Drivers of Smallholder Adoption and the Intensity of Conservation Agriculture in the Masvingo District of Zimbabwe

---

A thesis submitted in partial fulfilment

of the requirements for the Degree of

Master of Commerce (Agricultural)

at

Lincoln University

by

Machiweyi Obert Nicholas Kunzekweguta

Lincoln University

2016

Abstract of a thesis submitted in partial fulfilment of the
requirements for the Degree of Master of Commerce (Agricultural).

Drivers of Smallholder Adoption and the Intensity of Conservation Agriculture in the Masvingo District of Zimbabwe

by

Machiweyi Obert Nicholas Kunzekweguta

Conservation agriculture (CA) has been promoted among smallholders in Zimbabwe as a way of addressing challenges associated with poor soil fertility, low yields, and insufficient rainwater. The technique was introduced to smallholders as a manual technology. The expected benefits for adopters include improved and more stable crop yields, and higher returns to inputs used in farming. Despite its claimed advantages, smallholder adoption rates of CA in Zimbabwe remained low. Empirical studies of CA adoption have not explained the intensity of its uptake. This study investigates factors influencing both the use of CA and the intensity of its uptake amongst 237 smallholders sampled in the Masvingo district of Zimbabwe. The intensity of uptake was measured using an index that accounted for the number of CA components used, and the rate and extent of their application. The determinants of use and intensity were identified using a double hurdle model. Although most smallholders implemented the reduced tillage component of CA, only a few implemented all three components. Farm size and experience with CA technology impacted positively on the current use of CA. Distance from town (market) and ownership of an ox-drawn plough reduced the intensity of its uptake. Policy makers should consider institutional changes to improve smallholder access to cropland. Extension agencies should consider more participatory approaches that encourage farmer to farmer information dissemination and training. Contract farming could help overcome problems of accessing farm inputs. Sensitivity analysis showed that results change when the intensity of CA uptake is measured without accounting for the rate and extent of its application. This suggest a need for further research to establish an agreed, comprehensive measure of intensity.

Key words: Conservation agriculture; smallholders; adoption; intensity; food security; double hurdle model.

Acknowledgements

First of all, I would like to thank God Almighty for the gift of life, the ability to pursue my studies, and the great family that He gave me. In this regard, I want to show my appreciation to my beloved wife, Thandeka, and our son, Caleb, for their support during my study. These two are the source of my inspiration and the reason for me to aspire to achieve great goals. I would also like to thank my parents and sisters, Irene, Christina and Innocentia, who played an important role in making me what I am today.

My supervisors, Associate Professor Karl Rich and Associate Professor Michael Lyne, have been a great source of wisdom. They perfectly complemented one another, making them the best combination of supervisors. I would not have asked for anything more than having these two as my supervisors. I thank them and am indebted to them for their undying support, outstanding guidance, and dedication towards my work. I will be forever grateful.

I am grateful to New Zealand Aid for granting me the scholarship to conduct my studies. Without the scholarship, my dream of having an advanced qualification would not have materialised. Special thanks to the scholarship team, Sue Bowie, Jayne Borrill and Mandy Buller for the unwavering support and for ensuring that my stay in New Zealand is less stressful. I also extend my great appreciation to the administrative staff of the Faculty of Agribusiness and Commerce for their great service.

I would also like to express my sincere gratitude to my research team, Georgina Hove, Melody Mhlanga, and Stanny Mandizvidza for helping me in collecting data that were used in this study. I really appreciate the job well done, the sacrifices they made, and the dedication they had towards the success of my study. I also want to thank the agricultural extension personnel of Masvingo (ward 14), particularly Marygold Furusa, for their assistance throughout my data collection period. Many thanks to the farmers who granted us their time and willingly gave us the information that we needed.

My heartfelt gratitude goes to Dr K Mazvimavi who has been my mentor and inspired me to be an achiever, and to Dr C Murendo and Mr P Mugoni from ICRISAT for their support during my data collection.

Last, but not least, I want to thank my friends, Nkululeko Mpofu, Phibion Chiwara, Jerry Nboyine, Munyaradzi Machila, Innocent Kaba, Daniel Nkomboni, Danang Budi, Atish Lal,

Zheng Wang, and my New Zealand family Alex Pascoe, Paul Brown, Salma Dahawi, Joshua Koia, and everyone who has contributed in making my stay in New Zealand worthwhile and enjoyable.

Table of contents

Abstract ..... **i**

Acknowledgements ..... **ii**

Table of contents ..... **iv**

List of tables ..... **vii**

List of figures ..... **viii**

Glossary of acronyms ..... **ix**

Chapter 1 Introduction **1**

1.1 Background of the study 1

1.2 Rationale for the study 2

1.3 Summary of research objectives and research questions 3

1.4 Structure of the thesis 3

Chapter 2 Conservation agriculture and adoption – a review of the literature **4**

2.1 An overview of conservation agriculture 4

2.2 Promotion of conservation agriculture amongst smallholders in Zimbabwe 5

2.3 Efforts to overcome risk associated with new technologies 6

2.4 Trends in CA uptake during the input support era (2004 to 2013) 6

2.5 Empirical studies on the determinants of CA adoption and intensity 7

2.5.1 Measuring CA dis-adoption as a dichotomous variable 7

2.5.2 The role of perceptions in adoption decisions 8

2.5.3 Attempts to measure adoption and intensity 9

2.5.4 Identified gaps in the literature 11

Chapter 3 Research methodology **12**

3.1 Study technique 12

3.2 Analytical methods 13

3.2.1 CA intensity index (CAI) 13

3.2.2 Determinants of CA components uptake, the rate and extent of their application 15

3.3 Human ethics and privacy 17

Chapter 4 Study area, data collection and descriptive statistics **18**

4.1 Study area 18

4.2 Research design 21

4.3 Data collection 22

4.4 Household characteristics 22

4.5 Land endowment, farming techniques, and crop production 24

4.6 Area allocation, tillage systems, and crops grown 26

4.7 Adoption of CA components 28

4.8 CA components used by smallholders in 2014/15 season 29
4.9 Application of CA components to different tillage systems 30
4.10 Reasons for not using CA components 31
4.10.1 Using farmer perceptions to explain adoption decisions 31
4.10.2 Reasons given by farmers who did not implement CA components 32
4.11 Motivation to practise CA components 34
4.12 Access to advice 35
4.13 Summary 35

Chapter 5 Empirical results 37
5.1 Computation of the conservation agriculture index (CAI) 37
5.1.1 Estimation of CA component weights 37
5.1.2 Computation of CAI 39
5.2 The double hurdle model 41
5.3 Model specification and diagnostic tests 41
5.4 Factors determining adoption, intensity and extent of CA use 43
5.5 Sensitivity analysis – an overview of scenarios using alternative methods to measure adoption and intensity 47
5.6 Summary 49

Chapter 6 Conclusions and recommendations 50
6.1 Research summary 50
6.2 Conclusions and recommendations 51
6.3 Limitations of the study and areas for future research 54

References 55

Appendix A Household questionnaire used to collect information 60

Appendix B Definitions of variables used to estimate the double hurdle regression model 77

Appendix C Data set used to estimate the double hurdle model 78

Appendix D Data set used to estimate the double hurdle model continued 88

Appendix E Variance inflation factors 99

Appendix F Heckman test for selection bias 100

Appendix G Double huddle results without transformed farm experience 101

Appendix H Definitions of variables for additional household data used to compute descriptive statistics 102

Appendix I Household data used to compute descriptive statistics.....104

Appendix J Household data used to compute descriptive statistics continued 114

Appendix K Definitions of variables and codes for plot level data.....124

Appendix L Plot level data used to compute weights of CA components.....125

List of tables

Table 4-1: Sampling details 21
Table 4-2: Household characteristics (n=237) 23
Table 4-3 Farm characteristics (n=237) 25
Table 4-4: Relationship between distance and receipt of extension 26
Table 4-5: percentage of crops grown in different plots (n=995) 27
Table 4-6: Respondent use of tillage systems by crop type (% using) 28
Table 4-7: Adoption levels of different CA components, past and present adopters (%) (n=237) 29
Table 4-8: Frequency of individual and combination use of CA component (%) 29
Table 4-9: CA components applied under different tillage systems (n=995) 30
Table 4-10: Farmer perceptions of tenure security and the long-term benefits of CA (n=237) 31
Table 4-11: Reasons given by farmers who did not implement CA components by type of CA component 33
Table 4-12: Factors that influenced farmers to practise CA components 35
Table 4-13: Sources for farming advice 35
Table 5-1: Contribution of CA components to maize yield 38
Table 5-2: Computed weights for different combinations of CA components 38
Table 5-3: Computation of the index at plot level 40
Table 5-4: Variables used in the regression model and expected signs 42
Table 5-5: Estimated double hurdle model for factors influencing uptake of CA and level of use 44
Table 5-6 Scenario analysis of alternative approaches used to measure adoption and intensity 48

List of figures

Figure 4-1: Map of Zimbabwe showing the study area. Source: ICRISAT Matopos GIS unit (2015)..... 19
Figure 4-2: A typical basin plot, with village head searching for farmers' list (insert L) and farmer preparing planting basins (insert R) 20
Figure 4-3: A typical farmer's homestead and field (part of the study area). 20

Glossary of acronyms

ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
NGO	Non-government organisation
OLS	Ordinary least squares
PPS	Probability proportionate to size
PSU	Primary stage sampling units
SSU	Secondary stage sampling units
VIF	Variance inflation factor

Chapter 1
Introduction

This research investigates the factors that determine the adoption levels of conservation agriculture (CA) amongst smallholders in the Masvingo district of Zimbabwe. This chapter will present the background of the study, describe its relevance to Zimbabwe, and conclude by outlining the research objectives.

1.1 Background of the study

While smallholders in Africa rely heavily on agriculture for their livelihood, they face many challenges and lack the necessary resources to successfully cultivate their lands to their potential (Mazvimavi, 2011). These challenges include, but are not limited to, the lack of seed, fertiliser, and draught power. This is further exacerbated by the depletion of soil nutrients emanating from poor farming techniques and practices (Giller, Witter, Corbeels, & Tittonell, 2009; Ndlovu, Mazvimavi, An, & Murendo, 2014). Identifying improved farming strategies that can increase returns for smallholders has been, and continues to be, an essential goal for most governments and development agencies involved in poverty alleviation (Arslan, McCarthy, Lipper, Asfaw, & Cattaneo, 2014; FAO, 2012).

Conservation agriculture (CA) has been promoted by development agencies and governments in many parts of Southern Africa as a means of addressing land degradation and other crop production challenges faced by smallholders (Andersson & D'Souza, 2014; Knowler & Bradshaw, 2007; Mazvimavi, 2011). This is drawn from the success and positive impact that CA has had on commercial farmers in the USA and Brazil (Johansen, Haque, Bell, Thierfelder, & Esdaile, 2012; Kassam, Derpsch, & Friedrich, 2014; Pannell, Llewellyn, & Corbeels, 2014). The technology and practices associated with CA have been interpreted and defined differently in different contexts (Andersson & D'Souza, 2014). For this study, CA refers to a farming technique that is based on the integrated management of soil, water, and biological resources through: (i) minimum disturbance of soil (limited or no till), (ii) permanent soil cover (usually using crop residues), and (iii) crop rotation (Giller et al., 2009).

Proponents argue that CA technology can help to address the problems of poor soil fertility and low yields, and mitigate some of the socio-economic challenges faced by smallholders (Mazvimavi, 2011). When conducted properly, the technology allows for a more precise use

of inputs and better timeliness of farm operations. This leads to a more efficient use of scarce inputs, improves productivity (Kassam et al., 2014), and eases peak labour demands (Mazvimavi & Twomlow, 2009).

Significant investment and resources have been channelled towards supporting and upscaling CA technology among smallholders in many developing countries (Ndlovu et al., 2014). However, empirical studies have shown that the impact of CA on smallholders has been undermined by low adoption rates (Andersson & D'Souza, 2014). Farmers choose components of CA according to their perceptions of feasibility, costs and benefits given external factors such as the institutional and natural environment. In some areas, it is relatively easy to apply certain components but difficult to implement others (Giller et al., 2009; Pannell et al., 2014). For example, farmers in Zambia were found to use relatively less mulch and crop rotation practices (Arslan et al., 2014). Similar findings were reported in Zimbabwe (Pedzisa, Rugube, Winter-Nelson, Baylis, & Mazvimavi, 2015a). Though empirical studies indicate that the uptake of CA technology is low among smallholders, reasons for its low adoption are mixed (Andersson & D'Souza, 2014).

1.2 Rationale for the study

Most empirical studies of CA adoption measured the uptake and practice of CA as a binary variable, thus assuming CA to be an indivisible technology (Pedzisa, Rugube, Winter-Nelson, Baylis, & Mazvimavi, 2015b). In reality, smallholders often apply only one or two of the three principles (Giller et al., 2009; Mazvimavi & Twomlow, 2009; Pannell et al., 2014). The selection and uptake of specific CA components, and their intensity of use, also differ among individuals. Studies that focus on just one component, (e.g. minimum disturbance / basin digging) to measure the uptake of CA ignore the reasons farmers do not adopt the other components, or why some components may be sub-optimally applied. Gershon, Just, and Zilberman (1985) emphasise the importance of developing measures that account for different levels of uptake. Given that there are inconclusive findings on factors that influence uptake and adoption levels, the goal of this study is to generate information that will help decision-makers assess the value of promoting CA amongst smallholders in Zimbabwe. Most empirical studies on the uptake of CA by smallholders have focused on factors affecting adoption and very little work has been done on factors that influence their levels of use. Furthermore, many empirical studies on CA adoption were conducted when non-government organisations (NGO) were still actively promoting CA. This study was conducted

after NGOs had stopped providing free inputs to smallholders, thus eliminating the bias that can emanate from the receipt of free inputs.

1.3 Summary of research objectives and research questions

This research has three main objectives. The first objective is to construct an index that captures the degree and extent of the specific CA techniques applied by smallholders. This will improve on past CA adoption studies by developing a more accurate measure of CA uptake. The second objective is to identify the factors (including exposure to CA support) that influence the adoption of specific CA components in a sample of Zimbabwean smallholders. The third objective is to investigate the factors that explain the level of CA uptake as measured by the index scores computed for sampled households using a double hurdle adoption model.

The study will be guided by two main research questions:

1. What factors determine the uptake of CA components used by smallholders in the study area?

2. What factors determine the levels of technology use?

In order to address these questions, this research:

1. Constructs an index that captures the number of CA components used by smallholders, and the rate and extent of their application.

2. Investigates the factors that explain the uptake of CA components, the rate, and extent of use, using a double hurdle model.

1.4 Structure of the thesis

The following chapter reviews the relevant literature on CA and adoption studies. Chapter 3 presents the methods used to answer the research questions. Chapter 4 describes the data collection process and the study area. It also presents descriptive statistics. In Chapter 5, the process of constructing the conservation agriculture index is explained. In the same chapter, the factors that influence the uptake of CA components and intensity of use are presented based on an econometric analysis. This is followed by the final chapter, which presents conclusions and recommendations.

Chapter 2
Conservation agriculture and adoption – a review of the literature

This chapter presents an overview of the literature. It starts by detailing the origins of CA, then narrates its promotion in Africa. Relevant empirical studies are also presented. The chapter concludes by identifying various gaps that exist in the literature.

2.1 An overview of conservation agriculture

Conservation tillage techniques were developed as a response to land degradation challenges in the USA in the mid-1930s (Kassam et al., 2014). Degradation in this context mainly resulted from soil erosion, which was caused by impacts associated with wind and rainwater and aggravated by prevailing agricultural practices (Friedrich & Kienzle, 2007; Kassam et al., 2014). A collection of farming and land management practices were developed and promoted to alleviate the problem. These management strategies encouraged minimum tillage (or no-till) and the covering of the soil surface. The aim was to address land degradation through minimal interference with natural processes (Friedrich & Kienzle, 2007). Reduced tillage technology started spreading in the 1960s, first in the USA and then in Brazil, Argentina, and Paraguay. Research on reduced tillage farming was introduced in parts of Africa during the 1970s (Kassam et al., 2014). The technology spread well in commercial agriculture settings where mechanised equipment was utilised and where chemicals were used to control weeds. In the commercial farming sector, the technology has been associated with lower production costs through the reduced use of fuel and labour (Johansen et al., 2012). In Zimbabwe, reduced tillage was promoted as a response to land degradation and fuel shortages (Johansen et al., 2012), and spread amongst commercial farmers using mechanised equipment during the 1980s.

Even though reduced tillage practices have been widely adopted in other countries, their rates of uptake in African countries have been low. Kassam et al. (2014) estimate the percentages of cropland under reduced tillage to be approximately 69%, 57% and 15% for Oceania (Australia and New Zealand), South America, and North America, respectively. By contrast in Africa, the authors estimate that just 0.3% of arable land is under reduced tillage.

Reduced tillage technology has been promoted amongst subsistence farmers under the banner of conservation agriculture (CA). Despite the very different technologies used by

smallholders and commercial farmers, development agencies assumed that CA would ease some of the challenges faced by smallholders (Kassam et al., 2014; Ngwira, Johnsen, Aune, Mekuria, & Thierfelder, 2014). The type of CA that was promoted in Zimbabwe rests on three interlinked principles, namely (i) minimum disturbance of soil, (ii) maintaining soil cover and (iii) growing diverse plant species (crop rotation) (Kassam et al., 2014). The technology has recently gained attention given rising concerns about food security and the need to use natural resources more sustainably. CA has been viewed as an ecosystem-based technology that can lead to sustainable agricultural intensification, particularly for the poor who rely heavily on agriculture (FAO, 2012; Kassam et al., 2014).

2.2 Promotion of conservation agriculture amongst smallholders in Zimbabwe

Efforts to promote CA in Zimbabwe commenced with research trials conducted between 1988 and 1998 with limited involvement of smallholders (Johansen et al., 2012). Significant interventions involving smallholder farmers were implemented during the 2003/04 cropping season (Johansen et al., 2012; Marongwe, Nyagumbo, Kwazira, Kassam, & Friedrich, 2012). NGOs took the lead in promoting CA as a hand-hoe based technology where farmers had to prepare planting basins during the dry season (minimum disturbance of soil) and retain at least 30% soil cover (Mazvimavi & Twomlow, 2009). Crop rotation was also encouraged as part of the technology (Giller et al., 2009). NGOs initially targeted vulnerable farmers, who were defined as families who faced challenges in meeting their basic livelihood needs (Mazvimavi & Twomlow, 2009). Vulnerable households included farmers who had production constraints, mostly emanating from difficulties in accessing draught power and inputs such as fertiliser and seed (Andersson & D'Souza, 2014; Mazvimavi & Twomlow, 2009). CA was promoted owing to its ability to reduce smallholder reliance on draught power for land tilling, which often caused farmers to plant later in the season and resulted in yield losses (Giller et al., 2009; Kassam et al., 2014). The technology was also expected to solve problems associated with peak labour demand, while enhancing the more efficient use of scarce rainwater and inputs such as fertiliser through improved management practices (Mazvimavi, 2011; Mazvimavi & Twomlow, 2009).

2.3 Efforts to overcome risk associated with new technologies

In Zimbabwe, smallholders were initially provided with free inputs to encourage the adoption of CA technology so that its effects could be measured. Adopting new technologies exposes farmers to risk, especially smallholders who cultivate small areas for food staples with limited ability to purchase inputs (Pannell et al., 2014). Risk averse and resource constrained farmers are seldom willing and able to try new technologies (Arslan et al., 2014; Pannell et al., 2014). Smallholders in Zimbabwe allocate most of their resources to the production of food staples, and consume most of the staples they produce (Johansen et al., 2012). Cash earnings from the sale of surplus products tend to be trivial and, in the virtual absence of off-farm earnings, smallholders confront severe liquidity constraints (Ndlovu et al., 2014; Nyamangara et al., 2014). This reduces their ability to invest, particularly in cases where a new technology does not provide immediate benefits (Shiferaw & Holden, 1998). The temporary provision of free inputs was considered necessary to overcome risk aversion and the liquidity constraints that inhibit the adoption of technologies like CA.

2.4 Trends in CA uptake during the input support era (2004 to 2013)

Given the provision of free inputs by NGOs, the number of farmers practicing some form of CA in Zimbabwe increased from less than 20,000 households during the 2006/07 cropping season to approximately 120,000 households during the 2009/10 cropping season (Mazvimavi, 2011). By 2010/11, there were approximately 300,000 households practising CA, of whom almost 40% were spontaneous adopters who did not receive free inputs. However, despite a relatively high reported number of households implementing CA, the area of arable land under CA remained low. As of the 2010/11 season, CA was cultivated on 141,334 hectares, representing approximately 5% of the area allocated to maize (Marongwe et al., 2012). Furthermore, the adoption of mulching and crop rotation practices remained low owing to competing uses for crop residues and preferences for growing staple cereals over legumes (Mazvimavi, 2011; Pannell et al., 2014).

Additional constraints on adoption included the increased demand for labour, weed control (Nyamangara et al., 2014), and inadequate technical support (Giller et al., 2009; Mazvimavi & Twomlow, 2009). Other reported challenges include a lack of knowledge, perceived complexity of the technology, inappropriate tools, and a lack of herbicides (Johansen et al., 2012). In addition, CA was usually promoted as an indivisible package, implying that all three principles had to be adopted to realise its benefits (Giller et al., 2009). Some NGOs promoted

mechanised CA techniques that rely on improved equipment such as ox-drawn rippers and direct planters to address the perceived labour constraints (Johansen et al., 2012; Marongwe et al., 2012). Even so, the uptake of mechanised CA has also been disappointing, suggesting that other more binding constraints such as farmer perceptions about CA and institutional factors beyond the farm gate prevent its adoption (Andersson & D'Souza, 2014; Nyamangara et al., 2014). The number of farmers employing some form of CA declined after 2011 when some of the NGOs stopped providing free inputs (FAO, 2015).

2.5 Empirical studies on the determinants of CA adoption and intensity

2.5.1 Measuring CA dis-adoption as a dichotomous variable

While a number of studies have been conducted to identify the factors influencing the adoption of CA, Pedzisa et al. (2015a) focused on factors that explained its dis-adoption. In their study, Pedzisa et al. (2015a) used a binary dependent variable where dis-adoption was equal to 1 and 0 otherwise. However this approach has limitations where technology can be partially adopted, as it fails to incorporate different levels of uptake (Gershon et al., 1985).

Factors associated with dis-adoption included the education level and age of the household head, household size, NGO support, farm size, livestock ownership and assets owned. Pedzisa et al (2015a) found that farmers with more farming experience, larger household sizes, and those who were NGO beneficiaries were more likely to continue practising CA, while wealthier farmers were more likely to abandon CA. One explanation for this is that wealthier farmers own livestock and are therefore more inclined to return to conventional tillage using ox-drawn ploughs. Another related reason is that wealthier farmers face more acute labour shortages on-farm as their wealth derives from off-farm employment. Larger households tend to have more farm labour and are considered more likely to adopt CA, which is widely viewed as a labour and management intensive technology (Mazvimavi & Twomlow, 2009; Nyamangara et al., 2014). Farming experience may be linked to management capacity and risk preferences, as experienced farmers can leverage the knowledge accumulated over time and experiment more confidently with new technology. Pedzisa et al. (2015a) concluded that the lack of support from NGOs led to the abandonment of CA and recommended that ongoing support be extended to CA farmers. This raises questions about the sustainability of CA in poor countries.

2.5.2 The role of perceptions in adoption decisions

Shiferaw and Holden (1998) used farm and household characteristics to explain the levels of CA adoption by farmers in Ethiopia. They included farmer perceptions of land tenure security and soil erosion problems as explanatory variables. The decision to adopt CA was found to be positively related to high perceptions of soil erosion and the productivity of CA technology, farmer attitudes and exposure to new technology, and farm size. Even though controlled experiments have shown that CA is most effective as an indivisible technology, farmers may perceive this differently under conditions of imperfect information and learning by doing (Gershon et al., 1985; Pedzisa et al., 2015a). Perhaps farmers could be correct in having different perceptions about CA given that experimental settings may not be relevant to their conditions and may not consider farmer costs. Understanding farmer perceptions of CA benefits may aid in explaining adoption patterns (Moyo et al., 2012).

In Zimbabwe, as in many other African countries, smallholders operate under customary land tenure arrangements that constrain exclusive land rights (Mabuza, Sithole, Wale, Ortmann, & Darroch, 2013; Pannell et al., 2014). For example, farmers are not allowed to exclude their neighbours' livestock from their croplands in the winter after the harvest. However, under CA, basins should be left visible so that farmers do not have to dig them every season, while crop residues should remain as soil cover (Mazvimavi & Twomlow, 2009) and not grazed. Arguments that CA requires less effort after the first year of implementation (FAO, 2015; Mazvimavi & Twomlow, 2009) are less compelling when farmers do not have exclusive rights to their cropland. Incentives to adopt CA technology are further reduced as farmers cannot internalise the full benefits of their investment in CA. Mabuza et al. (2013) identified insecure land tenure as a constraint on smallholder investment in alternative land cultivation technologies in Swaziland.

Ruttan and Hayami (1998) theorise that farmers would lobby for institutional change when prevailing institutions prevent them from internalising the benefits of profitable technology. However this argument tends to ignore political resistance to institutional change (Lyne, 2009). In the case of CA, resistance is likely to come from livestock owners who tend to be wealthier and more influential members of rural communities. Persistent tenure insecurity is therefore expected to discourage the adoption of CA technology in Zimbabwe. However, when all smallholders are burdened with the same problem, it is difficult to measure the impact of insecure tenure owing to the absence of variation in land rights. This study will

elicit farmer perceptions of their tenure security. Even though smallholders operate under the same tenure, individual perceptions may be different.

2.5.3 Attempts to measure adoption and intensity

Some researchers acknowledge that CA can be partially adopted by farmers and these researchers have attempted to measure adoption and intensity using a continuous variable. Mazvimavi and Twomlow (2009) measured the adoption and intensity of CA using a tobit model. They constructed an index using the number of components adopted by farmers. In addition to the three main components of CA, they included other management practices such as weeding and fertiliser and manure application, giving a total of eight components. Their index ranged from zero to one, assigning a maximum value of one to farmers who practised all the eight components and zero to non-adopters. They found that gender of household head, access to extension, plot size, NGO support, experience with CA and rainfall, all had a positive impact on adoption and intensity. Their study was conducted at the time when farmers were offered inputs and technical support by NGOs and this may have biased the level of CA adoption and the factors determining uptake. Farmers who had implemented CA components for a longer period may have realised the benefits of the technology. The authors acknowledged the need to assign different weight to CA components but indicated that it was not possible at that time since CA had only been practised for few seasons. Their index did not incorporate the variation within each component. Furthermore, the approach they used assumes that farmers make a single decision on adoption and the intensity of adoption (Cragg, 1971).

Arslan et al. (2014) used a latent variable approach in their study on Zambia and measured CA adoption and intensity using a continuous variable. They calculated intensity as a percent of cultivated land under different CA practices. They also treated individual CA components separately. They found that socio-economic factors such as labour availability, education, and wealth were more important in explaining the adoption of crop rotation than the adoption of reduced tillage. Rotating crops usually implies a change in management practices, which tends to increase management and labour requirements (Giller et al., 2009). Full-time farmers with access to labour may be in a better position to implement crop rotation practices. Education is expected to improve the ability of farmers to understand and assimilate extension advice. Surprisingly, in their findings, education did not influence the adoption of reduced tillage, even though it is considered to be an improved management

practice. Wealthier farmers may be better positioned to use crop rotation practices using mechanised CA techniques and may be less reliant on producing maize as a food staple for their own consumption. Arslan et al. (2014) acknowledged the limited explanatory power of their model and recognised the importance of unobserved factors that influence farmer decisions. The lack of explanatory power might also be explained by factors that show little or no variation within samples, such as land tenure security. While it may well be possible to measure the level of tenure security, a lack of variation in observed or perceived levels of tenure security would prevent this variable from explaining levels of in CA adoption. A lack of variation means that the variable does not, in reality, explain variation in adoption even though it may be responsible for low levels of adoption.

Ngwira et al. (2014) studied CA adoption and the extent of adoption in Malawi using a two-step Heckman procedure to address sample selection bias. They found that the use of hired labour, membership in a farmer group, and the cultivation of a larger area of land increased the chances of adopting CA. The extent of adoption was positively affected by larger areas of cultivated land, farmer experience, and the location of the farmer. Working in farmer groups makes it easier to share information, and less time consuming for extension personnel to provide services to a group. Farmers who work in groups can also pool their experience and share the labour burden, for instance, by collectively digging seed basins for each group member. Peer effects can play a role in influencing behaviour and farmers in a group can influence one another to adopt technologies.

Ngwira et al. (2014) and Arslan et al. (2014) measured the intensity of CA as the percentage of land allocated to CA techniques and did not consider variations within the technology. Although Ngwira et al. (2014) indicated that farmers in Malawi who practise CA apply all three components in most cases, this measure of intensity ignores the potential variation within each component as farmers are likely to apply varying levels of each component. Improving the measures of CA uptake and intensity by accounting for variation within each component should provide more accurate information about the determinants of adoption. In addition, measuring intensity as the percentage of land cultivated using CA ignores the extent of adoption. Farmers scoring the same level of intensity (percentage) could be practising CA on very different areas of land. Standardising the area may thus help to address this weakness. Similarly to that by Mazvimavi and Twomlow (2009), a recent study by Pedzisa et al. (2015b) attempted to measure the intensity of adoption in Zimbabwe.

However, instead of converting the components into a continuous index, they used a count regression analysis to investigate the factors that influence the intensity of use as measured by the number of CA components practised by each farmer. Nevertheless, this approach also fails to accurately measure the intensity of CA adoption as it does not consider the extent (area) of CA adoption.

2.5.4 Identified gaps in the literature

The inconclusive findings from the surveyed literature may reflect an inadequate measurement of uptake and omission or a lack of variation in key explanatory variables. In addition, some studies did not explicitly indicate which of the components (reduced tillage, mulching, crop rotation) were used to measure CA. Moreover, previous studies on CA adoption were generally conducted at times when NGOs still actively promoted CA through the provision of free inputs. Reported adoption rates may therefore be misleading.

This study intends to build upon past studies of CA adoption by first developing an index of CA adoption that accounts for the number of CA components used and the rate and extent of their application. It then uses a double hurdle model to identify the factors that explain the use and intensity of CA uptake by smallholders in the Masvingo district of Zimbabwe.

Chapter 3
Research methodology

This section describes the methods that were used to select a representative sample in the study area and how data were collected from sampled households. Section 3.1 presents the sampling technique used, while Section 3.2 outlines the methods used to identify factors that determine the uptake of CA components and their levels of use. The last section of the chapter presents the ethical issues considered in the analysis and compliance with codes of conduct for the primary survey collection.

3.1 Study technique

The study was conducted in Ward 14 of the Masvingo District of Zimbabwe using quantitative methods. Masvingo was considered ideal for the study as NGOs and government extension have actively promoted CA in this district since 2004, and there are known variations in the levels of CA uptake by smallholders. The study area is representative of areas that are fairly exposed to CA and is of manageable size.

The data were elicited from a representative sample of smallholders drawn using a multistage sampling technique. The first stage involved the selection of villages (primary stage sampling units-PSUs) from the population of villages in the study area. The villages were selected with probability proportionate to size (PPS). This method of sampling accounts for differences in the size of villages. Within each selected village, the population of smallholders (secondary stage sampling units-SSUs) was listed and a random sample was drawn from each list using a constant sampling rate. This sampling approach generates a representative sample that can be analysed as if it were a simple random sample as it assigns equal probability of selection to all smallholders in the study area (Babbie, 2016, p. 216). A structured questionnaire was used in personal interviews with *de facto* household heads to gather information on household and farm characteristics. Enumerators hired and trained by the author administered the questionnaire and elicited information on the technology applied to each crop. The author measured each field of the interviewed smallholders using a meter wheel to obtain accurate area measurements.

3.2 Analytical methods

In order to better understand the adoption of CA and the intensity of its uptake, an index that takes into account the number of CA components applied, and the rate and extent of their application was computed. The created index was continuous in nature and aimed at overcoming the weaknesses associated with the use of dichotomous variables (variables scoring 0 or 1), particularly the inability of binary variables to sufficiently measure adoption in cases where partial adoption is possible. The method adopted in constructing the index is presented in the next section.

3.2.1 CA intensity index (CAI)

A conservation agriculture index (CAI) was constructed from plot level data gathered from smallholders surveyed. The constructed index reflected (i) the number of CA components used, both individually and in combination with one another, (ii) variation within the components adopted, and (iii) the area of land allocated to those components and combinations. This index made it possible to capture partial adoption as well as the extent to which CA is or is not used. The index was computed as:

$$CAI_i = \sum_r W_{ir} R_{ir} P_{ir} S_{ir} \quad \text{..... (1)}$$

Where in equation (1), CAI denotes the conservation agriculture index score computed for the i^{th} household. W is defined as the contribution of each CA component (or their combination) to yield, R is the farmer's rate of CA component application relative to the recommended application rate, P is the area of each plot relative to the total area planted by the farmer, and S is the area of each plot relative to largest plot in the data set. The subscript, r, represents the specific plot of the i^{th} household, with the CAI for a household summed over each plot. The values for W, R, P and S were obtained from the household survey data, with their computation described below.

The weights accounts for differences in the relative importance of CA components or combination of components. Ideally, the yield weights for different CA components (W) would be obtained from the literature or expert advice. However, to the best of the author's knowledge, there is no study that has decomposed the contributions of different CA components to their individual or combined impacts on yield. Expert advice was also not readily available as the experts who were approached indicated that they could not estimate the weight of each component. In order to address this, plot level yield data were regressed

on the CA components applied by farmers to estimate the weights of each component or combination of components. Typically, a household's farm would have more than one plot (parcel), and each plot may have different CA components or different combinations of CA components. Since information on the CA components applied by farmers was recorded at a plot level in the survey, this was coded as dummy variables in the regression model, which took values of 1 where a component (or combination) was practised, and zero otherwise. An ordinary least squares (OLS) regression model was used and was specified as:

$$Y_{ir} = \alpha_{0ir} + \sum_w a_{wir} X_{wir} + u_{ir} \quad \text{..... (2)}$$

In equation (2), Y_{ir} represents the maize yield observed for the r^{th} plot of the i^{th} household. On the right-hand side of the equation, α_{0ir} is a constant, α_{wir} are estimated parameters, X_{wir} are the CA components or combination of components (w) applied on each r^{th} plot of the i^{th} household, and υ_{ir} is the error term. Standardised coefficients obtained from the regression model were normalised to obtain weights for each component or combination.

The weights obtained from this process were then inserted into the plot level survey data by substituting the implemented component with its associated computed weight, with a weight of zero assigned to plots that did not use any of the CA components. More details is provided in Chapter 5.

The rate of CA components application (R) is a score obtained from farmer perceptions in the survey, in which farmers were asked to rank themselves against the recommended rate of component use. Where a farmer assumed that they used the component as recommended by extension officers, they were assigned a rate of 1. Scores for rate of CA components application ranged from 0 to 1 and were assigned at a plot level.

The values of P and S were derived from accurate field and plot measurement data from the survey. The value of P is simply the ratio of each r^{th} plot relative to the total area cultivated by the i^{th} household in the 2014/15 cropping season. This aims at capturing the proportion of area that each farmer allocates to each CA component or combinations. S was calculated as the ratio of each plot relative to the largest plot in the data set. The purpose of S is to differentiate the extent of CA application in cases where different farmers might practise CA components on very different plot sizes and obtain the same value for P.

The CA index computed in equation (1) is a measure of the intensity of CA as it captures information about adoption decisions, and the rate and extent of application. This approach builds and improves on previous studies. For example, in Malawi, Ngwira et al. (2014) measured CA uptake as the proportion of land cultivated using CA technology, but disregarded variation in the number of components used and variation within components. In Zambia, Arslan et al. (2014) assessed adoption intensity separately for reduced tillage (i.e. seed basins) and crop rotation, but did not consider mulching owing to data limitations. The computed index from this study considers all three components and combinations of components, the rate at which the components are applied, the scale of their application and their relative contributions to yield. Moreover, CAI is continuous, assigns larger weights to more intensive users, and captures partial adoption.

3.2.2 Determinants of CA components uptake, the rate and extent of their application

The computed index was subsequently used to investigate the factors that determine the uptake of CA components, and their rate and extent of use. The observable factors that are expected to affect these decisions include a number of household and farm characteristics identified in the previous chapter, including farm size, farming experience, education, perceptions of tenure security, peer effects, and previous exposure to CA support services.

Most of the previous adoption studies from the literature used a binary variable to measure adoption, making it appropriate to use either a logit or probit model. However, this approach does not capture the intensity of adoption which is a continuous variable. For this study, given that the index (CAI) used to measure adoption is continuous, logit and probit models are not appropriate. Furthermore, the CAI has positive values censored at zero; the CAI cannot be negative because farmers cannot negatively implement CA components. Ordinarily, a Tobit model could be used to overcome this problem as it better handles censored data and can be used to measure both adoption and intensity (Mazvimavi & Twomlow, 2009). However, the Tobit approach assumes that the decision to adopt and the decision on levels of adoption are the same, which may not be appropriate in this case (Cragg, 1971).

In this study, the decisions about the uptake of CA components and intensity levels are hypothesised to be determined through separate processes. In each season, the farmer has

to first make a decision to use CA components, then decide on the rate and extent of their use. Factors that affect the use of CA components may have a different impact on the two decisions made by farmers. For instance, a factor may positively affect one's adoption decision but negatively affect the intensity of that adoption decision. For example, farm experience may influence farmers to hold on to traditional farming techniques, impacting negatively on the adoption decision. On the other hand, once technology has been adopted, the knowledge that would have been accumulated over time can positively impact the intensity of its use. Tobit models are not able to sufficiently handle such scenarios (Garcia, 2013). Where these decisions are assumed to be separate processes, the two-stage Heckman procedure and double hurdle approaches are more appropriate (Garcia, 2013).

The double hurdle model makes it possible to separate the decision to participate and the decision made on the rate or extent of use. The double hurdle model assumes that an individual passes through two hurdles. The first hurdle is the decision of whether to implement CA or not, while the second hurdle is how much of a CA component is to be used (Cragg, 1971). The first hurdle uses a Probit regression, which takes 0 as the decision not to use a technology and treats all other positive values as 1, the decisions to adopt. This can be specified as:

$$P\left(w = \frac{1}{x}\right) = \varphi(x\gamma) \qquad \text{..... (3)}$$

In equation (3), P denotes the probability, w is a binary variable of CA components, φ represents the cumulative normal distribution, and x is a vector of farm and household characteristics that may influence adoption. The γ's represent the vector of coefficients to be estimated.

The second hurdle uses a truncated regression model to determine the factors that explain the intensity of adoption for individuals who decide to implement CA components (Burke, 2009).

$$Y = x\beta + \varepsilon \qquad \text{..... (4)}$$

In equation (4), Y represents the vector of CA intensity levels as measured by the CAI, x is a vector of farm and household characteristics that may influence intensity levels, β is a vector of estimated parameters, and ε is a vector of error terms.

Double hurdle models assume that the error terms of the two regression models are not related. However, given the nature of the study, it may be possible to have sample selection bias. For instance, a certain class of farmers may choose to adopt a technology (Heckman, 1979; Khandker, Koolwal, & Samad, 2010). Therefore, there is a need to test for selection bias before running the double hurdle regression. The Heckman approach better handles data that has selection bias. The model computes an Inverse Mills Ratio (lambda), which is included as a regressor in the second regression and absorbs the bias (Heckman, 1979). If lambda is statistically significant, it indicates the presence of selection bias. If selection bias is present, then the Heckman approach becomes an appropriate model to use. However, if selection bias is absent (as was the case in this study), the double hurdle efficiently estimates the determinants of CA adoption and intensity given than it better handles truncated data in the second hurdle (Burke, 2009).

3.3 Human ethics and privacy

The study complied with the provisions of article 6.2.3, sub-article 2 of Lincoln University's Policies and Procedures relating to Human Ethics. No application was made for Human Ethics clearance as the questions posed to respondents were non-personal in nature, and focused on matters that were within their professional competence. Following best practice, prospective respondents were provided with adequate information about the survey. They were informed that their participation was voluntary and they had the right to withdraw at any time during the interview. Respondents signed consent forms that guaranteed their anonymity and confidentiality. The researcher together with trained enumerators were familiar with the study area and aware of what was considered sensitive.

Chapter 4
Study area, data collection and descriptive statistics

This chapter starts by describing the study area, followed by a detailed account of how data was collected. Descriptive statistics are also presented in this chapter. A brief summary highlighting major issues that emerged from the descriptive statistics is presented at the end of the chapter.

4.1 Study area

Logically, in order to be able to assess the adoption of CA technology, there is a need to focus on areas that have been sufficiently exposed to the technology. Masvingo was considered ideal for the study as it is one of the few districts in which the promotion of CA technology was pioneered. The study was conducted in Ward 14 of the Masvingo district between October and December 2015. Ward 14 was selected because NGOs and government extension officers had actively promoted CA in this ward since 2004. After discussions with stakeholders who were actively involved in promoting CA, there was a general consensus that the ward is representative of areas that are fairly exposed to CA, of manageable size, and has sufficient variations in the levels of CA uptake by smallholders. The ward is located 60 km southeast of Masvingo town, near Lake Mutirikwi/Kyle of Zimbabwe (Figure 4-1). The largest part of the district is classified as semi-arid, and normally receives annual rainfall ranging from 450 to 650 mm between October and April (Moyo et al., 2012). Smallholders in the study area are predominantly subsistence farmers. In rare cases, they produce a marketable surplus which may be sold or stored for future consumption. Farmers in the study area rely heavily on rain-fed agriculture (Johansen et al., 2012; Moyo et al., 2012). The study area is characterised by mixed farming systems, where farmers practise both livestock rearing and crop production. Fishing is also one of the more common off-farm activities given that the area is located near the lake.

Figure 4-2 illustrates a typical smallholder plot where reduced tillage is implemented. The insert on the left shows the village head preparing part of the list of farmers that was used in sampling. The insert on the right shows a farmer digging planting basins. Figure 4-3 shows a typical homestead of smallholders in the study area. The images in Figures 4-2 and 4-3 were captured by the author during data collection.

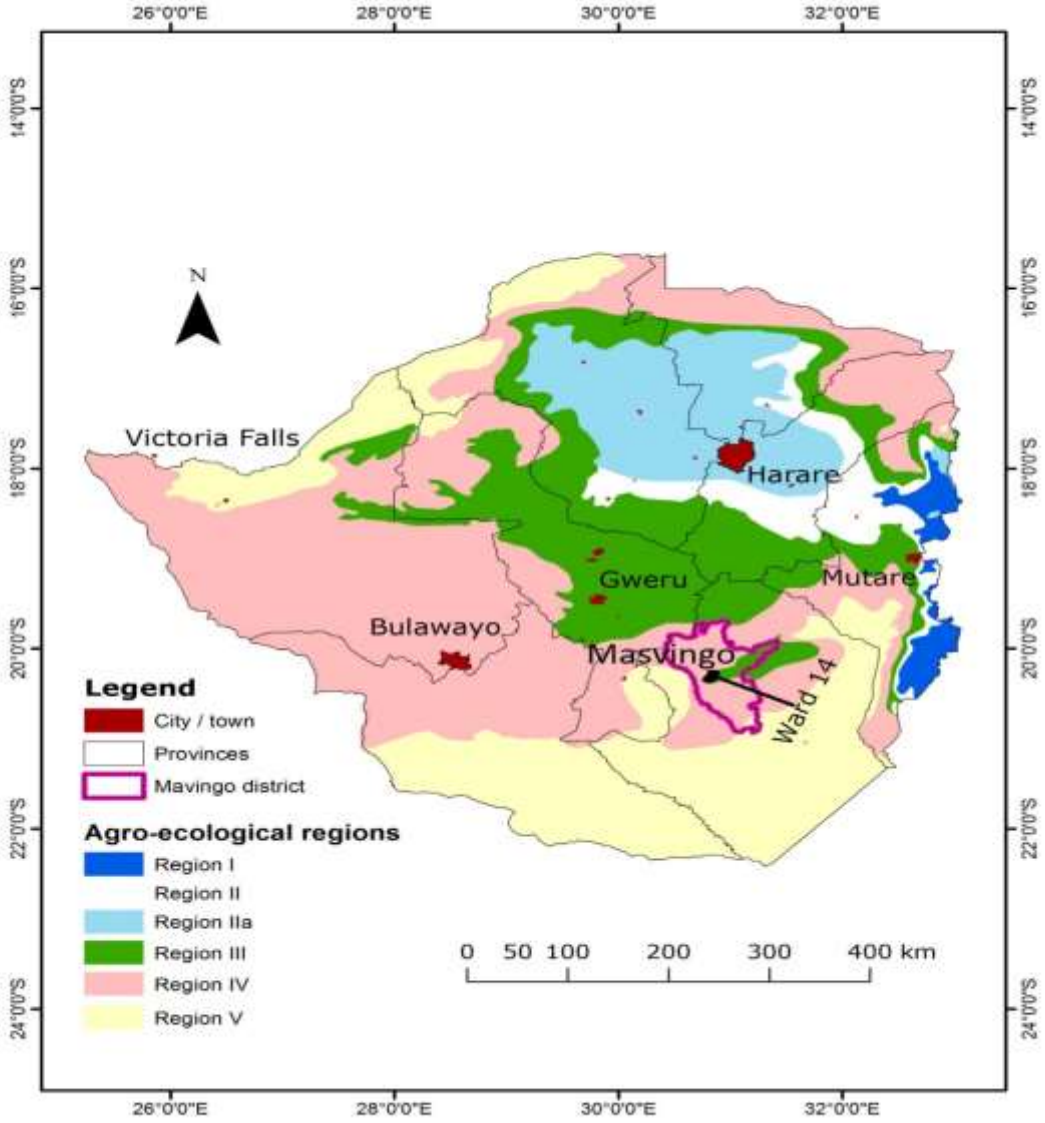

Figure 4-1: Map of Zimbabwe showing the study area. Source: ICRISAT Matopos GIS unit (2015)

Figure 4-2: A typical basin plot, with village head searching for farmers' list (insert L) and farmer preparing planting basins (insert R)

Figure 4-3: A typical farmer's homestead and field (part of the study area).

4.2 Research design

Households were selected using a multistage sampling technique. Table 4-1 summarises information on the ward, its villages, and its estimated population, as well as the breakdown of the sampling criteria used in study villages. This information was obtained from local leaders (village heads and ward councillor) with the assistance of the local agricultural extension personnel.

The ward had a total of nine villages with an estimated population of 1726 households. Based on this population pool, the first stage of sampling involved the selection of three villages with probability proportionate to size (PPS), where size was measured by the number of households estimated in each village. PPS controls for differences in the size of the villages. The villages that were selected were Zano, Rukovo and Mudare. A list of all households was then constructed for each of these selected villages. In the second stage of sampling, households were selected randomly from each list at a constant rate of 40%. Using PPS at the first stage of sampling and a constant sampling rate at the second stage imply that households enter the sample with equal probability. Consequently the sample is representative of the population and can be analysed as if it were a simple random sample (i.e. no weighting was required to compute unbiased estimates of population statistics) (Babbie, 2016, p. 216). A total of 240 farmers were selected and interviewed.

Table 4-1: Sampling details

Ward 14 villages	No. of HH	Cumulative range	Random numbers	Actual No. of HH	Sample size[2]	Usable questionnaires
Cheure	170	1-170				
Madhiyo	216	171-386				
Zano[1]	160	387-546	437	160	64	63
Mashonga	155	547-701				
Matshokoto	124	702-825				
Maburamba	147	826-972				
Rukovo[1]	135	973-1107	1053	135	54	52
Makombe	319	1108-1426				
Mudare[1]	300	1427-1726	1562	305	122	122
Total	**1726**			**597**	**240**	**237**

Source: Researcher computations using data obtained from local authorities

[1] Selected villages, [2] 40% of households sampled in each selected village

4.3 Data collection

Data were captured using structured questionnaires, which were administered by three experienced enumerators using the local language (Shona) under the supervision of the author. To enable them to fully understand the questionnaire, the enumerators were trained by the author through an interactive approach for a period of one week. The training involved practicing interviews (using local language) with the author and fellow enumerators. Questions that were not clear were identified, discussed and corrected during the training. This ensured consistent interpretation of questions among enumerators. After an adequate enumerator training, the questionnaire was pre-tested with 12 respondents and necessary amendments were made. Interviews were conducted with the *de jure* household head. However, in cases where the *de jure* head was not available, the *de facto* household head was interviewed instead.

In order to get accurate estimates of field sizes, each respondent's fields were measured by the author using a measuring wheel. In most cases, the fields were located next to homesteads and the author was able to measure the fields and plots while the enumerators conducted the interviews. In rare cases where the fields were far from the homestead, arrangements were made with the respondents to obtain area measurements in advance of the interview. Questionnaires were then coded and data captured using SPSS v23. Out of the 240 completed questionnaires, 237 (Table 4-1) were deemed usable, while only three were discarded as they had missing information. Excluded questionnaires belonged to those respondents who did not till their fields during the 2014/15 season.

4.4 Household characteristics

In order to understand the average household in the study area, descriptive statistics are presented before focusing on factors that influence adoption and intensity. Table 4-2 presents a summary of key descriptive statistics computed for all households (237) in the sample. On average, each surveyed households had 5.4 members, half of whom were minors under the age of 16. Each households had approximately 3.6 adult equivalent[1] workers. Very few (12%) had hired farm labour, and only three per cent pooled their labour with other

[1] Adult equivalent = Number of adults + 0.5 (number of children (<12) + number of pensioners (>65)).

households to share farm work. These characteristics may imply heavy reliance on family labour, including part-time contributions from school-going children.

Sampled households had an average of more than 20 years of farming experience using traditional farming methods, which includes the use of ox-drawn ploughs and hand hoes. Although conservation agriculture (CA) components (reduced tillage, mulch, and crop rotation) had been promoted in the study area for approximately 10 years, there is considerable variation in farmer experience with each component. The survey revealed that the average household had applied reduced tillage for approximately 5.5 years, mulch for 1.1 years, and crop rotation for 7.6 years. While the longer time period for crop rotation is not surprising, given that it was used prior to the introduction of CA, the data nevertheless suggests that an average smallholder does not take CA as an indivisible technology as desired by proponents, as there is wide variation in the applicability of individual components.

Table 4-2: Household characteristics (n=237)

Variable	Mean	Standard error
Household size	5.4	0.16
Number of males (adults ≥ 16 years)	1.3	0.06
Number of females (adults ≥ 16 years)	1.4	0.05
Number of minors (including children) < 16 years	2.7	0.12
Mean family labour (adult equivalent)	3.6	0.08
Age of household head (years)	50.6	1.07
Mean education level of household head (years)	7.5	0.22
Mean education level of decision maker (years)	7.4	0.22
General farming experience of household head (years)	21.3	1.02
Experience with reduced tillage / planting basins (years)	5.5	0.27
Experience with mulching (years)	1.1	0.18
Experience with rotation (years)	7.6	0.68
Mean household annual off-farm income in US$[2]	945.61	72.44
Percentage of male headed households	70.0	0.03
Male head responsible for cropping decision making (%)	51.1	0.03
Household heads that reside in homesteads (%)	87.8	0.02
Household that used hired labour for 2014/15 season (%)	12.2	0.02
Households that use collective labour (%)	3.0	0.21

[2] Annual off-farm income = Cash obtained from all off-farm sources including wage income, cash from petty trading, and remittances.

Source: Sample survey data

Household heads and household members that were in charge of making agricultural decisions were relatively well educated with an average of 7.5 and 7.4 years of schooling, respectively. This suggests that farmers in the study area are potentially in a better position to understand and use new farming methods. It also makes it possible to use other forms of extension like flyers and pamphlets rather than relying only on traditional direct contacts. The majority (70%) of the interviewed households were male headed. Interestingly, however, males were not responsible for cropping decisions in almost 50% of the households. This contrasts with the view that African women provide labour for cropping activities like weeding while men make management decisions (Farnworth et al., 2016). An average household had an annual off-farm income of about US$945. This translates to nearly US$78 a month for an average family size of 5.4 persons. This is significantly below the official poverty line which was reported to be around US$481 per month for a family of five as of April 2016 (Zimbabwe National Statistics Agency, 2016). This implies that the average household has to get an economic value (through farm products consumed or revenue) equivalent to $403 per month from farm related activities to get closer to the official poverty line. Approximately 87% of household heads resided on the farm at the time of the survey. This suggests a lack of off-farm employment opportunities and emphasises the importance of agriculture as a livelihood strategy.

4.5 Land endowment, farming techniques, and crop production

The survey revealed that, on average, a household had 1.6 hectares of arable land and cultivate roughly 1.2 hectares, leaving 0.4 hectares fallow (Table 4-3). As the study area is located near Lake Mutirikwi/Kyle, crops produced near the lake are frequently destroyed by hippopotamus. Only a few surveyed households (9.7%) indicated that they had a fenced field. Farmers with fields located near the lake often leave their plots fallow rather than risk crop losses. However, in other instances, farmers do not till all of their land due to a lack of adequate resources such as farm implements, labour and inputs (Giller et al., 2009; Ndlovu et al., 2014). Customary tenure systems often make it risky for household to rent unused land to potential users (Dengu & Lyne, 2007; Lyne, 2009).

Just over half of the sampled households owned cattle, while less than half (43%) owned a mouldboard plough. In this area, similar to other places in Zimbabwe, cattle are used as draught animals and play a significant role in smallholder farming. Farmers that own, or have access to, cattle and mouldboard ploughs are able to till larger areas of land and can also

plant early, thus resulting in better use of limited rains (Mazvimavi & Twomlow, 2009). Reducing dependency on these scarce resources (draught animals and mouldboard ploughs) has been one of the major reasons for promoting CA among poor smallholders (Andersson & D'Souza, 2014). In addition to its use as draught power, livestock ownership signifies wealth. On average, households had 2.2 tropical livestock units (TLU). This is an index that assigns weights to different types of livestock owned by each household. Cattle are assigned a weight of 0.7, while goats and sheep are assigned a weight of 0.1 (Jahnke, 1982).

Table 4-3 Farm characteristics (n=237)

Variable	Mean	Standard error
Mean land endowment (hectares)	1.58	0.06
Mean area cultivated in 2014/15 season (hectares)	1.18	0.05
Mean area left fallow in 2014/15 season (hectares)	0.40	0.04
Distance from nearest town in kilometres	61.21	0.59
Distance from government extension personnel in kilometres	5.99	0.29
Mean tropical livestock unit (TLU)	2.21	0.20
Percentage of households owning cattle	51.5	0.03
Percentage of households owing a mouldboard plough	43.5	0.03
Percentage of households with fenced plots	9.7	0.02
Receipt of CA free inputs prior to 2014/15 season (%)	56.1	0.03
Receipt of CA extension prior to 2014/15 season (%)	70.5	0.03
Receipt of CA extension in 2014/15 season (%)	41.4	0.03
Receipt of extension from social networks in 2014/15 season (%)	62.4	0.03
Percentage of households that produced maize	100	-
Percentage of households that produced groundnuts	79	0.03
Percentage of households that produced bambaranuts	74	0.03

Source: Sample survey data

When CA was introduced, smallholders were provided with free inputs to encourage them to try the technology. Just over half (56%) of the surveyed farmers indicated that they received free inputs to use on their CA plots prior to the 2014/15 season. Seventy percent of the sampled farmers also mentioned that they received CA extension during the same period. CA extension was offered by government and NGO extension personnel. The uptake of CA during this period was most likely influenced by this subsidy, and adoption studies conducted then may have suffered from this bias. However at the time of this study, local NGOs had stopped providing free inputs and extension support. Instead, farmers had to obtain inputs from the nearest town (Masvingo), located approximately 61.2 km from an average household.

The public sector continued to provide extension support to farmers after NGOs had left. Though extension advice is provided freely to farmers, not all farmers have access to this service. The survey revealed that just over 41% of the sample farmers had benefited from CA extension services provided by the government during the 2014/15 season. Surprisingly, more than 60% received extension support from social networks in the same period. Sources that were categorised under social networks included, but are not limited to, neighbours, friends, relatives and religious groups. These informal sources may have been more accessible than formal agricultural extension services.

Government extension officers use traditional methods of direct contact, which entails either visiting the farmer's field or gathering farmers at the ward centre. However, due to limited resources, extension officers may not be able to access farmers located farther from the ward centre. Similarly, farmers that are located further from the ward centre may find it difficult to attend the meetings. The t-statistics reported in Table 4-4 indicate that farmers located closer to extension officers were more likely to receive the extension support from the government.

Table 4-4: Relationship between distance and receipt of extension

Variable	Mean distance from extension offices in km		t-statistic[1]
	Recipient	Non recipient	
Receipt of CA extension prior to 2014/15 season	5.2	7.8	-4.14 ***
Receipt of CA extension in 2014/15 season	4.1	7.2	-5.65 ***

[1] Test for differences in distance between households that received extension services , *** denotes significance at 1%

Source: Sample survey data

4.6 Area allocation, tillage systems, and crops grown

Farms in the study region are normally divided into smaller parcels (plots), so that an average 1.6 ha farm comprises of several plots that may be managed quite differently. Farmers could have a mix of plots under conventional tillage, CA, conservation techniques, and other tillage systems like traditional digging using hand hoes.

Conventional tillage refers to use of mouldboard ploughs, whether owned or leased. Under conventional tillage, the minimum disturbance principle is violated as farmers till the land before planting. However, it is still possible to apply other conservation techniques like mulching and crop rotation.

CA refers to a tillage system based on the integrated management of soil, water, and biological resources through the minimum disturbance of soil, permanent soil cover, and crop rotation (Giller et al., 2009; Kassam et al., 2014). Under CA, all three components have to be implemented simultaneously on a single plot.

A farmer practice is not classified as CA where one of the CA components is not implemented, but where reduced tillage (planting basins) remains a mandatory component; then this is rather classified as a conservation technique. Under this technique, it is possible to implement only the reduced tillage component or in combination with other components (in this case, mulch and crop rotation). This relaxes the strict definition of conservation agriculture, which does not allow partial adoption. Introduction of the term "conservation technique" enables the classification of actual farmer practice, which, in some cases, does not use all of the three CA components.

Tillage systems that do not fit under conventional tillage or conservation techniques were classified as other techniques. This accommodates all other farmer innovations of practices such as digging the whole plot using a hand hoe (violating minimum disturbance), or creating very small basins in a manner different from the standard CA planting basins.

An individual smallholder may produce a variety of crops on different plots. Sample households had a total of 995 cultivated plots, of which approximately 53% were allocated to maize, 21% to groundnuts and 18% to bambaranuts. Other minor crops like finger millet, cowpeas, sorghum, beans, and sunflowers were rarely produced by farmers. These minor crops combined were found on just seven per cent of the cultivated plots (Table 4-5).

Table 4-5: percentage of crops grown in different plots (n=995)

Crop	Percentage of plots
Maize	53.3
Groundnuts	20.8
Bambaranuts	18.9
Finger millet (rapoko)	1.6
Cowpeas	1.5
Pearl millet	1.5
Sorghum	1.1
Beans	0.7
Sunflower	0.6

Source: Sample survey data

A majority (66%) of plots were tilled using conventional tillage (Table 4-6). However, the data revealed considerable crop-level variation. For instance, more than 80% of groundnuts and 90% of bambaranuts were produced using conventional tillage, while just over 50% of maize was produced using this tillage method. By contrast, conservation techniques were much more prevalent in maize production compared to other minor crops.

Table 4-6: Respondent use of tillage systems by crop type (% using)

Tillage systems	Crops grown in 995 plots				
	Maize (n= 530)	**Groundnuts (n=207)**	**Bambaranuts (n=188)**	**Other crops (n=70)**	**All crops**
Conventional	50.2	83.1	91.5	65.7	**65.9**
Conservation techniques (including CA)	47.0	9.7	3.2	18.6	**28.9**
Other techniques	2.8	7.2	5.3	15.7	**5.2**

Source: Sample survey data

4.7 Adoption of CA components

In Zimbabwe, CA has been promoted and theoretically defined as a combination of three components, namely reduced tillage, mulch and crop rotation (Giller et al., 2009). However the survey data reveals that farmers tend to disaggregate the technique according to their risk preferences and resources. This suggests that uptake levels for each component are likely to vary.

Survey results show that the uptake of CA components was not evenly spread for the major CA components (reduced tillage, mulch and crop rotation) within and across seasons. Disaggregated results for CA components (regardless of combinations) used by farmers currently and in past years are presented in Table 4-7. In both cases, there are different adoption rates per component. In past seasons, reduced tillage was used by a large majority of sampled farmers (86%), while crop rotation was used by a smaller proportion (61%), and mulching by a minority of farmers (25%). There is a slight drop in the percentage of farmers who were using CA components at the time of the survey. Reduced tillage was used by approximately 72% of the farmers, while crop rotation was used by 57%, and significantly lower percentage of farmers practised mulching (9%). The larger difference in mulching adoption signifies more acute constraints in implementing the component in comparison to the other two. Similar findings have been reported in past studies (Mazvimavi, 2011; Pannell

et al., 2014). These studies attribute low uptake of mulching to competing uses of crop residues as livestock feed.

Table 4-7: Adoption levels of different CA components, past and present adopters (%) (n=237)

Component	Practiced component in the past	Still practicing component
Reduced tillage	86.1	71.7
Crop rotation	60.8	56.5
Mulching	24.5	9.3

Source: Sample survey data

4.8 CA components used by smallholders in 2014/15 season

Table 4-8 provides insights on the frequency of use of different CA components by sampled smallholders for the 2014/15 season. Survey results revealed that nearly 50% of all plots in the sample were cultivated without any use of CA components. The remainder of the sample used one or more CA components. Reduced tillage on its own was used in 21.2% of cultivated plots, while crop rotation on its own was used in 19.4% of sampled plots. The survey data did not have instances in which mulching was implemented in isolation (without being combined with other CA components).There were a few cases where farmers used a combination of CA components, but these represented a minority of the sample households. A combination of reduced tillage and crop rotation was used in 8.3% of the sampled plots, while just 1.3% of the plots used all three components. Interestingly, plots that used all three CA components were marginally smaller than the sample average, suggesting that farmers applying CA either experiment with such practices on smaller plots or that resource constraints prevent their use on larger plots.

Table 4-8: Frequency of individual and combination use of CA component (%)

Component	% of plots (n=995)	Mean area (Ha)	Std. error
No CA component	49.0	0.28	0.01
Reduced tillage	21.2	0.25	0.01
Crop rotation	19.4	0.30	0.02
Reduced tillage and crop rotation	8.3	0.27	0.03
Reduced tillage and mulch	0.8	0.24	0.09
All three components	1.3	0.23	0.05
All plots		**0.28**	**0.01**

Source: Sample survey data

4.9 Application of CA components to different tillage systems

Disaggregating the different CA components enables a critical assessment of actual farmer practice, making it possible to disclose the components that are used by farmers and obtain insights on tillage systems on which they are applied on. Except for reduced tillage, other components like mulch and crop rotation can be implemented on conventional plots. Results in Table 4-9 show that even under conservation techniques, there were few instances where farmers combined reduced tillage with other components. Reduced tillage was combined with other components in less than a third of the sampled plots. Approximately 25.3% of the plots had a combination of reduced tillage and crop rotation, while only 2.8% of the plots had a combination of reduced tillage and mulch. Strictly defined CA, where all three components are applied, was found in only 4.2% of the conservation techniques plots. These results further emphasise the prevalence of partial adoption.

Crop rotation was the only CA component applied on conventional plots. Twenty-eight percent of the plots cultivated using ox-drawn ploughs employed crop rotation, while the rest (71.3%) did not use CA components. Tilling the land, combined with poor farming practices has been claimed to worsen the condition of inherently infertile soils (Kassam et al., 2014). This is a cause for concern given that after a decade of promoting CA and its components as a way of addressing soil degradation and fertility problems, a large portion of the land remains under this technique. This also poses questions on whether farmers perceive the benefit of CA, or whether CA is an appropriate technology for smallholder farmers.

Table 4-9: CA components applied under different tillage systems (n=995)

Components	Tillage systems (%)		
	Conservation techniques (n=288)	Conventional (n=656)	Other techniques (n=51)
No CA component	0	71.3	39.2
Reduced tillage	66.7	0	37.3
Crop rotation	0	28.7	9.8
Reduced tillage and crop rotation	26.3	0	11.8
Reduced tillage and mulch	2.8	0	0
All three components	4.2	0	2.0

Source: Sample survey data

Farmers used other techniques that cannot be classified under conventional tillage or conservation technique. These included digging the whole plot using hand hoes, which

violates the minimum disturbance principle of CA (39.2%). In other cases, farmers would dig small seed basins just deep enough to bury the seed (sometimes classified as dry planting). While this practice was also different from promoted CA, it did not violate the minimum disturbance principle. Farmers also used CA components on plots cultivated using other techniques. For example, approximately 37.3% of sampled plots had planting basins. This was classified as having implemented the reduced tillage component. Crop rotation was applied in 9.8% of the plots among plots classified as using other tillage techniques. Also, for plots using other techniques, approximately 11.8% combined reduced tillage with crop rotation, while only 2% used all three CA components.

4.10 Reasons for not using CA components

An important component of this study is understanding why farmers do not use CA in their production practices. Identifying the challenges faced by farmers in implementing the technology may make it easier for the government and NGOs to develop ways of addressing constraints to uptake. Exposing challenges can also lead to development of technologies that are appropriate for smallholders.

4.10.1 Using farmer perceptions to explain adoption decisions

One of the factors expected to discourage adoption is the tenure system. Smallholders in the study area operate under customary tenure, which has ill-defined property rights. However, it is difficult to measure its effects when everyone is operating under the same tenure system. An alternative way of assessing the effects of tenure where everyone is operating under the same system may be through the use of perceptions. Individual perception of the tenure security may differ even if the same tenure is in place. Given that farmers may make decisions based on their perception (Moyo et al., 2012), surveyed farmers were asked about their perception of tenure security. Roughly 60% of the sample households indicated that they perceived tenure to be secure (Table 4-10). This is not surprising given that the farmers had never experienced a broad bundle of durable and well-defined rights to land.

Table 4-10: Farmer perceptions of tenure security and the long-term benefits of CA (n=237)

Variable	Mean	Standard error
Perception of tenure security (dummy, 1 for positive, otherwise 0)	60.34	0.03
Perception of CA benefits (dummy, 1 for positive, otherwise 0)	89.03	0.02

Source: Sample survey data

Farmers were also asked about their perceptions of the long term benefits associated with CA. The rationale behind this lies on the assumption that if farmers perceive future benefits, then they would be more likely to adopt the technology. Nearly 90% of the farmers believed that CA had a positive impact on soil fertility and structure over time. This contrasts with the level of CA use reported in Table 4-8, showing that CA components were not implemented in most of the plots. This may suggest that there are other more binding factors that constrain adoption behaviour. Alternatively, a dummy variable may not sufficiently capture perceptions.

4.10.2 Reasons given by farmers who did not implement CA components

Farmers who did not use some or any of the CA components indicated a number of reasons for not adopting them. Challenges identified by non-adopters for each CA component are presented in Table 4-11. For reduced tillage, the survey data revealed labour demands as the major challenge, with over two-thirds (68.7%) of non-adopters reporting this as a factor. This is in line with findings from other researchers such as Mazvimavi and Twomlow (2009) and Nyamangara et al. (2014) who also reported that the adoption of reduced tillage is constrained by labour demands. A much smaller portion of farmers who did not implement reduced tillage (15.6%) indicated that the availability of farm implements such as ploughs made them abandon basin digging. This may show that some of the farmers use planting basins because of lack of resources. Farmers who do not have farm implements may adopt this technique so as to benefit from early planting rather than waiting for farm implements from neighbours (Mazvimavi & Twomlow, 2009). Other factors impeding the use of reduced tillage included a lack of knowledge on the technique (9.4%) and shortages of key inputs (6.3%).

The lack of adoption of mulching was most commonly influenced by a lack of fencing (26.7%). The communal tenure system makes it costly for farmers to erect and maintain fences. During the off season, fields become common grazing areas. In such settings, even those who have resources and can afford fencing are discouraged from doing so. Without fencing, the benefits to mulching lessen considerably. During data collection, some farmers indicated that they keep crop residues during the open grazing period and then use them as mulch only during the production period. However, proponents claim that for the benefits of mulching to be realised, there should be permanent cover, implying that fields should be covered even during the off season. Labour shortages also discouraged farmers from

mulching (23.9%), as did a lack of knowledge on this component (18.2%). Issues related to competing uses for crop residues like livestock feed were also cited as a constraint (10.6%). In some cases, crop residues play a major role as supplementary feed for livestock. Competing uses for crop residues exacerbate the challenges faced by farmers in implementing the component.

Table 4-11: Reasons given by farmers who did not implement CA components by type of CA component

CA component	Reasons for lack of implementation	Percentage of response
Reduced tillage (CA basins: n=32)	Labour challenges	68.7
	Availability of farm implements (e.g plough)	15.6
	Lack of knowledge	9.4
	Shortage of inputs	6.3
Mulching (n=180)	Plot not fenced / prone to livestock	26.7
	Labour challenges	23.9
	Lack of knowledge	18.2
	Crop residue used as livestock feed	10.6
	Mulching material destroyed by termites	10
	Crop residue used to make compost	8.9
	Does not perceive the benefits	1.7
Crop rotation (n=80)	Gives preference to cereal crops	58.7
	Labour challenges	15
	Lack of knowledge	12.5
	Few farming seasons	10
	Legumes seed not available	3.8

Source: Sample survey data

In addition, there is prevalence of termites in most parts of the country. Ten per cent of the farmers who did not apply mulch indicated that mulch is normally destroyed by termites, which defeats its purpose of covering the ground. A small portion of farmers (8.9%) reported that they prefer to use crop residues to make compost rather than to use them to cover their plots. Using crop residues to make compost may provide immediate benefits to farmers who are more risk averse, as mulching benefits require a longer time to be realised. Only a few indicated that they do not apply mulch because they do not perceive the benefits of doing so (1.7%). This may imply that farmers may perceive the benefits of mulching but, nevertheless, the benefits realised may not be sufficient to offset the costs associated with implementing them.

More than 50% of the surveyed farmers who did not apply crop rotation indicated that they prefer to produce cereal crops than legume crops. Cereals are staple foods and food security

is very important to these subsistence farmers. Limitations in labour (15%) and lack of knowledge (12.5%) further preclude the use of crop rotation. Younger farmers who had recently been allocated land concentrated on producing maize in their first years of farming (10%). There were a few instances (3.8%) where farmers failed to rotate crops owing to the unavailability of legume seed.

4.11 Motivation to practise CA components

The survey data highlighted the different sources of influence associated with the adoption of CA practices by adopters; these are summarized in Table 4-12. Interestingly, the data reveals that influence patterns vary significantly depending on the type of component considered. It was expected that NGOs would be the main source of influence given that CA was an NGO initiative. As noted in Table 4-2, just over 50% of those practicing reduced tillage, 74% those practicing mulching, and only 29% in the case of crop rotation reported NGOs as the main source of influence. Peer effects (neighbours) mattered for 26% of those practising reduced tillage and 24% of those practising crop rotation, but were less important (10%) for those practising mulching. As mulching was hardly practised in the study area, it is possible that neighbours would have less influence on implementation of this component.

While government extension personnel were involved in training, their influence on use of the reduced tillage and mulching components was limited, with less than 10% of respondents citing them as a main source of influence. This may be attributed to the fact that extension officers in the study area were resource constrained, and therefore could not visit some of the more distant farmers. While government and NGO extension officers use similar practices for training, these approaches were less effective for government extension officers, given that farmers had less incentive to walk long distances to attend training sessions that did not provide free inputs. Interestingly, government extension officers had a much larger influence on crop rotation (nearly 37% citing them as an influence). This may be due to the fact that this practice (crop rotation) was always promoted by government extension before the promotion of CA.

Though there were instances where NGOs and government extension jointly worked to spread CA technology, their combined effort was not very influential, typically cited by less than 10% of respondents for all components. There were very few cases (less than 5% of respondents) where farmers indicated that they adopted CA components out of a need to

improve yields. This response was expected to be important if farmers had perceived CA as an appropriate technology to solve challenges associated with low productivity. This might also highlight that a top-down approach was adopted during CA promotion, and overlooked the need for farmer participation in technology development and dissemination (Ngwira et al., 2014).

Table 4-12: Factors that influenced farmers to practise CA components

Source of influence	% of responses from adopters		
	Reduced tillage (n=204)	Mulching (n=58)	Crop rotation (n=144)
NGO officers	52.5	74.1	29.2
Neighbours	26	6.9	24.3
Government extension officers	8.3	6.9	36.8
Need to improve yields	4.4	-	2.8
Both NGO and government extension	3.9	10.4	4.2
Lead farmer	3.4	-	1.4
Other social groups	1.5	1.7	1.3

Source: Sample survey data

4.12 Access to advice

In terms of the source of other farming advice, the most commonly reported source of information was government extension officers (31.5%), followed by family members (23%), and farm leaders (21%). Social networks (family member, lead farmer, neighbour and village leaders) when aggregated accounted for a majority of responses as a source of advice, implying that this is an important pathway for the dissemination of new technology.

Table 4-13: Sources for farming advice

Source of advice relied on	Percentage of responses (n=200)
Extension officer	31.5
Family member / Relative	23
Lead farmer/ Elected agricultural leader	21
Neighbour	15
Village leaders	9.5

Source: Sample survey data

4.13 Summary

The results from the descriptive analysis shows that farmers do not take CA as an indivisible technology as desired by proponents. Similar findings are reported by Giller et al. (2009) and Pedzisa et al. (2015b). Only 1.3% of the sampled plots (Table 4-8) could be classified under the strict definition of CA requiring the simultaneous use of all three components (reduced

tillage, mulch and crop rotation) in a specific plot (parcel). The majority of farmer plots used less than three components, implying varying levels of adoption that cannot be accurately measured by a binary variable. This justifies the need to develop a measure that can accurately quantify partial adoption. The results also show the adoption challenges faced by farmers, namely, labour shortages, competing uses for crop residues, and limited knowledge. Heavy reliance on cereal crops makes it difficult for farmers to change from maize mono-cropping to the practice of crop rotation. This raises questions about the suitability of the technology, given the prevailing socio-economic challenges and institutional arrangements.

The next chapter augments the findings from the descriptive analysis by focusing on the construction of the CA index, which provides a better measure of the degree and extent of adoption and intensity.

Chapter 5
Empirical results

This chapter starts by outlining the development of the conservation agriculture index (CAI). After presenting results from the computation of the CAI, a recap of the econometric model is given, followed by a discussion of its specification and expected signs of chosen variables. Results from model diagnostic tests are then presented, including tests for multicollinearity in the model. The chapter concludes with a discussion of both results from the double hurdle model and sensitivity analysis involving different scenarios of measuring CA intensity compared against the method adopted in this study.

5.1 Computation of the conservation agriculture index (CAI)

The CAI was computed using data collected from the survey. The index was created to better measure adoption level and overcome the weaknesses identified in previous studies. The aim of the index is to provide a measure that takes into account the possibilities of incomplete or partial adoption. The index was computed using equation (1), described in Chapter 3. The equation is specified as:

$$CAI_i = \sum_r W_{ir} R_{ir} P_{ir} S_{ir}$$

5.1.1 Estimation of CA component weights

The survey data were used to generate estimates of the values of W, R, P, and S for use in the calculation of the CAI. In order to estimate W, the first step involved regressing plot level yield data for maize against CA components (individual and combinations) implemented by farmers using OLS (equation (2) described in Chapter 3). The regression model used is specified as:

$$Y_{ir} = \alpha_{0ir} + \sum_w a_{wir} X_{wir} + u_{ir}$$

Regression results used to estimate the weights of the CAI are reported in Table 5-1. As expected, the regression results show that the application of different CA components have positive impacts on yield. However, out of the five potential combinations reported by farmers in the sample, only three of these were statistically significantly (reduced till, reduced till plus crop rotation, and all three components combined).

Table 5-1: Contribution of CA components to maize yield

Combination of CA components	Coefficients	Standardised coefficient	
Reduced till only	647.52	0.248	***
Crop rotation only	245.64	0.067	
Reduced tillage and crop rotation	727.99	0.175	***
Reduced tillage and mulch	526.99	0.049	
All three components	1221.10	0.147	**
Constant	789.67		
F-statistic		8.187	***
Adjusted R^2		0.064	

*** and ** denotes 1 and 5% significance levels respectively

The standardised regression coefficients were subsequently used to compute the individual weights of the components and their interaction effects associated with the use of a combination of components. To do this, each standardised coefficient was first divided by the sum of all standardised coefficients (0.686) for the five combinations to obtain normalised interaction effects that add up to 1. Normalised interaction effects were then used to generate the weights for individual CA components or a combination of components. When more than one component was applied by a household, individual and interaction weights were combined. For instance, if a farmer practised only reduced tillage, a normalised weight of 0.36 was assigned. However, if the farmer combined reduced tillage with crop rotation, then the weights for reduced tillage (0.36), crop rotation (0.10), and the interaction effect of using both components (0.26) were added to obtain a total weight of 0.72 (Table 5-2).

Table 5-2: Computed weights for different combinations of CA components

Combination of CA components	Standardised coefficient	Interaction effect	Assigned weights
Reduced till only	0.248	0.36	0.36
Crop rotation only	0.067	0.10	0.10
Reduced tillage and crop rotation	0.175	0.26	0.72
Reduced tillage and mulch	0.049	0.07	0.43
All three components	0.147	0.21	1
Total	**0.686**	**1**	

Source: Sample survey

Attributing a greater weight for the reduced tillage component relative to other components has some logic given that it makes the largest contribution to yield and is a compulsory component that distinguishes between conventional and conservation techniques. Likewise,

a larger weight is assigned where more than one component was used, while a maximum weight of 1 is assigned if all three components were applied.

5.1.2 Computation of CAI

CA components were applied at different rates (R) on each plot. R was estimated by farmers during data collection. Farmers were asked to rank themselves against the recommended rate. Values of R range from zero to one. P represents the share of each plot in the total area cultivated by the farmer. This measures the extent of each component relative to other components. However, P could be the same for farmers practising CA on very different scales. To control for this, each plot was standardised relative to the largest area in the data set. This involved dividing each farmer's plot area by the size of the largest plot in the data set to obtain a local scale measure. Scale is important when the policy objective is to encourage widespread application of CA rather than its intensive adoption on just a small piece of land. An index based only on the number of CA components practised and their rate of application neglects scale effects and creates a misleading view of CA uptake, especially where there is a tendency to apply CA methods on small plots.

Table 5-3 provides an example of CA index computations for three sample farmers (A, B and C). In this case, assume that farmer A cultivated a total area of 1 hectare, farmer B cultivated a total area of 1.5 hectares, and farmer C cultivated a total of 2 hectares. Each farmer has three plots. To obtain the index score for each farmer's plots, the relevant component yield weights (W) in Table 5-2 are assigned to each component used. Each plot has a specific rate of CA component application (R), takes into account the particular share (P) of the total area cultivated by the farmer, and is scaled (S) relative to the largest plot in the data set (0.8 hectares). In Table 5-3, the index score at the plot level is computed as the product of W, R, P, and S. The plot index scores are then summed for each household to obtain the CAI. Summation of the plot index scores for each household was considered appropriate as the plot index scores had been standardised using (S), the local scale measure. In the example, farmers A, B, and C score 0.153, 0.210, and 0.269 respectively on the CAI, with the higher scores reflecting not only the relative importance of CA components and their rate of application, but also the scale of their application.

Table 5-3: Computation of the index at plot level

Farmer	Total cultivated area (ha)	Plot	Area (ha)	Technique	Component weight (W)	Rate of CA component application (R)	Proportion of plot relative to total cultivated area (P)	Area of the plot relative to largest plot in the data set (S)	Plot level index	CAI
A	1	1	0.3	R+C[1]	0.72	1	0.3	0.375	**0.081**	
		2	0.4	R[2]	0.36	1	0.4	0.5	**0.072**	**0.153**
		3	0.3	none	0	0	0.3	0.375	**0**	
B	1.5	1	0.1	none	0	0	0.067	0.125	**0**	
		2	0.6	R+C+M[3]	1	0.7	0.4	0.75	**0.210**	**0.210**
		3	0.8	none	0	0	0.53	1	**0**	
C	2	1	0.8	R[2]	0.36	1	0.4	1	**0.144**	
		2	0.5	R+C+M[3]	1	0.8	0.25	0.625	**0.125**	**0.269**
		3	0.7	none	0	0	0.35	0.875	**0**	

[1]R+C refers to a combination of reduced tillage and crop rotation, [2]R refers to reduced tillage only, [3]R+C+M refers to a combination of all three CA components

This robust approach makes it possible to measure actual farmer practice and to understand the nature of adoption by taking incomplete and partial adoption into consideration. The computed index takes into account the number of CA components applied, and the rate and extent of their application.

5.2 The double hurdle model

The CAI computed in the previous section was regressed against farm and household characteristics using the double hurdle model to investigate the factors that influence the uptake of CA components and their level of use. The decision to use the double hurdle model was strongly influenced by its ability to treat the two choices (adoption and intensity) made by farmers separately, and its capability in handling circumstances where factors explaining such choices would be having opposite effects. For instance, a variable can have a positive impact on adoption but have a negative influence on intensity (Garcia, 2013).

The first hurdle uses a binary variable for the adoption of CA components (positive CAI values treated as 1; otherwise 0) and estimates a probit model using equation (3) described in Chapter 3, and specified as:

$$P\left(w = \frac{1}{x}\right) = \varphi(x\gamma)$$

The second hurdle is a truncated regression model (equation 4, described in Chapter 3) that assumes a linear relationship between the CAI and observed farm and household characteristics. The model is specified as:

$$Y = x\beta + \varepsilon$$

5.3 Model specification and diagnostic tests

Table 5-4 shows the list of variables used in the regression and their expected signs. The variables were selected based on previous adoption studies presented in the literature review. Receipt of inputs in previous years (CAinput) was expected to influence the adoption decision but not the intensity decision. On the other hand, the use of hired labour (CAlab) and access to agricultural extension (CAextcur and Advsocial) were expected to influence intensity and not adoption. This is based on the notion that the adoption decision is made before the season begins, with events occurring during the season not altering the decision to adopt.

Table 5-4: Variables used in the regression model and expected signs

Variable abbreviation	Description of the variables that may influence adoption and intensity	Expected sign	
		Decision to adopt CA	Intensity of CA use
Decid	Gender of decision maker (male =1, otherwise 0)	-	-
Edudc	Education of decision maker in years	+	+
Hhresid	Household head reside on farm (yes=1, otherwise 0)	+	+
Ttlabour	Total household labour (adult equivalent)	+	+
CAbenefit	Perception of CA long term benefits (positive=1, otherwise 0)	+	+
tenureperc	Perception of tenure security (positive=1, otherwise 0)	+	+
Farmexp	General farming experience (years)	+	+
Farmexp sqd	Transformed general farming experience (years)^2	+	+
Basinyrs	Number of years practising basins	+	+
Mulchyrs	Number of years applying mulch	+	+
Rotatyrs	Number of years practising crop rotation	+	+
Landendow	Land endowment	+	+
Fence	Presence of fencing (yes=1, otherwise 0)	+	+
Plough	Ownership of ox-drawn plough (yes=1, otherwise 0)	-	-
LU	Tropical livestock unit	+	+
Liquidity	Liquidity (US$)	+	+
Distnmkt	Distance to nearest town in km	-	-
Distagri	Distance to government extension personnel in km	-	-
CAinput	Receipt of CA inputs in previous years	+	
CAhlab	Use of hired labour in 2014/15 season		+
Advsocial	Receipt of agricultural advice from social groups 2014/15		+
CAextcur	Receipt of CA extension in 2014/15 season		+

Diagnostic tests to check for multicollinearity were carried out before running the double hurdle regression. The initial model run yielded variance inflation factors (VIF) between 1.15 and 2.24, generally signifying a lack of severe multicollinearity. General farming experience (farmexp) was the only variable with a VIF value above 2, suggesting that this variable might have minor issues with multicollinearity. Gujarati (2003, p. 362) and Field (2005, p. 196) indicate that VIF values below ten are reasonable and can be ignored

Nevertheless, efforts to completely eliminate the multicollinearity problem were sought in order to get much more consistent and reliable estimates. To achieve this, farm experience was squared based on the reasoning that additional experience acquired puts a farmer in a better position to make agricultural decisions. In other words, experience becomes more important in decision making as the number of years practising farming increases. Only general farming experience (farmexp) was transformed since it was the only variable with a high VIF.

Having eliminated the possibility of multicollinearity, the Heckman two-step procedure was applied to test for sample selection bias. The results showed no evidence of selection bias, with the Inverse Mills Ratio not significant at 10% ($p = 0.412$). A lack of severe selection bias suggests that the double hurdle would yield efficient estimates. The double hurdle regression model's Wald statistic was significant at 1% suggesting a good model fit.

5.4 Factors determining adoption, intensity and extent of CA use

The double hurdle regression results are presented in Table 5-5. The first hurdle shows the factors that influence the decision to use CA components, while the second hurdle shows factors that influence intensity of its use. The gender of the main decision maker had a negative impact on both the decision to implement CA components and on the intensity of its use. However, its impact was only significant for the adoption decision. This suggests that households with male decision makers are less likely to adopt CA components. This can be attributed to the fact that CA was promoted as a hand hoe technique which is less attractive to males. On the other hand, the education level of the main decision maker and the availability of the household head on farm was not statistically significant in influencing either the adoption or the intensity decision. The availability of family labour had a positive impact on both adoption and intensity, but was also not statistically significant, suggesting that it is a less binding factor for adoption and intensity in this case. Similar findings on the

importance of labour were reported by Arslan et al. (2014). Though the use of hired labour for the 2014/15 season had a positive impact on intensity, it was also not a statistically significant determinant of intensity. The availability of labour was expected to be an important factor given that labour constraints are reported as one of the major reasons for the poor adoption of CA components.

Table 5-5: Estimated double hurdle model for factors influencing uptake of CA and level of use

Variable	First hurdle (Decision to adopt CA)		Second hurdle (Intensity of CA use)	
Decid	-0.8337	(-2.81) ***	-0.0766	(-1.46)
Edudc	0.0173	(0.39)	-0.0106	(-1.18)
Hhresid	-0.4127	(-1.05)	0.0414	(0.53)
Ttlabour	0.1017	(1.23)	0.0165	(1.25)
CAbenefit	0.5315	(1.38)	0.0301	(0.27)
tenureperc	-0.1366	(-0.46)	-0.0067	(-0.14)
Farmexp	-0.0546	(-1.79) *	-0.0040	(-0.81)
Farmexp sqd	0.0006	(1.15)	0.0001	(1.41)
Basinyrs	0.2887	(4.66) ***	0.0131	(1.66) *
Mulchyrs	-0.0505	(-0.60)	0.0116	(1.46)
Rotatyrs	0.0373	(2.23) **	-0.0036	(-1.38)
Landendow	0.4962	(2.57) **	0.0334	(1.70) *
Fence	-0.2432	(-0.50)	-0.0591	(-0.85)
Plough	-1.2923	(-3.47) ***	-0.1550	(-2.16) **
LU	0.0249	(0.42)	0.0095	(1.19)
Liquidity	0.1068	(0.74)	0.0155	(0.84)
Distnmkt	0.0134	(0.80)	-0.0082	(-2.27) **
Distagri	-0.0901	(-2.52) **	0.0107	(1.51)
CAinput	0.1576	(0.4)		
CAhlab			0.0923	(1.47)
Advsocial			0.1083	(1.85) *
CAextcur			0.0797	(1.55)
Constant	-0.2185	(-0.18)	0.0440	(0.19)
Wald statistic (18)	53.76 ***			
Number of observations	237			

***, ** and * denote 1, 5 and 10% significance levels respectively.
Fingure in parantheses are z-values

Experience with CA components was expected to have a positive impact on adoption and intensity of use. With more years of practising CA, farmers likely gain knowledge and expertise. Furthermore, they are likely to make better judgements by comparing the new technology with conventional techniques. In addition, some researchers have argued that CA

becomes easier with time (Mazvimavi & Twomlow, 2009). As expected, experience with reduced tillage techniques had a positive influence on both adoption and intensity. Those who have practised reduced tillage for a long time are likely to continue practising this component. This is consistent with findings by Pedzisa et al. (2015a). Similarly, the number of years practising crop rotation had a significant impact on adoption but had a negative, insignificant impact on intensity. The lack of importance on intensity may be attributed to the fact that many farmers practised crop rotation on conventional plots. Because of this, where crop rotation was applied, it could be used independently without necessarily combining it with other CA components. Application of crop rotation under conservation techniques may be further undermined by differences in basin size and spacing for legume crops and cereal crops. If a farmer has to apply crop rotation on plots in which they practise reduced tillage (planting basins), they have to establish new basins with a different dimension requiring a new learning curve. Experience with mulching was also not a significant determinant of either adoption or intensity. General farm experience had a negative impact on adoption of CA components, but did not influence intensity. However, the negative impact diminishes with increasing experience. This may suggest that experienced farmers are likely to stick to their traditional farming techniques

Farmers with larger farms were more likely to adopt CA components, with regression results showing a positive, significant relationship for both adoption and intensity. This highlights that such farmers can better absorb risk and allocate a larger portion of their land to try new technology. As expected, ownership of an ox drawn plough had a negative, significant impact on adoption and intensity. Farmers with ox drawn ploughs are more likely to use conventional tillage because it is less labour demanding. On the other hand, livestock ownership and liquidity were positively related to adoption and intensity though were not significant. This may suggest that wealth as measured by livestock ownership and liquidity is a less binding factor in making adoption and intensity decisions.

The receipt of CA inputs in the past had no impact on the adoption decision. This may indicate that the provision of inputs does not guarantee or sustain the adoption of technologies in later years. Earlier studies that were conducted when NGOs still provided free inputs reported that the receipt of inputs significantly influenced adoption (Mazvimavi & Twomlow, 2009; Pedzisa et al., 2015a). Given that at the time of this study, NGOs had stopped providing free inputs, the distance to the nearest market was used as a proxy for

access to inputs. Though proximity to the market does not necessarily mean the ability and wiliness to buy, it can be a good indicator about the accessibility of inputs. The results show that the distance from the nearest market (Masvingo town) was not a significant determinant of adoption, but had a negative, significant impact on intensity. Farmers who are located further away from the market are more likely to incur higher transport costs in acquiring inputs. This is exacerbated by the lack of infrastructure such as roads. Furthermore when CA was promoted, the use of complementary inputs like fertiliser was emphasized (Mazvimavi & Twomlow, 2009; Pedzisa et al., 2015b). This may influence farmers to assume that CA cannot be practised without using fertilisers.

As expected, the distance from public extension services negatively influenced adoption, suggesting that farmers who are located further away from public extension officers were less likely to practise CA components. Surprisingly, the distance from public extension officers and receipt of CA extension from them during the current cropping season (2014/15) did not have a significant influence on intensity. This may reveal the public sector's inefficiency in providing extension services due to resource constraints. Public extension usually relies on the direct contact method which entails visiting farmer fields or gathering them at the ward centre. Farmers may develop systems such as social networks to counter the challenges faced in obtaining these services, making public extension officers a less important source of extension advice. Alternatively, the approach used by NGOs of directly training farmers may have excluded public extension and undermined their influence in providing support for CA technology. The results further show that receiving agricultural advice from social networks significantly (albeit at a 10% significance level) influenced the intensity of use, suggesting that farmers may use this as an alternative source of agricultural extension. On the other hand, this may indicate that social networks can play an important role in knowledge dissemination, particularly where public extension services are constrained by a lack of resources.

Contrary to expectations, farmer perception of tenure security and CA benefits did not have a significant influence on either adoption or intensity decisions. This may not necessarily mean that tenure security and CA benefits do not affect decision making but may imply that a dummy variable may not be a sufficient measure of either tenure security or CA benefits. Perceptions may be broad and therefore may not be adequately captured using a few questions.

5.5 Sensitivity analysis – an overview of scenarios using alternative methods to measure adoption and intensity

This section attempts to show how the results change when the model is estimated using alternative measures CA intensity. A total of five scenarios (Table 5-6) were compared with the CAI developed for this study.

The first three scenarios simply drop or modify certain components of the CAI to test alternative measures of uptake, while scenarios 4 and 5 attempt to replicate other approaches used in previous studies. Scenario 1 computes an index that omits R, the rate at which CA components were used. Scenario 2 presents an index that uses equal weights (W) for CA components. This assumes that all components have the same level of importance. Scenario 3 excludes the scale factor, S, which controls for cases where farmers could be assigned equal weights despite applying CA on very different sized plots. Scenario 4 excludes altogether the area under which CA components are implemented (i.e., both P and S are dropped from the index). This has similarities to the measure used by Mazvimavi and Twomlow (2009), although in their approach they use more than three components, which were allocated equal weights and ignored variations within components. Similarly Pedzisa et al. (2015b) used a count regression which merely counts the number of components used and also ignored area under CA components. Finally, scenario 5 was defined using only the proportion of area allocated to CA components, omitting W, R, and S. This is similar to the approach taken by Arslan et al. (2014) and Ngwira et al. (2014), which ignores the number of components used and variations in rate of application.

Table 5-6 Scenario analysis of alternative approaches used to measure adoption and intensity

Variable	Complete index (CAI)	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	$\Sigma W_{ir} R_{ir} P_{ir} S_{ir}$	$\Sigma W_{ir} P_{ir} S_{ir}$	$\Sigma w_{ir} R_{ir} P_{ir} S_{ir}$	$\Sigma W_{ir} R_{ir} P_{ir}$	$\Sigma W_{ir} R_{ir}$	ΣP_{ir}
Decid	-	-	-	-	+	+
Edudc	-	-	-	- *	-	- **
Hhresid	+	+	+	+	-	+
Ttlabour	+	+	+	+	+	+
CAbenefit	+	+	+	+	+	+
tenureperc	-	-	-	+	+ **	- **
Farmexp	-	-	-	- *	-	-
Farmexp_sqd	+	+	+	+ **	+	+
Basinyrs	+ *	+	+	+ **	+	+
Mulchyrs	+	+ *	+ **	+ *	+	+
Rotatyrs	-	-	-	-	+	-
Landendow	+ *	+ *	+ *	- *	-	- ***
Fence	-	-	-	-	-	-
Plough	- **	- **	- **	- ***	-	- **
LU	+	+	+	-	-	+
Liquidity	+	+	+	+	+	+
Distnmkt	- **	- **	- *	-	+ *	-
Distagri	+	+	+	-	- ***	+
CAhlab	+	+	+	+ *	+	+
Advsocial	+ *	+ **	+ **	+	-	+
CAextcur	+	+	+	+ **	+ **	+
Constant	+	-	-	+ *	-	+ ***
Number of observations=237						

***, ** and * denote 1, 5 and 10% significance levels respectively.

The results from these alternative scenarios are summarised in Table 5-.6. While the first two scenarios (scenario 1 and 2) give similar results as the CAI, differences were quite apparent for the other three scenarios (scenario 3, 4 and 5). In scenario 3, 4 and 5, scale is neglected, making it possible for farmers implementing CA on very different areas to obtain the same or similar scores. Moreover, in some instances, farmers who intensively implement CA on small areas can obtain higher scores than farmers who apply one or two CA components on a relatively large area. This creates a misleading view of uptake and distorts the influence that different factors have on adoption intensity. The main implication of the sensitivity analysis is that alternative specifications of the CAI applied to the same dataset can result in important differences associated with the factors that influence adoption and intensity, and highlight the need to develop more standardised approaches that facilitate cross-contextual comparisons. The CAI used in this study improves previous measures of assessing both CA adoption and intensity, as it explicitly incorporates the number of components used, captures variations within each component, and more rigorously considers the area under which CA components are applied.

5.6 Summary

The discussions and the results from this chapter illustrate that household and farm characteristics have different effects on both the CA adoption decision and the intensity decision. Modelling adoption and intensity as a two-step process using a double hurdle model helped to better understand the factors that influence the two processes, and as a result, better conclusions and recommendations can be drawn. The presentation of different scenarios in Table 5-6 applied to the same dataset serves to illustrate the variations that emanate from using different approaches and highlights the need for researchers to develop agreed procedures or methods that can better estimate intensity. Though mixed findings from previous studies could be explained by differences in study sites (Giller et al., 2009), many inconsistencies derive from different measures of adoption and intensity. This lack of consensus makes it difficult to assess the adoption and intensity rates across different contexts (Andersson & D'Souza, 2014).

Chapter 6
Conclusions and recommendations

This chapter starts by summarising the research findings, followed by conclusions and recommendations for policy. The chapter concludes by outlining the limitations of this study and highlights areas for future research.

6.1 Research summary

In Zimbabwe, conservation agriculture was promoted as a means of addressing the challenges faced by smallholders in producing their crops. Smallholders fail to optimally utilise their land due to a lack of resources such as draught animals, fertiliser and seed, among other things. CA has been considered to be an environmentally friendly technology that could lead to sustainable agricultural intensification, particularly for the poor who heavily rely on agriculture. CA was promoted as a hand hoe technique that is based on three interlinked components, namely, reduced tillage, mulching, and crop rotation. CA requires smallholders to dig planting basins during the dry season, maintain at least 30% soil cover, and rotate crops. In the Zimbabwean context, CA was introduced by NGOs who initially provided smallholders with free inputs and technical support to encourage adoption. Public sector extension continued to provide technical support to smallholders after NGOs had stopped their support of CA. Smallholders who adopted CA were expected to realise benefits which included a more efficient use of inputs, and higher and more stable yields.

Despite these claimed benefits, the adoption of all CA components remains low in Zimbabwe. Studies that have attempted to measure adoption and factors influencing its uptake reported inconsistent findings. Furthermore, very little has been done to investigate factors that determine the intensity of its use. Some studies have relied on the use of a dichotomous variable in measuring adoption. This type of approach assumes that CA is an indivisible technology and therefore fails to incorporate partial adoption. Studies that attempted to assess CA use levels adopted methods that failed to adequately measure intensity levels. In addition, reported adoption rates do not explicitly show which of the three components were used to measure adoption.

This study investigated the factors that influenced the adoption and intensity of CA among smallholders in the Masvingo district of Zimbabwe using a more robust approach. In this

study, CA practices were decomposed to capture actual farmer practices. The study used cross sectional data that were collected from smallholders between October and December 2015 using a structured questionnaire. The information elicited from farmers included farm and household characteristics, farm operations, cropping patterns, reasons for adopting or not adopting CA, farmer perceptions of tenure security, and CA benefits.

The study constructed an index that incorporates all three components and combinations of CA components, based on the rate at which the components are applied, the scale of their application, and their relative contributions to yield. The computed index was then regressed against farm and household characteristics using a double hurdle model to investigate the factors that influence the adoption of CA components and the intensity of their use. A sensitivity analysis was also conducted to illustrate that the use of different measures of intensity generate different results even if using the same data set.

6.2 Conclusions and recommendations

Decomposing CA into its components made it possible to draw informed conclusions about actual farmer practice, adoption, and intensity levels. Farmers in the study area rarely implemented CA as an indivisible technology. Most of the farmers only implemented the reduced tillage component (basin digging) of CA. There were only a few instances where sampled farmers implemented more than one component. The results revealed that only 1.3% of the cultivated plots had all three components. Among other things, crop rotation is undermined by a preference for planting maize. Cereals such as maize are staple foods and are very important to subsistence farmers. Owing to this, farmers practise the mono-cropping of maize. Their inability to channel resources towards the production of legume crops hinders the uptake of crop rotation. Mulching is mainly constrained by livestock which feed on crop residues, a lack of knowledge, and labour demands. There is a trade-off between the use of crop residues as livestock feed or as mulching material. However, for farmers who do not have livestock, the lack of exclusive rights to land make it impossible to prevent their neighbours' livestock from consuming crop residues.

These differences in the levels of uptake within CA components justifies the computation of an index that is able to capture partial adoption. The sensitivity analysis further illustrated that using an incomplete measure of intensity (excluding other factors) yields different

results. This partially explains the reason for mixed and inconsistent findings in the literature.

Furthermore, using the double hurdle model was ideal for understanding factors that influence the two processes (adoption and intensity decisions). The results reveal that different factors have different impacts on adoption and intensity decisions. Other approaches that treat the two decisions as the same fail to distinguish between these different effects. The regression results revealed that the participation of females in decision making, experience with technology, land endowment, and proximity to public extension offices all had positive, significant impacts on adoption. On the other hand, the intensity of adoption was positively and significantly influenced by land endowment, general farm experience, proximity of input markets, and access to informal extension support. Ownership of a mouldboard plough had a negative, significant impact on both adoption and intensity.

A number of policy conclusions arise from this analysis. First, improving smallholder access to arable land might ease the land endowment constraints that reduce the uptake of CA. The survey data shows that farmers who had larger farms were more likely to be more intensive users of CA components as they are more able to absorb risk. In addition, preferences for cereal crops and food security considerations are less binding for farmers who have adequate land to produce sufficient amounts of staple crops. Therefore holding other things constant, if land constraints were relaxed, and if farmers have enough staple crops for their own consumption, they could more easily allocate some of their land to the production of legume crops (or practise crop rotation). Given that there were cases where farmers left their plots fallow, having a functional land rental market would enable farmers to rent out unused land to potential users. The possibility of renting out land may also result in financial benefits to farmers who rent their land out, while also having a positive impact on allocative efficiency (Lyne, 2009). However, at present, land markets may not function optimally under prevailing institutional arrangements.

Second, there is also a need for innovation in conservation practices that could allow the use of ox drawn farm implements. The results revealed that farmers who own a mouldboard plough were less likely to adopt CA components. CA technologies that encouraged the used of ox drawn farm implements could be more attractive to farmers who already have draught

power and those who own a plough. These innovations should be done in a participatory manner, involving farmers in developing technologies that they would prefer to use.

Third, efforts should be put in reviving agricultural markets to improve smallholder access to inputs. The regression results showed that farmers who are located near the market (with better access to inputs) are more likely to be intensive users of CA components. Demand pull interventions such as contract farming can help farmers overcome the challenges faced in acquiring inputs and concurrently give them the incentives to produce legumes for the market. Contract farming may be more sustainable than giving farmers free inputs as was practised in earlier CA programs, as it can help farmers to develop a more entrepreneurial mind set. The income they obtain from these high value legume crops could then be used to buy maize or supplementary food. However, for contract farming to be sustainable, there is a need to improve the economic environment to encourage private investment. There is also need to set up a conducive, supportive, and reliable legal framework that will protect both the farmers and private companies engaging in contract farming.

Fourth, there is a need to re-visit extension practices associated with CA. The model results showed that the distance from public extension and access to social advice had an impact on adoption. In addition, the regression results also show that farmers who practise CA for a long time are more likely to continue using the technology. This suggests that there is need to ensure that farmers who have adopted CA continue to have access to extension support. Moreover, promoting farmer led extension can be an effective way of addressing the challenges faced in obtaining extension services by those that have not yet adopted CA. This may involve identifying existing social networks to help them establish more formal structures. Both public extension agencies and outsourced extension from NGOs can help farmers to establish formal groups such as farmer associations, which may be used for information dissemination. A bottom-up approach could encourage farmer participation, thus setting up a good platform for getting effective feedback from farmers. In addition, such platforms may be useful in enabling farmer involvement in developing technologies that are more appropriate for smallholders, given that they better understand their operating environment and constraints faced.

6.3 Limitations of the study and areas for future research

These results were based on data collected from a particular ward of Masvingo district of Zimbabwe. The adoption trends found here may be different in other parts of the country. Factors identified in this study may have a different impact on adoption in different places, and therefore it is crucial to conduct site-specific studies. It may be worthwhile for future studies to use more robust approaches, as found in this study, to better estimate accurate adoption levels and intensity. More importantly, there is need to investigate ways of activating the land rental market. Further research may also focus on investigation of the impact of partial adoption on users and the environment, and on assessing the costs and benefits of different CA interventions.

References

Andersson, J. A., & D'Souza, S. (2014). From adoption claims to understanding farmers and contexts: A literature review of conservation agriculture (CA) adoption among smallholder farmers in southern Africa. *Agriculture, Ecosystems & Environment, 187*(0), 116-132. doi:10.1016/j.agee.2013.08.008

Arslan, A., McCarthy, N., Lipper, L., Asfaw, S., & Cattaneo, A. (2014). Adoption and intensity of adoption of conservation farming practices in Zambia. *Agriculture, Ecosystems & Environment, 187*(0), 72-86. doi:10.1016/j.agee.2013.08.017

Babbie, E. (2016). *The practice of social research* (14 ed.). Boston, USA: Cengage learning.

Burke, W. J. (2009). Fitting and interpreting Cragg's tobit alternative using Stata. *Stata Journal, 9*(4), 584-592.

Cragg, J. G. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica, 39*(5), 829-844. doi:10.2307/1909582

Dengu, T., & Lyne, M. C. (2007). Secure land rental contracts and agricultural investment in two communal areas of KwaZulu-Natal. *Agrekon, 46*(3), 398-409. doi:10.1080/03031853.2007.9523778

FAO. (2012). *Towards the future we want: End hunger and make the transition to sustainable agricultural and food systems. Report on Rio+20. FAO*. Rome. Italy. Food and Agricultural Organization of the United Nations (FAO). Retrieved from http://www.fao.org/docrep/015/an894e/an894e00.pdf

FAO. (2015). *Conservation agriculture contributes to Zimbabwe economic recovery*. Retrieved from http://www.fao.org/in-action/conservation-agriculture-contributes-to-zimbabwe-economic-recovery/en/.

Farnworth, C. R., Baudron, F., Andersson, J. A., Misiko, M., Badstue, L., & Stirling, C. M. (2016). Gender and conservation agriculture in East and Southern Africa: Towards a research agenda. *International Journal of Agricultural Sustainability, 14*(2), 142-165. doi:10.1080/14735903.2015.1065602

Field, A. (2005). *Discovering statistics using SPSS* (2 ed.): London, United Kindom: SAGE.

Friedrich, T., & Kienzle, J. (2007). *Conservation agriculture: impact on farmers' livelihoods, labour, mechanization and equipment*. Retrieved from http://www.fao.org/ag/ca/CA-Publications/ACSAD%202007.pdf

Garcia, B. (2013). Implementation of a double-hurdle model. *Stata Journal, 13*(4), 776-794.

Gershon, F., Just, R. E., & Zilberman, D. (1985). Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change, 33*(2), 255-298. doi:10.2307/1153228

Giller, K. E., Witter, E., Corbeels, M., & Tittonell, P. (2009). Conservation agriculture and smallholder farming in Africa: The heretics' view. *Field Crops Research, 114*(1), 23-34. doi:10.1016/j.fcr.2009.06.017

Gujarati, D. N. (2003). *Basic econometrics* (4th ed.): New York, United States: McGraw Hill.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica, 47*(1), 153-161. doi:10.2307/1912352

Jahnke, H. E. (1982). *Livestock production systems and livestock development in tropical Africa*. Kiel, Germany: Kieler Wissenschaftverlag Vauk.

Johansen, C., Haque, M. E., Bell, R. W., Thierfelder, C., & Esdaile, R. J. (2012). Conservation agriculture for small holder rainfed farming: Opportunities and constraints of new mechanized seeding systems. *Field Crops Research, 132*, 18-32. doi:10.1016/j.fcr.2011.11.026

Kassam, A., Derpsch, R., & Friedrich, T. (2014). Global achievements in soil and water conservation: The case of conservation agriculture. *International Soil and Water Conservation Research, 2*(1), 5-13. doi:10.1016/S2095-6339(15)30009-5

Khandker, S. R., Koolwal, G. B., & Samad, H. A. (2010). *Handbook on impact evaluation: Quantitative methods and practices*. Washington D. C, USA: World Bank Publications.

Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy, 32*(1), 25-48. doi:10.1016/j.foodpol.2006.01.003

Lyne, M. (2009). Institutional change to promote a rental market for cropland in communal areas of KwaZulu-Natal, South Africa. In J. K. Kirsten, A. Dorward, C. Poulton & N. Vink (Eds.), *Institutional economics perspectives on African agricultural development* (pp. 359-373). Washington D.C: IFPRI.

Mabuza, M. L., Sithole, M. M., Wale, E., Ortmann, G. F., & Darroch, M. A. G. (2013). Factors influencing the use of alternative land cultivation technologies in Swaziland: Implications for smallholder farming on customary Swazi Nation Land. *Land Use Policy, 33*(0), 71-80. doi:10.1016/j.landusepol.2012.12.009

Marongwe, S. L., Nyagumbo, I., Kwazira, K., Kassam, A., & Friedrich, T. (2012). *Conservation agriculture and sustainable crop intensification: A Zimbabwe case study*: Rome, Italy. Food and Agricultural Organization of the United Nations (FAO).

Mazvimavi, K. (2011). *Socio-economic analysis of conservation agriculture in southern Africa: Network paper 02*: Johannesburg, South Africa. Food and Agricultural Organization of the United Nations (FAO).

Mazvimavi, K., & Twomlow, S. (2009). Socioeconomic and institutional factors influencing adoption of conservation farming by vulnerable households in Zimbabwe. *Agricultural Systems, 101*(1–2), 20-29. doi:10.1016/j.agsy.2009.02.002

Moyo, M., Mvumi, B., Kunzekweguta, M., Mazvimavi, K., Craufurd, P., & Dorward, P. (2012). Farmer perceptions on climate change and variability in semi-arid Zimbabwe in relation to climatology evidence. *African Crop Science Journal, 20*(2), 317-335.

Ndlovu, P. V., Mazvimavi, K., An, H., & Murendo, C. (2014). Productivity and efficiency analysis of maize under conservation agriculture in Zimbabwe. *Agricultural Systems, 124*(0), 21-31. doi:10.1016/j.agsy.2013.10.004

Ngwira, A., Johnsen, F. H., Aune, J. B., Mekuria, M., & Thierfelder, C. (2014). Adoption and extent of conservation agriculture practices among smallholder farmers in Malawi. *Journal of Soil and Water Conservation, 69*(2), 107-119. doi:10.2489/jswc.69.2.107

Nyamangara, J., Mashingaidze, N., Masvaya, E. N., Nyengerai, K., Kunzekweguta, M., Tirivavi, R., & Mazvimavi, K. (2014). Weed growth and labor demand under hand-hoe based reduced tillage in smallholder farmers' fields in Zimbabwe. *Agriculture, Ecosystems & Environment, 187*(0), 146-154. doi:10.1016/j.agee.2013.10.005

Pannell, D. J., Llewellyn, R. S., & Corbeels, M. (2014). The farm-level economics of conservation agriculture for resource-poor farmers. *Agriculture, Ecosystems & Environment, 187*(0), 52-64. doi:10.1016/j.agee.2013.10.014

Pedzisa, T., Rugube, L., Winter-Nelson, A., Baylis, K., & Mazvimavi, K. (2015a). Abandonment of conservation agriculture by smallholder farmers in Zimbabwe. *Journal of Sustainable Development, 8*(1), 69-82. doi:10.5539/jsd.v8n1p69

Pedzisa, T., Rugube, L., Winter-Nelson, A., Baylis, K., & Mazvimavi, K. (2015b). The Intensity of adoption of Conservation agriculture by smallholder farmers in Zimbabwe. *Agrekon, 54*(3), 1-22. doi:10.1080/03031853.2015.1084939

Ruttan, V. W., & Hayami, Y. (1998). Induced innovation model of agriculture development. In C. K. Eicher & J. M. Staatz (Eds.), *International agricultural development* (3rd ed., pp. 163-178). Maryland: Johns Hopkins University Press.

Shiferaw, B., & Holden, S. T. (1998). Resource degradation and adoption of land conservation technologies in the Ethiopian Highlands: A case study in Andit Tid, North Shewa. *Agricultural Economics, 18*(3), 233-247. doi:10.1016/S0169-5150(98)00036-X

Zimbabwe National Statistics Agency. (2016). *Poverty analysis: Poverty datum lines - April 2016*. Retrieved from http://www.zimstat.co.zw/sites/default/files/img/publications/Prices/Poverty_04_2016.pdf.

Appendix A

Household questionnaire used to collect information

LINCOLN UNIVERSITY (CANTERBURY - NEW ZEALAND)

THE IMPACT OF PRACTICING CONSERVATION AGRICULTURE- October –December 2015 Survey

To Interviewer: Please ask the household whether they are willing to participate in this survey interview and explain that all data are kept confidential and will be used only for research purposes. The respondent should be an adult who makes decisions for the household or who is very familiar with the household's cropping activities. If husband and wife jointly manage the crops, both should be interviewed together. Participation of the wife should be encouraged. If respondents are willing to participate, they should sign the consent form before proceeding with the interview.

Informed consent and Declaration

This survey is part of a research project titled "Assessing the impact of conservation agriculture on smallholders in the Masvingo district of Zimbabwe". The research is conducted by Machiweyi Kunzekweguta under the supervision of Associate Professors Karl Rich (Karl.Rich@lincoln.ac.nz) and Michael Lyne (Michael.Lyne@lincoln.ac.nz) from Lincoln University, New Zealand. The purpose of the study is to learn more about how and why households practice CA technology. Participation in this survey will involve completion of a questionnaire and field measurements, and this will take approximately two hours. Your participation in this research is voluntary. You are free to withdraw your participation and data at any time during the interview. Your participation in this research is strictly confidential. Your name and contact details will not be disclosed in any way, and the information that you provide will remain anonymous. Copyright to the thesis resides with the researcher.

Should you have any question regarding the nature of the survey please contact the Supervisors or Researcher at the addresses listed above or call the Researcher at +263772642050.

Please express your full consent to participate in this survey by writing your name and signing below.

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

Signature:..... Date:.....

Name of enumerator _____ **Duration of the interview _____hrs _____Min**

Village (Name and number) _____ **Household common name_____**

Section A: Household demographics
Respondent details

	1. ***Name***	**2. Year first started farming**
RESPONDENT A1		
RESPONDENT A2		

A 3. Year this household started farming? _____

A4. Does the household head reside on-farm for more than 6 months a year? (**Y**es or **N**o) _____

A5. Who makes decisions regarding farming activities? _____1= Male household head, 2= Spouse (husband around but not actively involved in farming) (3= Female with husband living away, 4= Female without husband (widow, single, divorced)

A6. We would like to review the size and membership of this household. This includes people who resided here for more than 6 months in the past year (October 2014 – September 2015)

1. **Name** (This can be informal name)	**2. Gender (M or F)**	**3. Age in years**	**4. Relation to head of household**	**5. Years of schooling achieved by adults**	**6. Contribution to farm labour** **F**ulltime **P**art time **N**one	**7. Average Earnings (USD/Month)**	**8. Number of months obtained**	**9. Major source**	**10. Social welfare or pension earnings (US$/month)**

Section B: Exposure to CA and extension

Have you ever practiced any CA components (reduced tillage, mulching, crop rotation or a mix of these practices)? (**Yes** or **No**) _____

What CA components have you tried	**1. Year started practicing component**	**2. Who/what influenced you to practice this component[1]**	**3. Are you still practicing the component (Y or N)**	**4. If No, when did you stop**	**5. If stopped, what was the main reason for stopping**	**6. In your view, how has this component contributed towards soil quality[2]**
B1. Reduced tillage						
B2. Mulching						
B3. Crop rotation						
[1]**Codes for source of influence**: Agritex **(AG)**, **NGO**, Lead Farmer **(LF),** Neighbours **(NB)**, 5=Other (please specify)						
[2]**Codes for perception of soil quality:** Improved soil quality **(B),** No perceived difference **(ND),** Worsened soil quality **(W)**						

B2. If there are CA components you have never practiced, what are the reasons for not practicing?

_____

_____

Section C: Household access to extension support and inputs

We would like to review the type of extension support that was received by members of this household in the past 5 years. This includes details of the household member who received extension support and the household's level of satisfaction.

Please indicate who received the support and type of extension support received

Type of extension	**1. A member of the household received this extension** (**Y**es or **N**o)	**2. Name of hhld member who received the information**	**3. Extension supplied by: A**gritex **(AG) NGO** Lead **F**armer **(LF)**	**4. Year this hhld first received the extension support**	**5.Year last received extension support**	**How satisfied is the household with the[1]:**		**8. Did this support influence your farming practices** (**Y**es or **N**o)
						6. Frequency of extension support	**7. Quality of extension support**	
C1. General extension (not specifically CA)								
C2. CA basins								
C3. CA mechanised								
[1] **Codes for –Level of satisfaction:** Very satisfied **(VS)**, Satisfied **(S)**, Neutral **(N)**, Dissatisfied **(D)**, Very dissatisfied **(VD)**								

How far is your homestead from the extension offices? Distance _____units_____ Time _____hrs

C4. Have you ever receive any free or subsidised inputs to use on CA plots (**Yes** or **No**) _____

Type of input received Seed (**S**), Fertilizer **(F)**, Hoes **(H)**, Ripper**(R)**	**1. Who provided the inputs** NGO, Government, Other (please specify)	**2. Are you still receiving this input for free or at subsidised price** (**Y** or **N**)

Section D: Peer effects

In this section, we would like to review your sources of agricultural advice and the influence they have on your decision making.

	Person 1	Person 2	Person 3
D1. Do you have anyone whose advice in farming practices you would follow over anyone else's? (Yes or No)			
D2. Please indicate the category[1] that best describes this person.			
D3. Do you know this person socially (?) (Yes or No)			
D4. How many years have you known this person?			
D5. Does this person have formal training in agriculture? (Yes or No)			
D6. How many hours does it take to travel to this person's home on foot?			
D7. Does this person grow the same crops as you do? (Yes or No)			
D8. Does this person practice CA? (Yes or No)			
D9. Was your decision to practice or not to practice CA influenced by this person? (Yes or No)			
D10. What support[2] did this person provide that influenced your decision?			
D11. Is this person's farm **larger** or **smaller** than the average farm in this area?			
[1]**Categories:** 1=Spiritual/religious leader, 2=A political leader, 3=An elected or nominated agricultural leader, 4=Village elder, 5=Family relative, 6= Neighbour, 8= Extension worker 9= NGO agent, 10=Other (please specify)			
[2]**Types of support:**1=Information, 2=Technical help, 3= Credit, 4=Network with Agritex or NGO extension officers, 6= Other (please specify)			

D12. Does the village head practice CA? (Yes or No) _____

D13. Are you related to the village head? (Yes or No) _____

Section E: Farmer perceptions

Farmer's perception of peer effects

How would you respond to each of the following statements? Tick where appropriate.

	Strongly agree	Agree	Disagree	Strongly disagree	No opinion
E1. It is easier to implement farm technologies that everyone in the community is using					
E2. I consider what my neighbours think about farm technologies					
E3. I want neighbours' support in implementing new technologies					
E4. Belonging to a farmer group makes it easy to adopt new technologies					

Farmer's perception on farming

What developments can the household exercise on its own cropland? (tick where appropriate):

Right Response	Build structures	Plant trees	Erect fences to exclude others	Bequeath	Lease out	Sell
E.5 No						
E6. Yes, with consent from local authority						
E7. Yes, without approval from local authority						

How would you respond to each of the following statements?

	Strongly agree	Agree	Disagree	Strongly disagree	No opinion
E8. I can prevent my neighbours from grazing their cattle on my land after the					
E10. I can plant crops at any time without concern that cattle will damage my crop					
E11. If livestock damage a farmer's crop, the owners always compensate the farmer					
E12. I am happy to lease land to another farmer to plant seasonal crops					
E13. I am happy to lease land to another farmer to plant permanent crops					
E14. There are very few disputes over land in this village					

Farmer perceptions of CA technology

How would you respond to each of the following statements about conservation agriculture?

	Strongly agree	Agree	Disagree	Strongly disagree	No opinion
E15. CA can improve yields in most years					
E16. CA can improve yields when rainfall is lower than normal					
E17. CA can improve yields when rainfall is greater than normal					
E18. CA improves fertility of the soil if applied over a long period.					
E19. CA reduced the severity of soil erosion when applied to eroded soils					
E20. CA is worth using if you are provided with free inputs					
E21. CA is not effective in this area					
E22. CA requires too much labour for me to use it					
E23. CA increases weed pressure					
E24. CA benefits of CA only realised later					
E25. Accessing CA equipment is challenging					
E26. CA is not worth using at current output prices					
E27. The mulch requirement for CA conflicts with livestock management					
E28. Neighbours look down upon people practicing CA					
E29. Crop residues give a better return when used for feeding animals than in CA.					
E30. Herbicides require knowledge on how to use them.					
E31. It is difficult to meet the requirement of crop diversification in CA					
E32. More land is required for a farmer to practice CA					

On this page, map the household's fields indicating what crops were grown on each plot in the 2014/15 season, including plots left fallow. Assign codes to each plot. Measure or estimate the area of each plot. Rely on the farmer's estimates if fields are not accessible.
Area of Fallow plot_____

Section F: Crop production and technology use

Technology implementation

F1. Which crops did you grow in 2014/15 season and which components of CA did you implement? (Plot numbers, crop, tillage method and area should match the ones in the map. Crop rotation is defined as changing from cereal to legume within two seasons.

1. Plot location Garden Homestead Distant Land hired	**2. Plot No**	**3. Crop[1]**	**3. Main tillage method[2]**	**4. Date planted** Wk/mth	**5. CA component implemented[3]**	**6. When did you start practicing CA component on this plot**	**7. Have you continuously implemented this component on this plot (Yes or No)**	**8. Is the plot securely fenced**		**Area of plot**		**Area in which components were applied**		**13. Intensity of practice** (Use 10 stones for farmer to illustrate % of intensity
								(Yes or **No)**	Year fenced	9. size	10. Unit	11. size	12. Unit	

[1]**Codes for crops:** Maize **(M),** White Sorghum **(WS),** Red Sorghum **(RS),** Pearl Millet **(PM)** Groundnuts **(GN),** Cowpeas **(CP)** Bambaranuts **(BN)**

[2]**Tillage methods**: **Ox**-drawn plough, **Manual CA** basins, **Rippe**r, **Manual Non CA**, 5=other specify

[3] **CA components:** Reduced tillage (**RT**), Mulching (**M**), Crop rotation (**CR**) , Reduced tillage and mulching (**RT+M**), Reduced tillage and crop rotation (**RT+CR**), Mulching and crop rotation (M+CR), All three (**RT+M+CR**)

Section G: Crop management

In this section, we wish to know how you manage your plots. Which of the management practices did you implement in in your plots?

Management practice	Plot Number (plot numbers should match the ones in the map)- Put Yes if practice was done and No otherwise											
	1	2	3	4	5	6	7	8	9	10	11	12
G1.Winter weeding *(soon after harvest – without tilling the land)*												
G2. Winter plough (using ox-drawn plough**)**												
G3. Spot application of manure												
G4. Spot application of basal fertilizer												
G5. Spot application of top dress fertilizer												
G6. Timely weeding *(field kept largely weed free)*												
G7. Inter Cropping *(Cereal and legume)*												
G8. Pest control (timely response to pest and diseases)												

G9. Did you use any hired labour on your CA plots (Yes or No) _____

G10. Did you use any hired labour for you non CA (conventional) plots (Yes or No) _____

G11. Did you use collective labour (*Mushandira pamwe*) on your CA plot (Yes or No) _____

G.12. Did you use collective labour (*Mushandira pamwe*) on your non CA plot (Yes or No) _____

Section H: Crop production

H1. How much did you harvest for the 2014/2015 season? (Plot numbers should match the ones in the map)

1. Plot No	**Crop**[1]	**2. Date Harvested** wk/mth	**3. Soil type** Clay Loamy Sandy-loam	**4. How many times did you weed the plot**	**5. Was the seed certified**	**6. Did you apply herbicides?** (Yes or No)	**7. Did you use pesticides** (Yes or No)	**Amount harvested** (grain / shelled)	
								8. Amt	9. Unit
[1]**Codes for crops:** Maize **(M),** White Sorghum **(WS),** Red Sorghum **(RS),** Pearl Millet **(PM)** Groundnuts **(GN),** Cowpeas **(CP)** Bambaranuts **(BN)**									

Section I: Self sufficiency

I1. How many months per year do you normally have enough food to meet household needs_____

I2. Is your situation with regarding to food security improving? (Yes or No) _____

I3. If yes, what has contributed to the improvements? List in order of importance

1._____

2._____

3._____

Section J: Market for crop sales and input cost

J1. Have your ever sold your produce in the past five years? (Yes or No)_____

J2. Did you sell any of your produce from 2014/15 harvest (Yes or No)_____

J3. If yes please complete table below.

1. Crop Sold[1]	**Quantities sold**		**4. Price per unit**	**5. When sold (month)**	**6. Where did you sell your produce[2]**	**7. Is this your preferred market**	**8. If No, which one is your preferred market[2]**
	2. Amount	3. Unit					
[1]Codes for crops: Maize **(M),** White Sorghum **(WS),** Red Sorghum **(RS),** Pearl Millet **(PM)** Groundnuts **(GN),** Cowpeas **(CP)** Bambaranuts **(BN)**							
[2]Codes for output market: Local Market (village market) **(LM)**, Ward market (wards centre) **(WM),** Nearest town (Masvingo) **(NT)**							

How far is the household located from the market?

Type of market	**Household distance from the market**	
	1. Distance	2. Unit
J4. Local market (village level)		
J5. Ward market (ward centre)		
J6. Nearest town (Masvingo)		

Input cost

Item	**1. Total quantity used**		**3. Total quantity purchased**		**5. Total expenses (if in barter, estimate value) in US$**
	1. Quantity	**2. Unit**	**3. Quantity**	**4. Unit**	
J7. Ploughing and land preparation costs					
J8. Crops: Maize					
J9. White Sorghum					
J10. Red Sorghum					
J11. Pearl millet					
J12. Ground nuts					
J13. Bambara nuts					
J14. Cowpea					
J17. Manure					
J18. Fertilizers: Compound D					
J19. AN					
J20. Urea					
J21 Other specify					
J22. Herbicides/pesticides					
J23. Hired labour (indicate man days)					

Section K: Income and expenditure

Please indicate major sources of your income and household expenditure for 2015?

Major expenditure	**Average value obtained per month**	**Number of months in which cost was incurred in 2015**	**Major sources of income**	**Average value obtained per month**	**Number of months obtained in 2015**
K1. Food			K6. Livestock sales		
K2. Livestock inputs			K7. Cash remittances (within Zimbabwe)		
K3. Education			K8. Cash remittances (from outside Zimbabwe)		
K4. Health					
K5. Social events / Leisure					

Section L: Livestock and asset ownership

Livestock owned				**Asset owned**			
Livestock type	**Current number**	**Estimated current value per unit US$**	**Year acquired**	**Type of asset**	**Current number**	**Estimated current value per unit US$**	**Year acquired**
L1. Oxen and bulls				L5. Plough			
L2. Other cattle				L6. Scotch cart			
L3. Calves				L7. Cultivator			
L4. Goats				L8. Harrow			
				L9. Wheelbarrow			
				L10. Bicycle			
				L11. Television			
				L12. Radio			
				L13. Cell phone			
				L14. Tractor			
				L15. Car			

Thank the respondent for his/her time

Appendix B

Definitions of variables used to estimate the double hurdle regression model

Variable abbreviation	Description of the variable
RC	Respondent code (Unique for each household)
CAI	Conservation agriculture index
Scen1	Scenario 1, index computed without incorporating rate of CA use (R)
Scen2	Scenario2, index computed using equal weights for CA components
Scen3	Scenario 3, index computed without accounting for extent of CA use (S).
Scen4	Scenario 4, Index that does not include area allocated to CA components
Scen5	Scenario 5, Index that uses proportion of area allocated to CA only
Decid	Gender of decision maker (male =1, otherwise 0)
Edud	Education of decision maker in years
Hhrsd	Household head reside on farm (yes=1, otherwise 0)
Ttlab	Total household labour (adult equivalent)
CAbn	Perception of CA long term benefits (positive=1, otherwise 0)
tenur	Perception of tenure security (positive=1, otherwise 0)
Famx	General farming experience in years
$FamEX^2$	Transformed general farming experience $(years)^2$
Basinyrs	Number of years practising basins
Mulchyrs	Number of years applying mulch
Rotatyrs	Number of years practising crop rotation
Landendow	Land endowment
Fence	Presence of fencing (yes=1, otherwise 0)
Plough	Ownership of ox-drawn plough (yes=1, otherwise 0)
LU	Tropical livestock unit
Liquidity	Liquidity (US$)
Distnmkt	Distance to nearest town in km
Distagri	Distance to government extension personnel in km
CAinput	Receipt of CA inputs in previous years
CAhlab	Use of hired labour in 2014/15 season
Advsocial	Receipt of agricultural advice from social groups 2014/15
CAextcur	Receipt of CA extension in 2014/15 season

Appendix C

Data set used to estimate the double hurdle model

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
1,101	0.027	1	0.027	0.090	0.054	0.100	0.536	1	8	1	5	1	0	16	256.00
1,102	0.042	1	0.042	0.039	0.187	0.720	0.519	0	8	1	4	1	1	34	1,156.00
1,103	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	1	4	1	0	33	1,089.00
1,104	0.162	1	0.162	0.149	0.480	1.080	1.000	1	13	2	2	1	0	3	9.00
1,105	0.000	0	0.000	0.000	0.000	0.000	0.000	0	2	1	2	1	0	35	1,225.00
1,106	0.031	1	0.031	0.032	0.133	0.460	0.467	0	7	1	3	1	0	34	1,156.00
1,107	0.004	1	0.004	0.011	0.055	0.460	0.318	1	9	1	5	1	0	14	196.00
1,108	0.027	1	0.027	0.025	0.067	0.360	0.186	1	2	1	8	1	0	34	1,156.00
1,109	0.034	1	0.034	0.105	0.081	0.460	0.593	1	8	1	4	1	0	10	100.00
1,110	0.033	1	0.033	0.081	0.155	0.920	0.768	1	5	1	4	1	0	15	225.00
1,111	0.029	1	0.029	0.027	0.263	0.360	0.731	1	11	1	4	1	0	10	100.00
1,112	0.016	1	0.025	0.025	0.116	0.393	0.818	1	12	1	2	1	1	4	16.00
1,113	0.044	1	0.052	0.078	0.085	0.787	0.333	1	10	1	4	1	1	7	49.00
1,114	0.167	1	0.167	0.153	0.413	0.720	0.574	0	2	1	2	1	1	50	2,500.00
1,115	0.000	0	0.000	0.000	0.000	0.000	0.000	0	2	1	1	1	1	74	5,476.00
1,116	0.143	1	0.143	0.131	0.353	0.720	0.491	0	11	2	4	1	1	10	100.00
1,201	0.000	0	0.000	0.000	0.000	0.000	0.000	1	3	1	3	1	0	35	1,225.00
1,203	0.053	1	0.053	0.176	0.066	0.100	0.658	0	11	1	4	1	1	19	361.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
1,204	0.007	1	0.007	0.014	0.062	0.460	0.317	0	0	1	2	1	1	35	1,225.00
1,205	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	2	2	0	1	1	1.00
1,206	0.000	0	0.000	0.000	0.000	0.000	0.000	0	6	1	1	0	0	46	2,116.00
1,207	0.000	0	0.000	0.000	0.000	0.000	0.000	1	3	2	5	1	1	30	900.00
1,208	0.000	0	0.000	0.000	0.000	0.000	0.000	1	7	1	4	1	1	12	144.00
1,209	0.017	1	0.017	0.038	0.125	0.820	0.621	1	11	2	2	0	1	4	16.00
1,210	0.084	1	0.084	0.094	0.102	0.460	0.386	1	11	2	8	0	1	6	36.00
1,211	0.097	1	0.097	0.089	0.235	1.080	0.653	1	0	1	2	1	1	4	16.00
1,212	0.012	1	0.012	0.011	0.117	0.720	0.326	1	10	1	5	1	0	12	144.00
1,213	0.082	1	0.082	0.090	0.400	1.100	0.625	1	11	1	4	0	0	10	100.00
1,214	0.154	1	0.164	0.165	0.308	0.770	0.800	0	10	1	4	1	1	22	484.00
1,215	0.180	1	0.180	0.165	0.360	0.360	1.000	0	11	1	5	1	0	4	16.00
1,216	0.011	1	0.021	0.035	0.011	0.050	0.211	1	12	1	6	1	1	13	169.00
1,217	0.000	0	0.000	0.000	0.000	0.000	0.000	0	0	1	4	0	0	28	784.00
1,220	0.000	0	0.000	0.000	0.000	0.000	0.000	1	4	1	4	1	1	46	2,116.00
1,221	0.050	1	0.050	0.046	0.099	0.360	0.276	1	3	1	5	1	1	41	1,681.00
1,222	0.000	0	0.000	0.000	0.000	0.000	0.000	0	11	1	5	1	1	11	121.00
1,301	0.065	1	0.065	0.059	0.180	0.360	0.500	0	6	1	2	1	1	29	841.00
1,302	0.029	1	0.029	0.026	0.360	0.360	1.000	0	6	1	2	0	0	7	49.00
1,303	0.035	1	0.035	0.032	0.087	0.360	0.242	0	11	1	6	1	0	2	4.00
1,304	0.045	1	0.045	0.041	0.225	0.360	0.625	0	7	1	2	1	0	29	841.00
1,305	0.004	1	0.032	0.013	0.004	0.012	0.323	1	11	1	3	1	0	34	1,156.00
1,306	0.030	1	0.030	0.028	0.100	0.360	0.278	0	11	1	4	1	0	18	324.00
1,307	0.013	1	0.013	0.012	0.060	0.360	0.167	1	11	1	4	1	1	9	81.00
1,308	0.026	1	0.026	0.024	0.093	0.360	0.259	0	7	1	2	1	1	9	81.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
1,309	0.019	1	0.019	0.017	0.046	0.360	0.128	0	8	2	7	1	1	34	1,156.00
1,310	0.000	0	0.000	0.000	0.000	0.000	0.000	0	7	1	5	1	1	35	1,225.00
1,311	0.053	1	0.053	0.051	0.139	0.460	0.464	1	8	1	5	1	1	12	144.00
1,312	0.008	1	0.008	0.023	0.046	0.460	0.290	1	11	1	4	1	0	10	100.00
1,313	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	2	2	1	0	8	64.00
1,314	0.000	0	0.000	0.000	0.000	0.000	0.000	1	3	1	4	1	1	3	9.00
1,315	0.000	0	0.000	0.000	0.000	0.000	0.000	1	1	2	5	1	1	1	1.00
1,401	0.001	1	0.001	0.001	0.011	0.360	0.030	1	7	1	3	1	1	35	1,225.00
1,402	0.022	1	0.029	0.073	0.044	0.100	0.690	0	7	2	3	1	0	18	324.00
1,403	0.034	1	0.034	0.031	0.171	0.360	0.476	0	11	2	2	1	1	1	1.00
1,404	0.000	0	0.000	0.000	0.000	0.000	0.000	0	11	1	1	1	0	5	25.00
1,405	0.114	1	0.114	0.104	0.205	0.720	0.570	0	7	1	6	1	0	42	1,764.00
1,406	0.019	1	0.019	0.063	0.038	0.200	0.379	1	11	1	7	1	0	35	1,225.00
1,407	0.006	1	0.006	0.021	0.035	0.200	0.350	0	9	2	2	1	1	12	144.00
1,408	0.000	0	0.000	0.000	0.000	0.000	0.000	1	9	1	4	1	1	2	4.00
1,409	0.000	0	0.000	0.000	0.000	0.000	0.000	0	11	2	2	1	1	1	1.00
1,410	0.023	1	0.023	0.021	0.057	0.360	0.158	1	7	1	4	1	1	5	25.00
1,411	0.089	1	0.089	0.081	0.219	0.360	0.609	0	11	2	2	1	1	5	25.00
1,412	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	1	3	1	1	5	25.00
1,501	0.002	1	0.002	0.002	0.058	1.440	0.160	1	9	1	6	1	1	16	256.00
1,502	0.001	1	0.001	0.002	0.007	0.100	0.070	1	9	2	1	1	1	6	36.00
1,503	0.000	0	0.000	0.000	0.000	0.000	0.000	0	11	2	4	1	1	16	256.00
1,504	0.000	0	0.000	0.000	0.000	0.000	0.000	1	9	2	3	0	0	7	49.00
1,505	0.004	1	0.004	0.013	0.020	0.100	0.200	1	7	1	6	1	0	16	256.00
1,601	0.001	1	0.001	0.001	0.016	0.360	0.044	0	7	1	5	1	1	45	2,025.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
1,602	0.052	1	0.052	0.048	0.131	0.360	0.364	0	11	1	5	1	0	15	225.00
1,603	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	1	2	0	1	7	49.00
1,604	0.016	1	0.064	0.053	0.020	0.025	0.800	1	7	1	4	1	1	14	196.00
1,605	0.020	1	0.020	0.065	0.047	0.460	0.397	1	11	1	3	1	0	9	81.00
1,606	0.010	1	0.010	0.035	0.030	0.200	0.298	1	5	1	6	1	0	5	25.00
1,607	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	2	3	1	0	1	1.00
1,701	0.000	0	0.000	0.000	0.000	0.000	0.000	1	7	1	5	0	1	16	256.00
1,702	0.000	0	0.000	0.000	0.000	0.000	0.000	0	0	1	2	1	1	40	1,600.00
1,703	0.000	0	0.000	0.000	0.000	0.000	0.000	1	6	1	5	1	1	13	169.00
1,704	0.000	0	0.000	0.000	0.000	0.000	0.000	0	10	2	4	1	1	14	196.00
1,705	0.037	1	0.075	0.034	0.104	0.360	0.289	1	9	1	3	1	1	23	529.00
1,801	0.055	1	0.055	0.073	0.140	0.460	0.586	0	7	1	9	1	0	14	196.00
1,802	0.004	1	0.004	0.015	0.016	0.100	0.159	0	10	1	4	1	1	14	196.00
1,803	0.011	1	0.011	0.038	0.029	0.100	0.286	1	10	1	6	1	1	3	9.00
1,804	0.013	1	0.013	0.043	0.032	0.100	0.323	1	7	1	5	1	0	11	121.00
1,805	0.175	1	0.175	0.160	0.216	0.360	0.600	1	8	1	4	1	1	7	49.00
1,901	0.189	1	0.189	0.173	0.189	0.360	0.525	0	7	2	4	1	1	15	225.00
1,902	0.062	1	0.062	0.057	0.154	0.360	0.428	0	11	1	2	1	1	10	100.00
1,903	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	1	6	1	1	8	64.00
1,904	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	1	8	1	1	16	256.00
1,905	0.000	0	0.000	0.000	0.000	0.000	0.000	0	0	1	4	1	1	30	900.00
1,906	0.185	1	0.185	0.169	0.319	0.720	0.885	0	0	1	5	1	0	29	841.00
1,907	0.132	1	0.132	0.121	0.265	0.360	0.735	0	0	1	1	1	0	30	900.00
1,908	0.119	1	0.119	0.109	0.203	0.720	0.565	0	9	1	4	1	0	12	144.00
1,909	0.111	1	0.111	0.102	0.277	0.360	0.769	0	0	1	3	1	0	52	2,704.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
2,101	0.000	0	0.000	0.000	0.000	0.000	0.000	0	7	1	3	0	1	6	36.00
2,102	0.024	1	0.024	0.022	0.223	0.720	0.618	1	10	1	7	0	0	1	1.00
2,103	0.044	1	0.047	0.045	0.255	1.322	0.500	0	9	1	5	1	1	26	676.00
2,104	0.101	1	0.101	0.093	0.270	1.080	0.409	0	3	1	2	1	1	68	4,624.00
2,105	0.023	1	0.023	0.021	0.185	0.720	0.513	0	3	1	3	1	0	45	2,025.00
2,106	0.002	1	0.002	0.006	0.009	0.100	0.091	1	13	1	4	0	1	8	64.00
2,107	0.077	1	0.141	0.071	0.234	0.936	0.544	0	5	1	3	1	1	41	1,681.00
2,108	0.436	1	0.436	0.400	0.520	1.440	0.722	0	7	1	6	1	1	34	1,156.00
2,109	0.011	1	0.011	0.011	0.108	1.000	0.108	0	11	1	4	1	1	28	784.00
2,110	0.023	1	0.023	0.022	0.152	1.080	0.423	0	7	2	4	1	1	2	4.00
2,111	0.063	1	0.063	0.058	0.254	0.720	0.352	1	4	1	5	1	1	34	1,156.00
2,112	0.153	1	0.243	0.165	0.180	1.127	0.485	0	11	1	5	1	1	24	576.00
2,201	0.073	1	0.073	0.073	0.535	4.000	0.535	1	6	1	5	1	1	30	900.00
2,202	0.049	1	0.049	0.045	0.417	2.880	0.580	1	9	1	3	1	1	2	4.00
2,203	0.130	1	0.130	0.119	0.173	0.360	0.481	1	8	1	3	0	0	2	4.00
2,301	0.020	1	0.022	0.024	0.164	1.451	0.452	0	11	1	3	1	1	19	361.00
2,302	0.180	1	0.300	0.180	0.600	0.600	1.000	0	11	2	3	1	1	2	4.00
2,303	0.175	1	0.175	0.160	0.720	0.720	1.000	1	7	1	2	1	1	2	4.00
2,304	0.354	1	0.354	0.325	0.521	0.720	0.723	1	0	1	7	1	1	59	3,481.00
2,305	0.005	1	0.140	0.005	0.044	0.364	0.588	1	11	1	3	1	0	10	100.00
2,306	0.104	1	0.104	0.095	0.415	2.160	0.577	1	8	1	7	1	1	17	289.00
2,307	0.157	1	0.157	0.157	0.457	2.000	0.457	0	13	1	4	1	0	33	1,089.00
2,308	0.276	1	0.310	0.289	0.495	1.244	0.691	0	5	1	7	1	1	45	2,025.00
2,309	0.025	1	0.051	0.051	0.110	0.848	0.767	1	10	1	3	1	0	7	49.00
2,310	0.171	1	0.171	0.180	0.350	1.100	0.500	1	5	1	4	1	1	47	2,209.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
2,311	0.009	1	0.009	0.008	0.083	0.360	0.231	1	9	1	2	1	1	4	16.00
2,312	0.166	1	0.166	0.152	0.452	2.160	0.627	0	10	1	3	1	1	6	36.00
2,313	0.079	1	0.079	0.072	0.263	0.720	0.366	0	4	1	4	1	1	41	1,681.00
2,314	0.013	1	0.013	0.013	0.063	1.000	0.063	1	8	1	3	1	1	3	9.00
2,401	0.000	0	0.000	0.000	0.000	0.000	0.000	1	2	1	4	0	0	30	900.00
2,402	0.000	0	0.000	0.000	0.000	0.000	0.000	1	9	1	2	0	0	10	100.00
2,403	0.104	1	0.104	0.101	0.233	0.560	0.820	1	11	1	5	1	0	20	400.00
2,404	0.059	1	0.059	0.054	0.228	0.720	0.633	0	6	1	3	1	0	43	1,849.00
2,405	0.000	0	0.000	0.000	0.000	0.000	0.000	1	7	1	2	1	1	32	1,024.00
2,406	0.004	1	0.004	0.014	0.024	0.100	0.240	0	2	1	3	1	0	30	900.00
2,407	0.010	1	0.010	0.009	0.079	0.720	0.110	0	11	2	5	1	1	25	625.00
2,408	0.029	1	0.029	0.027	0.091	0.360	0.254	0	5	1	3	1	1	11	121.00
2,409	0.013	1	0.013	0.012	0.107	0.720	0.297	1	11	1	6	1	1	14	196.00
2,410	0.110	1	0.110	0.101	0.274	0.720	0.762	0	0	1	5	1	0	25	625.00
2,411	0.034	1	0.034	0.100	0.129	0.460	0.876	0	0	1	3	1	0	35	1,225.00
2,412	0.010	1	0.010	0.009	0.049	0.360	0.135	1	4	1	8	1	0	39	1,521.00
2,413	0.082	1	0.082	0.174	0.215	1.540	0.694	0	6	1	6	1	1	23	529.00
2,414	0.007	1	0.007	0.006	0.065	0.360	0.181	0	2	1	3	1	0	37	1,369.00
2,415	0.066	1	0.066	0.060	0.189	0.720	0.525	0	4	1	1	0	1	2	4.00
2,416	0.006	1	0.006	0.005	0.072	0.720	0.100	0	11	1	4	1	0	15	225.00
2,417	0.176	1	0.176	0.168	0.302	0.920	0.555	0	5	1	2	1	1	34	1,156.00
2,418	0.002	1	0.002	0.002	0.035	0.360	0.096	1	7	1	7	1	0	23	529.00
2,419	0.022	1	0.022	0.020	0.068	0.360	0.188	1	7	1	4	1	0	35	1,225.00
2,420	0.087	1	0.087	0.080	0.465	2.160	0.645	0	2	1	2	1	1	58	3,364.00
2,501	0.047	1	0.047	0.043	0.393	0.720	0.545	0	7	1	2	1	1	20	400.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
2,502	0.112	1	0.112	0.103	0.277	0.360	0.769	1	11	1	1	1	1	20	400.00
2,503	0.000	0	0.000	0.000	0.000	0.000	0.000	0	10	1	3	1	0	5	25.00
2,504	0.071	1	0.071	0.065	0.194	1.080	0.538	0	5	1	3	1	0	43	1,849.00
2,505	0.019	1	0.019	0.017	0.186	0.360	0.517	0	11	1	3	1	1	1	1.00
2,506	0.000	0	0.000	0.000	0.000	0.000	0.000	0	7	1	8	1	1	15	225.00
2,507	0.090	1	0.090	0.083	0.360	0.360	1.000	1	11	1	1	1	0	9	81.00
2,508	0.027	1	0.027	0.025	0.137	0.720	0.381	1	11	1	6	1	1	2	4.00
2,509	0.120	1	0.120	0.110	0.296	0.720	0.411	1	4	1	5	1	1	45	2,025.00
2,510	0.020	1	0.027	0.035	0.080	0.410	0.520	0	7	1	2	1	1	18	324.00
2,511	0.015	1	0.015	0.028	0.083	0.460	0.409	0	6	1	7	1	1	30	900.00
2,512	0.072	1	0.072	0.074	0.154	0.460	0.538	1	11	1	3	1	1	8	64.00
2,513	0.044	1	0.044	0.065	0.179	1.540	0.670	1	11	1	4	1	1	19	361.00
2,514	0.060	1	0.060	0.055	0.240	0.720	0.667	1	11	1	4	1	1	23	529.00
3,101	0.061	1	0.061	0.056	0.243	0.360	0.676	0	11	2	1	1	1	2	4.00
3,102	0.053	1	0.053	0.048	0.165	0.360	0.457	0	6	1	1	1	0	54	2,916.00
3,103	0.107	1	0.107	0.098	0.269	1.080	0.492	1	11	1	2	1	1	11	121.00
3,104	0.126	1	0.126	0.116	0.360	0.360	1.000	0	8	1	4	1	0	37	1,369.00
3,105	0.022	1	0.022	0.020	0.146	0.360	0.405	0	9	1	2	1	1	1	1.00
3,106	0.112	1	0.112	0.102	0.159	0.360	0.443	0	7	1	5	1	1	34	1,156.00
3,107	0.252	1	0.252	0.231	0.360	0.360	1.000	0	11	1	6	1	0	40	1,600.00
3,108	0.047	1	0.047	0.043	0.227	0.720	0.630	0	0	1	1	1	1	29	841.00
3,109	0.039	1	0.039	0.036	0.230	0.720	0.640	0	4	1	1	1	1	11	121.00
3,110	0.014	1	0.014	0.013	0.195	1.080	0.541	1	10	1	3	1	0	9	81.00
3,201	0.170	1	0.170	0.155	0.242	0.360	0.673	1	11	1	5	1	1	25	625.00
3,202	0.045	1	0.045	0.041	0.298	1.080	0.673	0	11	1	5	1	1	7	49.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
3,203	0.032	1	0.032	0.030	0.242	1.080	0.454	1	9	1	2	1	1	19	361.00
3,204	0.068	1	0.068	0.062	0.188	0.360	0.522	1	5	1	5	1	1	40	1,600.00
3,240	0.064	1	0.064	0.059	0.237	0.360	0.659	0	1	1	2	1	0	35	1,225.00
3,301	0.110	1	0.110	0.101	0.290	0.720	0.403	0	7	1	6	1	1	29	841.00
3,302	0.050	1	0.050	0.046	0.125	0.360	0.346	0	3	1	3	1	1	29	841.00
3,303	0.043	1	0.043	0.040	0.312	1.440	0.600	1	11	1	5	1	1	22	484.00
3,304	0.052	1	0.052	0.048	0.351	1.440	0.897	0	3	2	4	1	0	42	1,764.00
3,305	0.041	1	0.041	0.063	0.184	0.820	0.765	1	9	1	5	1	0	17	289.00
3,306	0.180	1	0.180	0.165	0.300	0.360	0.833	0	0	1	2	1	0	44	1,936.00
3,307	0.219	1	0.219	0.201	0.318	0.720	0.882	0	11	1	5	1	0	16	256.00
3,401	0.013	1	0.013	0.012	0.133	0.360	0.370	0	11	1	3	1	0	9	81.00
3,402	0.075	1	0.075	0.069	0.125	0.360	0.346	0	0	1	2	1	1	55	3,025.00
3,403	0.019	1	0.019	0.017	0.161	1.080	0.446	0	3	1	6	1	1	42	1,764.00
3,404	0.054	1	0.054	0.050	0.360	1.440	1.000	1	7	1	7	1	1	43	1,849.00
3,405	0.059	1	0.059	0.054	0.173	1.440	0.481	1	6	1	4	1	1	45	2,025.00
3,406	0.100	1	0.100	0.092	0.280	0.720	0.778	1	7	1	3	1	1	29	841.00
3,407	0.012	1	0.012	0.011	0.058	0.360	0.160	0	11	1	5	0	0	5	25.00
3,408	0.022	1	0.022	0.020	0.216	0.720	0.600	1	11	1	2	1	1	4	16.00
3,409	0.027	1	0.027	0.025	0.360	1.080	1.000	1	0	1	1	1	1	55	3,025.00
3,410	0.116	1	0.116	0.106	0.191	0.360	0.529	1	11	1	3	1	1	1	1.00
3,411	0.076	1	0.191	0.070	0.126	0.288	0.436	1	11	1	6	1	0	19	361.00
3,501	0.086	1	0.086	0.079	0.212	0.720	0.295	0	7	1	3	1	1	36	1,296.00
3,502	0.149	1	0.149	0.136	0.391	0.720	0.543	0	7	1	8	1	1	23	529.00
3,503	0.241	1	0.241	0.221	0.283	0.720	0.785	0	5	1	2	1	1	41	1,681.00
3,504	0.095	1	0.095	0.087	0.188	0.720	0.523	1	8	1	6	1	1	32	1,024.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
3,505	0.021	1	0.021	0.019	0.052	0.360	0.144	1	11	1	2	1	1	1	1.00
3,506	0.050	1	0.050	0.047	0.131	0.460	0.414	0	7	1	5	1	1	35	1,225.00
3,507	0.033	1	0.033	0.072	0.122	0.460	0.652	1	5	1	5	0	0	35	1,225.00
3,508	0.033	1	0.066	0.030	0.103	0.360	0.286	1	11	1	4	1	0	2	4.00
3,509	0.036	1	0.036	0.041	0.151	0.820	0.531	1	7	1	6	1	0	21	441.00
3,510	0.037	1	0.037	0.034	0.152	1.080	0.422	0	0	1	3	1	0	45	2,025.00
3,511	0.013	1	0.013	0.019	0.066	0.460	0.286	1	11	2	4	1	1	15	225.00
3,601	0.070	1	0.070	0.064	0.296	1.080	0.821	1	11	1	5	1	1	17	289.00
3,602	0.086	1	0.086	0.079	0.360	0.360	1.000	0	0	1	1	1	1	33	1,089.00
3,603	0.046	1	0.046	0.042	0.309	0.360	0.857	0	7	1	2	1	0	23	529.00
3,604	0.051	1	0.051	0.047	0.126	0.360	0.349	1	8	1	4	1	0	28	784.00
3,605	0.038	1	0.140	0.035	0.127	0.540	0.588	1	13	2	3	1	1	6	36.00
3,606	0.061	1	0.151	0.058	0.159	0.388	0.618	1	7	1	3	1	1	7	49.00
3,607	0.020	1	0.020	0.066	0.040	0.100	0.400	1	11	1	3	0	0	8	64.00
3,608	0.003	1	0.054	0.003	0.029	0.360	0.720	1	0	1	7	1	0	12	144.00
3,609	0.120	1	0.120	0.110	0.240	0.360	0.667	0	6	1	2	1	1	34	1,156.00
4,101	0.000	0	0.000	0.000	0.000	0.000	0.000	0	4	1	2	1	1	31	961.00
4,102	0.008	1	0.008	0.028	0.030	0.100	0.301	0	5	1	3	1	0	32	1,024.00
4,103	0.003	1	0.003	0.003	0.046	0.360	0.128	0	7	1	2	1	1	2	4.00
4,104	0.000	0	0.000	0.000	0.000	0.000	0.000	1	11	1	3	0	1	8	64.00
4,105	0.000	0	0.000	0.000	0.000	0.000	0.000	1	7	1	5	0	0	34	1,156.00
4,106	0.000	0	0.000	0.000	0.000	0.000	0.000	1	7	1	8	1	0	31	961.00
4,107	0.058	1	0.058	0.053	0.305	1.080	0.848	1	7	1	4	1	0	12	144.00
4,108	0.026	1	0.026	0.086	0.055	0.100	0.545	1	11	1	3	1	0	3	9.00
4,109	0.000	0	0.000	0.000	0.000	0.000	0.000	0	3	1	1	1	0	33	1,089.00

rc	CAI	Adopt	Scen 1	Scen2	Scen 3	Scen4	Scen 5	decid	edud	hhrsd	ttlbor	CAbn	tenur	famx	famEX^2
4,110	0.000	0	0.000	0.000	0.000	0.000	0.000	1	7	1	3	1	0	35	1,225.00
4,201	0.006	1	0.006	0.014	0.030	0.460	0.166	1	7	1	3	1	1	37	1,369.00
4,202	0.303	1	0.303	0.277	0.303	0.720	0.420	1	11	1	4	1	1	9	81.00
4,203	0.000	0	0.000	0.000	0.000	0.000	0.000	1	10	1	2	1	1	1	1.00
4,204	0.061	1	0.061	0.056	0.152	0.360	0.421	0	5	1	4	1	1	33	1,089.00
4,205	0.000	0	0.000	0.000	0.000	0.000	0.000	1	5	1	5	1	1	29	841.00
4,206	0.019	1	0.019	0.018	0.061	0.360	0.168	1	11	1	2	1	1	4	16.00
4,207	0.073	1	0.073	0.094	0.127	0.460	0.519	0	7	1	13	1	0	4	16.00
4,208	0.126	1	0.126	0.116	0.360	0.360	1.000	0	7	1	4	1	1	49	2,401.00
4,209	0.000	0	0.000	0.000	0.000	0.000	0.000	1	5	1	2	1	1	54	2,916.00
4,210	0.048	1	0.048	0.044	0.119	0.360	0.331	1	9	1	4	1	0	11	121.00
4,211	0.011	1	0.011	0.015	0.066	0.460	0.286	0	8	2	3	0	0	21	441.00
4,212	0.000	0	0.000	0.000	0.000	0.000	0.000	0	3	1	5	0	0	24	576.00
4,213	0.072	1	0.072	0.066	0.180	0.360	0.500	0	3	1	1	0	0	25	625.00
4,214	0.005	1	0.005	0.017	0.013	0.100	0.132	1	9	1	6	1	1	21	441.00
4,215	0.000	0	0.000	0.000	0.000	0.000	0.000	1	10	1	2	1	0	1	1.00
4,216	0.047	1	0.047	0.086	0.149	0.660	0.846	0	4	1	5	1	1	41	1,681.00
4,217	0.000	0	0.000	0.000	0.000	0.000	0.000	0	11	2	2	1	1	3	9.00
4,218	0.005	1	0.005	0.016	0.016	0.100	0.160	0	7	1	7	0	0	28	784.00

Appendix D

Data set used to estimate the double hurdle model continued

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
1,101	5	1	15	1	0	0	2.90	0.50	60.00	7.00	1	0	0	1
1,102	8	0	0	3	0	0	0.00	0.20	60.00	7.00	1	0	0	1
1,103	7	0	33	2	0	1	3.80	0.48	60.00	10.00	1	0	0	0
1,104	2	0	3	1	0	0	4.50	2.89	60.00	5.00	0	1	1	0
1,105	3	0	28	2	0	1	5.40	0.30	60.00	7.00	0	0	0	0
1,106	4	1	34	1	0	1	0.00	0.48	60.00	8.00	1	0	0	0
1,107	14	0	14	1	1	0	6.30	4.08	60.00	4.00	0	0	1	0
1,108	11	0	0	2	0	1	1.40	4.80	60.00	5.00	1	0	0	0
1,109	7	0	9	1	0	1	1.40	0.84	60.00	4.00	1	0	1	0
1,110	6	0	13	1	0	0	0.20	0.02	60.00	5.00	1	0	1	0
1,111	10	0	0	1	0	0	0.10	0.24	60.00	4.00	1	0	1	0
1,112	3	0	4	0	0	0	0.00	0.28	68.00	10.00	0	0	1	0
1,113	7	4	6	5	0	1	11.70	2.20	68.00	4.00	1	1	1	1
1,114	9	2	8	4	0	1	1.40	0.40	68.00	5.00	1	1	1	0
1,115	1	1	1	0	0	0	0.00	0.79	67.00	5.00	0	0	1	0
1,116	5	0	5	1	0	0	0.70	5.00	68.00	7.00	1	1	1	0
1,201	3	0	35	2	0	1	0.40	0.60	60.00	5.00	1	0	0	0
1,203	8	1	7	1	0	1	9.60	2.25	68.00	5.00	0	0	1	0

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
1,204	11	0	35	1	0	0	2.80	1.04	72.00	7.00	1	1	1	0
1,205	0	0	0	1	0	0	0.00	0.30	71.00	9.00	0	0	1	0
1,206	0	0	0	1	0	0	2.80	0.55	60.00	8.00	0	0	0	0
1,207	5	0	0	1	0	0	0.00	0.73	75.00	10.00	1	0	1	0
1,208	9	1	0	0	0	0	0.00	0.55	70.00	5.00	1	0	1	0
1,209	4	0	4	1	0	0	0.70	0.36	75.00	10.00	0	0	1	0
1,210	4	1	0	4	0	1	15.90	0.72	77.00	12.00	1	0	1	0
1,211	3	0	0	2	1	1	1.85	1.92	55.00	3.00	0	0	1	1
1,212	11	0	0	1	0	0	0.20	0.49	60.00	3.00	0	0	1	1
1,213	11	11	11	1	0	0	0.40	0.63	60.00	3.00	1	0	0	1
1,214	5	0	3	2	0	0	4.40	1.84	65.00	4.00	1	0	1	1
1,215	4	0	0	1	0	0	0.00	0.90	55.00	3.50	0	0	1	1
1,216	1	1	0	5	0	1	5.20	0.66	60.00	5.00	1	0	1	0
1,217	4	1	4	1	0	1	0.00	0.72	60.00	5.00	1	0	1	0
1,220	0	0	0	3	0	1	8.10	1.74	60.00	10.00	0	0	1	0
1,221	3	0	11	3	0	1	1.70	1.40	70.00	8.00	1	0	1	1
1,222	4	2	0	3	1	1	6.70	1.00	75.00	7.00	1	0	1	0
1,301	5	0	0	1	0	0	0.10	0.24	60.00	6.00	0	0	0	0
1,302	7	0	0	1	0	0	0.00	0.36	60.00	5.00	0	0	1	0
1,303	1	0	0	2	0	0	0.20	0.37	55.00	5.00	0	0	0	0
1,304	7	0	0	1	0	0	0.10	0.73	50.00	6.00	0	0	0	0
1,305	3	3	34	3	0	1	7.00	3.13	45.00	6.00	1	0	0	0
1,306	7	7	18	1	0	1	4.60	0.60	50.00	5.00	1	0	0	0
1,307	7	0	0	2	0	0	0.70	0.35	60.00	6.00	1	0	1	0

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
1,308	2	0	0	1	0	0	0.20	0.60	60.00	6.00	1	0	1	0
1,309	9	0	0	3	1	1	10.60	1.02	55.00	6.00	0	0	1	0
1,310	0	0	0	2	1	1	8.10	1.67	60.00	5.00	0	0	1	0
1,311	12	0	11	2	0	1	0.10	0.96	75.00	10.00	1	0	0	1
1,312	4	0	9	2	0	1	0.00	1.15	75.00	10.00	1	0	1	0
1,313	1	0	8	0	0	0	0.50	0.77	75.00	10.00	0	0	1	0
1,314	1	0	3	1	0	0	2.45	1.76	65.00	10.00	0	0	1	0
1,315	1	0	0	2	0	0	4.40	2.67	65.00	7.00	0	1	0	0
1,401	1	0	35	4	1	1	11.30	0.83	65.00	9.00	1	0	1	1
1,402	2	0	18	2	0	0	1.40	1.20	70.00	10.00	0	0	0	0
1,403	1	0	0	1	1	0	2.10	1.20	70.00	10.00	0	0	0	0
1,404	4	4	0	1	0	1	0.70	0.30	70.00	10.00	0	0	1	0
1,405	3	3	2	3	0	1	2.10	0.86	75.00	8.00	0	0	0	1
1,406	0	0	35	3	1	1	18.20	2.07	75.00	10.00	0	0	1	0
1,407	0	0	12	2	0	1	1.40	1.65	70.00	7.00	0	0	0	0
1,408	0	0	0	1	0	0	0.00	0.61	60.00	8.00	0	0	0	0
1,409	0	0	0	0	0	0	0.00	0.98	65.00	7.00	0	0	0	0
1,410	5	0	0	3	0	1	4.50	0.20	65.00	7.00	0	0	1	0
1,411	1	0	0	1	0	1	2.80	1.17	55.00	7.00	0	0	1	1
1,412	0	0	0	1	0	0	2.00	0.30	60.00	7.00	0	0	1	0
1,501	5	0	15	1	0	1	2.10	1.11	80.00	10.00	1	0	0	1
1,502	0	0	5	1	0	0	0.00	0.56	75.00	15.00	0	0	1	1
1,503	0	0	15	0	0	1	2.80	1.27	73.00	8.00	0	0	1	0
1,504	0	0	6	1	0	0	0.20	0.51	73.00	8.00	0	0	1	1

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
1,505	5	0	15	1	0	1	3.20	0.63	72.00	8.00	1	0	1	0
1,601	9	0	0	2	0	1	3.00	0.16	70.00	8.00	1	0	0	0
1,602	11	0	15	2	0	0	0.30	2.40	60.00	7.00	1	0	0	1
1,603	0	0	6	1	0	0	0.30	2.20	80.00	15.00	0	0	0	1
1,604	0	0	13	1	0	0	4.20	0.24	80.00	15.00	0	0	0	0
1,605	4	0	8	2	0	0	0.00	0.15	80.00	20.00	0	0	1	0
1,606	0	0	9	2	0	1	4.90	1.43	80.00	10.00	0	0	1	0
1,607	0	0	0	2	0	1	5.60	5.50	80.00	15.00	0	0	1	0
1,701	0	0	0	2	0	1	3.70	1.26	60.00	5.00	0	0	0	0
1,702	0	0	0	1	0	1	2.10	0.12	55.00	5.00	0	0	1	0
1,703	0	0	0	2	0	1	6.60	0.57	55.00	6.00	0	0	0	0
1,704	0	0	0	2	0	1	3.30	1.62	60.00	5.00	0	0	1	0
1,705	3	0	3	1	0	0	0.00	0.08	65.00	5.00	1	0	1	0
1,801	3	0	14	2	0	1	0.00	1.47	65.00	12.00	1	0	0	0
1,802	14	0	0	2	0	1	7.50	0.78	80.00	12.00	0	0	1	0
1,803	3	0	3	1	0	0	2.40	0.19	65.00	15.00	1	0	1	0
1,804	2	0	10	1	0	0	2.30	0.55	79.00	12.00	1	0	1	0
1,805	3	0	0	2	0	0	0.00	0.06	55.00	15.00	0	0	1	0
1,901	9	0	0	3	0	0	3.50	2.70	60.00	5.00	1	0	1	0
1,902	7	0	0	1	0	0	0.70	0.22	60.00	5.00	1	0	1	0
1,903	0	0	0	2	0	1	8.00	0.50	55.00	5.00	0	0	1	0
1,904	0	0	0	2	0	1	2.80	0.20	55.00	4.00	0	0	0	0
1,905	1	0	0	2	0	1	2.10	0.19	55.00	4.00	0	0	1	0
1,906	9	9	0	2	0	1	0.70	0.71	65.00	7.00	1	0	0	0

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
1,907	4	0	4	1	0	0	2.10	0.16	60.00	10.00	1	0	0	0
1,908	12	0	0	2	0	0	0.30	0.08	60.00	8.00	0	0	0	0
1,909	9	2	0	1	0	0	0.00	0.76	65.00	10.00	1	0	0	0
2,101	0	0	0	0	0	0	0.00	0.54	60.00	2.00	0	0	1	0
2,102	1	0	0	0	0	0	0.00	0.20	65.00	0.05	1	0	1	1
2,103	11	11	9	1	0	0	0.20	0.72	60.00	0.50	1	0	0	1
2,104	10	0	8	1	1	1	2.10	0.24	60.00	0.50	1	1	1	1
2,105	10	0	10	0	1	1	0.80	0.11	65.00	0.05	1	0	1	1
2,106	6	0	7	2	0	1	2.10	0.91	60.00	1.00	1	0	1	1
2,107	11	6	3	3	0	0	0.00	0.87	60.00	0.50	1	0	1	1
2,108	10	1	10	4	1	1	16.20	3.25	60.00	4.00	1	1	1	1
2,109	6	6	6	2	0	0	0.50	0.40	60.00	0.10	1	0	0	1
2,110	2	0	1	2	0	1	0.70	0.36	65.00	0.05	0	0	1	1
2,111	10	0	11	1	0	1	1.05	0.40	60.00	1.00	1	1	1	1
2,112	11	11	6	6	1	0	1.40	0.62	60.00	1.00	1	1	1	1
2,201	11	10	10	2	0	0	0.70	0.45	60.00	1.00	1	0	0	1
2,202	2	0	2	3	0	1	3.15	0.48	60.00	1.00	1	0	1	1
2,203	2	0	0	2	0	0	0.00	0.11	60.00	1.50	1	0	1	1
2,301	11	11	3	1	0	0	0.00	0.12	60.00	0.20	1	0	0	1
2,302	2	2	2	1	0	0	0.00	2.04	60.00	0.50	0	0	1	1
2,303	2	0	2	3	0	0	0.00	0.16	60.00	1.00	0	0	1	1
2,304	11	2	8	5	0	1	0.00	0.48	60.00	1.00	1	0	1	1
2,305	3	0	3	1	0	0	0.00	0.70	60.00	0.30	1	0	1	1
2,306	7	0	2	1	0	1	6.15	3.62	60.00	1.00	1	1	1	1

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
2,307	10	10	10	1	0	0	3.85	1.29	62.00	0.05	1	1	0	1
2,308	11	11	9	2	0	0	0.15	0.40	60.00	0.20	1	0	1	1
2,309	9	0	8	1	0	1	3.95	0.28	50.00	1.00	1	1	1	0
2,310	11	11	10	2	0	1	4.35	0.32	60.00	1.00	1	0	0	1
2,311	4	0	0	1	0	0	0.00	0.09	50.00	0.50	0	0	1	1
2,312	4	0	4	3	0	0	0.00	3.50	60.00	1.00	1	0	1	1
2,313	2	0	2	1	0	0	0.00	0.04	60.00	2.00	0	0	1	0
2,314	3	2	2	3	0	0	0.30	0.10	55.00	0.20	1	0	1	1
2,401	0	0	0	1	0	1	3.55	0.40	60.00	2.00	0	0	1	1
2,402	1	0	0	1	0	1	2.10	0.78	65.00	3.00	0	0	1	0
2,403	10	0	19	1	0	1	3.20	0.35	60.00	3.00	0	0	0	0
2,404	11	2	42	1	0	0	0.50	0.17	60.00	3.00	1	0	0	1
2,405	10	4	10	3	0	1	0.00	0.21	65.00	3.00	1	0	1	0
2,406	2	0	30	1	0	1	0.70	0.33	60.00	2.00	1	0	1	1
2,407	11	9	7	3	0	1	0.70	2.40	50.00	3.00	1	0	1	1
2,408	2	0	0	2	0	1	3.00	0.21	65.00	3.00	0	0	1	1
2,409	8	2	8	1	0	1	4.20	0.72	65.00	3.00	0	0	1	0
2,410	2	0	0	1	0	1	0.20	0.26	65.00	3.00	0	0	1	1
2,411	11	1	32	1	0	1	3.10	0.11	60.00	3.00	1	0	0	1
2,412	5	0	3	2	0	1	1.40	1.38	60.00	4.00	1	0	0	0
2,413	3	0	3	2	0	1	0.00	10.18	65.00	5.00	0	1	1	1
2,414	10	0	7	1	0	0	0.20	1.32	60.00	5.00	1	0	0	0
2,415	2	0	0	1	0	0	0.00	0.40	65.00	5.00	0	0	1	0
2,416	7	0	5	2	0	0	0.70	0.98	69.00	3.00	1	0	0	1

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
2,417	5	1	4	2	0	0	0.00	0.32	65.00	5.00	1	0	1	1
2,418	11	0	19	1	1	1	4.30	1.70	60.00	5.00	1	0	1	0
2,419	10	8	8	2	0	1	5.40	0.56	60.00	5.00	1	0	0	0
2,420	11	0	9	1	0	1	2.10	0.08	60.00	3.00	1	0	1	1
2,501	2	0	5	0	0	0	0.00	1.07	60.00	4.00	1	0	1	1
2,502	7	10	20	1	0	1	0.00	2.22	47.00	5.00	1	1	0	0
2,503	1	0	0	1	1	0	0.20	0.66	50.00	10.00	0	0	0	0
2,504	4	0	39	2	1	1	11.30	1.20	55.00	4.00	1	1	1	0
2,505	1	0	0	0	0	0	0.00	0.53	50.00	5.00	0	1	1	0
2,506	7	0	0	1	0	1	2.90	0.61	45.00	10.00	1	1	1	0
2,507	13	0	0	1	0	0	0.00	0.61	58.00	8.00	0	0	1	1
2,508	9	0	9	1	0	0	0.20	1.85	60.00	5.00	1	0	1	1
2,509	10	0	42	1	0	0	1.70	0.46	65.00	4.00	0	0	1	1
2,510	1	0	5	1	0	0	0.00	0.96	60.00	5.00	0	0	1	0
2,511	1	0	25	3	0	0	0.00	1.76	60.00	6.00	0	0	1	0
2,512	8	0	8	2	0	0	0.30	0.31	60.00	4.00	1	0	0	1
2,513	9	0	7	2	0	0	0.20	2.43	60.00	4.00	1	1	0	1
2,514	11	11	13	1	1	0	1.40	0.69	60.00	4.00	1	1	0	1
3,101	1	0	0	1	0	0	1.10	0.76	61.00	4.00	0	0	1	0
3,102	4	0	0	1	0	0	0.00	0.40	40.00	5.00	0	0	1	1
3,103	2	0	3	3	0	0	0.00	0.14	55.00	8.00	0	1	1	1
3,104	9	0	37	3	0	0	0.00	1.65	45.00	5.00	1	0	0	1
3,105	11	0	0	0	0	0	0.20	0.53	40.00	5.00	0	0	0	0
3,106	7	2	0	2	0	1	0.70	1.80	45.00	2.00	1	1	0	1

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
3,107	9	1	0	1	1	0	0.70	0.25	50.00	5.00	0	0	0	0
3,108	6	0	1	1	0	0	0.00	0.55	50.00	1.00	1	0	1	1
3,109	9	0	11	1	0	1	3.50	1.52	54.00	1.50	1	1	0	1
3,110	8	0	7	2	0	0	0.40	0.20	58.00	2.00	1	0	0	1
3,201	10	0	0	1	0	0	0.60	0.26	45.00	4.00	1	0	1	0
3,202	6	0	6	0	0	0	3.10	0.12	45.00	5.00	1	0	1	0
3,203	10	0	18	1	0	0	1.10	0.00	50.00	3.00	1	0	1	0
3,204	11	0	0	1	0	1	6.40	0.06	45.00	4.00	1	0	1	0
3,240	11	0	0	0	0	0	0.10	0.12	50.00	5.00	1	0	1	0
3,301	10	0	7	1	0	0	0.00	0.43	45.00	1.00	1	0	1	0
3,302	2	0	0	2	0	0	3.50	0.24	47.00	1.00	1	1	1	1
3,303	10	1	22	1	0	0	0.30	1.58	55.00	1.00	1	0	1	1
3,304	11	0	35	1	0	1	1.40	0.00	60.00	3.00	1	0	0	1
3,305	11	0	3	2	0	0	0.00	0.60	60.00	3.00	1	0	1	0
3,306	11	2	0	1	0	1	4.20	0.38	45.00	2.00	1	0	0	1
3,307	12	9	12	2	0	0	0.80	0.86	45.00	3.00	1	0	0	1
3,401	7	0	0	0	1	0	0.40	1.46	40.00	2.00	1	0	0	0
3,402	9	2	0	4	0	1	2.10	0.25	40.00	2.00	1	1	0	0
3,403	7	0	0	3	1	1	0.00	1.37	40.00	2.00	1	0	0	1
3,404	10	1	0	1	0	1	8.10	4.09	55.00	1.00	0	1	1	1
3,405	11	3	45	2	0	1	9.50	1.22	57.00	1.50	1	0	0	1
3,406	5	0	24	2	0	0	0.00	0.40	57.00	5.00	1	0	1	1
3,407	5	0	0	2	0	1	2.80	1.48	54.00	1.00	1	0	0	1
3,408	4	0	0	0	0	0	4.30	0.47	55.00	5.00	1	0	1	1

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
3,409	10	1	10	0	0	1	0.00	0.22	58.00	1.00	1	0	1	1
3,410	1	0	0	1	0	0	0.50	0.08	45.00	6.00	0	0	1	1
3,411	7	0	6	2	0	0	0.20	0.08	45.00	7.00	1	0	1	0
3,501	9	0	9	2	0	0	0.60	0.23	50.00	3.00	1	1	1	0
3,502	9	0	9	1	0	1	0.30	0.20	40.00	3.00	1	0	1	0
3,503	9	0	17	2	0	1	6.10	0.88	50.00	3.00	1	1	1	0
3,504	9	0	0	2	0	1	4.70	0.20	40.00	2.00	1	0	1	0
3,505	1	0	0	3	0	0	0.00	0.28	45.00	2.00	0	0	1	0
3,506	12	2	35	1	0	0	1.10	0.50	72.00	12.00	1	0	1	1
3,507	5	0	25	2	0	1	4.50	0.48	58.00	1.00	1	0	0	0
3,508	11	11	2	1	0	1	11.80	1.70	57.00	4.00	1	1	0	1
3,509	7	0	21	1	0	1	4.20	3.35	50.00	2.00	0	0	1	1
3,510	6	0	6	2	0	1	2.50	0.61	57.00	2.00	1	0	1	1
3,511	13	0	15	1	0	0	0.60	0.74	57.00	4.00	0	0	1	1
3,601	11	11	0	1	1	0	0.60	0.32	60.00	5.00	1	0	0	1
3,602	11	0	0	0	1	0	0.00	0.10	60.00	7.00	1	0	0	0
3,603	10	0	0	2	0	0	0.00	0.15	60.00	6.00	0	0	0	0
3,604	11	8	25	3	1	1	2.60	1.95	60.00	5.00	1	0	0	1
3,605	6	6	5	1	0	0	0.50	1.86	70.00	5.00	1	0	0	1
3,606	6	0	5	1	0	0	0.60	0.96	60.00	5.00	0	0	1	0
3,607	8	0	7	1	0	0	0.00	0.47	68.00	4.00	0	0	1	0
3,608	2	0	8	2	1	1	5.70	1.08	69.00	4.00	1	0	1	0
3,609	10	0	10	2	0	0	0.00	0.27	70.00	5.00	1	0	1	1
4,101	4	1	0	1	0	1	3.10	0.16	65.00	15.00	0	0	0	0

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
4,102	0	0	33	2	0	0	3.80	1.20	83.00	20.00	0	0	0	0
4,103	2	0	0	1	0	0	0.10	0.95	75.00	15.00	0	0	0	0
4,104	1	0	0	1	0	0	2.40	1.80	60.00	15.00	0	0	1	0
4,105	0	0	0	3	0	1	8.30	3.92	60.00	20.00	0	0	1	0
4,106	1	0	15	3	0	1	3.60	1.12	71.00	6.00	0	0	0	0
4,107	10	0	11	1	0	0	0.00	0.83	75.00	12.00	1	0	0	0
4,108	0	0	2	1	0	0	1.40	0.16	75.00	10.00	0	0	1	0
4,109	1	0	33	1	0	0	0.10	0.24	75.00	15.00	0	0	0	0
4,110	2	0	0	2	0	1	5.70	2.31	70.00	10.00	1	0	0	0
4,201	11	0	11	3	0	1	3.70	0.48	60.00	10.00	1	0	1	0
4,202	9	0	8	3	0	0	0.00	0.40	60.00	15.00	0	0	1	0
4,203	0	0	0	1	0	0	0.40	0.32	60.00	15.00	0	0	0	0
4,204	3	0	0	3	0	0	0.00	0.39	75.00	15.00	0	0	1	0
4,205	2	0	0	2	0	0	1.60	0.08	60.00	15.00	1	0	1	0
4,206	4	0	0	3	0	0	0.20	1.52	55.00	7.00	0	0	1	0
4,207	5	0	4	3	0	1	1.40	1.71	80.00	30.00	0	0	0	1
4,208	3	3	3	0	0	0	0.20	0.00	76.00	15.00	0	0	1	1
4,209	0	0	0	1	0	0	5.90	0.24	60.00	10.00	0	0	1	0
4,210	8	0	10	1	0	1	0.70	0.69	68.00	10.00	1	0	0	1
4,211	6	0	21	1	0	0	1.00	1.50	68.00	4.00	1	0	0	1
4,212	0	0	23	1	0	1	4.90	0.93	68.00	3.00	0	0	1	0
4,213	5	0	0	1	0	0	0.00	0.70	68.00	3.00	0	0	1	1
4,214	2	0	3	3	0	0	0.00	0.66	77.00	12.00	1	0	0	0

rc	Basin yrs	Mulch yrs	Rotat yrs	Land endow	fence	plough	LU	liquidity	Distn mkt	Dist agri	Ca input	CAhlab	Adv social	CAext cur
4,215	0	0	0	0	0	0	0.00	0.36	68.00	3.00	0	0	1	0
4,216	12	7	12	1	0	0	2.80	0.70	65.00	10.00	1	0	0	1
4,217	0	0	0	2	0	0	2.50	0.51	75.00	13.00	0	0	0	1
4,218	0	0	26	2	0	1	6.70	1.36	70.00	15.00	0	0	0	0

Appendix E

Variance inflation factors

Variable	(Decision to adopt CA)		(Intensity of CA use)	
	VIF Before transforming farmexp	VIF After transforming farmexp	VIF Before transforming farmexp	VIF After transforming farmexp
Decid	1.23	1.25	1.25	1.27
Edudc	1.97	1.97	1.97	1.97
Hhresid	1.26	1.27	1.26	1.27
Ttlabour	1.31	1.36	1.33	1.37
CAbenefit	1.17	1.17	1.18	1.18
tenureperc	1.21	1.21	1.31	1.31
Farmexp	2.24	14.54	2.24	14.74
Farmexp sqd		11.79		11.97
Basinyrs	1.75	1.76	1.57	1.60
Mulchyrs	1.31	1.31	1.48	1.49
Rotatyrs	1.33	1.40	1.34	1.43
Landendow	1.28	1.28	1.28	1.29
Fence	1.15	1.15	1.15	1.16
Plough	1.70	1.70	1.71	1.71
LU	1.73	1.73	1.82	1.82
Liquidity	1.18	1.18	1.31	1.32
Distnmkt	1.60	1.61	1.67	1.67
Distagri	1.69	1.69	1.92	1.92
CAinput	1.59	1.61		
CAhlab			1.30	1.31
Advsocial			1.33	1.34
CAextcur			1.32	1.34
Mean VIF	1.48	2.68	1.49	2.60

Appendix F

Heckman test for selection bias

Variable	(Decision to adopt CA)		(Intensity of CA use)	
Decid	-0.8337	(0.005)	-0.0205	(0.051)
Edudc	0.0173	(0.697)	0.0019	(0.283)
Hhresid	-0.4127	(0.294)	0.0075	(0.648)
Ttlabour	0.1017	(0.221)	0.0049	(0.093)
CAbenefit	0.5315	(0.166)	0.0042	(0.812)
tenureperc	-0.1366	(0.644)	-0.0042	(0.676)
Farmexp	-0.0546	(0.073)	-0.0013	(0.266)
Farmexp sqd	0.0006	(0.249)	0.0001	(0.075)
Basinyrs	0.2887	(0.000)	0.0034	(0.078)
Mulchyrs	-0.0505	(0.549)	0.0032	(0.080)
Rotatyrs	0.0373	(0.026)	-0.0006	(0.243)
Landendow	0.4962	(0.010)	0.0132	(0.011)
Fence	-0.2432	(0.620)	-0.0096	(0.522)
Plough	-1.2923	(0.001)	-0.0335	(0.007)
LU	0.0249	(0.671)	0.0016	(0.392)
Liquidity	0.1068	(0.459)	0.0024	(0.584)
Distnmkt	0.0134	(0.426)	-0.0014	(0.020)
Distagri	-0.0901	(0.012)	0.0014	(0.375)
CAinput	0.1576	(0.658)		
CAhlab			0.0258	(0.069)
Advsocial			0.0232	(0.031)
CAextcur			0.0128	(0.193)
Constant	-0.2185	(0.856)	0.0810	(0.092)
Inverse Mills Ratio			**0.023**	**(0.412)**
Wald statistic (20)	64.78	(0.000)		
Number of observations	237			

Fingure in parantheses are p-values

Appendix G

Double huddle results without transformed farm experience

Variable	First hurdle (Decision to adopt CA)		Second hurdle (Intensity of CA use)	
Decid	-0.7885	(-2.70) ***	-0.0660	(-1.25)
Edudc	0.0232	(0.52)	-0.0105	(-1.13)
Hhresid	-0.3860	(-0.98)	0.0507	(0.63)
Ttlabour	0.0841	(1.06)	0.0143	(1.05)
CAbenefit	0.5453	(1.45)	0.0198	(0.17)
tenureperc	-0.1343	(-0.46)	-0.0087	(-0.17)
Farmexp	-0.0223	(-2.01) **	0.0028	(1.27)
Basinyrs	0.2847	(4.60) ***	0.0129	(1.58)
Mulchyrs	-0.0537	(-0.64)	0.0109	(1.34)
Rotatyrs	0.0314	(1.99) **	-0.0046	(-1.63)
Landendow	0.4760	(2.51) **	0.0340	(1.63)
Fence	-0.1857	(-0.38)	-0.0566	(-0.77)
Plough	-1.3256	(-3.58) ***	-0.1406	(-1.99) **
LU	0.0251	(0.43)	0.0079	(0.98)
Liquidity	0.1117	(0.74)	0.0111	(0.59)
Distnmkt	0.0144	(0.86)	-0.0083	(-2.20) **
Distagri	-0.0932	(-2.67) ***	0.0120	(1.58)
CAinput	0.1048	(0.30)		
CAhlab			0.1042	(1.58)
Advsocial			0.1165	(1.90) *
CAextcur			0.0935	(1.71) *
Constant	-0.4608	(-0.39)	-0.0333	(-0.13)
Wald statistic (18)	53.69 ***			
Number of observations	237			

***, ** and * denote 1, 5 and 10% significance levels respectively.

Fingure in parantheses are z-values

Appendix H

Definitions of variables for additional household data used to compute descriptive statistics

Variable	Description of variable
gendhh	Gender of household head, (1=male, otherwise 0)
Agehh	Age of household head (year)
educhh	Education of household head (years)
Hhsize	Household size (total number of people residing at a homestead)
Hhfemal16	Number of female household members above the age of 16
Hhmale16	Number of male household members above the age of 16
Hhbelw16	Number of household members under the age of 16
cattleown	Ownership of cattle by household (1=yes, otherwise 0)
CAextpast	Access to CA extension in the past before 2013/2014 cropping season
CAcollab	Use of collective labour in CA plots
Cultarea	Total area cultivated (ha) in the 2014/15 cropping season
Fallow	Total area left fallow (ha) in the 2014/15 cropping season
Rdtillpst	Implementation of reduced tillage technique prior to 2014/15 cropping season (1=yes, otherwise 0)
Mulchpst	Implementation of mulching component prior to 2014/15 season (1=yes, otherwise 0)
Rotatpst	Implementation of crop rotation component prior to 2014/15 season (1=yes, otherwise 0)
rtcurnt	Implementation of reduced tillage during the 2014/15 cropping season (1=yes, otherwise 0)
Mlchcurnt	Implementation of mulching during the 2014/15 cropping season (1=yes, otherwise 0)
Crcurnt	Implementation of crop rotation component during the 2014/15 cropping season (1=yes, otherwise 0)

Variable	Description of variable
Influrt	Factors that influence household to practise reduced tillage
Influmlch	Factors that influenced household to practise mulching
Influcr	Factors that influence household to practise crop rotation
Reasrt	Reasons for not implementing reduced tillage
Reasmlch	Reasons for not implementing mulching
Reascr	Reasons for not implementing crop rotation
Agricadvc	Sources that were used for farming advices

Relevant codes for household data used in descriptive analysis

General code, -8 = Not applicable

Codes for influrt, influmlch and influcr

1=Government extension
2=NGO
3=Lead farmer
4=Neighbour
5=School
7=Need to improve yield
8=Social groups
13=Both NGO and Government extension

Codes for reasrt

1=labour challenges
2=Shortage of inputs
3=lack of Knowledge
4=availability of farm implements

Codes for reasmlch

31=labour challenges
32=lack of knowledge
33=No perceived benefits
36=crop residues used as Livestock feed
37=Mulch destroyed by termites
38= Plot not fenced/prone to livestock
39=Cop residue used to compost

Codes for reascr

61=Gives preference to cereal crops
62=Lack of knowledge
63=Labour challenges
64=Few farming seasons
65=legume seed not available

Codes for agricadvc

1=Religious leader
2=Political leader
3=Lead farmer
4=Village elder
5=Family or relative
6=Neighbour
8=Government extension
9=NGO agent

Appendix I

Household data used to compute descriptive statistics

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
1,101	1	40	8	6	3	1	2	1	1	0	0.95	0.00
1,102	1	63	8	7	2	2	3	0	1	0	0.81	2.02
1,103	1	70	11	8	3	2	3	1	1	0	2.21	0.12
1,104	1	36	13	4	1	0	3	1	0	0	0.68	0.00
1,105	0	76	2	6	1	0	5	1	0	0	1.92	0.00
1,106	1	56	7	4	1	1	2	0	1	0	0.75	0.00
1,107	1	35	9	6	2	2	2	1	0	0	0.55	0.81
1,108	1	85	2	10	4	2	4	1	1	0	2.17	0.00
1,109	1	40	8	6	1	1	4	1	1	0	1.19	0.00
1,110	1	83	5	6	1	2	3	0	1	0	0.95	0.00
1,111	1	38	11	6	1	1	4	0	1	0	0.15	0.81
1,112	1	27	12	4	1	1	2	0	0	0	0.45	0.00
1,113	1	36	10	7	1	1	5	1	1	0	4.71	0.00
1,114	0	71	2	4	1	1	2	1	1	0	0.70	3.00
1,115	0	97	2	2	2	0	0	0	1	0	0.38	0.10
1,116	1	40	11	5	1	1	3	1	1	0	0.82	0.20
1,201	1	82	3	4	1	1	2	0	1	0	0.24	1.62
1,203	1	40	11	6	1	2	3	1	1	0	1.23	0.00
1,204	0	49	0	2	1	0	1	1	1	1	0.80	0.30
1,205	1	31	11	5	1	1	3	0	0	0	0.75	0.00
1,206	0	66	6	2	2	0	0	1	0	0	1.16	0.20

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
1,207	1	57	3	6	1	1	4	0	1	0	1.00	0.00
1,208	1	35	7	8	1	1	6	0	1	0	0.35	0.00
1,209	1	25	11	3	1	1	1	1	0	0	0.66	0.00
1,210	1	32	11	14	3	2	9	1	1	0	3.56	0.00
1,211	1	83	0	4	1	1	2	1	1	0	1.77	0.00
1,212	1	40	10	6	1	2	3	0	1	0	0.58	0.00
1,213	1	54	11	9	1	1	7	0	1	0	0.56	0.00
1,214	0	43	10	4	1	1	2	1	1	0	1.25	0.63
1,215	1	54	11	6	2	1	3	0	1	0	0.50	0.50
1,216	1	31	12	9	2	4	3	1	1	0	4.75	0.00
1,217	0	71	0	8	2	1	5	0	1	0	0.50	0.00
1,220	1	76	4	7	1	1	5	1	0	0	2.30	0.81
1,221	1	62	3	7	2	1	4	1	1	0	1.81	0.81
1,222	1	46	11	6	1	2	3	1	1	0	2.52	0.00
1,301	1	44	6	4	0	1	3	0	0	0	0.72	0.00
1,302	0	97	6	4	2	0	2	0	0	0	0.08	0.81
1,303	1	40	11	6	1	2	3	0	0	0	1.65	0.00
1,304	0	54	7	4	1	1	2	0	0	0	0.32	0.20
1,305	1	46	11	3	1	2	0	1	1	0	3.10	0.00
1,306	1	49	7	6	1	2	3	1	1	0	1.08	0.20
1,307	1	35	11	5	1	1	3	0	0	0	1.26	0.81
1,308	0	51	7	2	1	1	0	0	1	0	1.08	0.20
1,309	0	56	8	9	2	3	4	1	0	0	3.16	0.00
1,310	1	60	7	5	1	2	2	1	0	0	1.33	0.21

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
1,311	1	62	8	7	3	1	3	0	1	0	1.12	0.40
1,312	1	33	11	5	1	1	3	0	1	0	1.24	0.80
1,313	1	33	11	3	1	1	1	0	0	0	0.40	0.08
1,314	0	56	3	4	1	1	2	1	0	0	1.10	0.02
1,315	1	56	9	8	2	3	3	1	0	1	1.56	0.20
1,401	1	55	7	5	1	2	2	1	1	0	3.37	0.25
1,402	1	43	9	3	1	1	1	1	0	0	1.13	0.40
1,403	1	30	11	3	1	0	2	1	0	0	0.42	0.61
1,404	1	40	11	2	1	0	1	1	1	0	0.78	0.00
1,405	0	79	7	8	3	2	3	1	1	0	1.93	0.81
1,406	1	64	11	8	4	2	2	1	0	0	2.64	0.00
1,407	1	36	9	2	2	0	0	1	0	0	1.00	0.81
1,408	1	41	9	7	1	1	5	0	0	0	1.13	0.00
1,409	1	24	7	3	1	1	1	0	0	0	0.44	0.00
1,410	1	67	7	8	2	1	5	1	0	0	2.56	0.00
1,411	1	30	11	5	1	1	3	1	1	0	0.66	0.81
1,412	1	28	11	5	1	1	3	1	0	0	0.91	0.40
1,501	1	62	9	13	1	2	10	1	1	0	1.00	0.00
1,502	1	30	9	3	1	0	2	0	1	0	1.14	0.00
1,503	1	49	11	5	2	1	2	1	0	0	0.48	0.00
1,504	1	30	9	4	1	1	2	0	0	0	1.08	0.20
1,505	1	55	7	6	2	2	2	1	1	0	1.00	0.00
1,601	1	77	7	6	1	3	2	1	1	0	1.82	0.40
1,602	1	45	11	7	1	2	4	0	1	0	1.10	1.00

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
1,603	1	36	11	3	1	1	1	0	1	0	0.60	0.60
1,604	1	58	7	5	1	1	3	1	0	0	1.00	0.00
1,605	1	78	11	4	1	2	1	0	0	0	1.43	0.60
1,606	1	54	5	8	3	1	4	1	0	0	2.28	0.00
1,607	1	30	11	5	1	1	3	1	0	0	2.20	0.20
1,701	1	51	7	8	3	1	4	1	0	0	2.37	0.00
1,702	0	52	0	2	1	0	1	1	0	0	0.40	1.00
1,703	1	60	6	6	0	2	4	1	0	0	1.82	0.00
1,704	1	37	9	6	2	0	4	1	0	0	0.75	0.81
1,705	0	39	9	5	1	1	3	0	1	0	1.24	0.00
1,801	1	58	11	13	2	4	7	0	1	0	1.28	0.40
1,802	0	49	10	5	2	0	3	1	0	0	1.76	0.04
1,803	1	39	10	9	1	3	5	1	1	0	1.40	0.00
1,804	1	45	7	5	1	1	3	1	1	0	1.24	0.00
1,805	1	34	8	5	1	1	3	0	1	0	1.35	0.61
1,901	1	35	11	6	1	1	4	1	1	0	2.90	0.12
1,902	0	27	11	5	1	0	4	0	1	0	0.94	0.40
1,903	1	46	11	9	2	4	3	1	0	0	2.41	0.00
1,904	1	42	11	10	2	1	7	1	0	0	1.62	0.00
1,905	0	52	0	7	3	1	3	1	0	0	1.57	0.08
1,906	0	63	0	10	3	1	6	0	1	0	1.13	0.61
1,907	0	68	0	3	1	0	2	1	0	0	0.68	0.00
1,908	1	38	11	6	1	1	4	0	0	0	2.07	0.40
1,909	0	69	0	3	2	1	0	0	0	0	0.52	0.40

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
2,101	0	39	7	4	1	0	3	0	0	0	0.40	0.00
2,102	1	32	10	8	3	3	2	0	0	0	0.33	0.00
2,103	0	46	9	5	1	1	3	0	1	0	0.80	0.00
2,104	0	88	3	2	1	1	0	1	1	0	1.18	0.00
2,105	0	65	3	5	2	0	3	1	1	0	0.49	0.00
2,106	1	39	13	6	2	1	3	1	1	0	2.23	0.00
2,107	0	67	5	5	3	0	2	0	1	0	1.29	2.00
2,108	1	60	7	6	2	2	2	1	1	0	1.80	2.00
2,109	1	65	11	4	2	1	1	0	1	0	0.93	1.21
2,110	0	35	7	5	3	0	2	1	1	0	0.78	0.81
2,111	1	60	4	7	3	1	3	1	1	0	0.71	0.40
2,112	1	47	11	5	1	2	2	1	1	0	6.22	0.00
2,201	1	54	6	5	1	3	1	1	1	1	0.86	1.00
2,202	1	32	9	4	1	1	2	1	1	0	0.35	2.57
2,203	1	31	8	5	1	1	3	0	1	0	1.56	0.00
2,301	0	37	11	5	2	0	3	0	1	0	1.08	0.00
2,302	1	27	11	5	1	1	3	0	1	0	0.30	0.40
2,303	1	29	7	3	1	1	1	0	1	0	0.24	2.50
2,304	1	80	0	10	3	2	5	0	1	0	0.94	4.00
2,305	1	37	11	5	1	1	3	0	1	0	0.85	0.00
2,306	1	38	8	7	1	2	4	1	1	0	1.30	0.08
2,307	1	51	7	6	2	1	3	1	1	0	1.10	0.00
2,308	0	63	5	12	1	3	8	0	1	1	1.31	0.81
2,309	1	40	10	5	1	1	3	1	1	0	1.29	0.00

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
2,310	1	68	5	5	1	3	1	1	1	0	1.50	0.00
2,311	1	25	9	4	1	1	2	0	1	0	0.46	0.05
2,312	1	29	11	4	1	1	2	0	1	0	1.69	1.00
2,313	0	58	4	5	3	0	2	0	0	0	0.82	0.00
2,314	1	28	8	4	1	1	2	0	1	0	3.20	0.00
2,401	0	98	2	5	3	1	1	1	1	0	0.55	0.40
2,402	1	28	9	5	1	1	3	1	1	0	1.15	0.00
2,403	1	42	11	5	2	2	1	1	0	0	0.84	0.00
2,404	0	67	6	5	1	1	3	0	1	0	0.79	0.00
2,405	1	54	7	2	1	1	0	0	1	0	2.22	0.28
2,406	0	63	2	5	2	0	3	1	1	0	0.75	0.50
2,407	1	47	11	5	2	2	1	1	1	0	1.09	1.70
2,408	0	57	5	4	3	0	1	1	1	0	1.26	1.00
2,409	1	42	11	7	2	3	2	1	1	0	0.78	0.00
2,410	0	57	0	6	2	2	2	0	1	0	1.05	0.00
2,411	0	52	0	4	1	1	2	1	1	0	0.56	0.00
2,412	1	68	4	11	4	2	5	1	1	0	1.48	0.40
2,413	0	64	6	8	3	2	3	0	0	0	1.96	0.00
2,414	0	55	2	5	1	1	3	0	1	0	0.55	0.81
2,415	0	65	4	2	1	0	1	0	0	0	0.80	0.00
2,416	1	40	11	6	1	1	4	1	1	0	0.81	1.62
2,417	1	60	5	4	0	2	2	0	1	0	1.53	0.61
2,418	1	40	7	10	2	2	6	1	1	0	0.69	0.40
2,419	1	78	7	5	1	3	1	1	1	0	1.72	0.00

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
2,420	0	73	2	2	1	0	1	1	1	0	0.62	0.00
2,501	0	37	7	2	1	1	0	0	1	0	0.22	0.00
2,502	1	43	11	1	0	1	0	0	1	0	0.53	0.12
2,503	1	30	8	5	1	1	3	0	0	0	0.22	1.00
2,504	0	62	5	3	1	1	1	1	0	0	1.58	0.00
2,505	1	26	9	4	1	1	2	0	0	1	0.19	0.13
2,506	1	35	7	11	2	2	7	1	1	0	0.96	0.00
2,507	1	43	11	1	0	1	0	0	1	0	0.25	1.10
2,508	1	42	11	8	1	3	4	0	1	0	1.05	0.25
2,509	1	64	4	5	1	2	2	1	1	0	0.98	0.00
2,510	0	78	7	3	1	0	2	0	0	0	1.17	0.24
2,511	0	53	6	9	2	2	5	0	0	0	0.99	2.00
2,512	1	34	11	5	1	1	3	0	1	0	1.30	0.25
2,513	1	40	11	4	1	2	1	0	1	0	1.82	0.00
2,514	1	53	11	4	1	2	1	1	1	0	0.75	0.25
3,101	1	33	11	2	1	0	1	1	1	0	0.37	0.20
3,102	0	70	6	2	1	0	1	0	1	0	0.70	0.00
3,103	1	33	11	3	1	1	1	0	1	0	1.59	1.50
3,104	0	75	8	7	2	1	4	0	1	0	0.35	2.50
3,105	1	25	10	3	1	1	1	0	0	0	0.37	0.12
3,106	1	60	8	11	1	2	8	0	1	0	1.58	0.40
3,107	1	67	8	9	4	2	3	0	1	0	0.70	0.32
3,108	0	79	0	1	0	0	0	0	1	0	0.54	0.30
3,109	0	68	4	2	2	0	0	1	1	0	0.50	0.00

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
3,110	1	40	10	5	1	1	3	0	1	0	0.37	2.00
3,201	1	48	11	6	2	1	3	0	1	0	1.04	0.14
3,202	0	39	11	5	1	1	3	1	1	0	0.39	0.00
3,203	1	53	9	3	1	1	1	1	1	0	0.60	0.00
3,204	1	63	5	6	1	3	2	1	1	0	0.69	0.00
3,240	0	56	1	2	1	0	1	0	1	0	0.41	0.00
3,301	0	44	7	8	2	3	3	0	1	0	0.94	0.40
3,302	0	64	3	3	1	0	2	1	1	0	1.17	0.40
3,303	1	52	11	6	3	1	2	0	1	0	0.60	0.28
3,304	0	61	3	4	1	2	1	0	1	0	0.39	0.25
3,305	1	40	9	9	2	1	6	0	1	0	0.85	1.00
3,306	0	69	0	3	1	0	2	1	1	0	0.72	0.20
3,307	1	44	11	5	1	3	1	0	1	0	0.94	0.61
3,401	1	40	10	5	1	1	3	0	1	0	0.27	0.20
3,402	1	93	2	3	1	2	0	1	1	0	1.73	2.00
3,403	1	65	4	9	3	2	4	0	1	0	0.65	2.00
3,404	1	54	7	11	2	2	7	1	1	0	0.55	0.50
3,405	1	75	6	5	2	1	2	1	1	0	2.06	0.20
3,406	1	46	7	6	1	1	4	0	0	0	0.90	0.81
3,407	0	37	11	8	1	2	5	1	1	0	1.25	0.35
3,408	1	35	11	4	1	1	2	1	1	0	0.30	0.10
3,409	1	76	0	1	0	1	0	0	1	0	0.20	0.00
3,410	1	28	11	4	1	2	1	0	0	0	1.15	0.00
3,411	1	40	11	6	1	3	2	0	1	0	1.39	0.81

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	cattleown	CAextpast	cacollab	cultarea	fallow
3,501	0	51	7	3	2	0	1	0	1	0	1.37	0.40
3,502	0	47	7	8	2	4	2	0	1	0	0.70	0.28
3,503	1	66	8	3	1	1	1	1	1	0	1.58	0.04
3,504	1	61	8	9	2	2	5	1	1	0	1.70	0.28
3,505	1	30	11	5	1	1	3	0	0	0	2.80	0.00
3,506	0	42	7	5	3	0	2	0	1	0	1.16	0.08
3,507	1	60	5	5	2	1	2	1	1	0	0.92	0.80
3,508	1	30	11	6	1	2	3	1	1	0	1.12	0.00
3,509	1	56	7	6	2	3	1	1	1	0	1.28	0.00
3,510	0	63	0	5	2	1	2	1	1	0	1.66	0.00
3,511	0	40	11	4	2	1	1	0	1	0	1.40	0.00
3,601	1	56	11	6	1	1	4	0	1	0	0.84	0.00
3,602	0	60	0	1	1	0	0	0	1	0	0.24	0.00
3,603	0	65	7	4	1	0	3	0	0	0	0.18	2.00
3,604	1	59	8	6	2	1	3	1	1	0	1.16	2.02
3,605	1	35	13	3	2	1	0	0	1	0	0.85	0.20
3,606	1	33	7	5	1	1	3	0	1	0	0.78	0.00
3,607	1	30	11	4	1	1	2	0	0	0	1.25	0.00
3,608	1	59	0	7	3	3	1	1	1	0	1.25	0.25
3,609	0	77	6	2	1	1	0	0	1	0	0.75	1.00
4,101	0	50	4	2	1	0	1	1	1	0	1.28	0.00
4,102	1	57	7	5	1	1	3	1	0	0	0.93	1.21
4,103	1	30	11	5	0	2	3	0	0	0	0.55	0.20
4,104	1	33	11	5	1	1	3	1	1	0	0.82	0.40

rc	gendhh	agehh	educhh	hhsize	hhfemel16	hhmale16	hhbelw16	Cattleown	CAextpast	cacollab	cultarea	fallow
4,105	1	59	7	6	2	3	1	1	0	0	2.81	0.00
4,106	1	54	7	11	2	2	7	1	1	0	2.20	0.40
4,107	1	40	7	6	1	2	3	0	1	0	0.66	0.60
4,108	1	31	11	5	1	2	2	1	0	0	0.88	0.00
4,109	0	51	3	1	0	1	0	0	0	0	0.75	0.00
4,110	1	64	7	6	1	1	4	1	1	0	1.65	0.20
4,201	1	61	7	5	1	1	3	1	1	0	2.65	0.00
4,202	1	40	11	4	1	1	2	0	1	0	2.38	0.40
4,203	1	26	10	4	1	1	2	0	0	0	0.39	0.40
4,204	0	55	5	6	1	0	5	0	1	0	0.95	1.62
4,205	1	63	5	7	1	1	5	1	1	0	1.01	0.81
4,206	1	28	11	4	1	1	2	0	1	0	1.90	1.00
4,207	0	44	7	13	5	4	4	1	1	0	2.08	1.20
4,208	0	75	7	8	1	1	6	0	1	1	0.35	0.00
4,209	1	83	5	3	1	1	1	1	0	0	0.83	0.40
4,210	1	61	9	5	0	2	3	0	1	0	1.21	0.00
4,211	0	40	8	3	1	1	1	1	1	0	1.12	0.00
4,212	0	60	3	6	1	2	3	1	0	0	0.90	0.00
4,213	0	48	3	1	1	0	0	0	1	0	0.80	0.00
4,214	1	39	9	7	1	3	3	0	1	0	3.04	0.00
4,215	1	38	10	4	1	1	2	0	0	0	0.20	0.00
4,216	1	78	4	8	1	2	5	1	1	1	1.35	0.00
4,217	1	26	11	7	2	0	5	1	1	0	1.68	0.81
4,218	1	56	5	9	1	3	5	1	0	0	1.87	0.00

Appendix J

Household data used to compute descriptive statistics continued

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
1,101	1	1	1	0	0	1	2	2	2	-8	-8	-8	8
1,102	1	0	0	1	0	0	2	-8	-8	-8	31	61	8
1,103	1	0	1	1	0	1	2	-8	1	-8	31	-8	-8
1,104	1	0	1	0	0	1	4	-8	8	-8	39	-8	5
1,105	1	0	1	0	0	0	2	-8	1	-8	32	-8	-8
1,106	1	1	1	1	0	1	2	2	1	-8	-8	-8	-8
1,107	1	0	1	1	0	1	3	-8	8	-8	33	-8	6
1,108	1	0	0	1	0	0	2	-8	-8	-8	31	61	8
1,109	1	0	1	1	0	1	2	-8	2	-8	32	-8	3
1,110	1	0	1	1	0	1	2	-8	4	-8	31	-8	8
1,111	1	0	0	1	0	0	2	-8	-8	-8	31	61	4
1,112	1	0	1	1	0	1	7	-8	7	-8	32	-8	5
1,113	1	1	1	1	0	1	1	1	1	-8	-8	-8	3
1,114	1	1	1	1	0	1	2	2	2	-8	-8	-8	5
1,115	1	1	1	0	0	0	1	1	1	-8	-8	-8	5
1,116	1	0	1	1	0	1	4	-8	4	-8	31	-8	6
1,201	1	0	1	0	0	1	2	-8	1	-8	36	-8	8
1,203	1	1	1	0	0	0	4	4	4	-8	-8	-8	5
1,204	1	0	1	1	0	1	2	-8	1	-8	31	-8	5
1,205	0	0	0	0	0	0	-8	-8	-8	-9	31	-8	5

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
1,206	0	0	0	0	0	0	-8	-8	-8	-8	32	62	-8
1,207	1	0	0	0	0	0	2	-8	-8	-8	38	62	3
1,208	1	1	0	0	0	0	2	2	-8	-8	-8	62	3
1,209	1	0	1	1	0	1	4	-8	4	-8	32	-8	5
1,210	1	1	0	1	0	0	2	2	-8	-8	-8	62	3
1,211	1	0	0	1	0	0	4	-8	-8	-8	32	62	6
1,212	1	0	0	1	0	0	4	-8	-8	-8	38	62	6
1,213	1	1	1	1	1	1	2	2	2	-8	-8	-8	8
1,214	1	0	1	1	0	1	2	-8	2	-8	38	-8	3
1,215	1	0	0	1	0	0	4	-8	-8	-8	37	-8	6
1,216	1	1	0	0	0	0	2	2	-8	-8	-8	61	3
1,217	1	1	1	1	0	1	2	2	2	-8	-8	-8	3
1,220	0	0	0	0	0	0	-8	-8	-8	1	31	63	4
1,221	1	0	1	1	0	1	2	-8	1	-8	38	-8	3
1,222	1	1	0	0	0	0	2	2	-8	-8	-8	61	3
1,301	1	0	0	1	0	0	4	-8	-8	-8	31	61	-8
1,302	1	0	0	1	0	0	4	-8	-8	-8	38	65	5
1,303	1	0	0	1	0	0	4	-8	-8	-8	32	64	8
1,304	1	0	0	1	0	0	4	-8	-8	-8	31	61	-8
1,305	1	1	1	0	0	1	2	2	1	-8	-8	-8	-8
1,306	1	1	1	1	1	1	2	2	1	-8	-8	-8	-8
1,307	1	0	0	1	0	0	4	-8	-8	-8	31	61	6
1,308	1	0	0	1	0	0	2	-8	-8	-8	38	61	5
1,309	1	0	0	1	0	0	4	-8	-8	-8	39	61	5

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
1,310	0	0	0	0	0	0	-8	-8	-8	1	38	63	5
1,311	1	0	1	1	0	1	2	-8	1	-8	36	-8	8
1,312	1	0	1	1	0	1	4	-8	4	-8	36	-8	3
1,313	1	0	1	0	0	1	4	-8	4	-8	38	-8	5
1,314	1	0	1	0	0	1	7	-8	4	-8	32	-8	6
1,315	1	0	0	1	0	0	4	-8	-8	-8	36	64	-8
1,401	1	0	1	0	0	1	1	-8	1	-8	38	-8	5
1,402	1	0	1	0	0	1	4	-8	4	-8	38	-8	8
1,403	1	0	0	1	0	0	4	-8	-8	-8	38	64	-8
1,404	1	1	0	0	0	0	2	2	-8	-8	-8	61	6
1,405	1	1	1	1	1	0	2	2	2	-8	-8	-8	8
1,406	0	0	1	0	0	1	-8	-8	1	1	38	-8	5
1,407	0	0	1	0	0	1	-8	-8	4	1	38	-8	-8
1,408	0	0	0	0	0	0	-8	-8	-8	1	31	-8	-8
1,409	0	0	0	0	0	0	-8	-8	-8	1	31	63	-8
1,410	1	0	0	1	0	0	4	-8	-8	-8	39	61	5
1,411	1	0	0	1	0	0	4	-8	-8	-8	39	61	6
1,412	0	0	0	0	0	0	-8	-8	-8	1	31	63	5
1,501	1	0	1	1	0	1	1	-8	1	-8	36	-8	8
1,502	0	0	1	0	0	1	-8	-8	4	1	31	-8	4
1,503	0	0	1	0	0	1	-8	-8	1	1	31	-8	3
1,504	0	0	1	0	0	1	-8	-8	1	2	36	-8	4
1,505	1	0	1	0	0	1	2	-8	1	-8	32	-8	3
1,601	1	0	0	1	0	0	2	-8	-8	-8	38	61	8

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
1,602	1	0	1	1	0	1	2	-8	1	-8	31	-8	8
1,603	0	0	1	0	0	1	-8	-8	4	4	36	-8	8
1,604	0	0	1	0	0	1	-8	-8	1	4	38	-8	8
1,605	1	0	1	1	0	1	4	-8	4	-8	32	-8	3
1,606	0	0	1	0	0	1	-8	-8	1	1	31	-8	4
1,607	0	0	0	0	0	0	-8	-8	-8	3	31	64	5
1,701	0	0	0	0	0	0	-8	-8	-8	4	38	-8	-8
1,702	0	0	0	0	0	0	-8	-8	-8	1	31	63	5
1,703	0	0	0	0	0	0	-8	-8	-8	1	31	63	-8
1,704	0	0	0	0	0	0	-8	-8	-8	4	36	-8	3
1,705	1	0	1	1	0	1	2	-8	2	-8	39	-8	3
1,801	1	0	1	0	0	1	2	-8	4	-8	31	-8	-8
1,802	1	0	0	1	0	0	4	-8	-8	1	31	-8	6
1,803	1	0	1	1	0	1	2	-8	1	-8	36	-8	4
1,804	1	0	1	0	0	1	8	-8	2	-8	38	-8	6
1,805	1	0	0	1	0	0	2	-8	-8	-8	31	61	5
1,901	1	0	0	1	0	0	2	-8	-8	-8	39	61	5
1,902	1	0	0	1	0	0	2	-8	-8	-8	39	61	5
1,903	0	0	0	0	0	0	-8	-8	-8	1	31	63	5
1,904	0	0	0	0	0	0	-8	-8	-8	4	37	-8	-8
1,905	1	0	0	0	0	0	4	-8	-8	-8	39	61	5
1,906	1	1	0	1	1	0	2	2	-8	-8	-8	61	-8
1,907	1	0	1	1	0	1	4	-8	4	-8	31	-8	-8
1,908	1	0	0	1	0	0	4	-8	-8	-8	38	61	-8

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
1,909	1	1	0	1	0	0	4	4	-8	-8	-8	65	-8
2,101	0	0	0	0	0	0	-8	-8	-8	3	32	62	5
2,102	1	0	1	1	0	1	4	-8	1	-8	32	-8	4
2,103	1	1	1	1	1	1	2	2	2	-8	-8	-8	8
2,104	1	0	1	1	0	1	1	-8	1	-8	37	-8	5
2,105	1	0	1	1	0	1	13	-8	13	-8	32	-8	8
2,106	1	0	1	0	0	1	7	-8	7	-8	37	-8	8
2,107	1	1	1	1	0	1	2	2	2	-8	-8	-8	3
2,108	1	1	1	1	0	1	2	2	2	-8	-8	-8	8
2,109	1	1	1	1	1	1	2	2	2	-8	-8	-8	8
2,110	1	0	1	1	0	1	13	-8	13	-8	39	-8	8
2,111	1	0	1	1	0	1	1	-8	1	-8	39	-8	8
2,112	1	1	1	1	1	1	2	2	2	-8	-8	-8	3
2,201	1	1	1	1	1	1	2	13	13	-8	-8	-8	8
2,202	1	0	1	1	0	1	3	-8	3	-8	33	-8	3
2,203	1	0	0	1	0	0	3	-8	-8	-8	32	64	3
2,301	1	1	1	1	1	1	2	2	1	-8	-8	-8	8
2,302	1	1	1	1	1	1	4	4	4	-8	-8	-8	5
2,303	1	0	1	1	0	1	4	-8	4	-8	37	-8	5
2,304	1	1	1	1	0	1	1	1	1	-8	-8	-8	4
2,305	1	0	1	1	0	1	2	-8	2	-8	37	-8	8
2,306	1	0	1	1	0	1	3	-8	3	-8	36	-8	6
2,307	1	1	1	1	1	1	2	2	2	-8	-8	-8	8
2,308	1	1	1	1	1	1	2	2	2	-8	-8	-8	4

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
2,309	1	0	1	1	0	1	1	-8	1	-8	38	-8	8
2,310	1	1	1	1	1	1	13	13	13	-8	-8	-8	8
2,311	1	0	0	1	0	0	3	-8	-8	-8	31	62	3
2,312	1	0	1	1	0	1	4	-8	4	-8	37	-8	6
2,313	1	0	1	1	0	1	4	-8	4	-8	37	-8	6
2,314	1	1	1	1	1	1	1	1	1	-8	-8	-8	3
2,401	0	0	0	0	0	0	-8	-8	-8	1	38	-8	8
2,402	1	0	0	0	0	0	8	-8	-8	-8	36	65	4
2,403	1	0	1	1	0	1	4	-8	4	-8	32	-8	-8
2,404	1	1	1	1	0	1	2	2	1	-8	-8	-8	8
2,405	1	1	1	1	0	1	2	2	2	-8	-8	-8	3
2,406	1	0	1	0	0	1	2	-8	1	-8	36	-8	3
2,407	1	1	1	1	1	1	2	2	1	-8	-8	-8	3
2,408	1	0	0	1	0	0	4	-8	-8	-8	38	61	6
2,409	1	1	1	1	0	1	2	2	2	-8	-8	-8	3
2,410	1	0	0	1	0	0	4	-8	-8	-8	37	-8	6
2,411	1	1	1	1	0	1	2	2	1	-8	-8	-8	8
2,412	1	0	1	1	0	1	2	-8	2	-8	38	-8	8
2,413	1	1	1	1	0	1	4	4	4	-8	-8	-8	5
2,414	1	0	1	1	0	1	2	-8	2	-8	36	-8	8
2,415	1	0	0	1	0	0	4	-8	-8	-8	32	63	5
2,416	1	0	1	1	0	1	1	-8	2	-8	31	-8	8
2,417	1	1	1	1	0	1	2	2	2	-8	-8	-8	6
2,418	1	0	1	1	0	1	2	-8	2	-8	36	-8	6

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
2,419	1	1	1	1	0	1	2	2	2	-8	-8	-8	8
2,420	1	0	1	1	0	1	2	-8	2	-8	37	-8	3
2,501	1	0	1	1	0	1	1	-8	1	-8	32	-8	5
2,502	1	1	1	1	1	1	13	13	4	-8	-8	-8	8
2,503	1	0	0	0	0	0	4	-8	-8	-8	38	61	-8
2,504	1	0	1	1	0	0	4	-8	4	-8	32	-8	3
2,505	1	0	0	1	0	0	4	-8	-8	-8	32	64	5
2,506	1	0	0	0	0	0	3	-8	-8	-8	32	61	3
2,507	1	0	0	1	0	0	7	-8	-8	-8	32	62	3
2,508	1	0	1	1	0	1	2	-8	1	-8	32	-8	6
2,509	1	0	1	1	0	1	2	-8	4	-8	37	-8	4
2,510	1	0	1	1	0	1	4	-8	4	-8	32	-8	6
2,511	1	0	1	1	0	1	4	-8	4	-8	37	-8	5
2,512	1	0	1	1	0	1	2	-8	2	-8	36	-8	8
2,513	1	0	1	1	0	1	2	-8	1	-8	37	-8	8
2,514	1	1	1	1	1	1	13	13	13	-8	-8	-8	8
3,101	1	0	0	1	0	0	7	-8	-8	-8	36	64	5
3,102	1	0	0	1	0	0	4	-8	-8	-8	32	61	6
3,103	1	0	1	1	0	1	4	-8	4	-8	32	-8	6
3,104	1	0	1	1	0	1	2	-8	2	-8	38	-8	8
3,105	1	0	0	1	0	0	4	-8	-8	-8	32	64	8
3,106	1	1	0	1	0	0	2	2	-8	-8	-8	61	8
3,107	1	1	0	1	0	0	2	2	-8	-8	-8	61	-8
3,108	1	0	1	1	0	0	1	-8	1	-8	38	-8	8

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
3,109	1	0	1	1	0	1	2	-8	2	-8	38	-8	8
3,110	1	0	1	1	0	1	2	-8	2	-8	32	-8	8
3,201	1	0	0	1	0	0	2	-8	-8	-8	32	61	5
3,202	1	0	1	1	0	1	2	-8	2	-8	31	-8	5
3,203	1	0	1	1	0	1	2	-8	4	-8	38	-8	5
3,204	1	0	0	1	0	0	2	-8	-8	-8	38	61	5
3,240	1	0	0	1	0	0	2	-8	-8	-8	38	61	6
3,301	1	0	1	1	0	1	2	-8	2	-8	39	-8	4
3,302	1	0	0	1	0	0	2	-8	-8	-8	31	-8	6
3,303	1	1	1	1	0	1	2	2	1	-8	-8	-8	3
3,304	1	0	1	1	0	1	2	-8	1	-8	33	61	8
3,305	1	0	1	1	0	1	2	-8	2	-8	38	-8	3
3,306	1	1	0	1	0	0	2	2	-8	-8	-8	63	8
3,307	1	1	1	1	0	0	2	2	1	-8	-8	-8	8
3,401	1	0	0	1	0	0	2	-8	-8	-8	32	-8	-8
3,402	1	1	0	1	0	0	2	2	-8	-8	-8	61	8
3,403	1	0	0	1	0	0	2	-8	-8	-8	38	61	8
3,404	1	1	0	1	0	0	2	2	-8	-8	-8	61	8
3,405	1	1	1	1	0	1	2	2	2	-8	-8	-8	8
3,406	1	0	1	1	0	0	2	-8	1	-8	32	-8	3
3,407	1	0	0	1	0	0	1	-8	-8	-8	38	62	8
3,408	1	0	0	1	0	0	13	-8	-8	-8	31	61	3
3,409	1	1	1	1	0	0	2	2	1	-8	-8	-8	3
3,410	1	0	0	1	0	0	4	-8	-8	-8	37	-8	4

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
3,411	1	0	1	1	0	1	2	-8	2	-8	37	-8	5
3,501	1	0	1	1	0	1	2	-8	2	-8	31	-8	5
3,502	1	0	1	1	0	1	2	-8	2	-8	31	-8	4
3,503	1	0	1	1	0	0	2	-8	4	-8	38	-8	5
3,504	1	0	0	1	0	0	2	-8	-8	-8	38	61	6
3,505	1	0	0	1	0	0	4	-8	-8	-8	31	-8	5
3,506	1	1	1	1	0	1	8	8	4	-8	-8	-8	4
3,507	1	0	1	1	0	1	2	-8	1	-8	32	-8	8
3,508	1	1	1	1	1	1	13	13	1	-8	-8	-8	8
3,509	1	0	1	1	0	1	7	-8	7	-8	38	-8	3
3,510	1	0	1	1	0	1	1	-8	1	-8	38	-8	3
3,511	1	0	1	0	0	1	1	-8	1	-8	37	-8	3
3,601	1	1	0	1	1	0	2	2	-8	-8	-8	61	8
3,602	1	0	0	1	0	0	2	-8	-8	-8	38	61	-8
3,603	1	0	0	1	0	0	2	-8	-8	-8	38	61	-8
3,604	1	1	1	1	1	1	2	2	1	-8	-8	-8	8
3,605	1	1	1	1	1	1	13	13	13	-8	-8	-8	8
3,606	1	0	1	1	0	1	4	-8	4	-8	37	-8	5
3,607	1	0	1	1	0	1	7	-8	7	-8	39	-8	6
3,608	1	0	1	0	0	1	1	-8	1	-8	37	-8	5
3,609	1	0	1	1	0	1	2	-8	2	-8	32	-8	3
4,101	1	1	0	1	0	0	4	2	-8	-8	-8	61	-8
4,102	0	0	1	0	0	1	-8	-8	4	1	38	-8	-8
4,103	1	0	0	1	0	0	4	-8	-8	-8	38	61	-8

rc	Rdtillpst	mulchpst	rotatpst	rdcurnt	mlchcurnt	crcurnt	influrt	influmlch	influcr	reasrt	reasmlch	reascr	agricadvc
4,104	1	0	0	0	0	0	2	-8	-8	-8	31	61	5
4,105	0	0	0	0	0	0	-8	-8	-8	1	38	-8	5
4,106	1	0	1	0	0	1	2	-8	1	-8	38	-8	-8
4,107	1	0	1	1	0	1	2	-8	1	-8	36	-8	-8
4,108	0	0	1	0	0	1	-8	-8	4	1	38	-8	4
4,109	1	0	1	0	0	1	7	-8	1	-8	39	-8	-8
4,110	1	0	0	0	0	0	2	-8	-8	-8	31	61	-8
4,201	1	0	1	1	0	1	2	-8	2	-8	31	-8	4
4,202	1	0	1	1	0	1	2	-8	2	-8	39	-8	6
4,203	0	0	0	0	0	0	-8	-8	-8	1	31	63	-8
4,204	1	0	0	1	0	0	2	-8	-8	-8	31	61	6
4,205	1	0	0	0	0	0	3	-8	-8	-8	31	61	3
4,206	1	0	0	1	0	0	4	-8	-8	-8	39	61	4
4,207	1	0	1	1	0	1	4	-8	1	-8	32	-8	-8
4,208	1	1	1	1	1	1	7	2	2	-8	39	-8	4
4,209	0	0	0	0	0	0	-8	-8	-8	1	31	63	6
4,210	1	0	1	1	0	1	1	-8	1	-8	38	-8	8
4,211	1	0	1	0	0	1	4	-8	4	-8	38	-8	8
4,212	0	0	1	0	0	1	-8	-8	4	3	38	-8	6
4,213	1	0	0	1	0	0	4	-8	-8	-8	36	61	3
4,214	1	0	1	0	0	1	2	-8	1	-8	36	-8	8
4,215	0	0	0	0	0	0	-8	-8	-8	1	31	63	3
4,216	1	1	1	1	0	1	2	2	2	-8	-8	-8	8
4,217	0	0	0	0	0	0	-8	-8	-8	2	38	61	8
4,218	0	0	1	0	0	1	-8	-8	4	1	38	-8	-8

Appendix K

Definitions of variables and codes for plot level data

Variable abbreviation	Description of the variable
RC	Respondent code (unique for each household)
plotno	Plot number
Crop	Code for crop grown on a particular plot
croprcd	Code for category of crop grown on a particular plot
Maintill	Main tillage used on a particular plot
Cacomp	CA component implemented on each plot
Yield	Yield measured in kgs per hectare at plot level
areaHa	Area of the plot in hectares
RTcomp	Reduced tillage component dummy (applied =1, otherwise 0)
CRcomp	Crop rotation component dummy (applied =1, otherwise 0)
R+Mcomp	Reduced tillage with mulching dummy (applied =1, otherwise 0)
R+CRcomp	Reduced tillage with crop rotation dummy (applied =1, otherwise 0)
All3comp	Application of all three components dummy (applied =1, otherwise 0)
Intens	Rate of CA components application, ranges from 0 to 1

Codes used on plot level data.

Crop codes	cacomp codes	Croprcd codes	Maintill codes
1=Maize	0=No CA component	1=Maize	1=Conventional tillage
2=White sorghum	1=Reduced tillage	2=Groundnuts	2=Conservation technique
3=Red sorghum	2=Mulching	3=Bambaranuts	3=Other techniques
4=Pearl millet	3=Crop rotation	4=Other crops	
5=Groundnuts	4=Reduced tillage + Mulch		
6=Cowpeas	5=reduced tillage + Crop rotation		
7=Bambaranuts	6=Mulching +crop rotation		
8=Beans	7=All three components		
9=Sunflower			
10=Finger millet			

Appendix L

Plot level data used to compute weights of CA components

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,101	1	1	1	1	0	1,250.00	0.120	0	0	0	0	0	0
1,101	2	1	1	1	3	686.27	0.510	0	1	0	0	0	1
1,101	3	7	3	1	3	581.40	0.172	0	1	0	0	0	1
1,101	4	5	2	1	3	0.00	0.150	0	1	0	0	0	1
1,102	1	1	1	2	1	740.74	0.270	1	0	0	0	0	1
1,102	2	1	1	2	1	666.67	0.150	1	0	0	0	0	1
1,102	3	7	3	1	0	22.22	0.180	0	0	0	0	0	0
1,102	4	5	2	1	0	266.67	0.120	0	0	0	0	0	0
1,102	5	9	4	1	0	44.44	0.090	0	0	0	0	0	0
1,103	1	1	1	1	0	0.00	0.104	0	0	0	0	0	0
1,103	2	1	1	1	0	679.35	0.368	0	0	0	0	0	0
1,103	3	1	1	1	0	367.65	0.408	0	0	0	0	0	0
1,103	4	1	1	1	0	416.67	0.360	0	0	0	0	0	0
1,103	5	10	4	1	0	133.33	0.120	0	0	0	0	0	0
1,103	6	7	3	1	3	277.78	0.180	0	1	0	0	0	1
1,103	7	5	2	1	3	106.31	0.301	0	1	0	0	0	1
1,103	8	5	2	1	0	88.89	0.180	0	0	0	0	0	0
1,103	9	7	3	1	0	0.00	0.104	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,103	10	1	1	1	0	0.00	0.090	0	0	0	0	0	0
1,104	1	1	1	2	5	0.00	0.225	0	0	0	1	0	1
1,104	2	1	1	2	1	2,400.00	0.450	1	0	0	0	0	1
1,105	1	1	1	1	0	247.10	0.405	0	0	0	0	0	0
1,105	2	1	1	1	0	39.54	0.405	0	0	0	0	0	0
1,105	3	1	1	1	0	370.64	0.405	0	0	0	0	0	0
1,105	4	5	2	1	0	500.00	0.300	0	0	0	0	0	0
1,105	5	1	1	10	0	494.19	0.405	0	0	0	0	0	0
1,106	1	1	1	2	1	600.00	0.250	1	0	0	0	0	1
1,106	2	1	1	1	0	400.00	0.250	0	0	0	0	0	0
1,106	3	5	2	1	3	666.67	0.150	0	1	0	0	0	1
1,106	4	1	1	1	3	0.00	0.100	0	1	0	0	0	1
1,107	1	1	1	2	1	9,000.00	0.050	1	0	0	0	0	1
1,107	2	7	3	1	3	507.94	0.126	0	1	0	0	0	1
1,107	3	1	1	1	3	793.65	0.126	0	1	0	0	0	1
1,107	4	5	2	1	3	0.00	0.252	0	1	0	0	0	1
1,108	1	1	1	2	1	988.39	0.405	1	0	0	0	0	1
1,108	2	1	1	1	0	370.64	0.405	0	0	0	0	0	0
1,108	2	6	4	1	0	9.88	0.405	0	0	0	0	0	0
1,108	3	1	1	1	0	9.88	0.202	0	0	0	0	0	0
1,108	3	6	4	1	0	19.77	0.202	0	0	0	0	0	0
1,108	4	5	2	1	0	0.00	0.405	0	0	0	0	0	0
1,108	5	7	3	1	0	106.67	0.150	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,109	1	1	1	1	3	0.00	0.607	0	1	0	0	0	1
1,109	2	1	1	1	0	0.00	0.202	0	0	0	0	0	0
1,109	3	1	1	2	1	500.00	0.100	1	0	0	0	0	1
1,109	4	7	3	1	3	264.75	0.283	0	1	0	0	0	1
1,110	1	1	1	2	5	833.33	0.120	0	0	0	1	0	1
1,110	2	1	1	1	3	370.64	0.405	0	1	0	0	0	1
1,110	3	1	1	1	3	79.07	0.202	0	1	0	0	0	1
1,110	4	7	3	1	3	133.33	0.120	0	1	0	0	0	1
1,110	5	5	2	1	3	40.00	0.100	0	1	0	0	0	1
1,111	1	1	1	2	1	1,363.64	0.110	1	0	0	0	0	1
1,111	2	1	1	1	0	1,235.48	0.040	0	0	0	0	0	0
1,112	1	1	1	1	3	1,029.57	0.243	0	1	0	0	0	0
1,112	2	5	2	1	3	790.71	0.040	0	1	0	0	0	1
1,112	3	7	3	1	3	395.35	0.040	0	1	0	0	0	1
1,112	4	1	1	2	1	4,118.28	0.121	1	0	0	0	0	1
1,113	1	1	1	1	3	3,000.00	1.000	0	1	0	0	0	1
1,113	2	5	2	1	3	150.00	1.000	0	1	0	0	0	1
1,113	3	8	4	1	3	370.64	0.809	0	1	0	0	0	1
1,113	4	1	1	2	5	617.74	0.405	0	0	0	1	0	1
1,113	5	7	3	1	3	100.00	1.000	0	1	0	0	0	1
1,114	1	1	1	2	5	864.84	0.405	0	0	0	1	0	1
1,114	2	7	3	1	3	213.33	0.300	0	1	0	0	0	1
1,115	1	1	1	1	0	394.74	0.380	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,116	1	1	1	2	5	864.84	0.405	0	0	0	1	0	1
1,116	2	5	2	1	3	88.89	0.180	0	1	0	0	0	1
1,116	3	7	3	1	3	133.33	0.240	0	1	0	0	0	1
1,201	1	10	4	1	0	340.43	0.235	0	0	0	0	0	0
1,203	1	1	1	1	3	4,324.19	0.809	0	1	0	0	0	1
1,203	2	5	2	1	3	266.67	0.240	0	1	0	0	0	1
1,203	3	7	3	1	3	177.78	0.180	0	1	0	0	0	1
1,204	1	1	1	1	0	203.25	0.246	0	0	0	0	0	0
1,204	2	1	1	2	1	1,082.25	0.092	1	0	0	0	0	1
1,204	3	1	1	1	3	615.76	0.162	0	1	0	0	0	1
1,204	3	7	3	1	3	307.88	0.162	0	1	0	0	0	1
1,204	4	5	2	1	3	342.86	0.140	0	1	0	0	0	1
1,205	1	1	1	1	0	0.00	0.500	0	0	0	0	0	0
1,205	2	7	3	1	0	64.00	0.250	0	0	0	0	0	0
1,206	1	1	1	1	0	44.44	0.360	0	0	0	0	0	0
1,206	2	1	1	1	0	316.21	0.101	0	0	0	0	0	0
1,206	3	5	2	1	0	217.39	0.074	0	0	0	0	0	0
1,206	4	1	1	1	0	115.94	0.276	0	0	0	0	0	0
1,206	4	7	3	1	0	181.16	0.276	0	0	0	0	0	0
1,206	5	7	3	1	0	679.35	0.074	0	0	0	0	0	0
1,207	1	1	1	10	0	600.00	0.500	0	0	0	0	0	0
1,207	2	7	3	1	0	192.00	0.250	0	0	0	0	0	0
1,207	3	5	2	1	0	32.00	0.250	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,208	1	1	1	1	0	300.00	0.250	0	0	0	0	0	0
1,208	2	1	1	1	0	640.00	0.100	0	0	0	0	0	0
1,209	1	1	1	10	1	1,666.67	0.060	1	0	0	0	0	1
1,209	2	1	1	10	1	2,000.00	0.100	1	0	0	0	0	1
1,209	3	1	1	1	3	128.00	0.250	0	1	0	0	0	1
1,209	4	7	3	1	3	64.00	0.250	0	1	0	0	0	1
1,210	1	1	1	1	0	1,250.00	0.240	0	0	0	0	0	0
1,210	2	5	2	1	0	0.00	0.090	0	0	0	0	0	0
1,210	3	1	1	2	1	572.08	0.874	1	0	0	0	0	1
1,210	4	1	1	1	0	1,369.86	0.110	0	0	0	0	0	0
1,210	5	5	2	1	3	64.00	0.500	0	1	0	0	0	1
1,210	6	7	3	1	3	96.00	0.250	0	1	0	0	0	1
1,210	7	1	1	1	3	64.00	0.500	0	1	0	0	0	1
1,210	8	10	4	1	3	200.00	0.500	0	1	0	0	0	1
1,210	9	1	1	1	0	300.00	0.500	0	0	0	0	0	0
1,211	1	1	1	2	1	864.84	0.405	1	0	0	0	0	1
1,211	2	5	2	1	0	384.00	0.063	0	0	0	0	0	0
1,211	3	7	3	1	0	720.00	0.100	0	0	0	0	0	0
1,211	4	1	1	1	0	200.00	0.250	0	0	0	0	0	0
1,211	5	1	1	2	1	800.00	0.500	1	0	0	0	0	1
1,211	6	1	1	2	1	400.00	0.250	1	0	0	0	0	1
1,211	7	1	1	1	0	80.00	0.200	0	0	0	0	0	0
1,212	1	1	1	2	1	0.00	0.125	1	0	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,212	2	1	1	2	1	256.00	0.063	1	0	0	0	0	1
1,212	3	1	1	1	0	128.00	0.063	0	0	0	0	0	0
1,212	4	5	2	1	0	64.00	0.063	0	0	0	0	0	0
1,212	5	7	3	1	0	64.00	0.063	0	0	0	0	0	0
1,212	6	1	1	1	0	500.00	0.200	0	0	0	0	0	0
1,213	1	1	1	2	7	952.38	0.210	0	0	0	0	1	1
1,213	2	7	3	1	3	654.55	0.110	0	1	0	0	0	1
1,213	3	5	2	1	3	160.00	0.100	0	1	0	0	0	1
1,213	4	1	1	1	3	2,142.86	0.140	0	1	0	0	0	1
1,214	1	1	1	2	5	900.00	0.500	0	0	0	1	0	1
1,214	2	1	1	1	3	300.00	0.500	0	1	0	0	0	1
1,214	3	7	3	1	0	256.00	0.125	0	0	0	0	0	0
1,214	4	5	2	1	0	0.00	0.125	0	0	0	0	0	0
1,215	1	1	1	2	1	1,000.00	0.500	1	0	0	0	0	1
1,216	1	1	1	1	0	800.00	0.750	0	0	0	0	0	0
1,216	2	1	1	1	3	400.00	1.000	0	1	0	0	0	1
1,216	3	1	1	1	0	350.00	1.000	0	0	0	0	0	0
1,216	4	5	2	1	3	80.00	1.000	0	1	0	0	0	1
1,216	5	7	3	1	0	224.00	0.500	0	0	0	0	0	0
1,216	6	1	1	1	0	400.00	0.500	0	0	0	0	0	0
1,217	1	1	1	1	0	900.00	0.500	0	0	0	0	0	0
1,220	1	1	1	1	0	1,000.00	1.000	0	0	0	0	0	0
1,220	2	5	2	1	0	48.00	1.000	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,220	3	7	3	1	0	106.67	0.300	0	0	0	0	0	0
1,221	1	1	1	2	1	600.00	0.500	1	0	0	0	0	1
1,221	2	1	1	1	0	187.50	0.800	0	0	0	0	0	0
1,221	3	5	2	1	3	3,125.00	0.080	0	1	0	0	0	1
1,221	4	1	1	1	0	581.40	0.430	0	0	0	0	0	0
1,222	1	10	4	1	0	106.67	0.300	0	0	0	0	0	0
1,222	2	1	1	1	0	1,200.00	0.600	0	0	0	0	0	0
1,222	3	1	1	1	0	2,192.98	0.570	0	0	0	0	0	0
1,222	4	1	1	1	0	1,280.00	0.350	0	0	0	0	0	0
1,222	5	5	2	1	0	2,656.00	0.500	0	0	0	0	0	0
1,222	6	7	3	1	0	640.00	0.200	0	0	0	0	0	0
1,301	1	1	1	2	1	277.78	0.360	1	0	0	0	0	1
1,301	2	5	2	1	0	66.67	0.120	0	0	0	0	0	0
1,301	3	7	3	1	0	16.67	0.240	0	0	0	0	0	0
1,302	1	1	1	2	1	200.00	0.080	1	0	0	0	0	1
1,303	1	1	1	2	1	875.00	0.400	1	0	0	0	0	1
1,303	2	1	1	1	0	90.91	0.550	0	0	0	0	0	0
1,303	3	7	3	1	0	250.00	0.400	0	0	0	0	0	0
1,303	4	5	2	1	0	333.33	0.300	0	0	0	0	0	0
1,304	1	1	1	2	1	20.00	0.200	1	0	0	0	0	1
1,304	2	5	2	10	0	714.29	0.070	0	0	0	0	0	0
1,304	3	7	3	1	0	500.00	0.050	0	0	0	0	0	0
1,305	1	9	4	1	0	260.42	0.480	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,305	2	1	1	1	3	1,000.00	1.000	0	1	0	0	0	0
1,305	3	1	1	1	0	1,000.00	1.000	0	0	0	0	0	0
1,305	4	4	4	1	0	225.00	0.400	0	0	0	0	0	0
1,305	5	7	3	1	0	1,250.00	0.100	0	0	0	0	0	0
1,305	6	5	2	1	3	1,041.67	0.120	0	1	0	0	0	1
1,306	1	1	1	1	0	697.67	0.430	0	0	0	0	0	0
1,306	2	1	1	2	1	833.33	0.300	1	0	0	0	0	1
1,306	3	5	2	1	3	1,000.00	0.150	0	1	0	0	0	1
1,306	4	7	3	1	3	900.00	0.200	0	1	0	0	0	1
1,307	1	1	1	2	1	3,095.24	0.210	1	0	0	0	0	1
1,307	2	5	2	1	0	200.00	0.320	0	0	0	0	0	0
1,307	3	1	1	1	0	416.67	0.600	0	0	0	0	0	0
1,307	4	5	2	1	0	256.00	0.125	0	0	0	0	0	0
1,308	1	1	1	1	0	277.78	0.360	0	0	0	0	0	0
1,308	2	1	1	2	1	535.71	0.280	1	0	0	0	0	1
1,308	3	5	2	1	0	106.67	0.300	0	0	0	0	0	0
1,308	4	7	3	1	0	114.29	0.140	0	0	0	0	0	0
1,309	1	5	2	1	0	80.00	0.600	0	0	0	0	0	0
1,309	2	1	1	1	0	800.00	1.000	0	0	0	0	0	0
1,309	3	7	3	1	0	45.71	0.350	0	0	0	0	0	0
1,309	4	1	1	2	1	1,359.03	0.405	1	0	0	0	0	1
1,309	5	8	4	1	0	0.00	0.809	0	0	0	0	0	0
1,310	1	1	1	1	0	926.61	0.809	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,310	2	7	3	1	0	57.14	0.280	0	0	0	0	0	0
1,310	3	5	2	1	0	133.33	0.240	0	0	0	0	0	0
1,311	1	1	1	2	1	500.00	0.400	1	0	0	0	0	1
1,311	2	1	1	1	0	625.00	0.400	0	0	0	0	0	0
1,311	3	7	3	10	3	240.00	0.200	0	1	0	0	0	1
1,311	4	1	1	1	3	1,250.00	0.120	0	1	0	0	0	1
1,312	1	1	1	1	0	25.00	0.400	0	0	0	0	0	0
1,312	2	6	4	10	0	3,750.00	0.040	0	0	0	0	0	0
1,312	3	5	2	1	3	360.00	0.200	0	1	0	0	0	1
1,312	4	1	1	1	3	114.29	0.280	0	1	0	0	0	1
1,312	5	1	1	2	1	1,250.00	0.080	1	0	0	0	0	1
1,312	6	7	3	1	0	41.67	0.240	0	0	0	0	0	0
1,313	1	1	1	1	0	1,875.00	0.080	0	0	0	0	0	0
1,313	2	1	1	1	0	833.33	0.120	0	0	0	0	0	0
1,313	3	1	1	1	0	1,500.00	0.200	0	0	0	0	0	0
1,314	1	1	1	1	0	250.00	0.200	0	0	0	0	0	0
1,314	2	1	1	1	0	250.00	0.800	0	0	0	0	0	0
1,314	3	7	3	1	0	100.00	0.100	0	0	0	0	0	0
1,315	1	1	1	1	0	583.33	0.600	0	0	0	0	0	0
1,315	2	1	1	1	0	200.00	0.160	0	0	0	0	0	0
1,315	3	5	2	1	0	25.00	0.400	0	0	0	0	0	0
1,315	4	7	3	1	0	40.00	0.400	0	0	0	0	0	0
1,401	1	2	4	1	0	1,000.00	0.100	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,401	2	1	1	1	0	2,000.00	0.050	0	0	0	0	0	0
1,401	3	1	1	1	0	1,000.00	0.100	0	0	0	0	0	0
1,401	4	1	1	2	1	1,000.00	0.100	1	0	0	0	0	1
1,401	5	1	1	1	0	1,000.00	0.500	0	0	0	0	0	0
1,401	6	5	2	1	0	238.10	0.420	0	0	0	0	0	0
1,401	7	1	1	1	0	666.67	0.300	0	0	0	0	0	0
1,401	8	1	1	1	0	1,600.00	0.500	0	0	0	0	0	0
1,401	9	2	4	1	0	375.00	0.400	0	0	0	0	0	0
1,401	10	2	4	1	0	125.00	0.400	0	0	0	0	0	0
1,401	11	1	1	1	0	1,600.00	0.500	0	0	0	0	0	0
1,402	1	1	1	1	3	700.00	0.500	0	1	0	0	0	1
1,402	2	1	1	1	3	535.71	0.280	0	1	0	0	0	0
1,402	3	7	3	1	0	1,000.00	0.150	0	0	0	0	0	0
1,402	4	5	2	1	0	500.00	0.200	0	0	0	0	0	0
1,403	1	5	2	2	1	400.00	0.020	1	0	0	0	0	1
1,403	1	1	1	2	1	160.00	0.200	1	0	0	0	0	1
1,403	1	7	3	2	1	40.00	0.200	1	0	0	0	0	1
1,404	1	1	1	1	0	386.09	0.648	0	0	0	0	0	0
1,404	2	7	3	1	0	625.00	0.080	0	0	0	0	0	0
1,404	3	5	2	1	0	320.00	0.050	0	0	0	0	0	0
1,405	1	1	1	2	1	583.33	0.600	1	0	0	0	0	1
1,405	2	1	1	2	1	400.00	0.500	1	0	0	0	0	1
1,405	3	1	1	1	0	625.00	0.400	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,405	4	5	2	1	0	937.50	0.080	0	0	0	0	0	0
1,405	5	7	3	1	0	750.00	0.200	0	0	0	0	0	0
1,405	6	1	1	1	0	500.00	0.150	0	0	0	0	0	0
1,406	1	1	1	1	3	2,500.00	0.500	0	1	0	0	0	1
1,406	2	1	1	1	3	2,000.00	0.500	0	1	0	0	0	1
1,406	3	1	1	1	0	2,500.00	0.500	0	0	0	0	0	0
1,406	4	5	2	1	3	551.02	0.490	0	1	0	0	0	1
1,406	5	5	2	1	3	2,346.67	0.150	0	1	0	0	0	1
1,406	6	7	3	1	3	200.00	0.500	0	1	0	0	0	1
1,407	1	5	2	1	3	1,500.00	0.200	0	1	0	0	0	1
1,407	2	1	1	1	3	1,000.00	0.150	0	1	0	0	0	1
1,407	3	1	1	1	3	1,000.00	0.200	0	1	0	0	0	1
1,407	4	1	1	1	0	833.33	0.300	0	0	0	0	0	0
1,407	5	7	3	1	0	333.33	0.150	0	0	0	0	0	0
1,408	1	1	1	1	0	617.74	0.809	0	0	0	0	0	0
1,408	2	5	2	1	0	114.29	0.140	0	0	0	0	0	0
1,408	3	7	3	1	0	88.89	0.180	0	0	0	0	0	0
1,409	1	1	1	1	0	535.71	0.280	0	0	0	0	0	0
1,409	2	5	2	1	0	50.00	0.080	0	0	0	0	0	0
1,409	3	7	3	1	0	100.00	0.080	0	0	0	0	0	0
1,410	1	1	1	2	1	988.39	0.405	1	0	0	0	0	1
1,410	2	7	3	1	0	59.30	0.809	0	0	0	0	0	0
1,410	3	5	2	1	0	79.07	0.809	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,410	4	4	4	1	0	833.33	0.300	0	0	0	0	0	0
1,410	5	1	1	1	0	625.00	0.240	0	0	0	0	0	0
1,411	1	1	1	2	1	617.74	0.405	1	0	0	0	0	1
1,411	2	5	2	1	0	33.33	0.120	0	0	0	0	0	0
1,411	3	7	3	1	0	57.14	0.140	0	0	0	0	0	0
1,412	1	1	1	1	0	800.00	0.500	0	0	0	0	0	0
1,412	2	5	2	1	0	52.17	0.230	0	0	0	0	0	0
1,412	3	7	3	1	0	44.44	0.180	0	0	0	0	0	0
1,501	1	1	1	1	0	1,875.00	0.320	0	0	0	0	0	0
1,501	2	1	1	1	0	781.25	0.320	0	0	0	0	0	0
1,501	3	1	1	2	1	1,250.00	0.040	1	0	0	0	0	1
1,501	4	1	1	2	1	1,250.00	0.040	1	0	0	0	0	1
1,501	5	2	4	2	1	250.00	0.040	1	0	0	0	0	1
1,501	6	1	1	2	1	1,250.00	0.040	1	0	0	0	0	1
1,501	7	1	1	2	1	1,250.00	0.040	1	0	0	0	0	1
1,501	8	5	2	2	5	400.00	0.040	0	0	0	1	0	1
1,501	9	5	2	2	5	400.00	0.040	0	0	0	1	0	1
1,501	10	6	4	2	5	400.00	0.040	0	0	0	1	0	1
1,501	11	6	4	2	5	800.00	0.040	0	0	0	1	0	1
1,502	1	1	1	1	3	200.00	0.080	0	1	0	0	0	1
1,502	2	5	2	1	0	120.00	0.200	0	0	0	0	0	0
1,502	3	1	1	1	0	1,041.67	0.480	0	0	0	0	0	0
1,502	4	1	1	1	0	250.00	0.080	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,502	4	5	2	1	0	62.50	0.080	0	0	0	0	0	0
1,502	5	1	1	1	0	750.00	0.100	0	0	0	0	0	0
1,502	6	7	3	1	0	133.33	0.120	0	0	0	0	0	0
1,503	1	1	1	1	0	1,000.00	0.400	0	0	0	0	0	0
1,503	2	5	2	1	3	0.00	0.080	0	1	0	0	0	1
1,504	1	1	1	1	0	468.75	0.480	0	0	0	0	0	0
1,504	2	7	3	1	0	106.67	0.600	0	0	0	0	0	0
1,505	1	1	1	1	3	1,000.00	0.200	0	1	0	0	0	1
1,505	2	5	2	1	3	240.00	0.200	0	1	0	0	0	1
1,505	3	7	3	1	3	160.00	0.200	0	1	0	0	0	1
1,505	4	1	1	1	0	1,000.00	0.400	0	0	0	0	0	0
1,601	1	1	1	2	1	1,250.00	0.080	1	0	0	0	0	1
1,601	2	1	1	1	0	500.00	1.000	0	0	0	0	0	0
1,601	3	5	2	1	0	250.00	0.200	0	0	0	0	0	0
1,601	4	7	3	1	0	266.67	0.120	0	0	0	0	0	0
1,601	5	9	4	1	0	40.00	0.100	0	0	0	0	0	0
1,601	6	1	1	1	0	1,544.35	0.324	0	0	0	0	0	0
1,602	1	1	1	2	1	2,500.00	0.400	1	0	0	0	0	1
1,602	2	1	1	1	0	2,000.00	0.500	0	0	0	0	0	0
1,602	3	5	2	1	3	1,500.00	0.200	0	1	0	0	0	1
1,603	1	5	2	1	3	333.33	0.120	0	1	0	0	0	1
1,603	2	7	3	1	3	80.00	0.200	0	1	0	0	0	1
1,603	3	1	1	1	0	357.14	0.280	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,604	1	5	2	1	3	120.00	0.200	0	1	0	0	0	1
1,604	2	1	1	1	3	312.50	0.800	0	1	0	0	0	0
1,605	1	1	1	2	5	1,272.26	0.039	0	0	0	1	0	1
1,605	2	1	1	1	0	375.00	0.400	0	0	0	0	0	0
1,605	3	7	3	1	0	188.68	0.170	0	0	0	0	0	1
1,605	4	5	2	1	3	503.14	0.095	0	1	0	0	0	1
1,605	5	1	1	1	3	60.38	0.530	0	1	0	0	0	1
1,605	6	10	4	1	0	240.00	0.200	0	0	0	0	0	0
1,606	1	1	1	1	0	2,500.00	0.200	0	0	0	0	0	0
1,606	2	1	1	1	0	2,250.00	0.200	0	0	0	0	0	0
1,606	3	1	1	1	3	714.29	0.280	0	1	0	0	0	1
1,606	4	7	3	1	3	71.43	0.280	0	1	0	0	0	1
1,606	5	1	1	1	3	125.00	0.400	0	1	0	0	0	1
1,606	6	5	2	1	0	225.00	0.320	0	0	0	0	0	0
1,606	7	1	1	1	0	500.00	0.600	0	0	0	0	0	0
1,607	1	1	1	1	0	450.00	1.000	0	0	0	0	0	0
1,607	2	1	1	1	0	500.00	0.200	0	0	0	0	0	0
1,607	2	9	4	1	0	250.00	0.200	0	0	0	0	0	0
1,607	3	1	1	1	0	500.00	0.400	0	0	0	0	0	0
1,607	3	5	2	1	0	10.00	0.400	0	0	0	0	0	0
1,701	1	1	1	1	0	2,500.00	1.000	0	0	0	0	0	0
1,701	2	4	4	1	0	2,692.31	0.130	0	0	0	0	0	0
1,701	3	5	2	1	0	308.87	0.809	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,701	4	7	3	1	0	232.56	0.430	0	0	0	0	0	0
1,702	1	1	1	1	0	494.19	0.405	0	0	0	0	0	0
1,703	1	1	1	1	0	700.00	1.000	0	0	0	0	0	0
1,703	2	5	2	1	0	100.00	0.240	0	0	0	0	0	0
1,703	3	7	3	1	0	61.54	0.260	0	0	0	0	0	0
1,703	4	4	4	1	0	312.50	0.320	0	0	0	0	0	0
1,704	1	1	1	1	0	1,482.58	0.405	0	0	0	0	0	0
1,704	2	4	4	1	0	869.57	0.230	0	0	0	0	0	0
1,704	3	5	2	1	0	200.00	0.120	0	0	0	0	0	0
1,705	1	1	1	2	5	277.78	0.360	0	0	0	1	0	1
1,705	2	5	2	2	5	233.33	0.240	0	0	0	1	0	1
1,705	3	7	3	2	5	133.33	0.240	0	0	0	1	0	1
1,705	4	1	1	1	0	494.19	0.405	0	0	0	0	0	0
1,801	1	1	1	2	1	1,625.00	0.400	1	0	0	0	0	1
1,801	2	1	1	1	0	833.33	0.300	0	0	0	0	0	0
1,801	3	5	2	1	3	2,666.67	0.150	0	1	0	0	0	1
1,801	4	1	1	1	3	571.43	0.350	0	1	0	0	0	1
1,801	5	7	3	1	0	200.00	0.080	0	0	0	0	0	0
1,802	1	5	2	1	3	500.00	0.080	0	1	0	0	0	1
1,802	2	7	3	1	3	300.00	0.080	0	1	0	0	0	1
1,802	3	1	1	1	0	160.00	0.200	0	0	0	0	0	0
1,802	4	5	2	1	0	200.00	0.200	0	0	0	0	0	0
1,802	5	1	1	1	3	535.71	0.280	0	1	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,802	6	1	1	1	0	125.00	0.400	0	0	0	0	0	0
1,802	7	1	1	1	0	288.46	0.520	0	0	0	0	0	0
1,803	1	1	1	1	0	625.00	0.400	0	0	0	0	0	0
1,803	2	1	1	1	3	500.00	0.400	0	1	0	0	0	1
1,803	3	5	2	1	3	25.00	0.400	0	1	0	0	0	1
1,803	4	7	3	1	0	50.00	0.200	0	0	0	0	0	0
1,804	1	1	1	1	3	0.00	0.400	0	1	0	0	0	1
1,804	2	1	1	1	0	416.67	0.600	0	0	0	0	0	0
1,804	3	5	2	1	3	600.00	0.080	0	1	0	0	0	1
1,804	4	7	3	1	0	0.00	0.160	0	0	0	0	0	0
1,805	1	1	1	2	1	494.19	0.809	1	0	0	0	0	1
1,805	2	4	4	1	0	208.33	0.240	0	0	0	0	0	0
1,805	3	5	2	1	0	114.29	0.140	0	0	0	0	0	0
1,805	4	7	3	1	0	200.00	0.160	0	0	0	0	0	0
1,901	1	1	1	2	1	650.00	1.000	1	0	0	0	0	1
1,901	2	7	3	1	0	133.33	0.240	0	0	0	0	0	0
1,901	3	5	2	1	0	61.54	0.260	0	0	0	0	0	0
1,901	4	8	4	1	0	39.54	0.405	0	0	0	0	0	0
1,902	1	1	1	2	1	1,111.93	0.405	1	0	0	0	0	1
1,902	2	7	3	1	0	114.29	0.280	0	0	0	0	0	0
1,902	3	5	2	1	0	61.54	0.260	0	0	0	0	0	0
1,903	1	1	1	1	0	864.84	0.809	0	0	0	0	0	0
1,903	2	5	2	1	0	106.67	0.600	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
1,903	3	7	3	1	0	32.00	1.000	0	0	0	0	0	0
1,904	1	1	1	1	0	679.52	0.809	0	0	0	0	0	0
1,904	2	7	3	1	0	39.54	0.405	0	0	0	0	0	0
1,904	3	5	2	1	0	98.84	0.405	0	0	0	0	0	0
1,905	1	1	1	1	0	1,125.00	0.400	0	0	0	0	0	0
1,905	2	7	3	1	0	44.44	0.360	0	0	0	0	0	0
1,905	3	5	2	1	0	39.54	0.809	0	0	0	0	0	0
1,906	1	1	1	2	1	666.67	0.300	1	0	0	0	0	1
1,906	2	1	1	2	1	142.86	0.700	1	0	0	0	0	1
1,906	3	5	2	1	0	1,500.00	0.050	0	0	0	0	0	0
1,906	4	7	3	1	0	625.00	0.080	0	0	0	0	0	0
1,907	1	1	1	2	1	64.00	0.500	1	0	0	0	0	1
1,907	2	5	2	1	3	1,250.00	0.080	0	1	0	0	0	1
1,907	3	7	3	1	0	0.00	0.100	0	0	0	0	0	0
1,908	1	1	1	2	1	250.00	0.600	1	0	0	0	0	1
1,908	2	1	1	2	1	263.16	0.570	1	0	0	0	0	1
1,908	3	1	1	1	0	0.00	0.300	0	0	0	0	0	0
1,908	4	10	4	1	0	0.00	0.400	0	0	0	0	0	0
1,908	5	7	3	1	0	80.00	0.200	0	0	0	0	0	0
1,909	1	1	1	2	1	125.00	0.400	1	0	0	0	0	1
1,909	2	5	2	1	0	400.00	0.040	0	0	0	0	0	0
1,909	3	7	3	1	0	400.00	0.080	0	0	0	0	0	0
2,101	1	1	1	1	0	1,029.57	0.243	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,101	2	5	2	1	0	197.68	0.162	0	0	0	0	0	0
2,102	1	1	1	2	1	1,290.32	0.078	1	0	0	0	0	1
2,102	2	7	3	1	0	256.00	0.125	0	0	0	0	0	0
2,102	9	1	1	2	1	800.00	0.125	1	0	0	0	0	1
2,103	1	1	1	2	4	2,500.00	0.100	0	0	1	0	0	1
2,103	1	6	4	2	4	80.00	0.100	0	0	1	0	0	1
2,103	2	1	1	2	4	1,000.00	0.100	0	0	1	0	0	0
2,103	3	6	4	10	1	20.00	0.100	1	0	0	0	0	1
2,103	4	5	2	10	5	213.33	0.150	0	0	0	1	0	1
2,103	5	3	4	10	1	1,000.00	0.050	1	0	0	0	0	1
2,103	6	1	1	2	5	1,750.00	0.200	0	0	0	1	0	1
2,104	1	1	1	2	5	741.29	0.405	0	0	0	1	0	1
2,104	2	3	4	2	5	250.00	0.400	0	0	0	1	0	1
2,104	3	6	4	2	5	208.33	0.240	0	0	0	1	0	1
2,104	4	8	4	2	5	533.33	0.060	0	0	0	1	0	1
2,104	5	1	1	2	1	1,875.00	0.080	1	0	0	0	0	1
2,105	1	1	1	2	1	1,600.00	0.125	1	0	0	0	0	1
2,105	2	1	1	2	1	384.00	0.125	1	0	0	0	0	1
2,105	3	5	2	10	1	768.00	0.063	1	0	0	0	0	1
2,105	4	5	2	1	0	512.00	0.063	0	0	0	0	0	0
2,105	5	5	2	1	0	640.00	0.050	0	0	0	0	0	0
2,105	7	7	3	1	0	384.00	0.063	0	0	0	0	0	0
2,106	1	1	1	1	0	370.64	0.202	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,106	2	1	1	1	0	247.10	0.405	0	0	0	0	0	0
2,106	3	1	1	1	3	247.10	0.202	0	1	0	0	0	1
2,106	4	1	1	1	0	247.10	0.405	0	0	0	0	0	0
2,106	5	5	2	1	3	474.43	0.202	0	1	0	0	0	1
2,106	6	7	3	1	3	216.21	0.809	0	1	0	0	0	0
2,107	1	7	3	1	0	88.89	0.360	0	0	0	0	0	1
2,107	2	1	1	2	5	864.84	0.405	0	0	0	1	0	0
2,107	3	5	2	2	5	69.57	0.230	0	0	0	1	0	1
2,107	4	1	1	2	5	0.00	0.300	0	0	0	1	0	1
2,108	1	5	2	1	0	192.00	0.500	0	0	0	0	0	0
2,108	2	1	1	2	5	1,500.00	1.000	0	0	0	1	0	1
2,108	4	1	1	2	5	833.33	0.300	0	0	0	1	0	1
2,109	1	1	1	2	7	2,500.00	0.100	0	0	0	0	1	1
2,109	1	6	4	2	7	160.00	0.100	0	0	0	0	1	1
2,109	2	1	1	1	0	494.19	0.202	0	0	0	0	0	0
2,109	3	5	2	2	1	625.00	0.120	1	0	0	0	0	1
2,109	4	7	3	1	0	158.14	0.405	0	0	0	0	0	0
2,110	1	1	1	1	0	2,500.00	0.020	0	0	0	0	0	0
2,110	4	2	4	1	0	2,133.33	0.030	0	0	0	0	0	0
2,110	5	1	1	2	1	0.00	0.030	1	0	0	0	0	1
2,110	6	5	2	1	0	2,080.00	0.100	0	0	0	0	0	0
2,110	7	1	1	1	0	80.00	0.100	0	0	0	0	0	0
2,110	8	1	1	2	1	2,500.00	0.100	1	0	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,110	9	1	1	1	0	500.00	0.100	0	0	0	0	0	0
2,110	10	1	1	2	1	1,000.00	0.200	1	0	0	0	0	1
2,110	11	7	3	1	0	640.00	0.100	0	0	0	0	0	0
2,111	1	1	1	1	0	400.00	0.040	0	0	0	0	0	0
2,111	2	1	1	1	0	2,500.00	0.060	0	0	0	0	0	0
2,111	3	1	1	1	0	1,250.00	0.120	0	0	0	0	0	0
2,111	4	5	2	2	5	625.00	0.080	0	0	0	1	0	1
2,111	5	1	1	2	5	300.00	0.250	0	0	0	1	0	1
2,111	6	7	3	1	0	625.00	0.080	0	0	0	0	0	0
2,111	7	10	4	10	0	600.00	0.080	0	0	0	0	0	0
2,112	1	1	1	2	4	741.29	0.809	0	0	1	0	0	1
2,112	2	10	4	1	3	2,500.00	0.060	0	1	0	0	0	1
2,112	3	2	4	1	3	5,882.35	0.043	0	1	0	0	0	1
2,112	4	1	1	2	5	0.00	1.000	0	0	0	1	0	1
2,112	5	5	2	1	3	0.00	1.000	0	1	0	0	0	1
2,112	6	7	3	1	3	0.00	1.000	0	1	0	0	0	1
2,112	7	1	1	2	4	1,041.67	0.240	0	0	1	0	0	1
2,112	8	6	4	2	5	3,333.33	0.030	0	0	0	1	0	1
2,112	9	8	4	2	5	1,250.00	0.040	0	0	0	1	0	1
2,201	1	1	1	2	7	6,250.00	0.080	0	0	0	0	1	1
2,201	2	1	1	2	7	2,000.00	0.200	0	0	0	0	1	1
2,201	3	1	1	2	7	1,500.00	0.100	0	0	0	0	1	1
2,201	4	5	2	10	0	480.00	0.100	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,201	5	6	4	10	0	160.00	0.100	0	0	0	0	0	0
2,201	6	5	2	10	0	300.00	0.200	0	0	0	0	0	0
2,201	7	1	1	2	7	900.00	0.080	0	0	0	0	1	1
2,202	1	1	1	2	5	6,400.00	0.005	0	0	0	1	0	1
2,202	2	1	1	2	5	6,400.00	0.020	0	0	0	1	0	1
2,202	3	1	1	2	5	3,413.33	0.150	0	0	0	1	0	1
2,202	4	5	2	10	1	640.00	0.025	1	0	0	0	0	1
2,202	5	1	1	2	5	640.00	0.025	0	0	0	1	0	1
2,202	6	5	2	10	1	133.33	0.060	1	0	0	0	0	0
2,202	7	7	3	10	1	133.33	0.060	1	0	0	0	0	0
2,203	1	1	1	2	1	333.33	0.750	1	0	0	0	0	1
2,203	2	5	2	2	1	13.33	0.750	1	0	0	0	0	1
2,203	3	6	4	1	0	16.67	0.030	0	0	0	0	0	0
2,203	4	7	3	1	0	333.33	0.030	0	0	0	0	0	0
2,301	1	5	2	2	5	259.46	0.185	0	0	0	1	0	1
2,301	2	1	1	2	4	1,482.58	0.121	0	0	1	0	0	1
2,301	3	1	1	2	4	617.74	0.121	0	0	1	0	0	1
2,301	4	1	1	2	1	263.57	0.121	1	0	0	0	0	1
2,301	5	1	1	2	1	131.78	0.121	1	0	0	0	0	1
2,301	6	7	3	1	0	79.07	0.405	0	0	0	0	0	0
2,302	1	1	1	2	7	500.00	0.300	0	0	0	0	1	1
2,303	1	1	1	2	5	1,235.48	0.243	0	1	0	0	0	1
2,304	1	1	1	2	5	1,323.53	0.680	0	1	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,304	2	5	2	2	5	61.54	0.260	0	1	0	0	0	1
2,305	1	1	1	2	1	2,000.00	0.100	1	0	0	0	0	1
2,305	1	6	4	2	1	160.00	0.100	1	0	0	0	0	1
2,305	2	1	1	2	5	40.00	0.400	0	0	0	1	0	0
2,305	3	5	2	1	0	426.67	0.150	0	0	0	0	0	0
2,305	4	7	3	1	0	160.00	0.100	0	0	0	0	0	0
2,306	1	1	1	2	5	2,200.00	0.250	0	0	0	1	0	1
2,306	2	1	1	2	5	1,400.00	0.250	0	0	0	1	0	1
2,306	3	7	3	1	0	160.00	0.300	0	0	0	0	0	0
2,306	4	5	2	1	0	704.00	0.250	0	0	0	0	0	0
2,306	5	1	1	2	5	1,400.00	0.250	0	0	0	1	0	1
2,307	1	1	1	2	7	3,750.00	0.100	0	0	0	0	1	1
2,307	2	1	1	2	7	1,853.22	0.405	0	0	0	0	1	1
2,307	3	5	2	2	5	583.33	0.600	0	0	0	1	0	1
2,308	1	1	1	2	4	1,833.33	0.300	0	0	1	0	0	1
2,308	2	1	1	10	7	823.66	0.607	0	0	0	0	1	1
2,308	3	7	3	10	5	185.32	0.405	0	0	0	1	0	1
2,309	1	1	1	2	5	2,333.33	0.150	0	0	0	1	0	1
2,309	2	5	2	1	3	1,493.33	0.150	0	1	0	0	0	1
2,309	3	1	1	1	3	4,666.67	0.150	0	1	0	0	0	1
2,309	4	1	1	1	3	1,521.74	0.690	0	1	0	0	0	0
2,309	5	7	3	1	0	266.67	0.060	0	0	0	0	0	0
2,309	6	10	4	1	0	133.33	0.090	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,310	1	1	1	1	3	3,600.00	0.250	0	1	0	0	0	1
2,310	1	5	2	1	3	384.00	0.250	0	1	0	0	0	1
2,310	2	1	1	2	7	1,600.00	0.500	0	0	0	0	1	1
2,310	3	1	1	1	0	0.00	0.250	0	0	0	0	0	0
2,310	4	1	1	1	0	0.00	0.250	0	0	0	0	0	0
2,311	1	1	1	2	1	1,428.57	0.105	1	0	0	0	0	1
2,311	2	7	3	1	0	240.00	0.050	0	0	0	0	0	0
2,311	3	5	2	1	0	53.33	0.150	0	0	0	0	0	0
2,311	3	7	3	1	0	26.67	0.150	0	0	0	0	0	0
2,312	1	1	1	2	5	1,111.93	0.405	0	0	0	1	0	1
2,312	2	5	2	1	3	126.32	0.380	0	1	0	0	0	1
2,312	3	7	3	1	3	128.00	0.250	0	1	0	0	0	1
2,312	5	1	1	2	5	1,729.68	0.405	0	0	0	1	0	1
2,312	6	1	1	2	5	800.00	0.250	0	0	0	1	0	1
2,313	1	7	3	1	3	114.29	0.280	0	1	0	0	0	1
2,313	2	5	2	1	3	66.67	0.240	0	1	0	0	0	1
2,313	3	1	1	2	5	833.33	0.300	0	0	0	1	0	1
2,314	1	1	1	2	7	1,500.00	0.200	0	0	0	0	1	1
2,314	2	1	1	1	0	75.00	1.000	0	0	0	0	0	0
2,314	2	5	2	1	0	32.00	1.000	0	0	0	0	0	0
2,314	3	7	3	1	0	48.00	1.000	0	0	0	0	0	0
2,401	1	1	1	1	0	1,235.48	0.202	0	0	0	0	0	0
2,401	2	1	1	1	0	247.10	0.202	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,401	3	5	2	1	0	106.67	0.150	0	0	0	0	0	0
2,402	1	1	1	1	0	1,000.00	0.250	0	0	0	0	0	0
2,402	2	1	1	1	0	700.00	0.500	0	0	0	0	0	0
2,402	3	5	2	1	0	160.00	0.200	0	0	0	0	0	0
2,402	4	7	3	1	0	80.00	0.200	0	0	0	0	0	0
2,403	1	1	1	2	1	411.83	0.486	1	0	0	0	0	1
2,403	2	1	1	1	3	1,000.00	0.100	0	1	0	0	0	1
2,403	3	1	1	1	3	160.00	0.100	0	1	0	0	0	1
2,403	4	5	2	1	0	2,142.86	0.070	0	0	0	0	0	0
2,403	5	7	3	1	0	400.00	0.080	0	0	0	0	0	0
2,404	1	1	1	2	1	2,333.33	0.300	1	0	0	0	0	1
2,404	2	5	2	1	3	2,187.50	0.160	0	1	0	0	0	1
2,404	3	7	3	1	3	769.23	0.130	0	1	0	0	0	1
2,404	4	1	1	2	1	1,250.00	0.200	1	0	0	0	0	1
2,405	1	7	3	1	0	160.00	0.200	0	0	0	0	0	0
2,405	2	1	1	1	0	128.00	0.250	0	0	0	0	0	0
2,405	3	1	1	1	0	64.00	0.250	0	0	0	0	0	0
2,405	4	1	1	1	0	416.67	0.120	0	0	0	0	0	0
2,405	5	1	1	1	0	5,500.00	0.100	0	0	0	0	0	0
2,405	5	5	2	1	0	4,500.00	0.100	0	0	0	0	0	0
2,405	6	1	1	1	0	166.67	0.300	0	0	0	0	0	0
2,405	6	5	2	1	0	26.67	0.300	0	0	0	0	0	0
2,405	7	1	1	1	0	14.81	0.540	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,405	8	7	3	1	0	0.00	0.060	0	0	0	0	0	0
2,406	1	1	1	1	3	1,388.89	0.180	0	1	0	0	0	1
2,406	2	5	2	1	0	1,111.11	0.090	0	0	0	0	0	0
2,406	3	7	3	1	0	3,571.43	0.014	0	0	0	0	0	0
2,406	4	7	3	1	0	735.29	0.136	0	0	0	0	0	0
2,406	5	1	1	1	0	1,041.67	0.096	0	0	0	0	0	0
2,406	6	5	2	1	0	740.74	0.135	0	0	0	0	0	0
2,406	7	1	1	1	0	1,000.00	0.100	0	0	0	0	0	0
2,407	1	5	2	1	0	333.33	0.120	0	0	0	0	0	0
2,407	2	1	1	2	5	2,083.33	0.120	0	0	0	1	0	1
2,407	3	1	1	1	0	0.00	0.500	0	0	0	0	0	0
2,407	4	7	3	1	0	0.00	0.350	0	0	0	0	0	0
2,408	2	1	1	1	0	0.00	0.160	0	0	0	0	0	0
2,408	2	7	3	1	0	62.50	0.160	0	0	0	0	0	0
2,408	3	1	1	2	1	781.25	0.320	1	0	0	0	0	1
2,408	4	1	1	1	0	0.00	0.250	0	0	0	0	0	0
2,408	4	7	3	1	0	64.00	0.250	0	0	0	0	0	0
2,408	5	5	2	10	1	533.33	0.120	1	0	0	0	0	1
2,409	1	5	2	1	0	457.14	0.210	0	0	0	0	0	0
2,409	2	1	1	2	1	3,750.00	0.080	1	0	0	0	0	1
2,409	3	1	1	2	1	960.00	0.150	1	0	0	0	0	1
2,409	4	1	1	1	0	1,322.31	0.303	0	0	0	0	0	0
2,409	5	1	1	1	0	3,846.15	0.033	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,410	1	1	1	2	1	1,250.00	0.400	1	0	0	0	0	1
2,410	2	1	1	2	1	1,250.00	0.400	1	0	0	0	0	1
2,410	3	5	2	2	1	240.00	0.100	1	0	0	0	0	1
2,410	4	7	3	10	1	200.00	0.100	1	0	0	0	0	1
2,410	5	10	4	10	1	1,000.00	0.050	1	0	0	0	0	1
2,411	1	1	1	2	1	2,222.22	0.090	0	1	0	0	0	1
2,411	2	1	1	1	3	370.64	0.405	0	1	0	0	0	1
2,411	3	5	2	1	3	2,142.86	0.070	0	1	0	0	0	1
2,412	1	1	1	2	1	1,750.00	0.200	1	0	0	0	0	1
2,412	2	1	1	1	0	494.19	0.202	0	0	0	0	0	0
2,412	3	5	2	1	0	266.67	0.120	0	0	0	0	0	0
2,412	4	7	3	1	0	118.61	0.405	0	0	0	0	0	0
2,412	5	7	3	1	0	213.33	0.150	0	0	0	0	0	0
2,412	6	4	4	1	0	247.10	0.405	0	0	0	0	0	0
2,413	1	1	1	2	5	535.71	0.280	0	0	0	1	0	1
2,413	2	5	2	1	3	160.00	0.300	0	1	0	0	0	1
2,413	3	7	3	1	3	53.33	0.300	0	1	0	0	0	1
2,413	4	1	1	10	3	444.44	0.900	0	1	0	0	0	1
2,413	5	1	1	2	5	555.56	0.180	0	0	0	1	0	1
2,414	1	1	1	2	1	1,500.00	0.100	1	0	0	0	0	1
2,414	2	1	1	1	0	247.10	0.202	0	0	0	0	0	0
2,414	3	5	2	1	0	40.00	0.100	0	0	0	0	0	0
2,414	4	7	3	1	0	0.00	0.150	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,415	1	1	1	2	1	394.74	0.380	1	0	0	0	0	1
2,415	2	6	4	1	0	2,500.00	0.020	0	0	0	0	0	0
2,415	3	5	2	1	0	44.44	0.180	0	0	0	0	0	0
2,415	4	7	3	1	0	44.44	0.180	0	0	0	0	0	0
2,415	5	1	1	2	1	1,250.00	0.040	1	0	0	0	0	1
2,416	1	1	1	2	5	617.74	0.081	0	0	0	1	0	1
2,416	2	1	1	1	0	123.55	0.405	0	0	0	0	0	0
2,416	3	1	1	1	0	741.29	0.202	0	0	0	0	0	0
2,416	4	5	2	1	0	133.33	0.120	0	0	0	0	0	0
2,417	1	1	1	2	5	1,235.48	0.607	0	0	0	1	0	1
2,417	2	5	2	1	3	168.42	0.380	0	1	0	0	0	1
2,417	3	1	1	1	3	1,235.48	0.202	0	1	0	0	0	1
2,417	4	7	3	1	3	53.33	0.300	0	1	0	0	0	1
2,417	5	1	1	1	3	5,000.00	0.040	0	1	0	0	0	1
2,418	1	1	1	1	0	311.53	0.321	0	0	0	0	0	0
2,418	2	1	1	2	1	3,787.88	0.066	1	0	0	0	0	1
2,418	3	5	2	1	3	666.67	0.150	0	1	0	0	0	1
2,418	4	7	3	1	3	533.33	0.150	0	1	0	0	0	1
2,419	1	1	1	2	1	1,081.05	0.324	1	0	0	0	0	1
2,419	2	1	1	1	0	494.19	0.405	0	0	0	0	0	0
2,419	3	1	1	1	0	0.00	0.405	0	0	0	0	0	0
2,419	4	5	2	1	0	88.89	0.180	0	0	0	0	0	0
2,419	5	7	3	1	0	123.55	0.405	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,420	1	1	1	1	0	2,083.33	0.120	0	0	0	0	0	0
2,420	2	10	4	10	5	2,083.33	0.060	0	0	0	1	0	1
2,420	3	5	2	10	5	1,200.00	0.040	0	0	0	1	0	1
2,420	4	1	1	2	5	3,000.00	0.100	0	0	0	1	0	1
2,420	5	1	1	2	5	176.00	0.250	0	0	0	1	0	1
2,420	6	1	1	2	5	240.00	0.050	0	0	0	1	0	1
2,501	1	1	1	2	5	2,083.33	0.120	0	0	0	1	0	1
2,501	2	5	2	2	5	320.00	0.100	0	0	0	1	0	1
2,502	1	1	1	2	1	741.29	0.405	1	0	0	0	0	1
2,502	2	1	1	1	0	823.66	0.121	0	0	0	0	0	0
2,503	1	1	1	1	0	4,444.44	0.023	0	0	0	0	0	0
2,503	2	1	1	1	0	1,025.64	0.195	0	0	0	0	0	0
2,504	1	1	1	2	1	2,666.67	0.150	1	0	0	0	0	1
2,504	2	1	1	2	1	3,000.00	0.200	1	0	0	0	0	1
2,504	3	1	1	2	1	1,500.00	0.500	1	0	0	0	0	1
2,504	4	5	2	1	0	308.87	0.324	0	0	0	0	0	0
2,504	5	7	3	1	0	123.55	0.405	0	0	0	0	0	0
2,505	1	1	1	10	0	1,069.52	0.094	0	0	0	0	0	0
2,505	2	1	1	2	1	3,000.00	0.100	1	0	0	0	0	1
2,506	1	1	1	10	0	2,500.00	0.200	0	0	0	0	0	0
2,506	2	1	1	10	0	2,500.00	0.360	0	0	0	0	0	0
2,506	3	1	1	10	0	864.84	0.405	0	0	0	0	0	0
2,507	1	1	1	2	1	1,600.00	0.250	1	0	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,508	1	7	3	1	0	32.00	0.250	0	0	0	0	0	0
2,508	2	7	3	1	0	0.00	0.100	0	0	0	0	0	0
2,508	3	5	2	1	0	80.00	0.100	0	0	0	0	0	0
2,508	4	1	1	2	1	250.00	0.200	1	0	0	0	0	1
2,508	5	1	1	2	1	625.00	0.200	1	0	0	0	0	1
2,508	6	1	1	1	0	40.00	0.100	0	0	0	0	0	0
2,508	7	1	1	1	0	1,000.00	0.100	0	0	0	0	0	0
2,509	1	1	1	2	5	1,976.77	0.405	0	0	0	1	0	1
2,509	2	5	2	1	3	57.14	0.280	0	1	0	0	0	1
2,509	3	7	3	1	3	80.00	0.300	0	1	0	0	0	1
2,510	1	5	2	1	3	57.14	0.280	0	1	0	0	0	1
2,510	2	1	1	1	3	1,359.03	0.405	0	1	0	0	0	1
2,510	3	7	3	1	3	57.14	0.280	0	1	0	0	0	1
2,510	4	1	1	2	1	1,482.58	0.202	1	0	0	0	0	1
2,511	1	1	1	2	1	3,706.45	0.162	1	0	0	0	0	1
2,511	2	7	3	1	3	79.07	0.405	0	1	0	0	0	1
2,511	3	1	1	1	3	2,265.05	0.243	0	1	0	0	0	1
2,511	4	5	2	1	3	266.67	0.180	0	1	0	0	0	1
2,512	1	7	3	1	0	400.00	0.100	0	0	0	0	0	0
2,512	2	1	1	2	1	1,500.00	0.500	1	0	0	0	0	1
2,512	3	5	2	10	3	40.00	0.100	0	1	0	0	0	1
2,512	4	1	1	1	3	250.00	0.200	0	1	0	0	0	1
2,512	5	1	1	1	0	250.00	0.200	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
2,512	5	7	3	1	0	20.00	0.200	0	0	0	0	0	0
2,513	1	1	1	2	1	2,000.00	0.100	1	0	0	0	0	1
2,513	2	1	1	2	1	2,000.00	0.250	1	0	0	0	0	1
2,513	3	1	1	2	1	2,400.00	0.188	1	0	0	0	0	1
2,513	4	1	1	2	1	1,619.43	0.247	1	0	0	0	0	1
2,513	5	5	2	10	3	480.00	0.050	0	1	0	0	0	1
2,513	6	7	3	10	3	0.00	0.050	0	1	0	0	0	1
2,513	7	1	1	1	3	0.00	0.435	0	1	0	0	0	1
2,513	8	1	1	1	0	1,400.00	0.500	0	0	0	0	0	0
2,514	1	1	1	2	1	2,600.00	0.250	1	0	0	0	0	1
2,514	2	7	3	10	0	160.00	0.250	0	0	0	0	0	0
2,514	3	1	1	2	1	400.00	0.250	1	0	0	0	0	1
3,101	1	1	1	10	1	1,200.00	0.250	1	0	0	0	0	1
3,101	2	5	2	1	0	1,041.67	0.060	0	0	0	0	0	0
3,101	3	7	3	1	0	1,666.67	0.060	0	0	0	0	0	0
3,102	1	1	1	2	1	468.75	0.320	1	0	0	0	0	1
3,102	2	7	3	1	0	250.00	0.200	0	0	0	0	0	0
3,102	3	5	2	1	0	277.78	0.180	0	0	0	0	0	0
3,103	1	4	4	1	3	494.19	0.405	0	1	0	0	0	0
3,103	2	1	1	2	5	1,976.77	0.405	0	0	0	1	0	1
3,103	3	7	3	1	3	118.61	0.405	0	1	0	0	0	1
3,103	4	1	1	2	1	1,184.21	0.380	1	0	0	0	0	1
3,104	1	1	1	2	1	2,142.86	0.350	1	0	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,105	1	1	1	2	1	1,333.33	0.150	1	0	0	0	0	1
3,105	1	7	3	2	1	213.33	0.150	1	0	0	0	0	1
3,105	2	7	3	10	0	714.29	0.070	0	0	0	0	0	0
3,106	1	1	1	2	1	1,142.86	0.700	1	0	0	0	0	1
3,106	2	10	4	10	0	3,000.00	0.050	0	0	0	0	0	0
3,106	3	4	4	1	0	204.08	0.490	0	0	0	0	0	0
3,106	4	7	3	1	0	3,750.00	0.120	0	0	0	0	0	0
3,106	5	1	1	1	0	227.27	0.220	0	0	0	0	0	0
3,107	1	1	1	2	1	500.00	0.700	1	0	0	0	0	1
3,108	1	1	1	2	1	1,666.67	0.090	1	0	0	0	0	1
3,108	2	1	1	2	1	400.00	0.250	1	0	0	0	0	1
3,108	3	5	2	1	0	20.00	0.200	0	0	0	0	0	0
3,109	1	1	1	2	1	3,750.00	0.120	1	0	0	0	0	1
3,109	2	5	2	2	1	150.00	0.080	1	0	0	0	0	1
3,109	3	7	3	1	0	480.00	0.100	0	0	0	0	0	0
3,109	4	1	1	2	1	1,250.00	0.200	1	0	0	0	0	1
3,110	1	1	1	2	1	2,500.00	0.040	1	0	0	0	0	1
3,110	2	1	1	2	1	1,875.00	0.080	1	0	0	0	0	1
3,110	3	1	1	2	1	1,875.00	0.080	1	0	0	0	0	1
3,110	4	5	2	1	0	300.00	0.120	0	0	0	0	0	0
3,110	5	7	3	1	0	1,280.00	0.050	0	0	0	0	0	0
3,201	1	1	1	2	1	1,071.43	0.700	1	0	0	0	0	1
3,201	2	5	2	1	0	228.57	0.140	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,201	3	7	3	1	0	240.00	0.200	0	0	0	0	0	0
3,202	1	1	1	2	1	985.22	0.203	1	0	0	0	0	1
3,202	2	1	1	1	0	2,666.67	0.038	0	0	0	0	0	0
3,202	3	5	2	1	0	355.56	0.045	0	0	0	0	0	0
3,202	4	7	3	2	5	711.11	0.045	0	0	0	1	0	1
3,202	5	1	1	2	5	6,666.67	0.060	0	0	0	1	0	1
3,203	1	1	1	2	1	1,428.57	0.140	1	0	0	0	0	1
3,203	2	1	1	2	5	769.23	0.130	0	0	0	1	0	1
3,203	3	7	3	2	5	91.43	0.175	0	0	0	1	0	1
3,203	4	5	2	1	0	53.33	0.150	0	0	0	0	0	0
3,204	1	5	2	1	0	133.33	0.120	0	0	0	0	0	0
3,204	2	7	3	1	0	76.19	0.210	0	0	0	0	0	0
3,204	3	1	1	2	1	2,777.78	0.360	1	0	0	0	0	1
3,240	1	1	1	2	1	740.74	0.270	1	0	0	0	0	1
3,240	2	7	3	1	0	114.29	0.140	0	0	0	0	0	0
3,301	1	1	1	2	5	1,184.21	0.380	0	0	0	1	0	1
3,301	2	5	2	1	3	88.89	0.180	0	1	0	0	0	1
3,301	3	7	3	1	0	88.89	0.180	0	0	0	0	0	0
3,301	4	1	1	1	0	988.39	0.202	0	0	0	0	0	0
3,302	1	7	3	1	0	88.89	0.180	0	0	0	0	0	0
3,302	2	5	2	1	0	88.89	0.180	0	0	0	0	0	0
3,302	3	1	1	2	1	988.39	0.405	1	0	0	0	0	1
3,302	4	1	1	1	0	617.74	0.405	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,303	1	7	3	1	0	62.50	0.080	0	0	0	0	0	0
3,303	2	1	1	2	5	0.00	0.160	0	0	0	1	0	1
3,303	3	5	2	1	0	93.75	0.160	0	0	0	0	0	0
3,303	4	1	1	2	1	1,250.00	0.120	1	0	0	0	0	1
3,303	5	1	1	2	1	625.00	0.080	1	0	0	0	0	1
3,304	1	1	1	2	1	2,000.00	0.200	1	0	0	0	0	1
3,304	2	1	1	2	1	4,166.67	0.120	1	0	0	0	0	1
3,304	3	1	1	2	5	6,666.67	0.030	0	0	0	1	0	1
3,304	4	5	2	2	5	3,750.00	0.040	0	0	0	1	0	1
3,305	1	1	1	2	1	1,500.00	0.100	1	0	0	0	0	1
3,305	2	1	1	2	1	2,000.00	0.250	1	0	0	0	0	1
3,305	3	1	1	1	3	333.33	0.300	0	1	0	0	0	1
3,305	4	7	3	1	0	160.00	0.100	0	0	0	0	0	0
3,305	5	5	2	1	0	160.00	0.100	0	0	0	0	0	0
3,306	1	1	1	2	1	833.33	0.600	1	0	0	0	0	1
3,306	2	7	3	10	1	2,083.33	0.120	1	0	0	0	0	1
3,307	1	1	1	2	1	600.00	0.750	1	0	0	0	0	1
3,307	2	7	3	1	0	625.00	0.080	0	0	0	0	0	0
3,307	3	1	1	2	1	2,000.00	0.075	1	0	0	0	0	1
3,307	4	5	2	10	1	3,333.33	0.030	1	0	0	0	0	1
3,401	1	1	1	2	1	4,500.00	0.100	1	0	0	0	0	1
3,401	1	5	2	2	1	320.00	0.100	1	0	0	0	0	1
3,401	2	7	3	10	0	714.29	0.070	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,402	1	1	1	2	1	1,666.67	0.600	1	0	0	0	0	1
3,402	2	1	1	1	0	370.64	0.405	0	0	0	0	0	0
3,402	3	5	2	1	0	370.64	0.405	0	0	0	0	0	0
3,402	4	7	3	1	0	308.87	0.324	0	0	0	0	0	0
3,403	1	1	1	2	1	4,000.00	0.100	1	0	0	0	0	1
3,403	2	1	1	2	1	4,000.00	0.150	1	0	0	0	0	1
3,403	2	5	2	2	1	1,333.33	0.150	1	0	0	0	0	1
3,403	3	1	1	2	1	2,500.00	0.040	1	0	0	0	0	1
3,403	3	5	2	2	1	2,500.00	0.040	1	0	0	0	0	1
3,403	4	5	2	1	0	2,500.00	0.080	0	0	0	0	0	0
3,403	5	7	3	1	0	1,111.11	0.090	0	0	0	0	0	0
3,404	1	1	1	2	1	7,500.00	0.100	1	0	0	0	0	1
3,404	2	1	1	2	1	9,500.00	0.100	1	0	0	0	0	1
3,404	3	1	1	2	1	2,500.00	0.200	1	0	0	0	0	1
3,404	4	1	1	2	1	4,333.33	0.150	1	0	0	0	0	1
3,405	1	1	1	1	0	375.00	0.400	0	0	0	0	0	0
3,405	1	5	2	1	0	180.00	0.400	0	0	0	0	0	0
3,405	2	1	1	2	1	320.00	0.100	1	0	0	0	0	1
3,405	3	1	1	2	1	1,000.00	0.400	1	0	0	0	0	1
3,405	4	1	1	2	1	4,500.00	0.400	1	0	0	0	0	1
3,405	5	1	1	10	1	2,777.78	0.090	1	0	0	0	0	1
3,405	5	2	4	10	1	533.33	0.090	1	0	0	0	0	1
3,405	5	5	2	10	5	177.78	0.090	0	0	0	1	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,405	5	6	4	10	5	533.33	0.090	0	0	0	1	0	1
3,406	1	1	1	1	0	80.00	0.200	0	0	0	0	0	0
3,406	2	1	1	2	1	833.33	0.300	1	0	0	0	0	1
3,406	3	1	1	2	1	750.00	0.400	1	0	0	0	0	1
3,407	1	1	1	2	1	1,000.00	0.200	1	0	0	0	0	1
3,407	2	1	1	1	0	750.00	0.200	0	0	0	0	0	0
3,407	3	1	1	1	0	600.00	0.250	0	0	0	0	0	0
3,407	3	7	3	1	0	64.00	0.250	0	0	0	0	0	0
3,407	4	1	1	1	0	1,000.00	0.100	0	0	0	0	0	0
3,407	5	7	3	1	0	160.00	0.250	0	0	0	0	0	0
3,408	1	1	1	2	1	2,500.00	0.060	1	0	0	0	0	1
3,408	2	1	1	2	1	833.33	0.120	1	0	0	0	0	1
3,408	3	5	2	1	0	800.00	0.060	0	0	0	0	0	0
3,408	4	7	3	1	0	266.67	0.060	0	0	0	0	0	0
3,409	1	1	1	2	1	1,000.00	0.100	1	0	0	0	0	1
3,409	2	1	1	2	1	1,000.00	0.050	1	0	0	0	0	1
3,409	3	1	1	2	1	480.00	0.050	1	0	0	0	0	1
3,410	1	7	3	1	0	57.14	0.280	0	0	0	0	0	0
3,410	2	1	1	2	1	576.56	0.607	1	0	0	0	0	1
3,410	3	5	2	1	0	123.08	0.260	0	0	0	0	0	0
3,411	1	1	1	2	5	576.56	0.607	0	0	0	1	0	0
3,411	2	5	2	1	3	53.33	0.300	0	1	0	0	0	1
3,411	3	7	3	1	3	65.89	0.486	0	1	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,501	1	1	1	2	5	2,470.97	0.405	0	0	0	1	0	1
3,501	2	7	3	1	3	79.07	0.405	0	1	0	0	0	1
3,501	3	5	2	1	3	100.00	0.160	0	1	0	0	0	1
3,501	4	4	4	2	5	247.10	0.405	0	0	0	1	0	1
3,502	1	1	1	2	5	657.89	0.380	0	0	0	1	0	1
3,502	2	5	2	1	3	100.00	0.160	0	1	0	0	0	1
3,502	3	7	3	1	3	100.00	0.160	0	1	0	0	0	1
3,503	1	1	1	2	1	750.00	1.000	1	0	0	0	0	1
3,503	2	5	2	1	0	88.89	0.180	0	0	0	0	0	0
3,503	3	7	3	1	0	100.00	0.160	0	0	0	0	0	0
3,503	4	1	1	2	1	833.33	0.240	1	0	0	0	0	1
3,504	1	1	1	2	1	1,647.31	0.607	1	0	0	0	0	1
3,504	2	5	2	1	0	118.61	0.405	0	0	0	0	0	0
3,504	3	7	3	1	0	158.14	0.405	0	0	0	0	0	0
3,504	4	1	1	2	1	1,071.43	0.280	1	0	0	0	0	1
3,505	1	1	1	2	1	1,235.48	0.405	1	0	0	0	0	1
3,505	2	1	1	1	0	641.03	0.780	0	0	0	0	0	0
3,505	3	5	2	1	0	59.30	0.809	0	0	0	0	0	0
3,505	4	7	3	1	0	39.54	0.809	0	0	0	0	0	0
3,506	1	1	1	1	3	1,200.00	0.080	0	1	0	0	0	1
3,506	2	5	2	1	3	600.00	0.080	0	1	0	0	0	1
3,506	3	7	3	1	3	80.00	0.200	0	1	0	0	0	1
3,506	4	1	1	2	1	500.00	0.400	1	0	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,506	5	7	3	1	3	160.00	0.200	0	1	0	0	0	1
3,506	5	9	4	1	3	80.00	0.200	0	1	0	0	0	1
3,507	1	1	1	2	1	2,000.00	0.200	1	0	0	0	0	1
3,507	2	7	3	1	0	666.67	0.120	0	0	0	0	0	0
3,507	3	1	1	1	3	2,500.00	0.400	0	1	0	0	0	1
3,507	4	5	2	1	3	480.00	0.200	0	1	0	0	0	1
3,508	1	1	1	2	5	1,250.00	0.320	0	0	0	1	0	1
3,508	2	1	1	1	0	1,250.00	0.400	0	0	0	0	0	0
3,508	3	7	3	1	3	240.00	0.200	0	1	0	0	0	1
3,508	4	5	2	1	3	120.00	0.200	0	1	0	0	0	1
3,509	1	1	1	2	1	3,000.00	0.200	1	0	0	0	0	1
3,509	2	1	1	2	1	2,321.43	0.280	1	0	0	0	0	1
3,509	3	3	4	1	0	500.00	0.100	0	0	0	0	0	0
3,509	4	10	4	1	0	1,000.00	0.100	0	0	0	0	0	0
3,509	5	5	2	1	0	400.00	0.200	0	0	0	0	0	0
3,509	6	1	1	1	3	500.00	0.200	0	1	0	0	0	1
3,509	6	7	3	1	3	160.00	0.200	0	1	0	0	0	1
3,510	1	5	2	1	0	133.33	0.060	0	0	0	0	0	0
3,510	2	5	2	1	3	360.00	0.200	0	1	0	0	0	1
3,510	3	1	1	1	0	625.00	0.400	0	0	0	0	0	0
3,510	4	1	1	2	1	1,250.00	0.200	1	0	0	0	0	1
3,510	5	1	1	2	1	1,000.00	0.200	1	0	0	0	0	1
3,510	6	1	1	2	1	500.00	0.300	1	0	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,510	6	5	2	2	1	300.00	0.300	1	0	0	0	0	1
3,511	1	1	1	2	1	500.00	0.200	1	0	0	0	0	1
3,511	2	1	1	1	0	375.00	0.400	0	0	0	0	0	0
3,511	3	1	1	1	3	250.00	0.200	0	1	0	0	0	1
3,511	3	5	2	1	3	80.00	0.200	0	1	0	0	0	1
3,511	4	5	2	1	0	120.00	0.200	0	0	0	0	0	0
3,511	5	7	3	1	0	480.00	0.200	0	0	0	0	0	0
3,601	1	1	1	2	1	988.39	0.202	1	0	0	0	0	1
3,601	2	7	3	10	0	333.33	0.150	0	0	0	0	0	0
3,601	3	1	1	2	1	494.19	0.202	1	0	0	0	0	1
3,601	4	1	1	2	1	882.49	0.283	1	0	0	0	0	1
3,602	1	1	1	2	1	416.67	0.240	1	0	0	0	0	1
3,603	1	1	1	2	1	1,333.33	0.150	1	0	0	0	0	1
3,603	2	5	2	10	0	1,280.00	0.025	0	0	0	0	0	0
3,604	1	1	1	1	0	741.29	0.405	0	0	0	0	0	0
3,604	2	1	1	2	1	1,235.48	0.405	1	0	0	0	0	1
3,604	3	5	2	1	3	1,000.00	0.200	0	1	0	0	0	1
3,604	4	7	3	1	3	1,000.00	0.150	0	1	0	0	0	1
3,605	1	5	2	1	0	80.00	0.100	0	0	0	0	0	0
3,605	2	1	1	2	5	1,250.00	0.400	0	0	0	1	0	0
3,605	3	1	1	2	1	160.00	0.100	1	0	0	0	0	1
3,605	4	7	3	1	0	64.00	0.250	0	0	0	0	0	0
3,606	1	1	1	2	5	2,223.87	0.405	0	0	0	1	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
3,606	2	5	2	1	3	533.33	0.120	0	1	0	0	0	1
3,606	3	7	3	1	3	88.89	0.180	0	1	0	0	0	1
3,606	4	1	1	1	3	2,500.00	0.080	0	1	0	0	0	1
3,607	1	1	1	1	3	700.00	0.500	0	1	0	0	0	1
3,607	2	7	3	1	3	128.00	0.750	0	1	0	0	0	1
3,608	1	7	3	1	0	100.00	0.100	0	0	0	0	0	0
3,608	2	1	1	1	3	312.50	0.800	0	1	0	0	0	0
3,608	3	5	2	1	3	160.00	0.250	0	1	0	0	0	1
3,608	4	1	1	10	1	50.00	0.100	1	0	0	0	0	1
3,609	1	1	1	10	1	200.00	0.500	1	0	0	0	0	1
3,609	2	5	2	10	1	144.00	0.250	1	0	0	0	0	1
4,101	1	5	2	1	0	2,000.00	0.150	0	0	0	0	0	0
4,101	1	1	1	1	0	1,388.89	0.180	0	0	0	0	0	0
4,101	2	1	1	1	0	300.00	0.500	0	0	0	0	0	0
4,101	3	7	3	1	0	248.89	0.450	0	0	0	0	0	0
4,102	1	5	2	1	3	1,333.33	0.150	0	1	0	0	0	1
4,102	2	1	1	1	0	1,333.33	0.300	0	0	0	0	0	0
4,102	3	1	1	1	3	714.29	0.280	0	1	0	0	0	1
4,102	4	7	3	1	0	1,250.00	0.200	0	0	0	0	0	0
4,103	1	1	1	2	1	714.29	0.070	1	0	0	0	0	1
4,103	2	1	1	1	0	628.93	0.159	0	0	0	0	0	0
4,103	2	5	2	1	0	628.93	0.159	0	0	0	0	0	0
4,103	2	7	3	1	0	314.47	0.159	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
4,104	1	1	1	1	0	1,875.00	0.400	0	0	0	0	0	0
4,104	2	5	2	1	0	91.43	0.175	0	0	0	0	0	0
4,104	3	7	3	1	0	100.00	0.240	0	0	0	0	0	0
4,105	1	1	1	1	0	1,200.00	1.000	0	0	0	0	0	0
4,105	2	5	2	1	0	48.00	1.000	0	0	0	0	0	0
4,105	3	7	3	1	0	39.54	0.809	0	0	0	0	0	0
4,106	1	1	1	1	0	5,000.00	0.400	0	0	0	0	0	0
4,106	2	5	2	1	3	160.00	0.400	0	1	0	0	0	1
4,106	3	1	1	1	0	1,250.00	0.600	0	0	0	0	0	0
4,106	4	7	3	1	3	1,875.00	0.400	0	1	0	0	0	1
4,106	5	1	1	1	0	1,250.00	0.400	0	0	0	0	0	0
4,107	1	1	1	2	1	500.00	0.200	1	0	0	0	0	1
4,107	2	1	1	2	1	500.00	0.200	1	0	0	0	0	1
4,107	3	5	2	1	3	400.00	0.100	0	1	0	0	0	1
4,107	4	1	1	2	1	312.50	0.160	1	0	0	0	0	1
4,108	1	1	1	1	3	937.50	0.480	0	1	0	0	0	1
4,108	2	5	2	1	3	180.00	0.400	0	1	0	0	0	1
4,109	1	1	1	1	0	561.64	0.356	0	0	0	0	0	0
4,109	2	1	1	1	0	292.74	0.171	0	0	0	0	0	0
4,109	3	7	3	1	0	152.38	0.105	0	0	0	0	0	0
4,109	4	5	2	1	0	278.26	0.115	0	0	0	0	0	0
4,110	1	1	1	1	0	1,000.00	0.500	0	0	0	0	0	0
4,110	2	5	2	1	0	1,000.00	0.300	0	0	0	0	0	0

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
4,110	3	1	1	1	0	833.33	0.300	0	0	0	0	0	0
4,110	4	4	4	1	0	53.33	0.150	0	0	0	0	0	0
4,110	5	10	4	1	0	0.00	0.200	0	0	0	0	0	0
4,110	6	7	3	1	0	0.00	0.200	0	0	0	0	0	0
4,201	1	1	1	1	3	2,666.67	0.300	0	1	0	0	0	1
4,201	2	5	2	1	3	32.00	1.000	0	1	0	0	0	0
4,201	3	7	3	1	0	39.54	0.809	0	0	0	0	0	0
4,201	4	2	4	1	0	247.10	0.405	0	0	0	0	0	0
4,201	5	1	1	2	1	5,000.00	0.140	1	0	0	0	0	1
4,202	1	1	1	2	5	400.00	1.000	0	0	0	1	0	1
4,202	2	4	4	1	0	833.33	0.180	0	0	0	0	0	0
4,202	3	5	2	2	1	160.00	0.200	1	0	0	0	0	1
4,202	4	7	3	2	5	32.00	1.000	0	0	0	1	0	1
4,203	1	1	1	1	0	555.56	0.180	0	0	0	0	0	0
4,203	2	7	3	1	0	76.19	0.210	0	0	0	0	0	0
4,204	1	1	1	1	0	500.00	0.300	0	0	0	0	0	0
4,204	2	1	1	2	1	125.00	0.400	1	0	0	0	0	1
4,204	3	10	4	1	0	200.00	0.250	0	0	0	0	0	0
4,205	1	1	1	1	0	1,111.11	0.360	0	0	0	0	0	0
4,205	2	4	4	1	0	714.29	0.140	0	0	0	0	0	0
4,205	3	9	4	1	0	416.67	0.240	0	0	0	0	0	0
4,205	4	5	2	1	0	370.37	0.270	0	0	0	0	0	0
4,206	1	1	1	2	1	1,406.25	0.320	1	0	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
4,206	2	4	4	1	0	952.38	0.210	0	0	0	0	0	0
4,206	3	5	2	1	0	48.00	1.000	0	0	0	0	0	0
4,206	4	7	3	1	0	172.97	0.370	0	0	0	0	0	0
4,207	1	1	1	1	3	625.00	0.480	0	1	0	0	0	1
4,207	2	7	3	1	3	33.33	0.300	0	1	0	0	0	1
4,207	3	5	2	1	3	320.00	0.300	0	1	0	0	0	1
4,207	4	1	1	2	1	250.00	0.600	1	0	0	0	0	1
4,207	5	5	2	1	3	100.00	0.400	0	1	0	0	0	1
4,208	1	1	1	2	1	1,428.57	0.350	1	0	0	0	0	1
4,209	1	1	1	1	0	888.89	0.450	0	0	0	0	0	0
4,209	2	5	2	1	0	114.29	0.140	0	0	0	0	0	0
4,209	3	7	3	1	0	66.67	0.240	0	0	0	0	0	0
4,210	1	1	1	1	0	500.00	0.200	0	0	0	0	0	0
4,210	2	7	3	1	3	55.17	0.290	0	1	0	0	0	1
4,210	3	1	1	2	1	1,000.00	0.400	1	0	0	0	0	1
4,210	4	5	2	1	3	100.00	0.120	0	1	0	0	0	1
4,210	5	1	1	1	0	80.00	0.200	0	0	0	0	0	0
4,211	1	1	1	1	0	250.00	0.200	0	0	0	0	0	0
4,211	2	1	1	1	0	500.00	0.200	0	0	0	0	0	0
4,211	3	1	1	2	1	125.00	0.160	1	0	0	0	0	1
4,211	4	1	1	1	0	0.00	0.200	0	0	0	0	0	0
4,211	5	7	3	1	3	160.00	0.200	0	1	0	0	0	1
4,211	6	1	1	1	3	100.00	0.160	0	1	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
4,212	1	10	4	1	3	0.00	0.100	0	1	0	0	0	1
4,212	2	1	1	1	0	416.67	0.120	0	0	0	0	0	0
4,212	2	5	2	1	0	166.67	0.120	0	0	0	0	0	0
4,212	3	1	1	1	0	687.50	0.400	0	0	0	0	0	0
4,212	4	1	1	1	0	1,875.00	0.080	0	0	0	0	0	0
4,212	4	7	3	1	0	62.50	0.080	0	0	0	0	0	0
4,213	1	1	1	2	1	1,125.00	0.400	1	0	0	0	0	1
4,213	2	4	4	2	1	125.00	0.400	1	0	0	0	0	1
4,214	1	1	1	10	0	156.25	0.320	0	0	0	0	0	0
4,214	1	8	4	10	0	75.00	0.320	0	0	0	0	0	0
4,214	2	1	1	1	3	0.00	0.400	0	1	0	0	0	1
4,214	2	8	4	1	3	25.00	0.400	0	1	0	0	0	1
4,214	3	1	1	1	0	0.00	0.480	0	0	0	0	0	0
4,214	4	1	1	1	0	750.00	0.320	0	0	0	0	0	0
4,214	5	1	1	1	0	333.33	0.240	0	0	0	0	0	0
4,214	6	1	1	1	0	0.00	0.160	0	0	0	0	0	0
4,214	7	5	2	1	3	240.00	0.200	0	1	0	0	0	1
4,214	7	7	3	1	3	20.00	0.200	0	1	0	0	0	1
4,215	1	1	1	1	0	1,000.00	0.100	0	0	0	0	0	0
4,215	2	1	1	1	0	500.00	0.100	0	0	0	0	0	0
4,216	1	1	1	2	1	1,804.51	0.333	1	0	0	0	0	1
4,216	2	1	1	1	3	1,442.31	0.208	0	1	0	0	0	1
4,216	3	1	1	1	3	384.62	0.390	0	1	0	0	0	1

rc	plotno	crop	cropsrcd	maintill	cacomp	yield	areaHa	RT comp	CR comp	R+M comp	R+CR comp	All3 comp	intens
4,216	4	1	1	1	3	961.54	0.208	0	1	0	0	0	1
4,216	4	7	3	1	3	480.77	0.208	0	1	0	0	0	1
4,217	1	1	1	1	0	274.29	0.350	0	0	0	0	0	0
4,217	1	5	2	1	0	274.29	0.350	0	0	0	0	0	0
4,217	2	7	3	1	0	57.14	0.280	0	0	0	0	0	0
4,217	3	1	1	1	0	714.29	0.700	0	0	0	0	0	0
4,218	1	1	1	1	0	600.00	0.500	0	0	0	0	0	0
4,218	2	5	2	1	0	1,333.33	0.300	0	0	0	0	0	0
4,218	3	1	1	1	0	468.75	0.320	0	0	0	0	0	0
4,218	4	7	3	1	0	111.11	0.450	0	0	0	0	0	0
4,218	5	1	1	1	3	333.33	0.300	0	1	0	0	0	1