011.

Contradiction 3 (reframed)	Proposed (model) solutions and actions	Responsible parties
Between SASRI's planned implementation of SUSFARMS and grower need for practical and economic evidence before accepting change	1. Determine economic and financial benefits of key BMPs.	SASRI Extension (lead), SA Canegrowers Extension, SASRI researchers, growers, SASA External Affairs.
	2. Extension to develop tools to make economic benefits visible.	
	3. Engage researchers and extension in learning about developing solutions <i>with</i> growers (context relevant).	
	4. Define and identify 'Champion Growers' and use the Champion Grower approach to facilitate grower and extension learning.	Extension Manager (lead) and LECs
	5. Develop appropriate a record keeping system and facilitate the use of the system to provide desired cost-benefit evidence.	Establishing what data is needed: Canegrowers. Establishing auditing criteria: SASRI extension and Knowledge Management (lead) and Canegrowers. Help setup grower recordkeeping system: SASRI Knowledge Management. Establishing SASRI system to collect and process grower data: SASRI extension and SA Canegrowers.
	6. Communicate the big picture around sustainability and how this relates to the industry sustainability vision and SUSFARMS to internal and external stakeholders.	SASA (Natural Resource Manager) and SA Canegrowers.
	7. Clarify the role of LECs and Soil Conservation Committees in the roll-out and support of SUSFARMS.	SASA Natural Resource Manager to lead and liaise with SA Canegrowers and SASRI Extension.
	8. Engage millers to participate in supporting SUSFARMS and foster a non-punitive grower-miller relationship in this regard.	SASA Natural Resource Manager to lead and liaise with SA Canegrowers and SASRI Extension.

The participants proposed that the industry undertake economic and financial analyses of the **benefits of implementing BMPs** to farmers. The reason for this suggestion is because the economic gains versus the costs of better practice are unclear and not necessarily evident to farmers, who tend to be risk averse. A facet of this research would involve **developing simple tools**, such as an appropriate record keeping system for SUSFARMS Progress Tracker results and farm output figures which farmers can use in their planning and decision making. Participants proposed that researchers and extensionists engage **and work collaboratively with farmers** as a means of stimulating mutual learning and ensuring contextual relevance when developing the tools.

To strengthen grower and extensionist learning, participants suggested examples or **‘Champion Farmers’** are identified in each mill supply area by the local extensionist in consultation with farmers from the area. These farmers and their farms would serve as real-life learning opportunities for fellow farmers and extensionists to engage with. Participants felt that the criteria for choosing a farmer as a ‘Champion Farmer’ needed clarity, and proposed the high adoption of SUSFARMS BMPs and regular use of the SUSFARMS Progress Tracker tool as key criteria to identify them.

The lack of an appropriate **recordkeeping** system was identified by participants as a hurdle for providing data for deriving farm-level BMP implementation cost-benefit evidence. Participants felt that the development of a suitable data capture system was a required first step.

Participants proposed that SA Canegrowers and the SASRI extension services collaborate to develop a **sustainability vision** for the industry and to identify how SUSFARMS will be used to achieve its sustainability goals.

The **role of Local Environmental and Cane Committees** in relation to facilitating and supporting sustainability learning and practice and the SUSFARMS tool was identified as needing clarity. The participants felt that this process should be led by the SASA Environment Manager in collaboration with SA Canegrowers and the SASRI extension services.

The last solution suggested by participants was for **millers to formally participate** in supporting SUSFARMS through a non-punitive grower-miller relationship that would encourage farmers to use and apply the SUSFARMS tool. The SASA

Environment Manager was suggested as the lead agent in collaboration with SA Canegrowers and the SASRI Extension Manager.

In concluding the workshop, participants suggested deferring analyses of Contradictions 1 and 2 to two ensuing workshops due to limited time. Participants suggested that the two follow-on workshops be held in venues more conveniently located to their respective workplaces, choosing Eston as the venue for the Midlands North and South farmers and Sezela as the venue for the South Coast farmers. The participants agreed that the same Change Laboratory used for workshop 1 could to be used for the follow-on workshops.

Fourteen (14) and nine Model Solutions, together with their attendant actions and responsible parties, were developed by participants in these two workshops. They are presented in more detail below (summarised in Table 4.1)

4.6.2 .Exploring Contradictions, Tensions and Model Solutions: Change Laboratory workshop 2a (Eston) and 2b (Sezela)

As mentioned in the previous section participants chose to explore Contradictions 1 and 2 in two separate workshops held in more local venues closer to their workplaces. The first of the second round of workshops (workshop 2a) was held in Eston in the KwaZulu-Natal Midlands on 5 October 2011. The next workshop (2b) was held at Sezela on the KwaZulu-Natal South Coast on 6 October.

Contradictions 1 and 2 (Table 4.3 and) were not reframed by participants in workshop 1 as participants agreed that the wording accurately represented the issues.

Workshop 2a and 2b followed the same method used in workshop 1 resulting in participants identifying 23 Model Solutions and corresponding actions (Table 4.3 and Table 4.4). In summary these solutions suggest developing regionally relevant training programmes and facilitating formal and informal training using various means, such as field days and trial SUSFARMS audits, with farmers.

The capturing of knowledge needs and feedback from farmers was also identified by participants as being important, as well as sharing information with key governance structures such as the Mill Group Boards, and gaining their sanction. Lastly, linking with and learning from other agricultural sectors that are dealing with sustainability related challenges, such as Plantation Forestry, was felt to be a potential way to strengthen learning and practice.

Table 4.3: Workshop 2a: Proposed solutions, actions and responsible parties for Contradiction 1 and 2. Eston, Kwazulu-Natal, 5 October 2011.

Contradiction	Proposed (model) solutions and actions	Responsible parties
1. Between the expectations on extension staff to improve/support sustainability practices and no formal or informal learning plan/structure and materials in place to strengthen sustainable agriculture learning.	1. Allow for official annual/bi-annual training on SUSFARMS.	SASRI Extension Manager
	2. Use SUSFARMS field days/trial audits as learning opportunities for extension and growers. Ensure they are contextually meaningful and involve LEC Committees.	Extension, LEC Chair
	3. Capture local sustainability related grower and extension knowledge needs.	Extension, LEC
	4. Include SUSFARMS into extension indaba and bi-annual staff meetings.	Extension Manager, MWP
	5. Include SUSFARMS as a standing item in Grower group information days and report-back meetings.	Extension, LEC (person must have standing/credibility)
	6. SUSFARMS included onto Mill Group Board as standing item.	LEC Chair or member
	7. Link with others implementing natural resource-based sustainability programs (e.g. NCT or FSC) to create and strengthen learning opportunities (extension, growers).	Extension Manager, MWP, Knowledge management
	8. Formulate key business and sustainability message and present to industry.	MWP, WESSA COO, SASA Environmental Manager
	9. Group growers into homogenous cells. Define and formalise cells into SUSFARMS Eco-zone working groups. Identify SUSFARMS working group champions.	Extension Specialist in collaboration with LEC and extension management.
	10. Gain local grower committee official support for LEC's role in coordinating SUSFARMS work.	Regional Extension Specialist to liaise with Grower Committee chairperson.

2. Between growers wanting more practical learning opportunities and the low attendance of/participation in grower days or meetings.	1. Develop and Formalise learning plan for local grower group which must include predetermined and officially recognized (by SASRI, Mill Group Board) grower contact session dates determined beforehand for the on-coming year.	Regional Extension Specialist, Extension Manager.
	2. Ecozone study groups to work through LEC.	Extension Specialist
	3. Cover more than one topic on a grower day – attach an 'unattractive' topic (e.g. SUSFARMS) onto an 'attractive' one (e.g. soil health, varieties).	Extension Specialist, LEC
	4. Grower days to be short, at an appropriate time of day (afternoon), in varied, nice and contextually relevant venues.	Extension Specialist, LEC

Table 4.4: Workshop 2b: Proposed solutions, actions and responsible parties for Contradiction 1 and 2. Sezela, KwaZulu-Natal, 6 October 2011

Contradiction	Proposed (model) solutions and actions	Responsible parties
1. Between the expectations on extension staff to improve/support sustainability practices and no formal or informal learning plan/structure and materials in place to strengthen sustainable agriculture learning.	1. Clarify objectives, roles and responsibilities for SUSFARMS between regions and SASRI/SASA, SA Canegrowers, grower councils.	Sezela Grower Affairs Manager, Umzimkulu Grower Affairs manager (or equivalent), Regional Extension Manager (lead for Umzimkulu), Regional Extension Specialist, LEC.
	2. Capture critical feedback from growers on SUSFARMS layout – does it work for them?	SASRI Extension Manager.
	3. Understand/investigate the grower region link with parent milling company (Illovo)	SASA Environmental Manager and SA Canegrowers to lead? MWP to Liaise with SASRI Extension Manager and SASA Environmental Manager on way forward and report back to Midlands and S. Coast grower regions.
	4. Place on-going SUSFARMS formal and informal learning within the <u>Annual Yield Comparison Project</u> (using Eco-zones or Homogenous Groups)	Sezela Extensionist (lead), SASRI Extension Manager.
	5. Develop a regionally relevant SUSFARMS/sustainability learning and practice <u>program of work</u> with set dates for SUSFARMS learning for the year ahead.	Sezela Grower Affairs Manager, Umzimkulu Grower Affairs Manager (or equivalent (lead), Regional Extension Manager, Regional Extension Specialist, LEC.
	6. Obtain official support from relevant local grower and miller management structures for the SUSFARMS/sustainability learning and practice program of work	Sezela Grower Affairs Manager (lead, on SCGA approval), R, D and E committee, LEC, SASRI Extension Manager, Illovo Sugar.
2. Between growers wanting more practical learning opportunities	1. When talking/training on SUSFARMS emphasise the long term nature of the process and the sustainability benefit, not environmental, to growers.	All

and the low attendance of/participation in grower days or meetings.	2. Link SUSFARMS learning/implementation to relevant and popular topics.	Extension Specialist
	3. Link SUSFARMS to sugarcane financial and accounting programme Canepro.	SA Canegrowers

4.7 Conclusion

During the course of this study participants (farmers and extensionists) were engaged in the unfamiliar learning process and methods related to CHAT and Change Laboratory. They were to examine their respective activity systems (cane production and extension service) as well as the integration of their two systems. The study identified a number of Contradictions and their associated Tensions related to the adoption of SUSFARMS.

The study found that the farmers and extensionists use a variety of ways to learn. While on the surface, learning could be 'categorised' into two types (horizontal and vertical), and within these, learning from a knowledgeable person through mediating tools, learning from peers, learning through observation and learning through practice and experimentation. The findings confirm however that, even in the case of the potentially discreet learning around technical issues, learning is both dynamic and complex. Farmers and extensionists often shift roles in the learning dynamic. On one or more points, a farmer may be the more 'knowledgeable' and the extensionist less knowledgeable. On another point, the roles may be reversed.

Within this dynamic complexity, farmers, in particular, expressed specific limitations to their learning. A key impediment to formal sustainable agriculture learning is the perception that learning inevitably leads to change and change is often not worth the expense nor the time required time to master it. This, however, could be overcome if knowledge, information and evidence as to the net benefit of adopting the proposed SUSFARM tool are generated along with the agency of farmers and extensionists,

All of this serves to underscore the value of strengthening learning partnerships and expanding them to include elements of the sugar industry that are currently 'excluded'. That the participants reviewed and, in some cases, revised the Contradictions and their associated Tensions is indicative of keen interest on the part of the farmers and extensionists to be understood and to learn. This is further supported by the fact that they generated specific recommendations to address the Contradictions and Tensions and that they recognised the limits of the power of the existing participants and thus identified the need to engage others in the effort.

CHAPTER 5 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In Chapter 4 the data was organised and presented under three broad headings: learning themes based on the framings of Mukute (2010), contradictions based on Engeström's (2011) notion of expansive learning theory and Change Laboratory workshops to deepen understanding and model solutions. In this chapter the main themes that emerged from the data presented in Chapter 4 are described using analytical statements after Basey (1999) to articulate key insights which are discussed in the light of the theoretical framework established in Chapter 2.

After the discussion of findings, this chapter provides a summary of the research and its main findings in relation to the original research questions and objectives. This leads into a discussion of the broader implications of the study and the findings in relation to agricultural extension. This is followed by a critical reflection on the study and its limitations before finally presenting some recommendations and areas for future research.

5.2 Analytical statement one: Practical workplace experience and interaction with peers underpins farmer and extension learning

When extensionists and farmers were asked to describe *how* they learn as individuals, most highlighted the value of their on-the-job experience and interaction with peers as important ways in which they learnt. Some mentioned tools, such as the internet, or the value of SASRI researchers as sources of information whilst others mentioned the value of having more experienced colleagues as mentors. Many also mentioned the value of learning from each other through witnessing on-farm examples of practice.

Elkjaer (2009) argues that although experience is not primarily associated with knowledge generation, it is possible to learn from experience. This is because experience can be used to create connections to the past and the future. This element of historicity is congruent with Engeström's (2001) third principle of CHAT which states that activity systems take shape and get transformed over lengthy periods of time and need to be considered not only in terms of the local history of the

activity system and its objects, but also in the history of the theoretical ideas and tools that shaped the activity.

Whilst experience is an important element in individual agency, it has its limitations. Usher (2009) argues that learners can become unreflective 'prisoners' of their experience, or have their experiences negatively reduced, colonised or suppressed by others. For this reason he argues that experience should be accompanied by reflectiveness and triangulated with investigation of personal meanings alongside the meanings of engaged others. In other words, to move learning from 'situated' towards being 'expansive'. Usher's suggestion of triangulating experience resonates with Engeström's (2001, 1987) principle of the multi-voicedness of activity systems and the value of harnessing distributed cognition in activity systems to ensure that multiple points of view, traditions and interests are accounted for.

5.3 Analytical statement two: The DWR process facilitated single-, double- and triple-loop learning

As discussed in Chapter 3, this study used DWR 'Change Laboratory' (CL) workshops as an intervention tool where evidence of professional concepts and practices was scrutinised by the researcher and the practitioner participants in order to formulate new forms of activity through an expansive learning cycle. Warmington *et al.* (2005, p21), in a study that drew on activity theory to inform its intervention research, concluded that there was "no doubt that there were frequent instances of workshop activity... which pointed towards potential transformations in professional practice". Warmington *et al.* noted that objects of practice were no longer perceived as 'given' or 'permanent' but as a set of practices open to transformation. This study's findings concur with Warmington *et al.* in that the DWR process resulted in changed representations of practice as evidenced in the rewording of contradictions and Model Solutions by participants (Tables 4.1- 4.5).

The Model Solutions proposed in the CL workshops were wide-ranging, from farmers using the SUSFARMS progress tracker as a learning tool, to identifying SUSFARMS champions in homogenous farming areas to serve as case study sites for farmer learning, as well as reformulating grower days to being short, relevant and at appropriate times of day and year to ensure their relevance to farmer needs.

To understand the nature of the Model Solutions that were formulated in relation to learning, Armitage's (2008) multiple-loop learning framework for environmental and resource management is helpful. The framework consists of three learning 'loops': single-loop, double-loop and triple-loop. Single-loop learning typically involves the identification of alternative strategies and actions, relating to the addressing or fixing of errors from routines (e.g. sugarcane harvesting techniques) to resolve specific problems and improve certain outcomes (e.g. increased incomes, higher yields). Double-loop learning, in contrast, occurs when entrenched worldviews and underlying values are challenged (such as a shared reconsideration of the goals of a management process) and involves the correcting of errors by adjusting values and policies, resulting in fundamental changes in learner behaviour. Triple-loop learning involves the correcting of errors by redesigning governance norms and protocols on which single- and double-loop learning are based.

Armitage argues that single-, double- and triple-loop learning is required to achieve transformative learning; in other words, learning in which an individual's perceptions are altered in a process of reflection and critical engagement, an elemental notion corresponding with Engeström's (2011, 1987) expansive learning theory. As mentioned in Chapter 4, Model Solutions were formulated by participants in the three CL workshops. Looking at these Model Solutions there are numerous examples where single-, double- and triple-loop learning are evident:

Single-loop learning: the Model Solutions relating to promoting communication and dialogue within and between SASA organisational structures, approaches for strengthening learning, cost-benefit analyses and information management tools for sustainability practice are indicative of single-loop learning in that they focus on ways in which existing sustainability practice and tools (such as SUSFARMS) can be included into routine learning, communication and information gathering activity.

Double-loop learning: the Model Solutions relating to clarifying the position and approach of the sugar industry to promote and support farmer and extensionist sustainability learning and practice, relate to the articulation and adjustment of values and policies which enable sustainable farming practice and learning, and more specifically, how SUSFARMS as a learning and extension tool can be used to achieve sustainable sugarcane agriculture.

Triple-loop learning: the Model Solutions relating to the reformulation of governance norms and protocols are examples of where triple-loop learning occurred. The solutions relating to the clarifying of objectives, roles and responsibilities between local grower councils, SASRI, SASA and SA Canegrowers at an industry level and clarifying the regional LEC's role in supporting SUSFARMS implementation, as well as attaining official support from relevant local grower committees and miller management structures, are more specific examples of triple-loop learning.

5.4 Analytical statement three: Farmer and extensionist learning moved from situated to expansive

As discussed in Chapter 2, activity theory (on which Engeström's (1987) expansive learning theory draws heavily) and situated learning theory represent some of the most influential attempts in reformulating educational approaches (Arnseth, 2008; Mukute, 2010). Dominant theoretical paradigms of education place mind and mental processes at their centre. However, in activity and situated learning theory educational activities are seen as pervasively social and cultural phenomena where learning occurs through practice (Arnseth, 2008). This re-thinking, in broad terms, means stepping away from taking social structures or individual cognition as the primary focus of educational practice and instead sees *social* practice as the primary object of inquiry. This orientation towards social practice is concurrent with a general tendency in the social and human sciences which questions the validity of treating human behaviour simply as the enactment of pre-existing codes and structures (Arnseth, 2008).

While situated learning theory offers a more internal perspective, activity theory offers a more external perspective on practice. In activity theory, the individual's practice is seen as being co-ordinated in regard to, and thereby reshaped and changed by, the fact that the individual pursues goals within certain social and material contexts, which are subject to a higher level of organisation than the individual or group. In Engeström's (2001) conceptualisation of activity theory, practice refers to how activity systems (as opposed to the individual or group) evolve and change in contexts of knowledge uncertainty, a notion relevant to this study in that the SUSFARMS tool and the associated learning needs and approaches to support its application, were not yet known and were being investigated.

As a step towards understanding farmer and extension learning in sugarcane agriculture, Chapter 4 described the four different ways sugarcane farmers and extensionists learn, namely: learning from a more knowledgeable other; learning from peers; learning through observation; and learning through practice and experimentation.

Theory suggests that situated learning is the 'default mode' for most learning. In this case, the farmers and extensionists will employ cultural resources and tools that have been developed historically and their meaning and significance tends to be produced and reproduced *in situ*. This phenomenon was strongly evident in how farmers and extensionists spoke about their sustainability learning and practice in their interviews and during the CL workshops (described in Chapter 3).

Situated learning was observed during phase one of the data generation where participants interacted with the researcher in interviews, relating their experiences and understanding of their current practice. The resultant interaction and learning was mostly situated, in that the modes of practice occurred within the already established historical and cultural setting of sugarcane agriculture farming and extension by drawing on current knowledge (Bruner in Illeris, 2009; Arnseth, 2008).

The strength of such situated learning is that it occurs within a particular social and physical environment and is therefore contextually meaningful and relevant to participants. However, because of the *in situ* reproductive nature of situated learning, it can give little consideration to outside or new knowledge and practice (Krasny & Roth, 2010; Usher, 2009). Further, Engeström (2001) argues that situated learning approaches put too much emphasis on social reproduction where conflicts of interest, ideology or power are often not the central elements of analyses or consideration. The risk is that while issues may be openly discussed, the range of solutions generated will not bring about the changes required to address the issues at hand because of the discomfort required to embrace the contradictions and the relative comfort of maintaining the *status quo* while ostensibly searching for solutions.

Conversely, when expansive learning is employed, contradictions are treated as an inherent aspect of the activity system, as opportunities for learning and change, and as a mechanism to address the unfamiliar. In this study, the learning context was

new and unfamiliar where no known or predetermined solutions to farming and extension practice for sustainable production of sugarcane using the SUSFARMS tool, existed.

It is the notion within expansive learning theory of reconceptualising the object and activity to embrace a radically wider horizon of possibilities that made it an important guiding framework for this study because it helped the farmers and extensionists explore issues in a context of knowledge uncertainty and consider things from 'outside' the known situation. In keeping with Engeström's (2001) notion of third generation activity theory, the focus of the participants in the CL workshops was not solely on farmer and extensionist activity or interpretations of their objects. Rather, the focus was on the *transformation* of object-oriented activity. As anticipated by theory, the participants redefined their practice through determining new modes of activity suggested by their Model Solutions and thereby greatly widening and expanding their horizons of possibilities.

This outcome is consistent with Warmington (2005) who argues that an expansive transformation is accomplished when the object and motive of the activity are reconceptualised to embrace a greatly wider horizon of possibilities than in the previous mode of activity. The CL workshops had allowed for a collective envisioning and a deliberate collective change effort by the farmers and extensionists (Warmington *et al.*, 2005) and a reframing of their established activity into new and expansive forms of the original activity.

It was observed that throughout the duration of the CL workshops, the participants continued to use three of the identified learning typologies: learning from a more knowledgeable other; learning from peers; with learning through observation and learning through practice and experimentation being more directly related to farming, rather than relational issues. However, the familiar learning typologies, when consciously carried out in the expansive learning framework, produced new and expanded options for addressing the issues of concern to the participants.

While it is beyond the scope of this study, it is anticipated that, - unlike 'solutions' found through situated learning where "experience in the lived in world" (Lave and Wenger in Arnseth, 2008, p291) cannot adequately offer satisfactory analytical tools for examining interconnections and the dynamic character of collective activity, and

where solutions are likely to be short-lived and limited to a particular time and place (Engeström, 2001) - it is anticipated that the solutions emerging from applying expansive learning will lead to an evolution and development of the activity systems (most likely over longer time-spans) with the capacity to address the unique challenges presented by SUSFARMS. Such evolution and development is likely to be manifested in the form of new institutions and organisations that will sustain the new learning activities and partnerships.

5.5 Analytical statement four: Harnessing distributed cognition strengthened the learning process around sustainable sugarcane farming

Distributed cognition can be described as the diversity of an actor's background from where knowledge can be drawn on in any particular context (Masara, 2010). The concept of distributed cognition, or 'multi-voicedness', is an important principle in Engeström's (2001) conceptualisation of CHAT (see Chapter 2). The principle states that an activity system is a community of multiple points, traditions and interests and that these views are multiplied in networks of interacting activity systems. Distributed cognition is thus both a source of trouble and source of innovation, demanding actions of translation and negotiation (Engeström, 2001; Masara, 2010). As discussed in Chapter 2, when an activity system adopts a new element from the outside (such as SUSFARMS) or a new object (such as sustainable farming practices), it can lead to tension and conflict when older established elements (for example, the rules or the division of labour) collide with the new one. Such contradictions not only generate disturbances and conflicts, but also opportunities for learning and innovation to change the activity.

In line with the principle of multi-voicedness, participants in this research project were drawn from the diverse backgrounds of farming and extension and from different regions of the KwaZulu-Natal province (as described in Chapter 3). Their knowledge and backgrounds varied historically and culturally, despite working on the common object of sugarcane agriculture. During the workshops participants probed the farmer and extension activity system and their situated practice. In doing so, they drew on their distributed knowledge constituted by their different socio-historical backgrounds. During the CL workshops these divergent views were harnessed towards constructing Model Solutions. Participants thus moved through a process of

identifying and understanding problems which they were grappling with, such as an information deficit around the cost-benefit risks of adopting SUSFARMS, towards developing Model Solutions, such as developing tools to make economic benefits visible and understandable, and tools for recordkeeping and information management. Participants from varying backgrounds and knowledge were thus able to contribute their different understandings towards constructing new meaning and Model Solutions to deal with the particular problems they identified. Masara (2010) noted in his research on social learning in agriculture that harnessing distributed cognition was useful in providing fertile ground for facilitating learning processes and the co-creation of new meaning in intervention workshops for extensionists and farmers, which is congruent with the findings of this research.

5.6 Analytical statement five: Contradictions relating to sustainability practice and learning occur within and between farmer, extension and SASA activity systems

As described in Chapters 2 and 3, this research surfaced farmer and extension activity contradictions and used them as key mechanisms for promoting change and development in relation to shifts in representations of professional practice within and between the farmer and extension activity systems. Contradictions (as discussed in Chapter 2) can occur at four levels (Krasny & Roth, 2010):

- Primary contradictions that occur within an individual element of an activity system, such as between the mediating artefacts or the rules.
- Secondary contradictions which occur between two elements of the same activity system, such as between rules and object.
- Tertiary contradictions which occur when an old or established form of an existing activity system clashes with a more advanced iteration of the same activity system.
- Quaternary contradictions which occur between two interacting and exchanging activity systems (Krasny & Roth, 2010; Masara, 2010; Mukute, 2010).

In understanding the nature of a contradiction, it helps to build understanding of where learning and change is occurring within and between activity systems. Krasny and Roth's (2010) description of the four levels at which contradictions can occur provide a helpful framework to understanding the nature of contradictions and the

shifts in representations of practice where they are located within and between the activity system. In overlaying the framework onto the contradictions that emerged from the interview and CL workshop data, it is evident that sustainable sugarcane practice and learning is faced with three levels of contradictions, namely: primary, secondary and quaternary (as discussed in Chapter 4). This finding is similar to that of Masara (2010) who found that farmers learning the new practice of commercial beekeeping also faced three levels of contradictions in their activity. Mukute (2009) in his study of expansive learning amongst farmers in Southern Africa found that all four levels of contradictions were evident in the activity systems under investigation.

5.7 Analytical statement six: The Developmental Work Research (DWR) approach enables people-centred learning and innovation as a contemporary extension approach for sustainable sugarcane farming

In Chapter 2 the value of people-centred learning and innovation (PCL&I) as an extension approach was discussed, and in Chapter 3 Developmental Work Research (DWR) as an approach towards facilitating PCL was described.

PCL&I puts learners first and consciously attempts to link them with other learners as well as other opportunities for learning and development so that learners not only enhance their knowledge and skills, but also change the contexts in which they are operating (Engeström *et al.*, 2005; Warmington *et al.*, 2005). However, PCL&I does not give guidance on how actors such as extensionists may facilitate or enable PCL&I practice. By drawing on the DWR methodology and the application of CHAT tools and CL workshops, the participants were enabled to jointly resolve contradictions within and between the farmer and extension activity system. This co-construction of new knowledge is a central dimension of PCL&I (Mukute, 2011, 2010).

Another central principal of PCL&I is engaging policy and structures that have a bearing on knowledge generation and practice. In the study's CL workshops, participants agreed that strategic leadership from the South African Sugarcane Association around the promotion of sustainable agriculture learning and practice is not evident to farmers, extensionists and external stakeholders. In developing Model Solutions and new forms of activity, participants suggested that SASRI develop an industry-wide vision of sustainability in the sector, with details of how the SUSFARMS tool could be used towards achieving this vision.

5.8 Summary of research

This study approached sustainable farming from a social science perspective, focusing on the human actor and not the bio-physical processes occurring in agro-ecosystems. It presented sustainability as an emergent property of stakeholder interaction, rather than as an objective attribute of an agro-ecosystem (after Röling and Wagemakers, 2001).

The research was guided by the central question of whether cultural historical activity theory and the expansive learning cycle can strengthen sugarcane farmer and extensionist learning and practice.

The research was conducted with a small group of South African sugarcane farmers together with their sugar industry extensionists in the KwaZulu-Natal Midlands and the South Coast of South Africa. Phase one data generation was collected mainly through individual semi-structured interviews, document review and observation. Interview data was analysed using inductive interpretation of analytical memos. Phase two data generation was generated through Change Laboratory workshops based on Engeström's (2000) Developmental Work Research methods and analysed using expansive learning as a theoretical framework and inductive interpretation of analytical memos.

5.9 Summary of key findings

As discussed in the preceding sections, six analytical statements were found to be the main trends that emerged from the study:

1. *Practical workplace experience and interaction with peers underpins farmer and extension learning*

In describing *how* they learn as individuals, farmers and extensionists spoke mostly of the value of practical on-the-job experience and the value of personal interaction with peers, as being important ways in which they learnt. Tools, such as the internet, or knowledge resources such as SASRI researchers were also acknowledged as important sources of information.

2. *The Developmental Work Research (DWR) process facilitated single-, double- and triple-loop learning*

Many of the Model Solutions generated by participants in the workshops focused on ways in which sustainability practice and tools (such as SUSFARMS) can be included into routine learning, communication and information gathering activities of farmers and extensionists (i.e. single-loop learning). In much of the dialogue and subsequent generation of Model Solutions, values and policies were examined in relation to how sustainable farming practices should be embraced by the sugar industry. Through doing so, participants underwent double-loop learning. Triple-loop learning, where the reformulation of governance norms and protocols happens, came about when participants generated Model Solutions relating to strengthening organisational involvement and support for sustainable farming learning and practice amongst key role-players within the industry.

3. *Intervention (Change Laboratory) workshops moved learning from situated to expansive*

The farmers and extensionists in this study were found to learn in a variety of ways that is contextually meaningful and relevant. Most learning, however, has been bound by situated learning. The research process enabled the farmers and extensionists to consciously engage in expansive learning to probe their context, identify barriers to change and constructively engage in determining new solutions and forms of practice that would not have otherwise emerged.

4. *Harnessing distributed cognition strengthened the learning process around sustainable sugarcane farming*

In line with the CHAT principle of harnessing 'multi-voicedness' and distributed knowledge in expansive learning processes, the CL workshops were comprised of farmers and extensionists with varying experiences and from varying geographic settings. This created a rich environment of multiple viewpoints which participants drew on in the co-construction of Model Solutions and practice.

5. *Contradictions relating to sustainability practice and learning occur within and between farmer, extension and SASA activity systems*

The contradictions relating to sustainable sugarcane practice and learning were found to be grouped into three categories:

- Primary contradictions that dealt with the difference between how farmers acted and what they say they wanted in relation to sustainable agriculture learning and practice (such as between growers wanting more practical learning opportunities and the low attendance of farmers at farmer days or meetings);
- Secondary contradictions which occurred between elements within either the farmer or extension activity system (such as between the economic benefits of implementing BMPs and the resource constraints faced by growers); and
- Quaternary contradictions which occurred between the two interacting and exchanging activity systems (such as the limitations inherent in the current extension model and growers' need for more frequent extension contact).

6. *Applying the DWR approach facilitates people-centred learning and innovation (PCL&I) for sustainable sugarcane farming*

The DWR approach addressed the shortcoming of PCL&I of not giving guidance on how actors may facilitate PCL&I by allowing extensionist and farmers to surface and interrogate hurdles to better practice and co-construct new knowledge and forms of practice through seeing dissonance and multi-voicedness as an opportunity for learning. DWR also allowed for the examination of industry policy and structures that have a bearing on knowledge generation and practice, another important principle congruent with PCL&I.

5.10 Broader implications for agricultural extension in the South African sugar industry

The study suggests, within a commercial sugarcane agriculture context, the value of moving from a teaching and technology transfer-centric extension paradigm towards a people-centred, learning and innovation paradigm where the focus is less on *what* is learnt, and more on the *how* of learning and with *whom*, to strengthen the learning partnerships and farmer and extensionist agency in relation to SUSFARMS.

The move towards a PCL&I approach will have profound implications for farmers and agricultural extension practice. It will bring new challenges, opportunities and roles for farmers and extension professionals. It will require new levels of professionalism

with new concepts, values, methods and behaviour (Pretty, 1995) as well as new institutional arrangements to bring farmers, researchers and extensionists closer together in their everyday workplaces to co-construct sustainable agriculture learning and practice – all of which the study has shown can be facilitated through expansive learning.

Agencies such as SASA and SASRI will need to review their approaches to engaging farmers when introducing comprehensive sustainability farm management tools such as SUSFARMS which demand broad-scale changes in complex and competing multiagency settings. Both institutionally and at the farmer-interface level, they will need to take cognisance of the way their client farmers learn and ensure their systems and their extensionists have the relevant capacity and skills to engage farmers in the required collaborative learning.

5.11 Critical reflections and limitations

Much of the available literature and research that was reviewed for this study originates from developing countries where learning theory and research was applied to small-scale growers. This study was situated in an industrialised agricultural setting outside of developmental agricultural contexts and suggests that cultural historical activity theory and expansive learning can be successfully applied across developmental and socio-economic continuums.

One of the major limitations of the study was that the DWR process is time consuming, demanding intensive and repeated interactions between the participant researcher and workshop participants. Farmers are generally reluctant to spend time off their farm in activities that do not demonstrate immediate or tangible returns. Likewise, extensionists feel reluctant to participate in workshops as they are increasingly being drawn away from being able to attend to their farmer 'clients' because of industry meetings and administrative tasks.

Being able to conduct interviews and hold workshops required access to, and the assistance of, extension workers to facilitate introductions to farmers. This process was dependant on high levels of trust that researchers may not always have time (within the time frames of a research project) to foster.

The limited time frame of the study required that a small group of farmers and extension workers engaging in dryland commercial sugarcane farming were engaged. In so doing, it was not possible to engage with irrigated sugarcane farmers further north in the country or with small-scale farmers on communally owned land. Whilst this approach may not have encompassed the broader industry context, it did allow for more in-depth probing and a greater depth and quality of some of the information (data) gathered. The implication is that the findings should not be unduly generalised.

Classical renditions of Engeström's Change Laboratory workshops call for videotaping and subsequent transcription and analyses of workshop dialogue for evidence of agentic speech indicative of transformative learning. This was not possible within the timeframe and resources of the study. Instead, key points were captured in writing on large cards and shared visually with participants during workshops for analyses and verification (Figure 3.1). This approach worked well and lessened the work load of the researcher, making the modified approach potentially more user friendly. It may however result in a coarser resolution of data.

5.12 Recommendations and areas for future research

The findings of this study suggest a range of recommendations along five lines: implementing Model Solutions generated by this study; continuing with/completing the expansive learning process initiated by this study; considering the broader implications of this study for the implementation of SUSFARMS, revisiting SASA and SASRI's extension philosophy and approaches; and recommendations for further research.

The process of studying the applicability of activity and expansive learning theory to the context of implementing SUSFARMS generated some practical Model Solutions. The next step should be for participants in the study to move beyond 'workshop talk' and take the changed *representations* of practice (Model Solutions) into changed practice.

To complete the work initiated by this study, it is recommended SASA/SASRI:

- Run Change Laboratory workshops involving the relevant senior managers to ensure that industry-level key decision makers are included in the expansive learning process, as they were not included in this study; and
- Run Change Laboratory workshops to refine Contradictions 4, 5 and 6 which were not addressed in this study, being beyond its scope.

Regarding the implementation of SUSFARMS, the findings of this study suggest that the relevant stakeholders recognise that sustainable agricultural practice and engaging with the SUSFARMS tool requires innovation and new forms of learning and practice for farmers and extensionists. Further, the contradictions and tensions that arise through farmer-extension collaborations should be seen as opportunities for innovation and joint learning and be recognised as key ingredients for developing new forms of practice. Further, the DWR approach should be applied in each extension region to support learning around sustainable agriculture and the use of the SUSFARMS tool not only within the commercial agriculture context, but also within the small-scale grower context.

The findings of this study strongly suggest that SASA and SASRI should consider reviewing their extension approach when introducing comprehensive sustainability farm management tools such as SUSFARMS which demand broad-scale changes in complex and competing multi-agency settings. Both institutionally and at the farmer-interface level, they should play close attention to understanding how their 'client' farmers learn and to ensuring their systems and extensionists have the relevant capacity and skills to engage farmers in the required collaborative learning.

The study did not investigate the structural or policy changes that SASRI and SASA would have to make to adopt activity and expansive learning theory as a framework for implementing SUSFARMS or similar (perhaps future) initiatives. The study also did not examine the knowledge and skills extension which personnel would require to adopt an expansive learning framework nor the extent to which such knowledge and skills are extant among the current corps of extensionists. Both areas of research would provide valuable insights into the requirements for implementing learning based extension in private sector extension.

5.13 Conclusion

This case study explored in the context of commercial sugarcane agriculture, a means of undertaking a transformative learning process. It comprised a 'light touch' adaptation of Engeström's (2000) DWR Change Laboratory workshop format to facilitate an expansive learning process. The workshops were focused principally on negotiating new representations of practice for farmers and extensionists by bringing together everyday understandings of practice with scientific, reflexive analyses. In doing so, the process moved practitioners beyond the highly situated knowledge that was their first port of call, towards a cultural-historical understanding of current practice. This allowed participants to see objects of practice not as 'given' or 'permanent', but as a set of practices open to interrogation and transformation (Daniels and Warmington, 2007), thereby giving them more powerful options to consider, and greater command in addressing, these and other issues they will undoubtedly face.

It is hoped that this research may inform SASA extension endeavours by shedding light on the learning processes of farmers and extension workers. It is also hoped that attention will be drawn to key aspects of learning that may previously have been overlooked and to the value of a developmental work approach to facilitate learning around the sustainability-extension nexus.

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APPENDICES

Appendix 1: Sample of transcribed interview script

Highlights show themes as per phase two data generation and analyses (Chapter 3)

Green: Learning

Yellow: Tensions

Pink: solution

When the previous guy was here, Edgar Bruggeman, our LEC seemed to be quite active.

VK: So you are on the LEC?

They had the AGM on Monday but I didn't go, I've been battling with a bit of bronchitis and flu and I didn't feel up to it, so I don't know whether I am back on the committee or not., my guess is that in these areas, once you are on the committee, you don't get off, even if you are not at the meeting, you get voted back on. When Edgar Bruggeman was here we used to get out into the field quite often, but obviously Otto, he has other priorities, he is more into varieties, I haven't been too active while he has been here. Not a criticism but just that we haven't really had, I can't remember, unless I have missed the odd meeting, but I am not aware of meetings that I have missed.

VK: And getting into the field, was that valuable?

Yes, we used to do farm visits and go and have a look at guys, what they were doing, particularly some of the younger growers, yes it was valuable because we used to go together with a chap from NCS and the chaps from the Department of Agriculture. It's just a little bit on the side.

VK: So how did you get into farming?

Well my old man has been here since the year dot and as I said to you earlier, he was born here, and it was just a natural thing for him to go to Cedara, and then back onto the farm.

VK: And if we look at sustainability, what is understanding of sustainability?

It's the long term profitability of running the farm and whether we can remain as profitable cane growers, whether we can sustain what was here in the past. And whether we can keep up with what is happening around and about, keep your costs under control, and whether the money you are getting from your product is sufficient to cover those costs. That I would say is what is being able to sustain what we are doing,

VK: So with that in mind, what are the main things that you focus on in terms of achieving sustainability?

One of the things here, and it seems to be, I won't say it is a major problem, the production, our tons per hectare, we used to average about 110 and that slowly dropped and there is obviously reason, because somewhere along the line, not that our fertilization has declined,, even with the higher fertilizer prices, we continue to put, we put lots of fertilizer, because we are fairly sandy here, so somewhere along the line our soils are not the same sort of quality as they were because mostly this area was a timber area, although we have farmed cane here since about 1952 but on a very small scale, but you know we were taking out timber and converting to cane, and as these lands have been under monoculture for some time under cane, you notice the production declines so we got to try and get that up again. And obviously we are losing something from the soil so we are not just taking the normal soil samples, we are doing deep sampling as well, and digging pits to check to see what the soil profiles are like and what it is telling us down there. So hopefully that will pick up some of the problems we are encountering. We have also found that over the years we have always limed, but now we are having to use a lot more lime, and gypsum, and the soils are coming back showing lime and gypsum to a bigger degree than what they were before and obviously that may be something - some of the trace elements as well are now becoming an issue.

VK: So soil health is a key issue for you?

[shortened]

Appendix 2: Data generation and analyses tools

Appendix 2a: Framework guiding individual semi-structured interviews with extensionists and farmers: *practice*

These questionnaires formed the basis of conversation between the researcher and sugarcane farmers and extensionists who work on sustainable agriculture issues in their daily workplaces. The frameworks were informed by dimensions of activity theory and were used to generate data on how and why extensionists and farmers learn and practice sustainable agriculture. At the same time, the interviews were intended to establish the current contradictions in the activity systems and trace their root causes. The information was used in subsequent change laboratory workshops to single out key learning issues among farmers in their different contexts and how they may be overcome. Two farmers and one extensionist were interviewed in four different growing regions in KwaZulu-Natal

Questions for guiding conversations	Activity system element
1. How did you get involved in extension work/farming?	Historicity/motivation
2. What do you understand by the term 'sustainable'?"	Object
3. What are the main aspects of sustainable practice that you work on?	Object
4. Who do you work with on this and how?	Community and division of labour
5. What formal and informal rules and operating procedures that promote or constrain your work on supporting better management practice?	Rules/T&C
6. What motivates you to incorporate environmental BMP practices into your extension/farming activities?	motivation
7. What challenges/constraints have you faced when working with better management practices (regulatory, institutional, knowledge)?	Tensions and Contradictions
8. How could the implementation of BMPs be strengthened amongst growers and extension specialists?	Solutions

Appendix 2b: Framework guiding individual semi-structured interviews with extensionists and farmers: *learning*

1. How do you learn about sustainable practices and has this changed in anyway over time?	Tools and historicity
2. What are the important tools, techniques or concepts you use when farming or practicing extension?	Tools
3. What constraints/challenges do you face when learning about sustainability issues?	Tensions and Contradictions
4. How do you think these constraints and limitations that you face can be overcome?	Solutions

Appendix 2c: Example of analytical memo to abductively identify tension themes from interview quotes

INTERVIEWEE CODE	TENSION QUOTE	THEMES
g8	I find that I haven't got the time to go to those meetings [LEC], but I still have a keen interest in it. pg 2	Lack of time to attend meetings, field days, study groups, courses
g8	Chaps [farmers] just don't have the time or they just won't come [to farmers days] if there are more than say two a year. Pg 4	Lack of time to attend meetings, field days, study groups, courses
g8	There are a couple of things that are killing us in the sugar industry: monocropping, and using chemical fertilizers. Pg 3	Declining yields
g8	Degradation of the soil from an organic matter point of view is serious. There are just no carbons left in the soils. Pg 4	Resistance to investing now for delayed, but longer term returns
g8	Unfortunately we have got ourselves in a groove where we are locked in because of the cost issue. Pg3. [The] constraint is ...financial...you see your yields going down and the way to sort it out is actually too costly. Pg 5	Finances limited to implement BMPs
g8	Our yields are not what they used to be and are in a slow decline. pg 4	Declining yields
g8	I believe the sugar industry is getting left behind in a bit of a time warp...we are plodding on with our monocropping. Pg 5.	Resistance to change
G5	Our tons per hectare [has] slowly dropped; our soils are not the same sort of quality as they were, not that our fertilization has declined. Pg 1.	Declining yields

Appendix 2d: Example of an analytical memo used to group Tensions in order to abductively generate Contradictions, with link to interviewee

	CONTRADICTION	TENSIONS THAT CONTRIBUTE TOWARDS CONTRADICTION		
1	Between the capacity of the Extension Specialists & the expectations of growers	<p>1. The skills required by extension specialists are diverse so identifying and agreeing to what skills training is needed is challenging.</p> <p>2. Extension staff need to be allowed the time to develop their skills.</p> <p>3. Finding experienced and skilled extension staff to replace the staff that leave SASRI is difficult.</p> <p>4. Extension at times is not engaging with what growers want to know. (ext mgt)</p> <p>5. It's a challenge for extension staff to be aware of what individual grower needs & expectations are and to be able to respond adequately to an individual grower's situation.</p>	<p>ext 1</p> <p>ext 1</p> <p>ext 2</p> <p>ext 1</p> <p>ext 1</p>	<p>eGMi5</p> <p>eGMi5</p> <p>eGMi13; eDMi9</p> <p>eCBi2</p> <p>eGMi3,8</p>
2	Between SASRI's planned implementation of SuSFarMS & grower/extension staff resistance to change , record keeping & working with/investing in new forms of technologies	<p>1. Growers tend to resist audits/providing evidence of practice.</p> <p>2. Growers often need convincing of the value of keeping adequate and accurate records.</p> <p>3. Some growers are interested in new technology/ideas, others are often not.</p> <p>4. Implementing sustainability practices is voluntary and requires the willingness of people to participate, which is often not there.</p> <p>5. Growers or extension don't like being told that they could improve on their practices and need to change.</p>	<p>gwr 2</p> <p>gwr 1, ext 1</p> <p>ext 1</p> <p>ext 2</p> <p>ext 3</p>	<p>gBSi4; gToNi9</p> <p>gMNi5; eJBi4</p> <p>eJBi4</p> <p>eOdHi4; eBEi4</p> <p>eDWi2; eCBi1,5; eGMi6</p>

Appendix 3: Sample of thank you letter sent to participants

From: Vaughan Koopman <koopman@wetland.org.za>

Sent: 25 May 2011 10:33 AM

To: *[Names of extensionists and farmer participants]*

Subject: SUSFARMS workshop 28 June

Dear all

Just a quick email to thank you for the time you set aside to talk to me recently.

Your input is contributing towards a joint SASRI-WESSA initiative to develop learning and support approach for growers and extension specialist for SUSFARMS as SASRI readies itself to officially begin rolling-out SUSFARMS to growers in July.

Your continued input into this process of gathering and understanding the challenges a grower and extension specialist faces when implementing sustainability practices is most important. Equally important are your ideas on how your' learning and implementation needs in this regard can be strengthened and supported. I have managed to capture some very useful information during my discussions. This information will be presented to you for further input and consideration at a workshop in July at SASRI. Please note that it is really important that you attend as it is during this workshop that we will jointly work through the findings from the interviews and identify and prioritize important challenges and opportunities to focus on. In other words you will be jointly crafting a strategy to support yourselves to learn about and implement SUSFARMS (and the BMPs contained within).

Please note that the initial 2 workshops have been reduced to 1 workshop in response to concerns that 2 workshops was too many for people to attend. The workshop will be held on 28 June at SASRI. It will be a full day, but achievable nonetheless.

An agenda will be sent out closer to the time. Please contact me on the number below if you have any queries.

Looking forward to seeing you on the 28th!

Vaughan

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