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Facilitating Conservation Agriculture in Namibia through Understanding Farmers' Planned Behaviour and Decision Making

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Facilitating Conservation Agriculture in Namibia through Understanding Farmers' Planned Behaviour and Decision Making

Främjande av "Conservation Agriculture" i Namibia genom att förstå bondens beteende och beslutsfattande

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Foreword

As a child I was deeply affected by seeing deforestation, scrawny livestock, degraded soils and empty stomachs in Northern Namibia. Ever since those days I have been carrying around the question: "how can the farmers of the North feed themselves while at the same time living in a healthy and beautiful environment?" There was no way of approaching this question until I was finally fortunate enough to partake in the Agroecology Master program in Sweden. My eyes were opened to systems thinking and a holistic approach to agriculture that focuses specifically on people. Only by integrating the farmers and listening and learning from them could we hope to come up with solutions. With this knowledge and the research skills I accumulated over 6 years of studies I returned to the soil of my roots to finally try and address my question. It is a powerful thing to immerse oneself in understanding the people working the land of one's home and through speaking and living with them I now realize that there is no single answer to the question. Instead, there are many answers because my central question has been divided into smaller ones and every place is unique and requires locally appropriate solutions. Nonetheless, by focusing on a specific aspect of the problem and working specifically in the North Central Regions (formerly known as the Ovamboland) I was able to find at least some answers. It is my hope that through my findings I can contribute to improving the livelihoods of subsistence farmers in these areas. It is not about 'feeding the world' or maximum profits here but rather about the humble possibility of making a dignified living in a healthy communal farming landscape. Therefore I would like to dedicate this work to all the people that have helped me to reach this point, those that have walked a part of the path with me as well as those that will benefit from it.

Abstract

Subsistence agriculture in Northern Namibia has been unable to feed the population due to out-dated agricultural techniques and erratic rainfall patterns. However, a novel Conservation Agriculture (CA) technique has been developed and introduced in Namibia which significantly boosts yields and stabilises them against droughts and floods. However, at the end of 2011 only 800 farmers had adopted the method and so there is an urgent need for up-scaling. The purpose of this study was to understand adoption of CA by studying farmers' socio-psychological motivation and decision making processes, and general aiding and hindering factors in order to inform NGO's and government on what to consider in up-scaling CA. The study was based on the Theory of Planned Behaviour (Ajzen, 1991) and a Decision Making Process Model that was derived from Verbeke (2000) and Oehlmer *et al.* (1998). Fieldwork consisted of 20 interviews with CA farmers, non-CA farmers, extension officers, regional counsellors and tractor owners and was carried out in the North Central Regions of Namibia from January to March 2013. Purposive sampling and semi-structured interviews were employed and this was augmented with participant observations (Bernard, 2006). Transcribed interviews were coded both inductively and deductively and analysis was done by structuring themes along the theoretical background.

It was found that attitudes towards CA were positive and thereby intentions to adopt it were strong among farmers; this was due to easier farming with higher yields and income returns and good social acceptability. However, the lack and tardiness of land preparation services in terms of ripping the soil curtailed farmers' actual capacity to implement CA. The decision to adopt CA was often taken immediately, based on better yields and most importantly on seeing CA in someone else's field. Aiding the uptake of CA was a strong interest of all stakeholders and positive policy and political environments. The main hindering factor was the lack of land preparation service provision by government and the private sector. However, it was found that good opportunities exist for provision of land preparation services by the private sector but not government with its currently ineffective administrative structure. The study concluded that farmers had strong intentions to adopt CA and easily decided to try CA, but that the lack of land preparation was severely hindering wider-scale uptake. Therefore this study recommends NGO's and government to support the establishment of private land preparation enterprises through business information provision and clarification of government strategies so that they aid rather than hinder such establishment.

Keywords: Namibia, Conservation Agriculture, Theory of Planned Behaviour, Farmer Decision Making, Adoption, Ripping, Subsistence

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List of Acronyms

CA	Conservation Agriculture
CBA	Community Based Adaptation Project
CES	Creative Entrepreneurs Solutions
CONTILL	Conservation Tillage Project which was run by NAB, NRC, NNFU, MAWF and the Golden Valley Agricultural Research Trust of Zambia
DAP	Draught Animal Power
GEF	Global Environment Facility
MAWF	Ministry of Agriculture, Water and Forestry
NAB	Namibian Agronomic Board
NCAP	Namibia Conservation Agriculture Project
NGO	Non-governmental Organisation
NNFU	Namibian National Farmers Union
NRC	Namibia Resource Consultants
NSCT	Namibia Specific Conservation Tillage Method as developed by the CONTILL project
SADC	Southern African Development Community
SGP	Small Grants Programme under GEF
TPB	Theory of Planned Behaviour
UN	United Nations
UNAM	University of Namibia
UNDP	United Nations Development Programme
USAID	United States Agency for International Development

Introduction

The purpose of this study was to understand farmers' socio-psychological motivation to adopt Conservation Agriculture (CA), what considerations they made in deciding to do this and to identify other factors aiding or hindering uptake of CA. Namibia is an arid country and its agriculture is subject to severely low crop yields due to out-dated agricultural techniques and climate change. CA is a solution to this, but in order to improve the low adoption rates (only 800 farmers at the end of 2011) NGO's and the government need to understand how wider-scale adoption can be facilitated. This is where this thesis aims to contribute. In this section the reader will be introduced to the background of the problem in order to understand the context and the urgent need for solutions to agriculture's problems in Namibia. Subsequently, the problem statement outlines the need for the increased adoption of CA; following will be the motivation for research. Lastly, the research questions describe the study's investigation into the above mentioned aspects.

Problem Background

Namibia is the driest sub-Saharan country in Africa and is home to just over two million inhabitants as per 2010 Census. Namibia consists of more than ten language groups, the dominant one being the Ovambo peoples. The economy of the country is mostly reliant on mining, tourism, manufacturing and agriculture, the latter of which making up around 5% of GDP but employing 29% of all working persons and therefore being of central importance to the country (Namibia Statistics Agency, 2012).

The North of the country receives the most rainfall and is the only area where the climate permits agriculture in the form of dry land rain-fed crop production (Auala, 1973). The only perennial rivers of the country are found along its southern and northern borders and the rainy season is confined to the summer months, leaving large areas of the country devoid of surface water for most of the year and inhibiting irrigation. Namibia's highly variable climate also brings recurrent droughts and floods, especially in the north which is dominated by flood plains. The underlying climatic conditions and the seasonal variability in precipitation leave dry land crop production vulnerable and as a result only unusually good rainfall years yield enough crop production to meet local demands (Wiegers *et al.*, 2009).

Problem Statement

The Oshivambo speaking peoples of central northern region of Namibia traditionally rely on rain-fed agriculture to produce their staple diet mahangu (pearl millet – *Pennisetum glaucum*) and a number of other crops such as sorghum, maize, cowpeas and Bambara nuts. Mahangu is the dominant crop grown as it has good drought resistance characteristics, can survive high temperatures and does well in sandy soils (Uno, 2005). However, recurrent droughts and floods cause harvests to fail and combined with a number of other constraints such as out-dated agricultural techniques, the national average yield of the staple diet mahangu is extremely low (Kooy, 1973). During the period from 1990 to 2000 it was a dismal 230 kg/ha (Mallet and du Plessis, 2001). As a result, Namibia is a net importer of grains and in 2012 had to import 191 400 tonnes which represented 42% of the national grain demand (Uno, 2005). Even though the main crop being grown in the northern regions is mahangu, 42 800 tonnes of this grain had to be imported in 2012 alone (NEWFIU, 2012).

The low mahangu yields are a large contributor to the need for food relief by the Namibian government; in 2008 it was forced to provide six months of food relief to the value of N$ 228 million (Wiegers *et al.*, 2009). Observations on the ground are supported by scientific projections which predict a progressively more erratic weather with climate change making rainfall events more intense but further apart in time and overall reductions in precipitation of up to 30% (Midgley *et al.*, 2005; Rowswell and Fairhurst, 2011). These trends are increasingly putting farmers at risk, especially against the background of already very low yields.

The main driver of low agricultural outputs, besides impacts of climate change and erratic weather patterns is the widespread use of traditional yet out-dated farming practices (FAO, 2009). At the root of this are improper tilling, planting and fertilizing (Rigourd *et al.*, 1999; Uno, 2005).

It is therefore important to find solutions to increase the average mahangu yields. This could be done by improving agricultural methods to boost yields and mitigate weather impacts as is being done through the use of a novel Conservation Agriculture (CA) technique. This CA method has been in development since 2005 and boosts average mahangu yields to 1670 kg/ha. It relies on a simple set of techniques that have been developed together with communal mahangu farmers in the Namibian context and not only improves yields but stabilises them over time by mitigating against climate change impacts (NCBA, 2012).

The development of a site-specific CA or Conservation Tillage technique as a response to low yields and increasing environmental degradation is not unique to Namibia. Among many other African nations Zambia, Ghana, Tanzania and Zimbabwe have also witnessed similar efforts (Muliokela, 1998; Jonsson, 1998; Boa-Amponsem *et al.*, 1998; Chuma and Hagmann, 1995). However, adoption

of CA techniques across Africa remains low with only a few exceptions such as Southern Zambia, South Africa and Ghana (Giller *et al.*, 2009). In general though, it was recognised that farmer participation and integration of their socio-economic conditions into the development of CA techniques markedly improved adoption on a wider scale. Nyagumbo (1998) also found that a top down approach to extension (that is the education of farmers about CA) was greatly hampering adoption in Southern and Eastern Africa. In another study from Zimbabwe Norton (1995) mentioned a social risk of CA adoption which consisted of community members holding adopters back in order for them not to leave the status quo of the community. Such socio-psychological elements have often been noticed, but have not been directly investigated (Fowler and Rockstrom, 2001). In their study in Tanzania Jonsson (1998) on the other hand found that adoption of Conservation Tillage[1] methods was improved to rapid rates as a result of the consideration of farmers priorities. A critical mass of adopters was also found to be necessary to trigger widespread adoption across Southern Zambia which shares a border with Namibia (Kaoma-Sprenkels *et al.*, 1999). Lastly, in Zimbabwe Lubwama (1999) found that socio-economic factors can greatly affect the uptake of CA. She listed among others land ownership, availability of implements, and culture and traditions as being important issues.

Learning from the various CA efforts around the continent it therefore seems that widespread adoption of CA calls for farmer participation, consideration of farmer priorities and a bottom up approach to development and education. Furthermore, a critical mass of adopters and investigations into socio-psychological and socioeconomic factors influencing adoption are conducive to adoption.

Any effort to improve the low adoption rates (around 800 farmers at the end of 2011) of CA in Namibia therefore will have to consider these aspects. This study thus proposes to investigate the socio-psychological factors underlying the adoption of CA from a bottom up perspective that considers the priorities of farmers and seeks to understand the decision making process undergone in adoption of CA. It also proposes to investigate socioeconomic parameters. Understanding the socio-psychological background, the steps taken in the decision to implement CA and socioeconomic influences will hopefully aid on-going and future CA projects in boosting adoption rates across Northern Namibia. Currently about 233 522 persons across the Northern crop growing Regions derive their income from subsistence agriculture (Namibia Statistics Agency, 2012). Therefore, there is a very large scope and need for the spread of CA.

[1] Conservation Tillage is defined as “Any tillage system that reduces loss of soil or water relative to conventional tillage; often a form of non-inversion tillage that retains protective amounts of residue mulch on the surface” (Mannering and Fenster, 1983; pg. 141).

Motivation for Research

There is an acute need for better dry land crop yields in Namibia, which is evidenced by the low average grain yields that routinely lead to large imports and emergency food relief programmes (FAO, 2009; Wiegers *et al.*, 2009). As CA offers a simple and effective solution to low crop yields and helps farmers to mitigate against climate change it should be actively supported and implemented. However, at the end of 2011 CA had only been implemented by around 800 farmers, necessitating urgent up-scaling of CA projects run by NGO's and initiatives by the MAWF. However, to facilitate the adoption of CA these institutions will need to gain a deep insight into the socio-psychology of farmers when it comes to adopting CA, and how they go about deciding whether to implement them or not. To further improve the understanding of the situation an investigation into specific factors aiding and hindering the spread of CA in the region will also be of value. This is where this research aims to fill the gap and provide such a rich picture.

Study Purpose, Research Questions and Aims

The purpose of this study was therefore to identify socio-psychological factors motivating farmers to adopt CA, understanding the decision making process involved in adoption and identifying factors aiding and hindering it. The aim of the study was to identify how this purpose can be used to inform NGO's and government to facilitate the adoption of CA on a wider scale. The purpose is reflected in research questions one through three and the aim in research question four.

Resultantly, the specific questions guiding the line of questioning were:

1) What motivates farmers to adopt CA?
    a) What is the attitude towards CA?
    b) What social norms affect adoption of CA?
    c) What are the control factors acting on the uptake of CA?

Questions 1) a), b) and c) specifically address the socio-psychological factors underlying the motivation of farmers to adopt CA. As suggested by the Theory of Planned Behaviour (Ajzen, 1991), attitudes, social norms and control factors constitute an intention of carrying out a behaviour (i.e. adoption of CA). By understanding these three factors it should therefore be possible to understand what motivates farmers to adopt CA.

2) What considerations are made in the decision making process leading to adoption of CA?

Question 2) addresses the decision making process starting with the realization of having a problem leading all the way to adoption of CA and ending at post-adoption evaluation (although this process

is not linear). By understanding the main considerations such as personal values and responsibility bearing it should be possible to understand how farmers choose to adopt CA and what factors play a role in the process. This includes searching for information and evaluating alternatives for example.

3) What helps and restrains the adoption of CA?

This question addresses the important issue of restraining and aiding factors that influence the adoption of CA, giving special attention to socioeconomic parameters. To gain an understanding of what restrains and helps farmers in the adoption of CA it will be easier to facilitate this adoption, which leads onto the next research question.

4) How can the above be used to facilitate the uptake of CA?

Finally, question 4) seeks to understand how a more widespread adoption of CA can be facilitated with the knowledge gained from questions 1) through 3). This question is important in making the research applicable and useful to the agricultural situation in Northern Namibia.

The Setting

In the following section the reader will be introduced to the study location, local culture and CA as well as CONTILL projects in order to establish the background and setting which contextualises this study. In order to gain a deeper picture of the adoption of CA from the farmer's perspective it is necessary to consider this background, especially as this study focuses on a socio-psychological approach. This approach falls under the social sciences and, as was affirmed by Bharwani *et al.* (2005) to be of relevance, any social science finding will need to be considered in the wider cultural and physical setting in which it evolved.

Study Location

The study was conducted in and around the town of Ondangwa, which is located in the North Central Regions of Namibia (see Figure 1). The North Central Regions comprise of the Regions[2] Oshikoto, Oshana, Omusati and Ohangwena and is the traditional area inhabited by the Ovambo. The region is characterised by relatively high annual rainfall of between 400 and 550 mm, sandy and loamy soils, large flood plains called 'oshana' (singular) and open woodland and shrub land (Mendelsohn *et al.*, 2002; le Roux and Mueller, 2009). It is among the most densely populated areas in the country and apart from the urban centres of Ondangwa, Ongwediva, Oshakati and Eenhana most people live in rural homesteads and are reliant on input extensive rain-fed agriculture and livestock rearing (Uno, 2005).

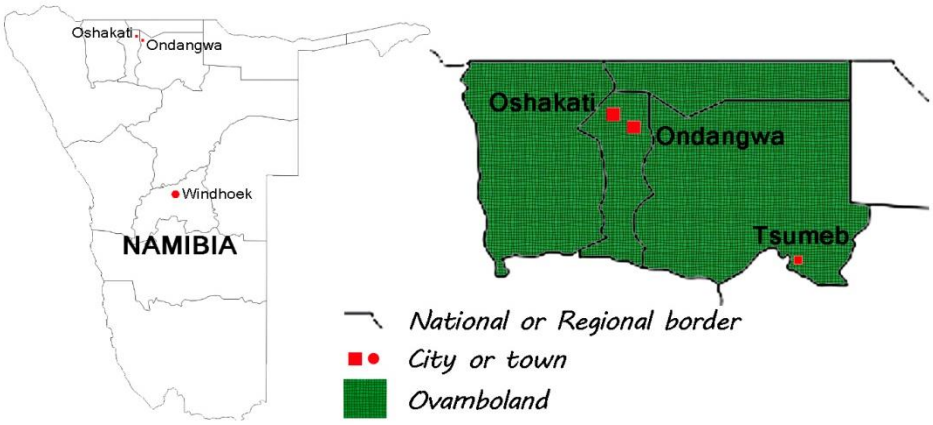

Figure 1 Map of Namibia and the North Central Regions consisting of the Regions Oshikoto, Oshana, Omusati and Ohangwena.

[2] When capitalised the word 'Region' will refer to a political sub-division of the country (there are 13 of these and they serve as administrative units), when not capitalised the word 'region' is used synonymously with area.

Ovambo Culture Profile

The Ovambo peoples are the most populous ethnicity of Namibia and are settled mostly in the North Central Regions of the country (formerly known as the Ovamboland). Here they have been living for about four centuries (Kooy, 1973). The Ovambo peoples consist of seven discrete tribes that are separated by numerous cultural differences but all share a mutually intelligible language which is collectively known as Oshivambo. The tribes are the Ndonga, Kwanyama, Ngandjela, Kwambi, Kwaludhi, Mbalantu and the Nkolonkadhi-Eunda. The Ovambo are of Bantu origin and initially migrated into the North Central Regions from the upper Zambezi regions. They are an agricultural and pastoralist people that rely mostly on rain-fed agriculture to grow their staple crop mahangu (finger millet), maize, beans, ground-nuts, sorghum, melons and pumpkins. Seasonal supplementation to livelihoods is also derived from hunting, fishing and foraging. Ovambo societies were initially established on the sandy flood plains of the region and conducted agriculture on the higher lying ground between the perennial rivers known as Oshana (singular). Traditional labour division placed responsibility for crop production on women and the rearing of livestock on men. Men also dominated the public sphere (and continue to do so), but the culture is in fact based on matriarchal lines (Gewald, 2003). Traditionally kings, their advisors and headman constituted the political system and they ruled Ovambo society through autocratic decisions that were nonetheless based on consultation with the population through tribal gatherings (Auala, 1973).

The Ovambo not only form the biggest part of the Namibian population, they are also witnessing rapid population growth. In 1960 there were 239 363 Ovambo and by the latest national census of 2009/2010 they numbered 998 109 (representing 48,3% of total population), clearly illustrating the rapid population growth (South Africa, 1971; Namibia Statistics Agency, 2012).This has led to ever increasing pressure on the natural and social resources of the region and also forces many to seek jobs in urban centres, mines, fisheries and commercial farms to the south, a trend that started with the famine of 1915 and strengthened through the contract labour system of Apartheid (Auala, 1973; Gewald, 2003). It is commonly the men and the youth that migrate to find jobs elsewhere, leaving rural areas in the north bereft of labour and potentially tearing the social fabric. This in particular affects the subsistence agricultural sector as young and strong hands are direly needed to cultivate the land. Further stress is added to this situation through the high prevalence of HIV/Aids that not only causes high mortality but significantly affects the strength of people working in agriculture (Baier, 1997; de la Torre *et al.*, 2009).

However, despite the political power being largely concentrated with the Ovambo peoples, the North Central Regions are still home to many of the poorest citizens of the country. This is due to numerous factors. The North Central Regions have historically been bordered by large areas of uninhabited land which has isolated it from attack by other ethnicities but also cut it off from trade and communication with the greater region, in particular the rapidly developing South Africa (Kooy, 1973). Starting around the 1890's political turmoil due to mercantilist trading, the introduction of fire-arms, cattle diseases and slave trade also undermined the traditional system of authority based on kings, their advisers and local headmen. Additionally, its development was hampered by historical disadvantage stemming from German colonial and Apartheid rule and the war for independence (Gewald, 2003).

However, despite these historical inequalities, the region continues to struggle even as it receives the most intense government attention of all regions in terms of development effort. One major reason for this is the fact that the Ovambo peoples are traditionally rural people relying on rain-fed agriculture and dry-land grazing of livestock, the former of which is notoriously susceptible to erratic weather patterns and out-dated farming methods.

The CA and CONTILL Projects

Conservation Agriculture (CA) is an umbrella term used for a large variety of agricultural methods that have soil conservation at their core. The concept has been differently defined by many stakeholders, but here I will use the following definition "any tillage system that reduces loss of soil or water relative to conventional tillage; often a form of non-inversion tillage that retains protective amounts of residue mulch on the surface" (Mannering and Fenster, 1983; pg. 141).

Around the year 2005, the Ministry of Agriculture, Water and Forestry (MAWF) of Namibia realized that something had to be done to improve national mahangu and other dry land crop yields. Through a subsequent initiative by the MAWF, CA was first introduced into Namibia in 2005 by a project named CONTILL (short for Conservation Tillage project). It was run by Namibian National Farmers Union (NNFU), Namibian Agronomic Board (NAB) and Namibian Resource Consultants (NRC) and was active from 2005 through October 2011. The UNDP GEF SGP Community Based Adaptation pilot project then got involved in CA in collaboration with CONTILL to specifically implement CA in climate sensitive areas. However, some confusion as to the continuation of CA existed up until a new project in 2012 picked up where CONTILL had left off. This project is called the Namibia Conservation Agriculture Project (NCAP) and will be running for 3.5 years. It is implemented by CLUSA International, in collaboration with a Namibian NGO called Creative Entrepreneurs Solutions (CES) in

Ondangwa. The project is funded from Washington by the USAID Office of Foreign Disaster Assistance. Under the initial CONTILL project a Namibia specific conservation tillage method (NSCT)[3] was developed in conjunction with farmers, the University of Namibia (UNAM) and Gerhard Baufeldt who designed and built the tilling implements. The method draws on specialised ripping attachments for tractors and animal drawn plough frames that were developed through the project to suit local soils. The project showed that the national average mahangu yield of 230 kg/ha could be improved to 1500 kg/ha through the use of the NSCT method (Mallet and du Plessis, 2001; NCBA, 2012). As a result of this marked improvement in yields, the government of Namibia included the promotion of CA in a number of their policies such as the National Policy on Climate Change for Namibia as well as openly encouraging the implementation of CA through the MAWF (Government of the Republic of Namibia, 2011).

Traditional versus CA Method

The traditional way of growing mahangu and other crops uses disc or mouldboard ploughs, redundant and unplanned seeding and broadcast fertilization. Discing and the use of mouldboard ploughs pulverizes the soil, reducing soil carbon content and causing soil erosion by wind and water. Also, no in-field water harvesting takes place and no mulching protects the soil against desiccation and erosion, leading to low availability of soil moisture. No constant traffic is used and the consequent hard pan that is formed by soil compaction is not opened up through tillage. This exposes fields to flooding and prevents deep root penetration which would otherwise protect crops against wind-throw. Seeding is done by opening a small hole with a hoe and dropping a handful of seeds and then covering them. In this way too many plants are established on the same spot and the lack of thinning causes intraspecific competition that stunts plant growth and effectively reduces yields. Seeding is also not done in a planned manner so that optimal plant density and distribution is not observed. Lastly, manure is applied to the field in a broadcasting manner which places a lot of manure in areas where no crops are growing. As there is a general lack of sufficient manure it means that many plants do not receive adequate fertilization. In general, agricultural knowledge is passed from generation to generation through work in the fields and cultural customs. This causes a general unawareness of the possibility to question established methods and innovate for new ones.

In contrast, the Namibia specific conservation tillage technique was developed as a method that draws on ripping, mulching, improved seeds, constant traffic, new planting and fertilizing techniques

[3] The Namibia specific conservation tillage method will henceforth be interchangeably referred to as NSCT or CA

and DAP. The ripping implement is designed to break open the hard pan and form ridges between the furrows which will divert rain into them. In this way the ridge/furrow system performs in-field water harvesting and allows for better water penetration; additionally, surface mulching inhibits evaporation (Giller *et al.*, 2009). All of these directly lead to improved moisture availability and yields (Li and Gong, 2002). Furthermore, through improved water penetration the opened hard pan mitigates against floods and through in-field harvesting the ridge/furrow system mitigates against droughts. This means that not only are yields improved, they also become more reliable in the face of the erratic rainfalls of northern Namibia (NRC, 2009). As erratic weather patterns are projected to become increasingly severe due to climate change there is even more of a need for mitigation in agriculture (Midgley *et al.*, 2005; Rowswell and Fairhurst, 2011). High winds coming from clouds will probably also increase in the future as a result of increased intensity of rainfall events; something that NSCT mitigates against via better root penetration of crops. By breaking the hard pan, the roots of mahangu for example can penetrate much deeper and make the crop much more resistant to wind-throw.

The method incorporates mulching of furrows with crop residues of the previous growing season to inhibit evaporation, increase soil organic content, keep the soil surface cool and provide a micro-climate conducive to beneficial soil biota (Erenstein, 2002). The use of seeds from improved varieties is also supported by the method to increase yields. Constant traffic is also implemented by driving the tractor on the same tracks every year, thereby limiting soil compaction to those areas only. Lastly, a clearly structured planting and fertilizing method is used to achieve regular planting distances, optimal plant densities and fertilization restricted to where crops are growing. Thinning at early stages of crop establishment is also performed, further regulating plant densities (NRC, 2009).

Another tenet of the method provides for the use of DAP to rip fields in years where tractors are unavailable. After a field has been ripped by a tractor the ridges and furrows can be maintained for a number of years through the use of DAP, thereby enabling the most rural of farmers to practice CA even when tractor driven land preparation is unavailable.

Theoretical Background

The theoretical framework used to design and guide the study was composed of the Theory of Planned Behaviour (TPB) as championed by Ajzen (1991) and a Decision Making Processes Model which was synthesised from two different models put forward by Verbeke (2000) and Oehlmer *et al.* (1998).

The TPB

The Theory of Planned Behaviour is a social psychological model that seeks to explain human behaviour (Ajzen, 1991). It stipulates that behaviour is driven by three factors (Figure 2): how positively or negatively the outcomes of the behaviour are valued (attitude towards behaviour), the subjective social pressures (subjective norms) related to the behaviour and the perceived personal capacity to fruitfully engage in the behaviour (perceived behavioural control). In combination, these three form a negative or positive intention to engage in the specific behaviour. Furthermore, when actual control over the behaviour (i.e. money or skills) is adequate, the individual will act on their intention. This means that actual control is the final mediator of behaviour and that even a positive intention may not always be acted on due to restraints in actual control. It was however, also suggested that in some cases actual control can be substituted by perceived behavioural control Ajzen (2005). This may not always be realistic though, as in some instances the individual may have an incomplete or inadequate view of the actual control affecting the behaviour, possible resultant from a lack of knowledge of the circumstances.

Attitude, subjective norm and perceived behavioural control are themselves a combination of the behavioural (i), normative (ii) and control (iii) beliefs held by an individual, respectively. These in turn consist of the possible outcomes of a behaviour and assessment of these (i), the expectation of referents (i.e. family, friends etc.) and the wish to adhere to them (ii), and the extent to which the individual feels able to successfully engage in the behaviour which includes aiding hindering factors and how potent these are judged to be (iii). To safeguard the validity of the TPB only beliefs that are available to the memory of an individual should be used. Any belief that does not fulfil this criterion is unlikely to contribute to attitudes, subjective norms or perceived behavioural control.

Although the TPB represents a complete model of explaining behaviour, it does not include a mechanism for knowing the relative importance of attitudes, subjective norms and perceived behavioural control in the explanation of the behaviour (Wauters *et al.*, 2010). The relative weighting of these three factors will vary in different instances as a result of dissimilar behaviours and people under investigation. Such was illustrated by Trafimow and Finlay (2001) who found that individuals could be strongly under control of either attitudes or subjective norms and that this varied between different behaviours. This dynamic within the TPB could therefore possibly limit its accuracy of identifying the specific components most influential in motivating farmers to adopt CA.

The TPB has been used in studies similar to this one. Wauters *et al.* (2010), for example conducted a study on the adoption of soil conservation techniques in Belgium in which they were seeking to isolate factors limiting the adoption of soil conservation methods among farmers. They found the

TPB to be a good framework for their analysis, as its socio-psychological approach was effective in isolating attitudes as the underlying hindrance to adoption. In another study of strawberry farmers in Florida Lynne *et al.* (1995) found the TPB to be the most accurate theory in explaining farmers' behaviour when it came to adopting and financing novel water saving techniques.

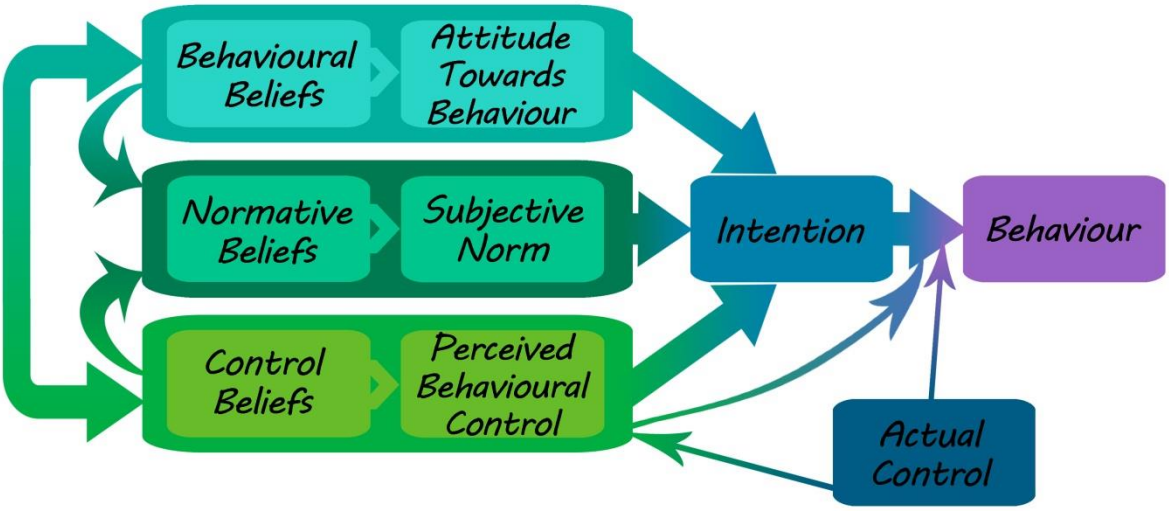

Figure 2 The Theory of Planned Behaviour. Note the influence of actual control and possible influence of perceived behavioural control indicated by the curved arrow; adapted from Ajzen (2006).

The TPB in This Study

Having seen the effectiveness of the TPB in investigating uptake of novel agricultural techniques in Belgium and Florida, it was applied in this study to investigate farmers' motivation to adopt CA in northern Namibia. In using the theory, attitudes were seen as attitudes towards the new CA methodology, subjective norms as the expectations and reactions of referents to adopting or wanting to adopt CA and perceived behavioural control as the amount of personal control over such adoption. Actual control was then seen as those factors aiding or inhibiting adoption in the 'real world', i.e. when it came down to physically implementing the new method.

Decision Making Process Model

To understand how the adoption of CA by farmers can be facilitated, an investigation of the decision making process was undertaken by this study. Recognizing the steps in making the choice to adopt CA will help to identify where the process is being hampered. This can inform where it may need to be supported in order to better facilitate the uptake of CA. To achieve this, a synthesised model of decision making processes was drawn up. It was informed by attempts made by Verbeke (2000) and

Oehlmer *et al.* (1998) to define steps in the decision making process of consumers and farmers, respectively. Verbeke (2000) proposed a linear model in which a logical progression is made from problem recognition to choice. In contrast Oehlmer *et al.* (1998) put forward a more reflexive model in which processes are non-sequential and constant evaluation and adaptation is important to the process of arriving at a choice.

The model proposed by Verbeke (2000) was utilised because it is based on a classical model of decision making processes consisting of four steps: problem recognition, information search, alternative analysis and decision/behaviour. These are generally agreed to be basic components of any decision making process model (Engel *et al.*, 1993).

However, Verbeke's (2000) model sees the decision making process as a linear one. This may reflect theoretical thinking of scholars but is not mirrored in actual decision making processes of farmers. These instead tend to be non-linear and influenced by personal psychological traits such as responsibility bearing and personal values and goals (Oehlmer *et al.*, 1998, Edward-Jones, 2006). As these are complex and interactive it cannot be expected that weighty decisions such as which agricultural method to use should be arrived at in a linear and predictable fashion. This was supported by a study on strategic decisions (choosing agricultural methods is arguably a strategic decision) which found such non-linearity and described the dynamic as a "groping, cyclical process" (Mintzberg *et al.*, 1976; pg. 265). However, despite its non-linearity, the model proposed by Verbeke (2000) was seen as an informative platform from which to build a new model because it outlined basic steps that are recognised as important in the literature. For this reason it was included in the synthesis of a new model.

The non-linearity proposed by Oehlmer *et al.* (1998) as well as the concepts of responsibility bearing and personal values and goals was added to the model by Verbeke (2000).

Figure **3** illustrates the resultant model which informed this study.

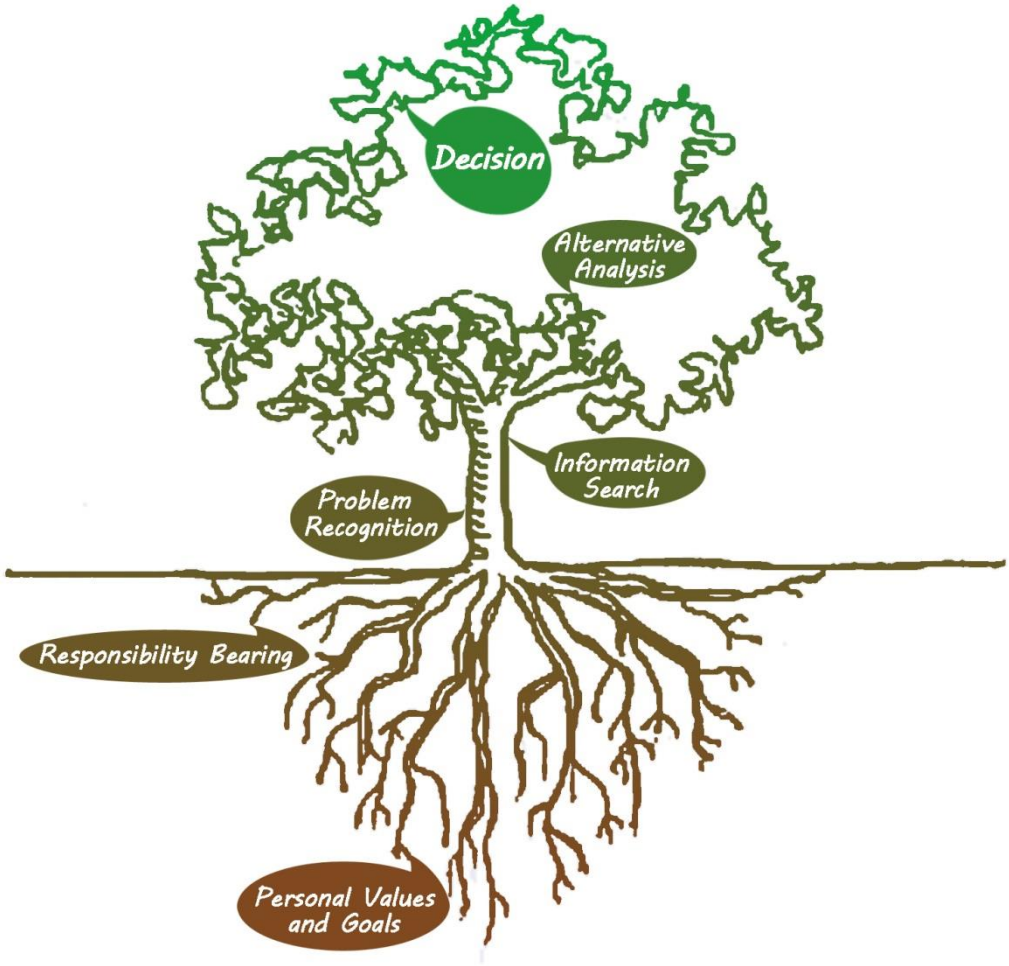

Figure 3 The above decision making model was synthesised from Verbeke (2000) and Oehlmer *et al.* (1998). It has been illustrated with the help of a tree to emphasise its non-linear and complex nature. A tree relies on all its parts simultaneously and cyclical and feedback processes are inherent, which is also the case for this decision making process model.

It needs to be emphasised at this point that this study, unlike others that drew on the TPB and decision making models did not attempt to predict any behaviour of farmers. The author agrees with Bharwani *et al.* (2005; pg. 2184) who maintained that "many, if not most, complex socio-ecological systems will remain unpredictable even if an understanding of the influences of behaviour within the system is achieved". For this reason this study should only be seen as an attempt to gain insight into

the motivation and decision making process leading to the adoption of CA and not as an attempt at prediction of such adoption.

Methods

Study Overview and Research Design

The purpose of this study was to investigate what attitudes and intentions motivate communal farmers of the North Central Regions to adopt CA, how they take the decision of adopting it and what factors are aiding or restraining this process.

To fulfil this purpose the study was designed using a qualitative approach which has been suggested to be appropriate when focussing on opinions, beliefs and attitudes (Alvesson and Sköldberg, 2009). Interviews were the specific qualitative method used, and from among these semi-structured interviews were chosen due to their open-ended nature which facilitates in-depth answers and the raising of new topics by informants (Kvale and Brinkmann, 2008). The short duration of fieldwork and trying not to miss important themes were also seen to necessitate the use of semi-structured interviews (Bernard, 2006).

For the study a total of 20 interviews were conducted in and around the town of Ondangwa between the 22nd of January and 22nd of March of 2013. The 20 informants were composed of 13 CA farmers, three non-CA farmers, two extension officers, one counsellor and one tractor owner. Interviews were conducted wherever interviewees were encountered, most often at homesteads, in their fields or in an office. Informants were told what the study was about and what their answers would be used for. Permission for audio taping of the interview and taking of notes was asked for and anonymity and the discreet handling of all personal information were guaranteed to all interviewees. It was also emphasised that they would directly benefit from the study by receiving a popular version of the thesis which will be translated into the local language of Oshivambo.

Most interviews were conducted in Oshivambo and only a few in English. A translator was used to translate between English and Oshivambo and he also acted as a key informant, filling in gaps and answering questions. This was possible as he had extensive knowledge of the project and local culture. Three of the interviews were translated by a second translator who was also part of the NGO implementing the NCAP project. Participant observation was also drawn on to elicit information mostly on the political and administrative structure and local culture; this was seen as important to enable subsequent interpretive or hermeneutic analysis of the data (Kvale and Brinkmann, 2008).

An interview guide was drawn up and questions were arranged in themes (e.g. questions on behavioural beliefs and normative beliefs). The guide was continuously adapted to cater for the changing theoretical background, inadequacies in formulation due to cultural differences between

interviewer and informant and newly emerging topics. The changing theoretical background was due to the development of the decision making process model. From Verbeke's (2000) theory four steps of the decision making process were initially taken to inform the construction of open ended questions for the interviews. After the first few interviews the theory was augmented by revising the linear process to allow for more reflexive and circular decision making as discussed by Oehlmer *et al.* (1998). Revision of the theory was prompted due to the obvious non-linearity of the decision making process described by farmers.

The interview guide was also designed to allow for considerable flexibility and therefore not every informant was asked the same questions. The design of interview questions was adapted to the occupation of informants. As a result CA farmers were asked different questions than the counsellor, for example. Asking open ended questions often led to new topics appearing in interviews and following up on these required such a flexible approach.

The interviews were transcribed by the interviewer and at the end of every day field notes were written up; this was important in order to document participant observations.

Sampling Method and Informant Backgrounds

Purposive sampling was used to select informants. In this approach it is known what knowledge informants may possess and they are chosen accordingly. This is reportedly the best way to investigate a cultural phenomenon and was therefore considered appropriate to this study. It can be argued that a change in agricultural method in a society whose identity is closely linked with agriculture can arguably be seen as a cultural phenomenon. This sampling method is also appropriate to exploratory work and studies conducted within a limited time frame, as was the case with this study (Bernard, 2006). When identifying informants, the number of years they had been practicing CA (ranging from zero to nine years), occupation, tractor ownership and knowledge of CONTILL/NCAP were kept in mind. Different levels of experience with CA were important as non-CA farmers could elaborate on the pre-implementation attraction of CA. CA farmers could elaborate on the motivation and decision making process prior to adopting CA as well as decision making processes after adoption. Counsellors and extension officers were interviewed to gain insight into higher levels of the political and administrative structure which are impacting farmers. The tractor owner was selected to find out about restraints and opportunities for land preparation service providers.

From a study design point of view, farmers and the tractor owner, extension officers and the counsellor were interviewed to gain a bottom up and top down understanding of the situation,

respectively. Using both bottom up and top down approaches was viewed as important in ascertaining what attitudes and beliefs were held, what the policy environment looked like and what factors were affecting the uptake of CA in the region and through time. The bottom up approach was specifically chosen to ensure the benefit of the study to local subsistence farmers as only such an approach ensures an advantage through "using and building upon the resources already available: local people, their knowledge and their autochthonous natural resources" (Altieri, 2002; pg. 2).

A few questions about the background of informants were also posed; these included age, number of children and roles in society, and were aimed to gain a better understanding of the informant and their position in the life of the community. These variables were shown by Edward-Jones (2006) to influence the decision making process when farmers adopt a new agricultural technique.

Data Analysis and Presentation

This study was conducted by drawing on both on inductive and deductive approaches. Themes were identified from the data as research progressed, leaving room for reformulation of theories and questions to better understand emerging topics. However, themes were grouped into different components of the theoretical backgrounds employed and this can be said to be more deductive. The analysis followed a similar pattern in which the inductive style was seen to be appropriate due to the exploratory nature of drawing up themes (see Bernard, 2006). However, it needs to be mentioned that in the process of analysing data deductive thinking was applied not only in organizing emerging themes but also in formulating theories on the go and testing them against the interview data (Ruona, 2005). The specific method of data analysis was similar to that of Grounded Theory as outlined by Bernard (2006). The Grounded Theory was not strictly followed though as it calls for open coding that does not adhere to any pre-formulated theories. As this study was drawing on the TPB and Decision Making Process Model it was not possible to follow this principle of Grounded Theory. Coding was however still employed and the process was iterative, as is the case in Grounded Theory. The justification for choosing Grounded Theory as a guiding principle was the exploratory nature of the work and the fact that it was based on semi-structured interviews and participant observation, therefore being a strictly qualitative study (Kvale and Brinkmann, 2008). The findings of the analysis will be presented as paraphrased exemplar quotes and will be arranged by research question and themes.

Constraints and Shortcomings

A significant constraint of this study was the limited time frame. It was felt that more time to build rapport with informants and conduct follow up visits and interviews would have yielded much more detailed and in-depth information. This was backed up by the translator who directly remarked in a conversation on 15th of February 2013 that in order to gain a deep and meaningful insight into farmers' daily lives and problems one would need to spend more time with them (Andreas pers. comm., 2013).

It was also pointed out to the interviewer during a discussion on February 14th 2013 that the struggle for independence continues to affect especially the older generations of the Ovambo peoples and causes them to be careful with giving out information to strangers, particularly those of European heritage (Johansson pers. comm., 2013b). This will almost certainly have influenced responses in interviews due to a similar trauma having been found to affect answers in a study in the nearby town of Rundu (Brinkman, 2000).

The language barrier also proved to be a constraint as it affected the accuracy of both questions and answers. At times it was observed during interviews that a lengthy response from informants was condensed into a short one through the process of translation (and vice versa). This means that translation was not necessarily direct and probably included re-formulation and skewing through interpretation and summarisation (Kvale and Brinkmann, 2008). Additionally, a second translator was used for three of the interviews and this may have introduced unreliability in the data due to different interpretations and style of translation.

Unfamiliarity with the local culture, its customs and norms presumably also posed some problems as common gestures that would have built rapport with informants were unknown to the interviewer and could thus not be used to gain more trust and provide deeper insights. The unfamiliarity with local culture and language most likely also meant that misunderstandings and distortion of information took place as words and concepts in English do not necessarily correlate with concepts in Oshivambo. This was seen in a question on perceived risk. It was routinely translated using the word 'problem' instead of 'risk' and accordingly almost no answers pertaining directly to risk were obtained. This experience was shared by Mwesigye (1996) while conducting a study in Uganda and was therefore not seen as unique to this study. Back translation, as was used by Mobley *et al.* (1996) in a study of child mortality in Namibia, would have been a good way to test and control for this and other effects of translation bias. However, the limited time frame of the study rendered back translation impractical.

Another problem during interviews was phone calls and text messages received by the translator, informant or interviewer. This was due to forgetting to switch off mobile phones, miscommunication

or disremembering to ask for all phones to be turned off. As a result four interviews were interrupted, causing a disruption in the flow of the interview. However, the flow could be re-established soon after and no lasting effect on the interview was noticed other than the interruption of whatever was being said at the time. A courtesy bias error may also have been introduced through the foreign interviewer and the presence of a translator who was himself part of the NCAP project (Grenier, 1998). This has also been termed the social desirability effect, especially when a third party that is part of the project covered by questions is present (this was the case in two interviews). Some critique of the project and the CA method may have been stifled as a result of this error or effect. Also, a third-party-present effect may have been introduced through the presence of a spouse which happened in two interviews (Bernard, 2006).

Lastly, internal validity of the study may have been affected by the changing theoretical background of the decision making model. Having changed some questions as a result of the evolving theory may have limited the propensity for comparing answers of the first few with subsequent informants.

Results

About the Informants

The informants were between 29 and 74 years of age, 7 of them were male and 13 female. In total 13 CA farmers, three non-CA, two extension officers, one Regional Counsellor and one tractor owner were interviewed. For all interviewed farmers, the average size of land under crops was 4.2 ha and that under CA 2.3 ha. CA farmers had between two and eight years of experience with the method. Most farmers were heading their households and were therefore responsible for agricultural decisions.

The researcher was 25 years of age, male and originally from Namibia although of European descent.

The results obtained from the interviews are presented below. These are supplemented with relevant quotes which are paraphrased and not always actual words of the informant due to translation.

The results of research questions 1 and 2 concern the interviews conducted with farmers and results presented for research question 3 are drawn from interviews with the extension officers, counsellor and tractor owner.

RQ 1 – What Motivates Farmers to Adopt CA?

Behavioural Beliefs

A belief that was consistently brought up by all farmers was that of improved yields through the use of CA. Most respondents also mentioned deeper root penetration which resulted in increased wind throw resistance. CA was also associated with positive beliefs about saving seeds and manure, enabling better water infiltration and facilitating in-field water harvesting.

"The yields you are getting from CONTILL [NSCT] are so much higher" CA farmer, female, 41 years.

"In CA the roots are strong and they are just standing" CA farmer, female, 59 years.

"*CA wastes less manure and seeds*" CA farmer, female, 63 years.

"*It improves water infiltration in the fields*" Non-CA farmer, female, 44 years.

"Even if you have a little rain the water will go on your plants" CA farmer, male, 69 years.

CA was also believed to bring about faster and healthier plant growth, less weeds and easier weeding. This was reportedly facilitated by the more organized way of planting. All together this was reported to bring enough food and therefore improved food security in households, even to the extent of being able to sell surpluses.

"Plants are healthier than the conventional ones" CA farmer, female, 32 years.

"And there's not much weed" CA farmer, female, 41 years.

"Weeding in CA is so easy" CA farmer, female, 74 years.

"This method brings enough harvest and enough food" CA farmer, male, 79 years.

"With CA you are able to go and sell your surplus" CA farmer, female, 68 years.

Informants also expressed positive beliefs about CA being cheaper and a better way of doing land preparation than the traditional method. The new method was also seen as a positive development (i.e. modernization) that brings dignity and peace in the household and enabled informants to provide for school fees and the needy (such as orphans and elderly). However, all of this was said to be dependent on early land preparation.

"You pay less for CA than the old way, and you get higher yields" CA farmer, female, 56 years.

"Discing is eroding the soil" CA farmer, female, 54 years.

"*Ripping opens the soil and then the roots are going deep"* CA farmer, female, 63 years.

"That we got CA is good because I mean it's like the world is moving forward" CA farmer, female, 56 years.

"With enough food in the house I feel I am a human being" CA farmer, male, 79 years.

"If you have food in the house then you have peace" CA farmer, female, 54 years.

"Now I can sell some surplus and get money for the school fees" CA farmer, female, 74 years.

"We can now assist others that are in need" CA farmer, female, 59 years.

"Only if they come early with the ripper then I will get much more harvest" CA farmer, female, 56 years.

Farmers were promised better yields by CONTILL/NCAP and therefore generally expected them. However, they often would test this assumption for themselves. They were however, generally convinced when they saw CA in someone else's field.

"I was told by the extension officer that the yields would be better" CA farmer, male, 65 years.

"I have the hope that I will get better yields" Non-CA farmer, female, 53 years.

"I tried CA to see whether there will be a difference or not" CA farmer, female, 74 years.

"People believe when they see" CA farmer, female, 54 years.

Normative Beliefs

The beliefs held about social norms and cultural influences were generally positive with regard to CA. Although initial criticism due to the new tilling method was widespread it nonetheless abated when referents witnessed the improved growth in the field. Criticism then turned to support and interest in adopting CA which lead referents to visit informants in order to test working with CA or receiving training and advice. Some referents also simply came to witness CA in the field, sometimes even in secret.

"At the beginning people were very crazy, they say ach, they are just spoiling the soil, playing with the soil" CA farmer, female, 41 years.

"As soon as the plants were a half a meter tall they wanted to know how it works" CA farmer, male, 65 years.

"The neighbours and friends they want this CA" CA farmer, female, 74 years.

"The others then came to gain knowledge from me" CA farmer, female, 32 years.

"*She only see footprints there, the people were checking whether things were growing*" CA farmer, female, 41 years.

Sometimes the initial criticism came from within the household (usually from the spouse) or was based on the fact that white people were part of the project team. However, criticism in the household never lasted for very long and that against the project team members was not taken to heart.

"Our husbands used to say, ah you are just running up and down" and *"Later they changed their minds*" CA farmer, female, 74 years.

"*Others said: she is very stupid. Now she is giving the land to the white people*" and "*they didn't know that the white people are also learning from me*" CA farmer, male, 69 years.

To some informants the opinions of referents were important (and often encouraging), others did not heed them. However, the introduction of CONTILL/NCAP projects often was influencing informants to adopt CA and the expectations of project members (in terms of performance and continuation of CA) was also influencing farmers to adopt and continue with CA.

"I did not worry about their opinions because I wanted to test CA" CA farmer, female, 74 years.

"What they said, it encouraged me to be very strong, to work very hard" CA farmer, female, 54 years.

"These CONTILL meetings emphasised people to use CA" Non-CA farmer, female, 53 years.

"We were monitored and evaluated [by CONTILL] to see who has taken care" CA farmer, female, 74 years.

No clashes between CA and the local culture were reported except for one informant mentioning the new tilling method to be contradictory to customs. Some informants reported increased respect in the community due to their success with CA and the only negative reaction from referents after the implementation of CA concerned the late arrival or non-arrival of tractors for land preparation.

"We believe not to open the soil" CA farmer, female, 74 years.

"No there is no problem here with the culture and CA" CA farmer, female, 41 years.

"They know in the community that we have done the best we can" CA farmer, female, 74 years.

"Other people were getting angry at me, that I registered them and that the tractor did not come" Non-CA farmer, female, 44 years.

Control Beliefs

Most informants felt that they were capable of getting information, physical help such as weeding and inputs such as seeds through their own actions. Some also explicitly expressed their wish to improve their situation and many felt empowered by CA. Most interviewees were in control of decision making in their households and only one person reported not feeling empowered in getting information or improving their situation. Information and physical support (such as ripping and seeds) often came from the CONTILL/CBA/NCAP projects or the NNFU.

"I just keep an eye and ear out wherever I hear that there is information or assistance" Non-CA farmer, female, 39 years.

"*I want to do something about my situation*" Non-CA farmer, female, 44 years.

"I feel I am very rich in mind now" CA farmer, female, 74 years.

"I couldn't do anything because I didn't have any other alternative or experience" CA farmer, female, 63 years.

"*I got the information from the CA people*" CA farmer, female, 68 years.

Some informants increased the land under CA and some also stated the need for early land preparation and that they would increase the land under CA if ripping was done early in the season. However, even without ripping some farmers were able to adopt some aspects of CA. Others were able to use DAP or hoes to rip the soil.

"I just want the land preparation to be done early" CA farmer, female, 56 years.

"If ripping will be early then I will do a lot or the whole field" Non-CA farmer, female, 39 years.

"Even without ripping I can use the CA planting method" CA farmer, female, 74 years.

"I can also use hoes or the donkeys to till" Non-CA farmer, female, 53 years.

Older informants often said that old age was lessening their ability to work the land effectively and lack of labour (including absence of children) exacerbated this. One informant said that physical remoteness inhibited information transfer and the receiving of tilling services. Lastly, not knowing the size of one's land affected informants' planning abilities.

"I'm becoming old and can't work so much anymore" CA farmer, female, 74 years.

"I didn't have enough people to weed" CA farmer, male, 69 years.

"The long distance is a problem when trying to get information, training and also the ripper" CA farmer, female, 63 years.

Intention

CA Farmers expressed the intention to continue with the method and to increase the acreage under CA.

"We should continue doing what we are doing" CA farmer, female, 74 years.

"I want to produce my own food security in the house; I want to expand my mahangu field" CA farmer, female, 54 years.

Non-CA farmers expressed their intention to test or start CA, wanting to know more about the method. Some also wanted to learn new methods of agriculture, something that was seen to be fulfilled by the arrival of CA.

"I want to try doing CA" and *"I want to know more about CA"* Non-CA farmer, female, 44 years.

"I wanted to learn a new method" CA farmer, male, 69 years.

Actual Control

Informants consistently brought up that there was a lack of tractors or ripping implements for existing tractors. Some lacked animals for DAP or had problems with the tractor drivers. Lack of access to finance inhibited the purchase of tractors.

"There is a lack of tractors for ripping the land" CA farmer, female, 59 years.

"We didn't have animals for ploughing and we had problems with the tractor driver" CA farmer, female, 32 years.

"I cannot afford to buy a tractor" CA farmer, male, 65 years.

Late land preparation affected almost all farmers, and this was hinted to be related to the reliance on CONTILL/MAWF tractors. Some informants' ability to do CA was limited by the money that was available for ripping the fields. Other constraints were erratic rainfall (droughts and floods), lack of inputs such as fertilizer, pest problems and poor soils. Lack of information on and experience with CA was mentioned as a control factor. Similarly, remoteness was reported which limited the receipt of information and training.

"Because I got land preparation late and due to the lack of rain it looks like this" CA farmer, female, 56 years.

"We are dependent on the CA project for the tractors" and "*The soil is very poor and the rainfall is unpredictable*" CA farmer, female, 68 years.

"I didn't have enough money for ripping my whole land" CA farmer, female, 54 years.

"We have problems with birds and army worms" CA farmer, male, 69 years.

"We are very far from the information centre" CA farmer, female, 63 years.

Receiving only little rain was however said to be sufficient to get a decent harvest and another factor enabling CA was the support farmers received from their children, both through labour and financial inputs.

"Even when you receive little rain the water is going to your plants and the yield is good" CA farmer, female, 63 years.

"The kids, they are giving their support" Non-CA farmer, female, 53 years.

Table 1 summarizes the findings obtained through the use of the Theory of Planned Behaviour.

Table 1 Summary of results obtained through questions guided by the Theory of Planned Behaviour (results have been structured according to the components of the theory (Ajzen, 1991)).

Behavioural beliefs	**Normative beliefs**	**Control beliefs**
Better yields and improved food security	Initial criticism also from within the household	Informant could get information, help and inputs through their actions
Ability to sell surplus and provide for others	Seeing CA in-field persuaded referents, so they want to try it	Informant feels empowered through CA
Saving seeds and manure	Referents came to witness or test CA or get advice and training	Information/support came from CONTILL/NCAP projects or NNFU meetings
Deeper roots and better wind resistance	Encouragement to do CA from within the household	DAP or hoes can be used to rip in the absence of tractors
Better infiltration of in-field harvested water	Criticism due to white people's involvement	Informant increased land under CA
Less weeds and easier to weed	Opinions unimportant	Old age decreasing agricultural ability
Faster growth and healthier plants	Opinions important and encouraging	Lack of labour
More planned and organized way of planting	Increased respect in the community due to success with CA	Remoteness inhibiting information transfer and ripping services
Better land preparation than traditional way	There were no clashes with the culture	Problem with unknown land size
CA cheaper than traditional way	Presence of CONTILL/NCAP projects pushing informant to adopt CA	Informant wants early ripping and would then increase CA acreage
Importance of early land preparation		
CA brings dignity and peace in the household		
CA as positive development (i.e. modernization)		

	Intention	**Actual control**
	Intention to continue CA	Lack of tractors and/or ripping implements
	Intention to increase CA acreage	Lack of animals for DAP
	Intention to test or start CA	Problem with tractor driver
	Wants to know more and compare ripping/discing	Lack of money for buying tractor
	Wants to learn new methods	Late land preparation
		Dependence on CONTILL/CA for ripping
		Finances limit ability or extent of doing CA
		Rainfall, pest and soil problems
		Lack of information or exposure to CA
		Remoteness is a problem with information and training
		Even little rain leads to a good harvest
		Support from kids, incl. labour and finances

RQ 2 – What Considerations are made in the Decision Making Process Leading to Adoption of CA?

Personal Values and Goals

Informants reported a number of important values and a few goals. These were found to be generally related to or overlapping with farmers' attitudes towards adopting CA, as contained in the Theory of Planned Behaviour. Three farmers mentioned learning new things as a positive value. Three reported priding themselves for receiving certificates due to their success with CA or for having learnt a new method. Progress and development in agricultural techniques as in life was reported to be good by some. Being food secure and subsequently having peace in the household was seen as important (directly overlapping with findings of the TPB, see under 'Behavioural beliefs' in Table 1). Food security was a goal for every fourth informant; others mentioned that it safe guarded their dignity or lead to a better and healthier life.

"Progress in agriculture is good" CA farmer, female, 56 years.

Four respondents mentioned the importance of being able to sell surplus production in order to earn money. Some also talked about their sense of responsibility for others (i.e. children and the needy) and their sense of community. More than a quarter of informants expressed the wish to spread CA in the community.

"*I want to have food security in the house and I want to work hard so that I can sell some surplus to get some money*" CA farmer, female, 63 years.

"I am having a big hope other farmers will also join CA" Non-CA farmer, female, 53 years.

Some mentioned CA having improved their standing in society and four informants were proud to be farmers, thereby producing their own food and being independent from hand-outs and begging. Some explicitly mentioned their satisfaction with CA and being involved with it and one non-CA farmer mentioned their wish to improve their situation through CA. Many also expressed a desire to learn new things.

"*We want to be trained and learn new things*" CA farmer, female, 59 years.

Responsibility Bearing

All informants owned their land and 12 of them lead their household and were responsible for decision making. Two respondents shouldered additional responsibilities by taking care of orphans and other people in need. All CA farmers started CA incrementally and did not apply the method to their whole land at once.

"*I am the one making my own decisions because I am leading the household*" CA farmer, female, 74 years.

"In the beginning I started with the 4ha to see whether I could expand it if it is bringing more food" CA farmer, female, 63 years.

Problem Recognition

Informants did not explicitly mention how they became aware of the problems they were facing. Only two of them stated problem recognition, this happened through the arrival of CA which initiated their awareness of being able to produce surplus and sell it as well as the fact that the old method was wasteful.

"Before CONTILL came we did not even have an idea that you can produce a lot of mahangu and go and sell" CA farmer, female, 74 years.

"When they trained me I started to open my eyes and mind, we are wasting a lot of manure and seeds" CA farmer, female, 63 years.

Information Search

Through questions on how they were trying to solve their problems and where they went looking for information it was found that one in five informants were actively looking for information on CA and/or other solutions to their problems. Information was sought mainly from the NCAP project. The rest of the farmers heard about and/or received training on CA from other farmers, the radio, community and farmer group meetings or extension officers. Nine informants said that their information came from the CONTILL and NCAP projects through meetings and farmer field days. The farmer meetings held under the auspices of the NNFU were an information source for five more farmers. Four informants said they will or did go somewhere to receive information and/or training, and two had attended a workshop in Grootfontein, a few hours south of the North Central Regions. Some farmers also cited seeing CA in another field as an information source.

"I heard about it in the radio and so I actively went looking for a solution from the NCAP office" CA farmer, female, 56 years.

"We had officials trying to assist us" CA farmer, female, 68 years.

"The people from CONTILL, they came to give information" CA farmer, female, 74 years.

Alternative Analysis

For the stage of analysing different alternatives five farmers mentioned the wish to compare CA to the old method and a few wanted to test the ripping implement to see how it works and if it gives good results. Some had seen CA in other people's fields and noted the better yields. One farmer held the belief that ripping is better than disc harrowing and a number of informants said that there was no problem with CA. A few people had other alternatives such as multiplying seeds or using DAP in case the ripper did not arrive. However, half of the informants said that they saw no other alternatives to CA. A few mentioned CA being cheaper than the old way of ploughing due to the fact that it was being subsidised by the CONTILL/NCAP projects. Anecdotal data collected through participant observation suggested that the end of such subsidies might cause land preparation for CA to cost the same as that for the traditional way of ploughing. Lastly, some said that the late arrival of tractors forced them to apply old farming methods.

"I wanted also to see the new method, how others were using it and how it works" CA farmer, female, 63 years.

"I have seen no other alternative to CA" and *"I didn't see any risk, any problem with this CA"* CA farmer, male, 79 years.

"If the ripping comes late at least I have tried on my own and have ploughed the land" CA farmer, female, 32 years.

Decision

Two thirds of all farmers decided immediately upon hearing about CA to try it or adopt it. Upon trying they found yields to be much better, which was the case even when little rain was received (contrary to conventional yields with little rain). Three informants explicitly mentioned that their expectations of CA had been exceeded by the yields and some stated that the yields were the reason they continued or even expanded their CA areas. Some farmers received physical help in terms of seeds and implements from the CONTILL project. More than half of CA farmers said they had no

problems with CA and many also expressed their content with CA. No one changed any aspects of the CA method.

"They wanted to try it immediately when they heard it from farmers union" CA farmer, female, 74 years.

"We got big heads and a big harvest of mahangu and when I realized this was a bumper harvest I expanded to other plots" CA farmer, male, 79 years.

"Even poor rainfall gets you yields" CA farmer, female, 32 years.

"The harvest was better than what I had expected" CA farmer, female, 63 years.

"I was very happy. If I had not been happy I would not have said come back again" CA farmer, female, 59 years.

Table 2 summarizes the findings obtained through the use of the Theory of Planned Behaviour.

Table 2 Summary of results obtained through questions informed by the Decision Making Process Model which was synthesised from Verbeke (2000) and Oehlmer *et al.* (1998) (results have been structured according to the components of the theory).

Personal Values and Goals	**Responsibility Bearing**	**Problem Recognition**	**Information Search**
Learning is positive and desire to learn	Started CA incrementally to test it and limit risks	Awareness about selling surplus	Information from officials or CONTILL/CA
Proud of certificates or learning new things	Extra responsibilities of kids or needy people	Awareness about wasteful methods	Information from NNFU or community groups or other farmers
Development is desired			Information from the radio
Peace in the household is important			Informant actively looking for info
Food security is important, it improves life			Went or will go somewhere to get info
Improved standing in society			Saw CA in another field
Proud to be a farmer			
Informant wants to improve their situation			
CA should be spread			
Sense of responsibility and community			
Having food increases dignity			
Wish to have enough food			
Selling surplus for money is important			

Alternative Analysis	**Decision**
Better yields with CA	Decided to do CA immediately
CA is cheaper than conventional way	Yields were much better
Ripping is better than conventional ploughing	Better yields even with little rain
There are no problems with CA	Expectations were exceeded
Saw CA in another field	Good yields led to continuation/expansion of CA
Wanted to compare implements or methods	Physical help came from CONTILL/CA
DAP is available	No problems with CA
Late ripping leaves only the conventional ploughing	Happy with CA
No alternative to CA	Didn't change anything about the method

RQ 3: What Facilitates and Restrains the Adoption of CA?

Socioeconomic Factors

All informants owned their land and all but four were leading their households. This means that they were largely taking all decisions and were responsible for the household.

Aiding Factors

Two extension officers, a counsellor and a tractor owner were interviewed to gain an insight into the off-farm dynamics that might be influencing the uptake of CA.

Both government staff and farmers get interested in CA because of the higher yields it offers. Farmers in particular were convinced by seeing the higher yield of CA in someone's field and this is encouraged by some government staff.

"*I support CA, reasons being that the yield is more*" and "*They [farmers] are interested because it all increases yield*" Extension officer, male, 29 years.

"*So farmers adapt only when they… see how it has worked*" and "*I am basically telling the farmers to go and witness, to go and see physically"* Extension officer, male, 29 years.

Good communication between staff and farmers facilitates awareness of CA; this happens through the radio, meetings and farm visits. The trust that farmers apparently have for their leaders aids in this. Official policies and job descriptions encourage staff to push the adoption of CA.

"I'm in close contact with everybody. With agricultural associations and with all the leaders in the constituency" and "*the politicians they are elected leaders; they are trusted by the people*" Regional Counsellor, male, 56 years.

"We send them messages through the radio" Extension officer, male, 44 years.

"The MAWF is advising farmers to implement the CONTILL [NSCT] system" Extension officer, male, 44 years.

"It's in the job description to promote CA within the community" Extension officer, male, 29 years.

Some private tractors already exist; there is a good market for providing ripping services and there are opportunities for buying and up-keeping tractors.

"There are six private tractor owners [in the constituency]" Extension officer, male, 29 years.

"You have a list of 60 farmers and you are the only [tractor owner]… so there is a market" Tractor owner, male, 60 years.

Lastly, there is a market for mahangu and therefore surplus production can be sold readily, encouraging the use of CA.

"Mahangu is a commodity that is like diamonds, everybody wants it" Regional Counsellor, male, 56 years.

"NAB is buying mahangu from the communal farmers" Extension officer, male, 44 years.

Hindering Factors

Interview data and participant observation suggested that the ripping services promised to farmers by the government have mostly failed to materialize. This was due to faulty equipment, lack of funds and ineffective administration. There was also a general lack of private tractors for land preparation.

"The government equipment has got a technical shortcoming" and "*Private tractor owners they are also just not there"* Regional Counsellor, male, 56 years.

The government subsidy for private tractor owners is not found to be used due to pay-out delays. It is reported to be quite costly to run tractors and especially when the tractor finances are not managed properly this can lead to break downs and maintenance problems. Drivers also present problems for tractor owners as they tend to damage the machine or cause problems with managing the proceeds.

"Most of the tractor owners don't really use these subsidy vouchers" Extension Officer, male, 29 years.

"Some of them don't want to be on the subsidy system or they don't understand the system" Regional Counsellor, male, 56 years.

"At the end a little thing broke and it is standing" Tractor owner, male, 60 years.

"It is maintenance, it's repair and of course diesel is going up like you can't imagine" and "*[the driver] he may take the tractor for a jaguar*" Tractor owner, male, 60 years.

The government land preparation programme is also directly competing with existing and prospective private tractor owners. This is discouraging them from investing in this sector. Jealousy of existing tractor owners causes them to dissuade prospective ones from investing.

"Why the people are not acquiring tractors is because of this competition with the government" and "*Existing tractor owners don't want those that don't have a tractor to get one ; they are always saying a tractor is risky, it is not a good business and so you will end up in a debt*" Regional Counsellor, male, 56 years.

Interview responses and participant observation suggest that the MAWF structure is ineffective in its internal administration and knowledge transfer. Within the Ministry there is also a lack of funds to promote CA. Among all stakeholders there is also a lack of knowledge and understanding of CA which hinders its uptake. Lastly, farmers and extension officers are heavily reliant on NGO's for the propagation and implementation of CA.

"The MAWF system itself is very slow and the understanding of seniors which are not on the ground is very slow; a lot still needs to be done when it comes to receiving of information" and "*Most of the farmers who received the CONTILL [NSCT] methods... is just the farmers that benefited from the NGO"* Extension Officer, male, 29 years.

"Another problem is the understanding of CA" Regional Counsellor, male, 56 years.

Table 3 summarizes the findings from questions on socioeconomic, aiding and hindering factors.

Table 3 Summary of results obtained through questions on socioeconomic, aiding and hindering factors. Note that results on aiding and hindering factors were obtained from interviews with Extension Officers, Regional Counsellors and the tractor owner and are therefore external to the opinions of farmers.

Socioeconomic Factors	Aiding Factors	Hindering Factors
Owning the land	Higher yields attracts government staff	Lack of tractors for ripping
Leading household and making decisions	Good communication between staff and farmers	Costly to run tractors
	Policy support for CA and staff mandated to support CA	Tractor owners don't use subsidy as it does not work
	Good market for providing ripping	Jealousy of existing tractor owners
	Existence of private tractors	Problems with tractor drivers
	Farmers strongly interested in CA due to seeing higher yields	Government competition a threat
	Government staff are good at spreading the word about CA	Government ripping services failed due to ineffective MAWF structure
	Opportunities for buying and running tractors	Lack of funds in MAWF to promote and support CA
	There's a market for surplus mahangu	Reliance on NGO's for ripping services
		Lack of knowledge and understanding about CA

Analysis

This section provides an analysis of the results obtained through interviews and participant observation. Themes will be identified from within the data and this will be done with the help of the theoretical backgrounds used. The section is arranged by research question (and therefore by theoretical background) in order to clearly separate the different areas of inquiry. It will conclude with a short consideration of the theoretical backgrounds and how these interacted and affected the Analysis.

RQ 1 – What Motivates Farmers to Adopt CA?

This question was based on the use of the Theory of Planned Behaviour (TPB) and was sub-divided into the components of the theory (Ajzen, 1991) (see "Theoretical Background" for a description of the components).

Behavioural Beliefs

The behavioural beliefs about adopting of CA were positive which lead to positive attitudes towards the behaviour. This was based on behavioural outcomes being judged as conducive to easier and more productive agriculture through easier weeding, better plant growth and improved yields. CA was also associated with increased resilience against adverse weather and erratic rainfall through better wind resistance of plants and more stable yields in the face of droughts and floods. Food security was reportedly improved by the higher yields and this facilitated personal dignity and peace in the household. The sale of surplus was seen as another outcome of the behaviour which enabled providing for others, most often by paying school fees for children. CA as a whole was said to be an improvement, partly also because it represented a better and cheaper way of tilling and a more organized method of planting. CA being cheaper may however be a result of the subsidisation received from the CONTILL and NCAP projects. Participant observation revealed that CA could cost similarly as much as traditional land preparation once this subsidy ends at the end of the NCAP project. Therefore, this belief may fall away once the project has come to an end in 2016. However, this will probably not have a large effect on overall behavioural beliefs as a discussion with NCAP implementers on the 28th of February 2013 suggested that farmers save up money for land preparation, even if it is relatively costly (Andreas and Johansson pers. comm., 2013). Interview data supported this as only 3 out of sixteen farmers mentioned not being able to rip as large an area as

desired due to financial constraints. In any case, it is likely that the improved ability to sell surpluses will in future improve farmer's financial standing and thereby eliminate this restraint.

One belief that was mediating all the above was the need to receive land preparation early in the season. Farmers stated that unless this is the case CA would not fully realize its' potential.

On another note, Fowler and Rockstrom (2001) found that female headed small-scale farming households in Africa often sought Conservation Tillage techniques due to the reduced time and effort requirements and improved yields. The informants of this study included thirteen female farmers (out of sixteen farmers) and half of those lead their households; in light of Fowler and Rockstrom's (2001) findings this may explain why behavioural beliefs stated by informants were so positive towards CA.

Normative Beliefs

It was found that initial criticism was commonplace, most often coming from surrounding farmers but also from within the household. However, this changed to support and interest in CA as soon as CA was witnessed in the field. This means that the notion of 'seeing is believing' which was encountered in interviews and participant observation must have been at work here; the approach taken by NCAP seems therefore to be an effective one due to being based on in-field demonstration plots. Whether farmers heeded the opinions of others was mixed and there seemed to be no relationship between socioeconomic indicators (such as age or sex) and paying attention to others opinions. No one seemed to have been discouraged by criticism and it seemed only that referents' support for CA was encouraging adoption and continuation of CA. Some informants confirmed this by directly stating that they continued CA due to encouragement by others.

Besides one farmer mentioning a cultural disagreement due to the new way of tilling (which she did not heed) there seemed to have been no clashes between CA and the local culture. This is important to know as it rules out any systemic rejection of CA by people of the Ovambo culture.

All above behavioural beliefs aggregate to form the perceived social norms. These were positive once referents had seen the performance of CA in the field. It was felt by the researcher however, that answers pertaining to social norms were not as in depth as they could have been. Especially when asked about whether CA caused conflicts with the culture the answers did not seem to cover what was being asked. This could have been due to limited understanding of the nuances of the Ovambo culture. Therefore, it must be emphasised that the results obtained under the section of perceived social norms may not be completely representative of the situation.

Control Beliefs

Most informants felt that they were able to search for and receive information, physical help and training. Only one farmer reported feeling powerless in connection with her remote location which inhibited her receiving information and ripping services. Despite this, informants generally felt empowered through CA. Some problems did emerge however. Old age limited the ability of some farmers to perform CA as fully as possible, there was said to be a lack of labour and limitations on planning capacity by not knowing the size of one's land. The need for early land preparation was also again stressed by informants.

Overall, the perceived behavioural control which derives from control beliefs found to be positive. Informants generally felt they could successfully engage in doing CA, even if somewhat limited by remoteness, old age and lack of labour. The role played by lack of labour and old age was not specific to CA and remoteness was only a problem with one informant. These factors were therefore not seen as significant hurdles to the ability of farmers to perform CA.

Intention

Intention is usually an aggregate of attitude towards behaviour, subjective norms and perceived behavioural control (see "The TPB"). However, a number of intentions were directly stated by informants and these were added here.

CA farmers expressed the wish to continue with the method and/or expand the area under CA. Non-CA farmers mentioned the desire to test or start doing CA and learning more about the implements and method. Additionally, attitude towards behaviour, subjective norms and perceived behavioural control were all positive (as described above) and in aggregation point towards a positive intention of adopting and continuing CA. Thus, all above intentions were positive towards CA and provided with enough actual control should lead to continuation or adoption of CA.

Actual Control

Factors specifically limiting the capacity of farmers to implement CA were problems with lack of ripping services and services coming too late. A deficiency of information and exposure to CA and dependence on CA projects for ripping services were also mentioned, but was not emphasised as much as the lack of ripping services and its timeliness. What helped the adoption or performance of CA was that even a little rain produced decent yields and the fact that children lent support to

farmers which ameliorated the lack of labour. Most CA farmers could not continue CA in the absence of tractors (since the end of the CONTILL project) and non-CA farmers said they could not start for the same reason. This therefore, strongly affected the uptake and continuation of CA.

Thus the lack of and late land preparation services were the single most important hurdle to the uptake and maintenance of CA in the study area. This observation echoes a study by Wall (2007) which concluded that small scale farmers can be severely restrained from adopting CA if appropriate implements are not available.

Summary of the Findings of the TPB

Farmers' behavioural attitudes towards adopting CA were positive based mainly on effort saving, improved yields and livelihoods benefits of this. Subjective norms were supportive of CA once referents had seen CA in the field and culturally CA seemed to pose no problems, most probably because it had been developed in conjunction with the farmers and within their cultural context. This was backed up by Nyagumbo (1999) who stated that development of techniques in cooperation with farmers and cultural acceptability of these techniques play a major role in facilitating their uptake. The perceived behavioural control also suggested positive personal control over adoption of CA, mainly due to access to information and training and feeling empowered by CA. Intentions of farmers were very positive and pointed towards adoption and expansion of CA. However, despite the positive intentions mentioned by farmers and positive intentions derived from attitudes, perceived norms and behavioural control the actual controls on the behaviour were significant. Late and lacking land preparation directly hampered the adoption of CA and therefore seems to be the bottleneck in this process. Overall, the TPB pointed to a positive socio-psychological environment which facilitated adoption of CA, being hampered only by problems with land preparation services. Figure 4 shows these findings diagrammatically and aggregates findings into positive or negative contributions to farmers' motivation to adopt CA.

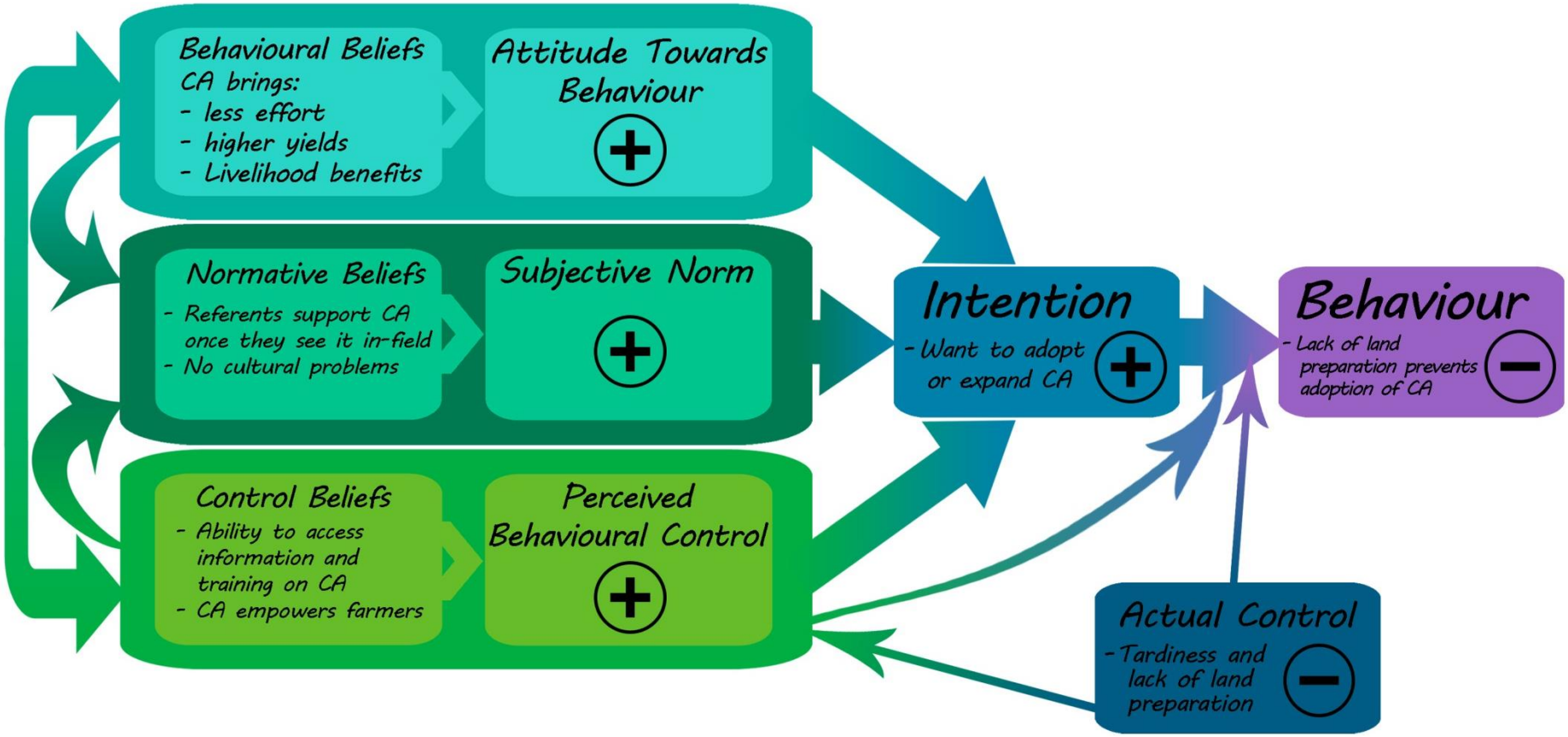

Figure 4 Diagram of the Theory of Planned Behaviour with the most important findings this study obtained through its use (Ajzen, 1991). The plus and minus symbols under each component signify positive and negative contributions to farmers' motivation to adopt CA, respectively. Note that although all components making up the intention to adopt CA were positive, it was the actual control that was negatively influencing farmers' adoption of CA.

RQ 2 – What Considerations are made in the Decision Making Process Leading to Adoption of CA?

Research question 2 draws on the Decision Making Process Model that was synthesised from Verbeke (2000) and Oehlmer *et al.* (1998). The results will be analysed using the steps outlined by the model (see "Decision Making Process Model").

Personal Values and Goals

Learning new things and improving their disposition in life through progress were held as positive values by farmers. Being recognised by the community and CA projects for such progress was also important and informants were generally proud of their way of life. Producing one's own food and being independent were strongly valued as components of this, and these were said to be supported by CA. Improved food security, dignity, peace in the household and better financial standing were seen as important. This led farmers to value the spread of CA as positive and worthy of their support. CA reportedly also facilitated farmers' wish to have more food and to be able to provide for others because a sense of responsibility for the community was felt by some informants.

Therefore, CA seemed to have generally strengthened central values held by farmers and facilitated the arrival at certain goals. This is an encouraging observation which is supported by Jonsson's (1998) study of Tanzanian farmers which found that respecting and strengthening their priorities and values lead to improved adoption rates. The literature suggests that this is due to values of farmers indicating their needs and motives and goals being their attempts to satisfy these. Consideration of these is what drives their decision making processes (Oehlmer *et al.*, 1998).

Responsibility Bearing

All farmers owned their land and most made all decisions on it. This undoubtedly instilled a sense of responsibility which caused the incremental adaptation of CA. By testing CA on a part of the land first, informants minimized risks and therefore handled responsibility in a careful manner. Oehlmer *et al.* (1998) suggest that responsibility bearing influences the decision making process by realising who is accountable for the decision and acceptance of post-adoption evaluation. In this case informants seemed to be well aware of their responsibilities and handled them carefully, thereby engaging with this aspect of decision making processes.

Problem Recognition

Besides all the problems that were mentioned in connection with 'Behavioural beliefs' under research question 1, the arrival of CA projects raised awareness about the wastefulness of the old method and not being able to sell surplus. The recognition of problems seems to have been continuous and sub-conscious as questions directed to how informants became aware of their problems did not result in answers of key moments of problem realization. Rather, answers pointed to more a gradual awareness of problems such as may be gained by seeing them develop slowly over the years.

Problem Recognition is an integral part of the decision making process. Only when a problem is identified can it motivate the farmer to seek solutions (Oehlmer *et al.*, 1998). Therefore, the gradual realisation of problems described above probably motivated farmers to evaluate CA as a solution and make the decision to adopt it. Interestingly, in this case the solution itself seemed to be the key to farmers becoming aware of their problems.

Information Search

The aspect of information search influences the decision making process by mediating which solutions become available and providing knowledge on their characteristics. It is therefore of central importance to this process. It was found in this case that information on CA reached informants via the radio, CONTILL/CBA/NCAP, NNFU farmer meetings, community groups or extension officers. Actively looking for information was widespread and seeing CA in someone else's field was said to be an important information source. Similar findings were made by Nyagumbo (1998) who in a study on adoption of CA in Southern and Eastern Africa found top down approaches of teaching farmers about CA to hamper adoption. By the same token, the bottom up approach of demonstration plots and farmer field days taken by CONTILL/CBA/NCAP seemed to have been conducive to adoption. Furthermore, witnessing CA in-field presumably corroborated other information gathered and so these information channels may also be seen as important due to complementing each other. This was supported by a study from nearby Zambia in which Kaniki (2009) found that farmers relied on more than one information source at any one time. Most farmers also reported frequently relying on personal experience such as seeing CA in-field.

Overall there seems to have been no problem of information transfer between information sources and farmers. However, apart from seeing CA in the field the frequent mention of information coming from farmer and community groups suggested that these may be an important channel of information transfer. The question arises whether farmers outside these groups had similar access

to information. Such question was not covered by this study as it would have involved seeking informants based on non-participation in such groups. Also, this potential dynamic was not yet known at the time of sampling informants and was therefore not included in the scope of this study; subsequent research however, might wish to investigate this question.

Alternative Analysis

CA was generally assessed to be the only and a better alternative to the traditional method. This was based on improved yields, being a better way to till and presenting no significant problems in implementation. Evaluating CA as an alternative was mostly enabled by seeing it in someone else's field. In case of not receiving land preparation only few farmers had the possibility of using DAP, the rest were forced to revert to traditional methods. Testing the CA implements and method were also a feature of analysing CA as an alternative. Overall this means that after some initial testing and supported by in-field observations, CA was found to be a better alternative to traditional methods.

The evaluation of the alternatives is vital to the decision making process as it is part of the "decision event" (Oehlmer *et al.*, 1998; pg. 276). How an alternative is evaluated therefore strongly influences whether it will be chosen by the farmer or not.

Decision

The decision to immediately adopt CA was widespread and mostly based on better yields being promised. Witnessing improved yields, even with little rain persuaded farmers to continue with the method, especially because their expectations of yields were generally exceeded. Help with implementation was received from CONTILL/NCAP and encountering no problems with the method aided in informants being content with CA. Their happiness with CA was supported by the fact that none of them changed the method.

Summary of Findings under the Decision Making Process Model

CA strengthened central values held by farmers, most importantly by improving food security and income and enabling them to be proud farmers (this was similar to what was found under the TPB). Testing CA was important in limiting risks and bearing responsibility. Problem recognition was a slow and gradual process leading to awareness of the inadequacy of old methods. Information was not limiting due to access to various channels, chief among which were demonstration plots that helped

persuade farmers. CA was generally assessed to be a better alternative to the old ways and many farmers decided to adopt it immediately upon hearing about it.

All the above indicates that CA is fulfilling requirements of easy adoption as has been suggested in relevant literature (Jonsson, 1998; Nyagumbo, 1998; Kaniki, 2009). The fact that the decision to adopt CA is often taken without delay and the method is not changed bears testimony to this.

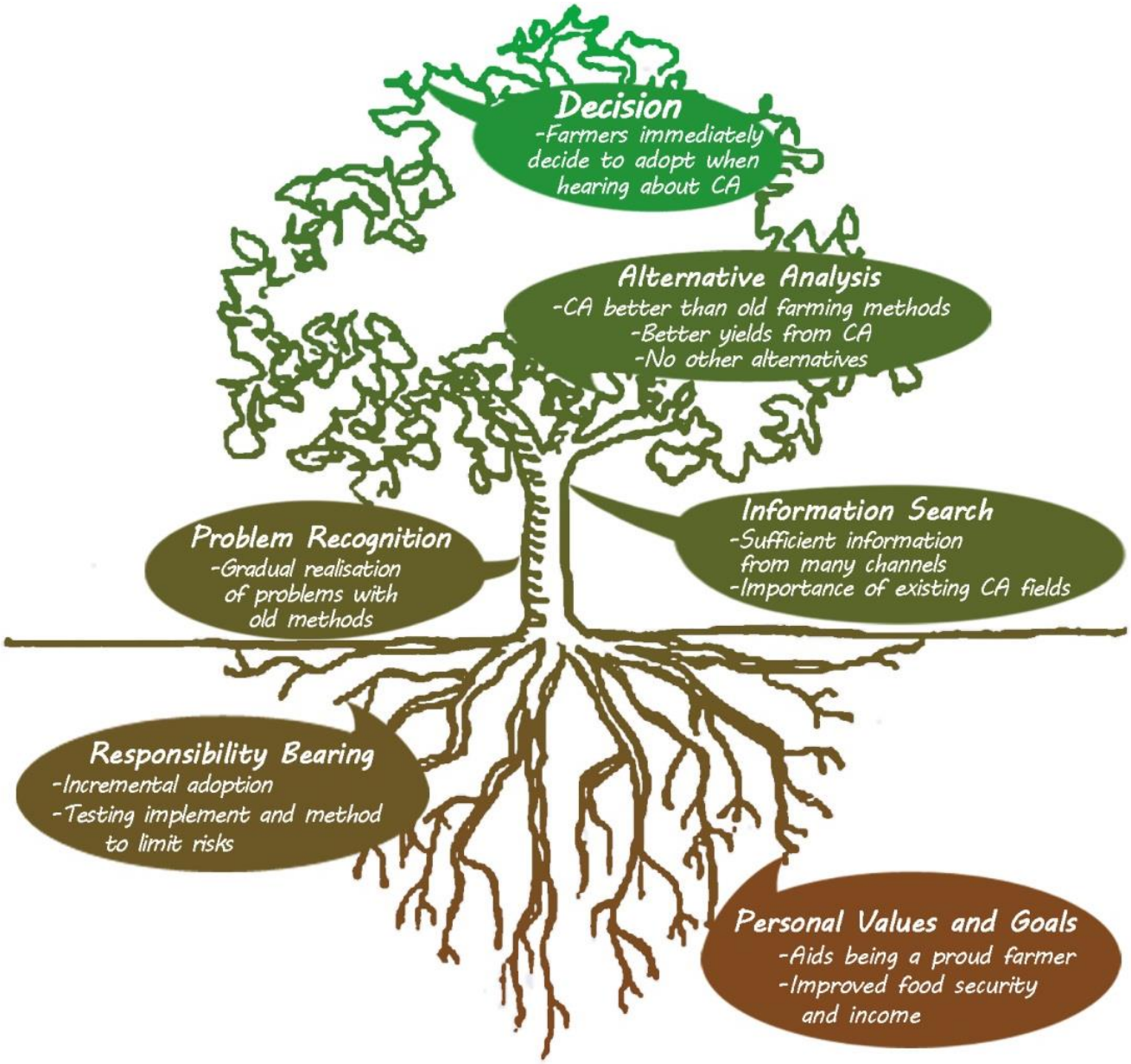

Figure 5 Diagram of the findings obtained through the use of the Decision Making Process Model synthesised from Verbeke (2000) and Oehlmer *et al.* (1998). No significant hurdles to farmers' deciding to adopt CA were found by this study. Note that the diagram draws on the shape of a tree. This highlights the non-linearity of the decision making process model by mimicking the cyclical, non-linear functioning of a tree where nutrients and water can travel in all directions, not just from roots to shoots.

RQ 3: What Facilitates and Restrains the Adoption of CA?

Socioeconomic Factors

All informants had children and were owners of their land and often also took all decisions on it. This will have contributed to testing CA incrementally to minimize risks as discussed above. Furthermore, there was no correlation between socioeconomic factors such as age or societal roles and the attention paid to opinions of others.

Aiding Factors

The adoption of CA was found to be aided by government officials becoming interested in and supportive of CA, strong interest from farmers and a good market environment for ripping services and selling of mahangu. Officials are reportedly well connected to farmers and mandated to support CA through government policies and job descriptions. Furthermore, good opportunities for improved availability of ripping services exist due to numerous tractors being in private hands (though not having ripping implements yet) and opportunities for financing new tractors and equipment arising. Novel financing methods were put forward by the Agribank of Namibia and Kongalend (a financing institution) during the study period.

Overall, strong interest from farmers and government officials, supportive policy and political environments and good opportunities for private sector involvement in land preparation services were aiding the uptake of CA.

Hindering Factors

Despite this however, there was a stark lack of tractors for the provision of ripping services. Tractor owners not making use of the government subsidy system, high running costs, problems with drivers and competition from government tractors posed threats to ripping service provision by the private sector. Together with jealousy of existing tractor owners prospective service providers were discouraged from investing in a tractor and/or ripping implements. This partly mirrors observations made by Norton (1995) who found that in Zimbabwe farmers will hold others back from adopting CA in order for them not to leave the status quo of the community. Although this finding pertains to farmers and not tractor owners it may be pointing to the same dynamic. If this is the case then this study demonstrated that jealousy can be a factor in the adoption of new techniques (through purchase of new implements) among land preparation service providers. Fowler and Rockstrom (2001) stated that this jealousy aspect is often noted but not addressed by researchers. All the above

and the failure of the government ripping program contributed to the reliance on CONTILL tractors. This general lack of tractors is therefore seriously hindering the adoption of CA, especially in light of all informants mentioning the lack of tractors as a restraint.

Data obtained through participant observation and interviews suggested that the main reason for the lack of involvement of private tractor owners with CA land preparation was a paucity of information, especially regarding solutions to the above mentioned problems. A tractor workshop was organised by CES during the study period and comments from attending tractor owners echoed this observation. It is therefore of importance to address this lack of information in order to boost the provision of ripping services. By sufficiently informing prospective tractor owners, the influence of jealousy of existing tractor owners would also be circumnavigated. Prospective tractor owners would be empowered by receiving information independently of jealous biases and could therefore be more likely to purchase a tractor and ripper. This suggestion comes in direct response to Fowler and Rockstrom's (2001) comment that the element of jealousy is often noted but not addressed by researchers.

Finally, it was found that the potential aiding factor of government officials being interested in CA was negated by lack of funding, ineffective structuring of government which also inhibits information flow among officials, misinterpretations of the NSCT method and jealousy among officials (similar again, to what Fowler and Rockstrom (2001) found). Between these factors, government support on the ground dwindled to almost nothing. This observation was supported by the complete absence of government ripping services during the study period although 20 tractors had been purchased by government around May of 2012 (Weidlich, 2013). This further highlights the importance of encouraging private ripping service providers and the need for NGO's to make the adoption of CA operationally independent of the government. This should not be seen as a call to ignore the efforts made by government. Instead, these deserve acknowledgment especially as the policy environment and high ranking officials (including the Minister of Agriculture, Water and Forestry) support implementation of CA. Their support officially endorses efforts to increase adoption of CA which is important in a culture where the leaders are respected and followed (this was directly stated by an informant). NGO's and others working to spread the adoption of CA will therefore need to be clear about what support is available from government and at which point the private sector must be drawn on. This study has hopefully contributed to understanding where this point lies.

Summary of Results Pertaining to Aiding and Hindering Factors

Strong interest in CA among farmers and government officials, supportive policy and political environments and opportunities for establishing private land preparation services aided the adoption of CA. On the other hand, ineffective government support and a lack of information and ripping implements were posing threats to the adoption of CA. Especially the lack of tractors and implements for ripping services is a major hurdle.

Analysis of Theoretical Backgrounds Used

Overall, the analysis of data revealed overlaps in the theoretical models used. It was noted for example, that questions formulated under the TPB elicited answers that were useful for both the TPB as well as the Decision Making Process Model and vice versa. This was seen as positive by the author as it strengthened the insights gained under each model. Sometimes answers from a TPB question illuminated aspects of the decision making of farmers that had not emerged through the use of the Decision Making Process Model for instance. This was seen in a number of cases, which included direct overlaps between Behavioural Beliefs (TPB) and Personal Values and Goals (Decision Making) pertaining to attitudes towards learning new things and the desirability of progress in agriculture. Another example linked Personal Values and Goals (Decision Making) and Intentions (TPB) through repeated mention of CA needing to be spread. Many more examples could be listed, instead the interested reader is referred to Table 1 and Table 2 for comparisons among overlapping results. The same tables may be used to identify differences between the theories. Although they overlapped on a number of themes there were also differences between their findings. For example, the Decision Making Process Model investigated farmers' values, responsibility bearing and information search. None of these were covered by the TPB. Therefore, it was found that the theories supplemented each other both through overlaps as well as investigation of separate themes.

Some of the overlap observed could arguably be seen as redundant and preventive of deeper insights in other areas. An example is the list of benefits of CA mentioned by farmers when asked questions that were guided both by "Alternative Analysis" (Decision making) and "Behavioural Beliefs" (TPB). This was due to the exploratory nature of the study where themes were unknown at the time of fieldwork. Subsequent studies may have better knowledge of what to expect in the field. They could therefore eradicate some of the redundancy and gain deeper insights into other themes by having more time for them. This could be done for instance by focusing more questions on "Actual Control" (TPB) (which was found to be most important in the socio-psychological motivation

of farmers) and less on “Behavioural Beliefs” (TPB) as it overlaps with “Alternative Analysis” (Decision making).

Overall, the empirical strengths of the models used were that they provided a framework around which interview questions could be built. Trying to understand dynamics such as socio-psychological and decision making processes would have been too complex to approach without such guiding frameworks. However, the rigid subdivision into sub-themes (e.g. “Behavioural Beliefs” or “Information Search”) was seen as a weakness of the theories. It prevented more spontaneous thoughts and questions and might have affected data analysis by forcing the data into pre-conceived categories.

Discussion

The purpose of this research was to identify socio-psychological factors which motivate farmers to adopt CA, understanding the decision making process undergone and aspects aiding and hindering this uptake. How the understanding of the above can be used to facilitate the adoption of CA on a wider scale in Northern Namibia constituted the aim of the study. This section discusses the major findings in order to inform the aim of understanding how adoption of CA can be better facilitated by NGO's and government. Limitations of the study will be clarified and recommendations for practitioners and future research will be made.

Implications and Limitations of the Study

It was found that socio-psychological dynamics among farmers were favourable towards CA. The method was associated with an improved way of conducting agriculture. It was said to be easier to do, leading to better outcomes than the traditional way due mainly to improved and stabilised yields and their positive impacts on livelihoods. The social and cultural setting was also conducive to CA as there were no significant clashes with the Ovambo culture and agricultural traditions. This illustrated the advantage of the NSCT method in being specifically tailored to the farmer's needs. It was found that development of agricultural techniques was seen as positive and once referents had seen CA in the field they were supportive of it. Farmers generally felt empowered by CA. They also stated that they were able to engage in CA and gathering information and skills about it. Most informants expressed very positive intentions towards CA by stating that they wanted to adopt it (in the case of non-CA farmers) or continue doing it and expanding the area used for it. Furthermore, non-explicit intentions aggregated under the TPB showed that farmers had positive intentions in engaging with CA due to afore mentioned socio-psychological factors identified by the study. The actual control however placed significant restraints on the capacity of farmers to adopt and carry out CA due mainly to the lack of land preparation services (see Figure 4). The fact that late and non-existent land preparation hampered adoption of CA significantly was suggested by their frequent mention.

The decision to adopt or try CA was often taken immediately upon being informed about it. The most important information sources were farmer groups and seeing CA in the field. It was emphasised continuously that in the Ovambo culture 'seeing is believing' which was supported by the literature where personal experience of CA was found to be important in deciding to adopt it (Kaniki, 2009). The fact that the CONTILL/NCAP projects have been centring their approach on demonstration fields was therefore found to be effective. CA was said to strengthen core values of

farmers such as improved food security, dignity and peace as well as their independence and ability to provide for others. It is important that CA achieved this as it facilitates its social and cultural acceptability and thereby boosts adoption rates, a fact that was already demonstrated in Tanzania by Jonsson (1998). Due to farmer's attempts to limit risks the adoption of CA was incremental and recognition of problems with the old methods was on-going and not defined by aha-moments of sudden insight. Farmers evaluated CA as a better alternative to the old ways; many also stated it was the only alternative but still wanted to test the implements and method in order to limit risks. These aspects of the decision making process therefore highlight that CA seems to be easily taken up by farmers if they have information about it or have seen it in the field and that the method is socially and culturally acceptable. Thus no significant hurdles to adoption of CA were encountered in the decision making process of farmers (see Figure 5).

Interviews with government representatives and tractor owners highlighted aiding and hindering factors affecting the adoption of CA. Strong interest in CA from government officials and farmers and a supportive policy and political environment facilitated the spread of CA. However, ineffective government implementation of support for CA and the lack and tardiness of land preparation services hindered adoption. The problem with ripping services was found to be a severe constraint and mirrors findings from the TPB. It was however found that profitable opportunities exist for private tractor owners to provide ripping services due to a large market and emerging financing options. However, jealousy among tractor owners and the lack of information about existing opportunities hampered investment in tractors and ripping implements.

Socioeconomic factors investigated showed that all farmers owned their land and took all decisions on it. This was found to drive concerns for the success of their agriculture as well as incremental adoption of CA due to the need to limit risks. Together with the wish of many to first test the implements and CA method this illustrated that farmers critically engaged with adoption of CA through careful implementation and did not simply blindly adopt the method.

In summary, it was found that the different theoretical approaches to the research questions yielded overlapping results that confirmed each other. The improved outcomes of CA, its social acceptability and ease of implementation motivated farmers to adopt it. They easily took this decision once they heard about it or saw it in the field but nonetheless adopted it cautiously. However, significant restraints exist to wider adoption of CA due to the lack and tardiness of land preparation services. Therefore, the low adoption rates seemed to be a result of factors external to farmers' socio-psychological and decision making processes. These will need to be addressed in order to improve adoption rates of CA.

By using the TPB to assess farmers' adoption of CA in a qualitative way this study has contributed to the literature. This is due to the TPB usually being used in more quantitative approaches which draw on structured questionnaires and not semi-structured interviews as this study has done (e.g. Lynne *et al.,* 1995; Wauters *et al.,* 2010). Furthermore, the Decision Making Process Model synthesised from Verbeke (2000) and Oehlmer *et al.* (1998) has augmented findings made under the TPB and therefore could be seen as a contribution to the field of studying decision making processes as it represents a novel and effective combination of theoretical backgrounds. This study's most significant contribution however lies in improving the understanding of aspects of socio-psychological and decision making processes of small scale farmers in the North Central Regions in conjunction with the adoption of CA. A lack of studies on this topic was found and further confirmation came on the 31st of January 2013 by one NCAP member directly stating the lack of studies focussing on qualitative assessments at the farmer level (Johansson pers. comm., 2013a). By investigating aiding and hindering factors the study furthermore sought to complete the picture so that practitioners would gain a bottom up (farmer perspective) and top down (other stakeholder) view of the situation. Therefore this study has contributed directly to local work done by NGO's, government and other stakeholders involved in promoting CA.

It must be acknowledged however, that the findings of this study are not generalizable due to being reliant on a relatively small sample size, very specific cultural and environmental contexts and practical limitations discussed in the "Methods" section. Another limitation may be due to the purposive sampling method used. This approach only yielded respondents that had heard of CA, wanted to adopt it or had already done so. As a result, it was unclear whether other farmers that heard of CA (or those that have not yet) and were not part of the study would be positively inclined to adopt it. Furthermore, the empirical weakness of the theories used to inform this study was that they may have affected data analysis by forcing themes into pre-conceived categories. This may have affected the complexity and inter-relatedness of findings under this study.

However, despite this, practitioners in the field should be able to draw useful conclusions from this study. These will be outlined below.

Lessons for NGO's and Government

The aim of this study was to find out how wider-scale adoption of CA could be facilitated in Northern Namibia. This was done in order to inform NGO's and government on the best way forward. The study found that the main factor slowing adoption rates among farmers was not connected to their decision making processes but rather socio-psychological dynamics and external hindering factors.

Both socio-psychological and external hurdles were found to be the lack and tardiness of ripping services. Therefore, in order to boost adoption rates it is imperative to address this issue.

Provision of land preparation services by the MAWF was found to be ineffective. Therefore the need for involvement of the private sector was evidenced. It was observed that significant opportunities exist for the private sector to become involved; these were based on a large potential market of CA farmers, existing tractors and emerging financing options for procurement of tractors and ripping equipment. However, the lack of information at the level of existing and prospective tractor owners was inhibiting the realization of this potential. This study therefore recommends NGO's and the government (through the MAWF) to improve this information gap. By bringing information directly to existing and prospective tractor owners, they could realize the existing opportunities and be freed from biased information received from other jealous tractor owners. The policy and political environment in Northern Namibia is positive towards CA. This should be seen as encouragement and bargaining chip in motivating tractor owners to supply ripping services.

This study recommends the MAWF to clarify and streamline its Rain Fed Dry Land Crop Production programme in terms of land preparation services. The MAWF needs to either act on claims of providing ripping to farmers or avoid making such claims. In both cases, it is unlikely to meet the large demand for ripping services observed by this study (due to having only one tractor per constituency) and should therefore urgently focus on creating an enabling environment for the establishment of private ripping service providers.

Recommendations for Further Research

This study identified farmer and community groups as an important pathway of information flow to farmers. However, as most informants of the study were part of such groups it did not become evident whether not being part of such a group would inhibit farmers from receiving information on CA. Therefore, future research may wish to address this issue by investigating informational pathways and the relative importance of farmer and community groups in providing a platform for information exchange among farmers and other stakeholders. Furthermore, the ineffective nature of the MAWF was perpetually encountered during the study period. What exactly lies at the heart of this dynamic was however perceived to be too complex for analysis by this study. It is therefore highly recommended to future researchers to investigate the structure and dynamics of the MAWF to ascertain why it has not been able to implement policies on CA and meet its claims of land preparation service provision. Another area of interest could be the investigation of how to best set up private sector ripping services and how to sustainably link these with CA farmers, especially once

NCAP has come to an end. Currently NCAP represents the contact node between farmers and service providers. Therefore, by the time the project has come to an end private service providers will have to have established a system of independent contact with existing and prospective CA farmers. A future study may wish to investigate how exactly the establishment of such a system could be facilitated by NCAP.

Conclusions

This study found that subsistence farmers in the North Central Regions had positive attitudes and intentions towards CA and these lead to adoption of the method. They perceived CA as an improved agricultural technique through being less laborious, yielding more and having more livelihood benefits downstream than the old methods. Upon being informed about or seeing CA in the field, farmers quickly made the decision to adopt it based on its benefits to them, not only in yields and improved livelihood but also through its social acceptability and support of central values. Despite the decision to try CA, most farmers implemented it carefully in increments in order to limit risk; however, the method was not changed by farmers which suggested them being content with it. Furthermore, a positive policy and political environment and strong interest from all stakeholders aided the spread of CA. However, it was found that wider-scale adoption of CA was significantly hindered by a lack of land preparation services. This was a common concern of nearly all informants, not only the farmers. This lack of ripping services arose from ineffective provision of such services by the MAWF and insufficient involvement of the private sector due to lack of information on existing opportunities. The study found that this lack of land preparation services was the most significant factor influencing the adoption of CA. Although farmers have positive attitudes and intentions, easily decide to try CA and the general environment for the adoption of CA is positive, this lack of ripping services was severely slowing the spread of CA.

It was therefore recommended by this study that NGO's and government engage with the private sector to strengthen its capacity to provide land preparation services to existing and prospective CA farmers. The lack of information needs to be addressed and government will have to take a clear stance on its role in this process.

Although this study has made valuable contributions to the literature and the development community engaged with CA in the North Central Regions it should not be seen as generalizable. Other Regions in Northern Namibia may face similar problems with the uptake of CA; it is however, not recommended to assume that the problems facing CA in the North Central Regions are identical to those in other Regions. Nonetheless, this study has broken ground on the issue of facilitating the spread of CA in Namibia and is therefore useful as an indicative guide to involved stakeholders. It is the hope of the author that lessons from this study will be drawn by NGO's and government and that thereby the propagation of CA can be facilitated across Northern Namibia.

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