Why do farmers partially adopt conservation farming practices? A sociological study of stubble retention in NSW and Victoria

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Abstract
Despite considerable investment in Australia and abroad to promote the benefits of conservation farming, rates of on-farm adoption in some regions have been slower than expected. Recent research suggests that this may be due to the preference by farmers for partial adoption of conservation farming practices. However, such research provides limited insights into why farmers may prefer partial adoption. This paper aims to address this issue by drawing upon qualitative data from a DAFF-funded project exploring stubble retention practices by grain growers in NSW and Victoria. Our study reveals that while growers recogni=se the significant benefits in retaining crop stubbles, there exist a range of constraints in moving towards full stubble retention. Growers seek to reconcile these benefits and constraints through partial adoption. They continue to selectively and reluctantly burn stubble as they recognise that moving towards full stubble retention would undermine their flexibility to manage biophysical and financial variability. This finding suggests that improving the uptake of stubble retention requires greater accommodation of growers' existing practices, as well as recognition that selective burning may be complementary to growers retaining crop stubbles.

Keywords
Conservation farming; social research; partial adoption; relative advantage; stubble retention; trialability

Introduction

Conservation farming, including no till, conservation tillage and retaining crop stubble, is increasingly encouraged by government and farming organisations as an alternative to stubble burning. The benefits of conservation farming are well-known and include: retaining and improving soil carbon, avoiding the loss of nutrients from burning, improved plant biomass, and healthier and more productive crops (Scott *et al*., 2010). Yet, despite considerable investment in Australia and abroad to promote the benefits of conservation farming, rates of on-farm adoption in some regions – such as those with higher rainfall in parts of Victoria and Southern NSW – have been slower than expected (D'Emden *et al*., 2008, Grabowski and Kerr, 2014, Lal, 2007, Llewellyn *et al*., 2012). Research to date seeking to explain the slow adoption rates has focused primarily on the obstacles faced by farmers in adopting conservation farming practices (McRobert and Rickards, 2010). These may include capital and labour constraints, increased costs associated with the need to upgrade machinery, lack of observed benefits, and problems with weed control. In much of this work, adoption is measured as a binary distinction where the farmer is classified as either an adopter or non-adopter (e.g., Davey and Furtan, 2008, D'Emden *et al*., 2008, Knowler and Bradshaw, 2007). More recently, scholars have recognised that the adoption of conservation farming practices is an ongoing and complex process characterised by incomplete or partial adoption. From this perspective, farmers may adopt some practices, but 'maintain a degree of flexibility in their approach to soil disturbance and respond to economic and seasonal drivers' (Llewellyn *et al*., 2012: 204). Indeed, recent research argues that the key to successful no-till farming is greater flexibility in farming practices, such as the introduction of strategic tillage (Dixon, 2014). While drawing attention to the complexity of adoption processes, and particularly the significance of partial adoption, this research provides limited insights into why some farmers may prefer partial adoption of specific conservation farming practices. The aim of this paper is to address this issue. Drawing upon qualitative social research into stubble retention by grain growers in NSW and Victoria, we investigate why farmers do not adopt full stubble retention, despite recognising the soil benefits.

Explaining partial adoption

In a seminal synthesis of the adoption literature, Pannell et al (2006) argue that there are two key issues that shape farmers' decisions whether or not to adopt conservation and environmentally-oriented practices. The first is *relative advantage*, which refers to the extent to which an innovation/practice is better than that which it supersedes: this is shaped by 'a range of economic, social and environmental factors' and depends specifically 'on the landholders' unique set of goals and the biophysical, economic and social context where the innovation will be used' (Pannell et al., 2006). The second feature is *trialability*, which is basically the extent to which an innovation/practice can be trialled on-farm, and the various factors – economic, social and environmental – that shape what a farmer can realistically learn from the trialling process. Trialling is vitally important, since it 'allows the landholder to avoid the risk of large financial costs if the practice turns out to be uneconomic or fails due to inexperience' (Pannell et al., 2006). While the concepts of relative advantage and trialability have been applied previously to understand the obstacles to farmers' conversion to no-till farming (McRobert and Rickards, 2010), they are yet to be applied systematically to make sense of (a) why farmers might not fully adopt stubble retention, and (b) the consequences for stubble management practices. We address these issues in the remainder of this paper.

Methods

The research reported in this paper forms part of a broader project funded by the Commonwealth Department of Agriculture. The project aimed to trial on-farm stubble and soil nutrient practices to increase carbon stored in soil in broadacre cropping regions of southern, central NSW and Victorian dryland and irrigated areas. Social research was a crucial dimension of the project. Qualitative research methods – comprising group and individual interviews – were used to assess growers' knowledge, understanding and practices of stubble management. Group interviews were conducted with a sample of 6-14 landholders from each of the six grower groups involved in the broader project. Individual semi-structured interviews with two growers from each group enabled more detailed exploration of, as well as insights into, stubble management practices. All interview s were transcribed for analysis and initially analysed using principles of grounded theory. That is, open coding was firstly conducted to find common descriptors, followed by a second cycle of axial coding which sought to develop connections and relationships between codes (Miles and Huberman, 1994). Axial coding enabled us to develop contexts around particular code labels that emerged through open coding, which were essential for us to interpret participant reports. Finally, the data were analysed using a thematic analysis by exploring patterns across the data.

Relative advantage: burning vs stubble retention

Most participants recognised the need to reduce burning of stubble and to increase stubble retention on their property. Motivations to do so were related mainly to personal goals and values around burning and/or tilling. For example:

> I think farmers are coming to the conclusion themselves. That, you know got sick of the dust and the dust problems and can see there's moisture benefits. (Farmlink, Group interview)
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> Yeah I've been trying to do that [retain stubble] all my life … we've made some big mistakes…. There's been a goal of my life I didn't like burning. (Rural Management Strategies, Grower B)

Pragmatic/business reasons were also viewed as important. In the following cases, retaining stubble was viewed as being less costly than burning.

> …it was a business decision for us [to retain stubble]. That was basically the main reason … it just worked for us, you know. Not as much labour around, small family farm and the opportunity was there to develop it. (Central West Farming Systems, Group interview)
>
> There's a lot of cost in burning today. Like, it's something that really if you could stop doing it tomorrow you would. (Holbrook Landcare Network, Group interview)

A number of growers believed that retaining stubble had benefits over burning in terms of retaining soil nutrients and moisture.

> The soil needs to be improved and you go on burning it, where's all the organic matter, you only get a bit out of the root system that's left after you burn it; and it depends how hot the burn is, how much is left. Whereas if you can avoid burning it a bit, even if you've got to do a little bit more work, I think that's better. (Holbrook Landcare Network, Grower B)
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> You retain a lot more soil moisture at the surface by keeping that cover…. I mean we just didn't see value in burning. (Southern Farming Systems, Grower B)

A key theme that emerged from the data was the growing incompatibility of previous practices, namely burning of stubble, with personal beliefs and values as well as with farm profitability. This had an important influence on growers' views on the benefits of adopting stubble retention practices. Thus, reduced labour intensity as well as improved soils and soil moisture emerged as the most significant reported benefits of retaining stubble. For example:

> I reckon it's less labour intensive like 'cause you can sort of put one bloke on a sprayer and it keeps your paddock clean all summer to having someone sort of ploughing and boarding and all that sort of stuff…. You burn less diesel. (Rice Research Australia, Group interview)

> …I think [stubble retention] keeps more in the soil and just ground cover, moisture infiltration. When it's bare, particularly this Mallee country can blow and all that sort of stuff…. I'd just like to try and get more humus in the soil, just make it softer sort of thing. (Central West Farming Systems, Grower A)

Negative experiences from trialling stubble retention

Despite the relative advantages reported in retaining stubble, growers across the group and individual interviews reported numerous challenges in implementing stubble retention in practice. This created problems in moving towards full adoption of stubble retention. The most significant of these were the impact of pests, diseases and weeds where stubble is retained. For example:

> There's probably, in most cases there's advantages to burning it. There's problems when you keep it, there are pests that you've got ... weed management is hard when you keep it. (Farmlink, Group interview)

> We have too many diseases, like our leaf spotting in wheat, to retain our stubbles [after the end of March] … so we are stubble burners…. Our burns are coolish, but the risk from pests and diseases from sowing into stubbles here is too high for me to take. (Holbrook Landcare Network, Grower A)

Biophysical constraints, such as being in a high rainfall zone, and higher costs, were mentioned also as important limitations influencing growers' capacity to move towards full stubble retention.

> In this valley, in here where it's high rainfall, heavier soils and heavier trash management generally speaking with traditionally up until now narrow growth spacings, a lot of that work [stubble retention] is very hard to implement. (Holbrook Landcare Network, Group interview)

> I don't think people who don't make a profit can really do stubble [retention]…. The nitrogen tie up for the first few years is just horrendous. The bills of urea, ...truckloads of urea that come through the gate here, really all we're doing is feeding the breakdown of organic matter until it starts giving back to us. (Rice Research Australia, Grower A)

While not usually associated in the literature with the trialability of a technology/practice, our research found that technological/technical constraints represented a major challenge for growers in incorporating stubble prior to sowing. For example:

> You're really restricted by the implements that you have and your row spacing and whether it's a tyned implement or a disc implement. (Rice Research Australia, Group interview)

> A lot of machinery can't handle [stubble], it can't (Southern Farming Systems, Group interview).

For a number of growers, moving towards full stubble retention required upgrading of machinery, a costly option especially for growers with mixed farming enterprises where grain is not the predominant commodity in their farming operation.

The relative advantages of selective stubble burning

As a consequence of the challenges in implementing stubble retention, many growers continue to selectively burn stubble. In these circumstances, burning is a crucial back-up option, which is used reluctantly to minimise risk and improve growers' flexibility to deal with seasonal variations in stubble loads. For instance:

> …the cool burn we do in the autumn is probably as much as I'd like to do. In the cereals I don't burn anything … I mean basically if you can't get through it and you can't do anything else with it and bale it or do something else with it, you have to burn it, that's what you have to do. (Rice Research Australia, Grower B)

> I mean traditionally [growers in the district] probably did use fire but maybe they're not using fire as much as what they used to. But if they're going to, it's in those big years when fire is needed to … physically break them [stubbles] down in that short period of time. (Central West Farming Systems, Grower B)

Burning is also critical for some farmers in improving weed management as the following quotes illustrate:

> At the end of the day we've got to make money and if it means burning the stubble once every now and again to get that crop, to get the chemicals to work, to have that crop a better crop, well we can do it. (Rural Management Strategies, Group interview)
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> Burning does a good job for Trifluralin and that sort of thing but I'm still not convinced it's the right way to go about it. (Southern Farming Systems, Grower B)

Conclusions

This paper has argued that personal, biophysical and cost-related motivations are more important to grain growers than external pressures (such as regulation or community pressure) in making decisions on cutting back of burning and increasing stubble retention. Growers have a high level of awareness of the economic and environmental benefits associated with stubble retention. However, there exist a range of reported technical, biophysical, biological and cost challenges and constraints that contribute to problems in achieving these benefits. These are consistent with those reported in the existing conservation farming literature. Nevertheless, unlike previous studies that treat such challenges as obstacles to adoption, our study reveals that many growers are willing to trial stubble retention. Stubble retention is *partially adopted* because of the negative experiences in trialling/implementation as well as the recognition that moving towards full stubble retention would undermine growers' flexibility to manage biophysical and financial variability. Flexibility is crucial for some farmers in enhancing trialability (McRobert and Rickards, 2010). Recent Australian research emphasises the importance of flexibility – such as the introduction of strategic tillage – in improving the success of no-till farming (Dixon, 2014). In our study, it is selective burning of stubble that provides growers with flexibility in their stubble management practices, and, given the reported benefits, may be important in giving growers additional confidence in continuing to engage in stubble retention. This finding suggests that improving the uptake of stubble retention requires greater accommodation of growers' existing practices, as well as recognition that selective burning may be complementary to growers retaining crop stubbles.

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