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Tree planting by smallholder farmers in Malawi: Using the theory of planned behaviour to examine the relationship between attitudes and behaviour

Seline S. Meijer [a, b, *], Delia Catacutan [c], Gudeta W. Sileshi [d], Maarten Nieuwenhuis [a]

[a] UCD Forestry, Agriculture & Food Science Centre, University College Dublin, Belfield, Dublin 4, Ireland
[b] World Agroforestry Centre (ICRAF) Eastern and Southern Africa Regional Programme, Chitedze Agricultural Research Station, Lilongwe, Malawi
[c] World Agroforestry Centre (ICRAF) Vietnam, No. 8, Lot 13A, Trung Hoa Street, Yen Hoa Ward, Cau Giay District, Hanoi, Viet Nam
[d] Plot 1244 Ibex Hill, Lusaka, Zambia

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ABSTRACT

This study examined farmers' attitudes towards tree planting on farms in Malawi, using the theory of planned behaviour as a conceptual framework. Questionnaires containing a scale that measures attitudes, subjective norms, and perceived behavioural control in relation to tree planting were administered to 200 farmers in Chiradzulu and Mzimba districts in Malawi. Farmers who reported planting trees in the last five years had more positive attitudes, subjective norms and perceived behavioural control compared to farmers who have not planted trees. A hierarchical logistic regression analysis showed that membership of a farmer group and attitudes had a significant positive influence on reported behaviour. Nevertheless, many farmers considered household needs such as buying food and agricultural inputs, as well as children's education, as more urgent than investing their scarce resources in tree planting, suggesting that poverty is a barrier to tree planting.

1. Introduction

Malawi is one of the poorest and least developed countries in the world, where ensuring food security and environmental conservation are major challenges. The country is characterised by a low human development index, ranking in the 174th place out of 189 countries in 2014 (UNDP, 2014). Gross National Income (GNI) per capita was a mere $715 in 2013 (UNDP, 2014) and it was estimated that 71.2% of the population lived below the poverty line of $1.25 a day (World Bank, 2013b). Life expectancy at birth is low with 55.3 years (UNDP, 2014) and child mortality is high, with 83 deaths per 1000 live births in 2011 (World Bank, 2013b). An important source of livelihood is agriculture, with about 85% of the population being engaged in agricultural activities (NSO, 2012). The population of Malawi was estimated to be 14.9 million in 2010, with an average annual growth rate of 3.1% (World Bank, 2013a). The rapid population growth is increasing the pressure on land, and as a result, smallholders are forced to undertake more intensive agriculture with continuous cropping, which in turn results in declining levels of soil fertility and crop yield, compromising food security (Sanchez & Swaminathan, 2005). As a result of these developments, 28% of the population were classified as being undernourished between 2005 and 2007 (FAO, 2010b) and 47.8% of children are affected by stunting (FAO, 2013). Moreover, the increasing population pressures, declining soil fertility and crop yield, and the subsequent agricultural expansion, are major drivers of deforestation in Malawi (Hyde & Seve, 1993; Place & Otsuka, 2001). The country has lost 659,000 ha of forest between 1990 and 2010 (FAO, 2010a) and annual deforestation rates are still believed to be among the highest in the region.

Agroforestry practices, when appropriately targeted to biophysical and socio-economic conditions, have the potential to address some of the problems of poverty, food insecurity and environmental degradation. It has been demonstrated that agroforestry can increase crop yields, as nitrogen-fixing trees have been shown to improve soil fertility and boost crop yields (Sileshi,

* Corresponding author. UCD Forestry, Agriculture & Food Science Centre, University College Dublin, Belfield, Dublin 4, Ireland.
E-mail addresses: seline.meijer@gmail.com (S.S. Meijer), d.c.catacutan@cgiar.org (D. Catacutan), sileshigw@gmail.com (G.W. Sileshi), maarten.nieuwenhuis@ucd.ie (M. Nieuwenhuis).

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Akinnifesi, Ajayi, & Place, 2008). In Malawi, several studies have reported increased yields in agroforestry systems compared to monoculture crops (Akinnifesi, Makumba, & Kwesiga, 2006; Akinnifesi, Makumba, Sileshi, Ajayi, & Mweta, 2007; Chirwa, Black, Ong, & Maghembe, 2003). Improved crop yields as well as the sale of tree products such as fruits, firewood and poles can increase income, as was demonstrated in Nigeria, Tanzania and Zambia (Ajayi, Akinnifesi, Sileshi, & Kanjipite, 2009; Ngambeki, 1985; Reyes, Quiroz, & Msikula, 2005). Several studies have linked low agricultural productivity in Africa to hunger and malnourishment, and propose that restoring soil health and fertility through agroforestry practices can help address this problem and improve food security (Garrity, 2004; Garrity et al., 2010; Jama & Pizarro, 2008; Pretty, Morison, & Hine, 2003; Sanchez, Buresh, & Leakey, 1997; Sanchez & Swaminathan, 2005). In addition, agroforestry can improve the ability of farmers to deal with the effects of climate change (Verchot et al., 2007), through the diversification of incomes, increase in farm profitability and better protection against the damaging effects of strong winds and water flows by controlling soil erosion and acting as a windbreak (Mbow, Smith, Skole, Duguma, & Bustamante, 2014; Thorlakson, Neufeldt, & Dutilleul, 2012). Agroforestry can also benefit ecosystem services (Izac & Sanchez, 2001; Jose, 2009) and biodiversity conservation (Bhagwat, Willis, Birks, & Whittaker, 2008). Growing trees on farm has the potential to contribute towards a more sustainable use of natural resources by providing alternative sources of fuel wood, fodder, timber for construction, medicine and food, which otherwise might have been taken from natural ecosystems such as forest reserves (Ashley, Russell, & Swallow, 2006; Jose, 2009; McNeely & Schroth, 2006; Noble & Dirzo, 1997; Pandey, 2002).

Despite the multiple benefits associated with tree planting activities, it has been argued that adoption of agroforestry has lagged behind the scientific and technological advances in agroforestry research (Mercer, 2004). Numerous studies have examined the challenges facing the uptake of agroforestry, yet conventional adoption studies have had a tendency to only look at personal, social and economic variables when explaining agroforestry adoption (Ajayi & Catacutan, 2012; Franzel, Coe, Cooper, Place, & Scherr, 2001; Keil, Zeller, & Franzel, 2005; Kiptot, Hebinck, Franzel, & Richards, 2007; Meijer, Catacutan, Ajayi, Sileshi, & Nieuwenhuis, 2015). Pattanayak, Mercer, Sills, and Yang (2003) provide an extensive review of the factors affecting the adoption of agricultural and forestry technologies by smallholders. They reviewed 120 cases of adoption and concluded that the factors which explain technology adoption within an economic framework can be grouped into five categories: preferences, resource endowments, market incentives, biophysical factors, and risk and uncertainty. They performed a meta-analysis to evaluate the significance of the adoption categories and conclude that although their results suggest that preferences and resource endowments are the most common factors included in the studies, risk, biophysical and resource factors are most likely to significantly influence adoption behaviour (Pattanayak et al., 2003). Preferences reflect the broad category of farmer specific influences such as risk tolerance, conservation attitude and intra-household homogeneity; however, as these are difficult to measure explicitly, socio-demographic proxies such as age, gender, education, and social status were used instead. In Malawi, Thangata, Hildebrand, and Gladwin (2002) used a model to simulate household decision-making on the uptake of agroforestry and concluded that the adoption pattern for improved fallows (a rotational system that uses specific tree species as the fallow species) is primarily driven by the availability of land and labour. Subsequently, Thangata and Alavalapati (2003) examined the differences between adopters and non-adopters of the fertilizer tree *Gliricidia sepium* and found that age of the farmers, extension contact and the number of people contributing to farm work are important factors in the adoption process.

More recent studies have also looked at socio-psychological factors, such as perceptions and attitudes, to explain adoption behaviour in relation to farm level tree planting (Douthwaite, Manyong, Keatinge, & Chianu, 2002; Fischer & Vasseur, 2002; Meijer, Catacutan, et al., 2015; Mekoya, Oosting, Fernandez-Rivera, & Van der Zijpp, 2008; Sileshi, Kuntashula, Matakala, & Nkunika, 2008). For example, Zubair and Garforth (2006) studied the perceptions and attitudes of farmers in Pakistan and found that their willingness to grow trees on their farms was a function of their attitudes towards the benefits and challenges of growing trees. McGinty, Swisher, and Alavalapati (2008) looked at the role of self-efficacy in the decision-making process of agroforestry adoption in Brazil and concluded that perceived behavioural control, attitudes about conservation and available labour contributed significantly to the intention to adopt or maintain agroforestry. Likewise, Sood and Mitchell (2004) claimed that socio-psychological factors of farmers need to be taken into consideration when planning socially acceptable agroforestry programs in the Western Himalayas. Farmers' perceptions of the restrictions on tree felling on their own land and their attitudes towards agroforestry were found to be the most important socio-psychological factors influencing the decision to grow trees. These studies demonstrate that socio-psychological factors such as perceptions and attitudes can explain the incidence and extent of tree planting activities; however, relatively few studies have looked at the role of socio-psychological factors in explaining agroforestry adoption, and specifically in comparison with other explanatory variables.

The effectiveness of tree planting programs and activities will be largely determined by the degree to which we understand and address the factors which encourage or discourage farmers to plant trees. It is essential to comprehend how farmers perceive the benefits and challenges associated with tree planting in order to explain the current extent of tree planting in Malawi and scale up these efforts in the future. To accomplish this, it is important to understand the decision-making process of farmers who plant trees on their land. In addition to the beliefs farmers hold with regards to the possible positive and negative outcomes of tree planting activities, their decisions are also influenced by the opinions and behaviour of relevant others in their surroundings as well as the practical possibilities they have to plant trees (Ajzen, 1991).

The theory of planned behaviour (TPB; Ajzen, 1991) was used to analyse farmers' attitudes toward tree planting in this study. The TPB argues that a person's behavioural intention depends on the person's attitude towards the behaviour, the subjective norms, and on the perceived behavioural control. An attitude is defined as "a person's favourable or unfavourable evaluation of the behaviour" and is formed by the beliefs about the likely outcomes of the behaviour (salient beliefs) and the evaluations of these outcomes (Fishbein & Ajzen, 1975). The subjective norm is the perceived social pressure to perform or not to perform the behaviour and is constructed by beliefs about the perceived expectations of others to carry out the behaviour (normative beliefs) and the motivation to comply with these expectations. Perceived behavioural control reflects the extent to which the individual feels he or she is able to actually carry out the behaviour, which is based on beliefs about factors that may facilitate or impede performance of the behaviour (control beliefs) and the perceived power of these factors (Ajzen, 1991). Together, the attitude toward the behaviour, the subjective norms, and the perception of behavioural control lead to the formation of a behavioural intention, which in turn leads to the performance of the behaviour (Ajzen, 1991).

The TPB has received widespread support as a model to predict intentions and behaviour in a range of fields. In a review of 185

studies testing the TPB, Armitage and Conner (2001) found support for the efficacy of the TPB in predicting intentions and behaviour across a variety of domains. The theory has long been used to examine intentions and behaviour in relation to health. A recent meta-analysis of 237 tests from 206 articles reporting on health-related behaviours found that particularly physical activity and diet behaviours were better predicted by the TPB, whereas risk, detection, safer sex and abstinence from drugs were poorly predicted (McEachan, Conner, Taylor, & Lawton, 2011). In addition, the TPB has also been applied to other types of behaviour; for example, Kautonen, Van Gelderen, and Tornikoski (2013) found support for the application of the TPB and the concept of behavioural intention to understand complex economic behaviour such as entrepreneurship. The TPB has also been used widely to explain environmental behaviours. Some studies have focused on specific environmental behaviours, such as the use of public transportation (Heath & Gifford, 2002), car use (Bamberg & Schmidt, 2003), recycling (Nigbur, Lyons, & Uzzell, 2010), the intention to visit an environmentally friendly hotel (Han, Hsu, Lee, & Sheu, 2011; Han, Hsu, & Sheu, 2010), engagement in environmental activism (Fielding, McDonald, & Louis, 2008), using unbleached paper, reducing meat consumption, use of alternative transportation, use of energy-saving light bulbs, turning off the faucet while brushing teeth (Harland, Staats, & Wilke, 1999), monitoring domestic electricity consumption (Webb, Benn, & Chang, 2014), and environmental behaviour in the workplace (Greaves, Zibarras, & Stride, 2013). Other studies have looked at environmental behaviour in general (Kaiser, Wölfing, & Fuhrer, 1999) and showed that the TPB is an effective model to predict ecological behaviour (Kaiser & Gutscher, 2003). The TPB has also been used to study the attitudes, intentions and behaviour in relation to farm-level tree planting and was found to be a suitable model to understand such attitudes and behaviour (McGinty et al., 2008; Zubair & Garforth, 2006).

Although most studies that evaluate the TPB focus on how the main TPB constructs affect intentions (and sometimes also behaviour), few studies have looked at the influence of socio-economic variables and their influence on intentions and behaviour. It has been suggested that attitudes might be more successful in predicting behaviour than socio-economic variables (Greaves et al., 2013; Meijer, Catacutan, et al., 2015); however more research is needed to better understand this. A study looking at demographics and attitudes in relation to visiting an environmentally friendly hotel found that green attitudes were significantly associated with the expressed intention to visit a green hotel (Han et al., 2011). However, except for gender differences, the intentions did not significantly differ for other demographic factors such as age, education level or household income (Han et al., 2011). Previous research also suggests that although socio-economic factors play a role in affecting the adoption of agroforestry technologies, socio-psychological factors might be as or even more important in understanding and predicting farmers' decisions to adopt agroforestry (McGinty et al., 2008; Meijer, Catacutan, et al., 2015).

This study uses the TPB as a theoretical framework to examine farmers' attitudes towards tree planting and the relationship between these attitudes and self-reported tree planting behaviour in two regions of Malawi. The study aims to understand the attitudes towards tree planting, the socio-economic variables influencing these attitudes, the variables that predict tree planting behaviour, and the barriers that constrain tree planting. There are distinct differences in the conditions between the northern and southern regions of Malawi, with the south having relatively high population densities and low forest cover (Mauambeta, Chitedze, Mumba, & Gama, 2010; NSO, 2008). As a result of lower population pressures and more abundant forests in the north, it has been suggested that farmers in the north are less motivated to engage in agroforestry activities compared to farmers in the south. In addition, previous research has suggested that male and female farmers play a different role when it comes to decision-making and implementation of activities related to tree planting and tree management in Malawi (Meijer, Sileshi, Kundhlande, Catacutan, & Nieuwenhuis, 2015). Tree planting and tree management were found to be mainly the domain of men; however, decision-making on tree planting by the wife and joint decision-making on tree management resulted in higher densities of trees planted on farms compared to situations where decisions were made by the husband alone. These findings suggest that there might be differences in the attitudes and behaviours related to tree planting between men and women as well. Therefore, this study will not only look into differences in attitudes and behaviours between farmers in the northern and southern regions of Malawi, but also differences between male and female farmers.

Specifically, we intend to test the following hypotheses:

Hypothesis 1. The core TPB constructs towards tree planting are correlated with socio-economic variables and differ between male and female farmers and between farmers in the north and south of Malawi.

Hypothesis 2. A combination of TPB constructs and socio-economic variables can better predict tree planting behaviour than a model containing only either socio-economic variables or TPB constructs.

2. Materials and methods

2.1. Study area

Malawi is a relatively small landlocked country in southern Africa, occupying an area of 11.9 million hectares, of which 22% comprises inland waters (Lakes Malawi, Malombe, Chilwa and Chiuta). The climate is tropical and rainfall is concentrated in a single wet season between November and April, with average rainfall varying from 800 mm in the low-lying areas along Lake Malawi to 1000–1500 mm in the high-altitude plateaux. Almost all households involved in farming cultivate maize, making it the most important staple food. Other important food crops are pulses, groundnuts and cassava. In addition, cash crops grown for export include tobacco, tea, sugar, coffee and macadamia. The population is concentrated in the south of the country, with 184 persons per square kilometre compared to 63 in the Northern Region (NSO, 2008). Due to the high population densities, the average landholding size for smallholder farmers is small, with most farmers cultivating less than a hectare (Bunderson, Bodnar, Bromley, & Nanthambwe, 1995). Firewood is the most common source of energy for cooking, used by 96% of the population in rural areas as the main energy source (NSO, 2008). It has been estimated that 34% of the total land area of the country is covered with forests, which corresponds to about 3.2 million hectares, of which only 23% can be found within formally protected areas (FAO, 2010a).

This study focused on two study sites in Malawi: the northern district Mzimba and the southern district Chiradzulu. Mzimba district is characterized by relatively high levels of forest cover and low population densities. In contrast, most forests have disappeared in Chiradzulu district, where population densities are high. Chiradzulu is mainly characterized by matrilineal kinship structures, where a married couple resides in the original village of the wife and land rights are passed down to the females in the family, whereas most households in Mzimba follow patrilineal kinship rules, where a couple takes up residence in the village of

the husband after marriage and land is passed down from fathers to sons (Takane, 2008).

2.2. Methodology

This paper employs a mixed method approach, drawing on both quantitative as well as qualitative research methods (Johnson & Onwuegbuzie, 2004). A mixed methods approach is valuable as it can draw from the strengths and minimize the weaknesses of both and it is now being widely used and recognised as a research paradigm in itself (Johnson, Onwuegbuzie, & Turner, 2007). A quantitative household survey was used to elicit information on respondents' characteristics, their behaviour in relation to tree planting, as well as the attitudes, subjective norms and perceived behavioural control in relation to tree planting. In addition, qualitative focus group discussions were used to explore some of these findings in more detail and as a way of triangulating the results of the questionnaires.

2.3. Household survey

A household survey was used to elicit information on respondents' attitudes, perceptions and behaviour in relation to tree planting. Prior to the survey, informal visits and discussions with farmers and an exploratory survey were conducted in both study areas to elicit information about beliefs, attitudes, normative referents and control factors in relation to tree planting. In these interviews respondents were asked about their experiences with and opinions of planting trees and this information was used to develop the final questionnaire. The questionnaire consisted of two parts. The first part contained questions about personal, household and farm characteristics, as well as questions on the extent of tree planting. Several socio-economic variables were extracted from this part of the survey and used in the analyses in this paper, including gender, age, education level, kinship structure (matrilineal versus patrilineal), household size, farm labour (number of household members that contribute to farm labour), estimated annual income (estimated by the respondent in the local currency), food security (estimated average number of months per year the household produces enough food to feed the household, estimated by the respondent) and whether the respondent is a member of a farmers group. The questionnaire also asked respondents about any trees they have planted on their farms, making the behaviour we study reported rather than actual measured behaviour. The second part of the questionnaire consisted of an attitude scale to assess the attitudes, subjective norms and perceived behavioural control towards tree planting according to the TPB methodology (Ajzen, 1991).

Based on the responses during the informal discussions and exploratory survey, items for an attitude scale were developed to measure the TPB constructs towards tree planting. In addition to items about the attitude towards the behaviour, the questionnaire also included statements about the subjective norms and perceived behavioural control (Ajzen, 1991). The attitude scale used indirect measures to evaluate attitude, subjective norms and perceived behavioural control, using two components to measure each construct (Table 1). The response format used in the attitude scale was a five point Likert scale (Likert, 1931). The two components of attitude – salient belief and outcome evaluation – were each measured on a scale ranging from 'strongly agree' (5) to 'strongly disagree' (1) for belief strength, and 'extremely good' (2) to 'extremely bad' (−2) for outcome evaluation. The two components of subjective norm - normative belief and motivation to comply - were evaluated on a scale ranging from 'strongly agree' (2) to 'strongly disagree' (−2) that the referent would encourage the behaviour, for normative belief strength, and 'strongly agree' (5) to 'strongly disagree' (1), for motivation to comply with the referent. To construct the perceived behavioural control, the control beliefs were measured on a scale ranging from 'strongly agree' (5) to 'strongly disagree' (1) that it was likely that the control factor would be encountered, and the power of the control factors was measured on a scale ranging from 'strongly agree' to 'strongly disagree' that the control factor enabled (2) or disabled (−2) tree planting.

The items in the attitude scale were translated into the local Chichewa language for the south and Tumbuka language for the north of Malawi to make sure they were asked in exactly the same way to each respondent. The final list of items was piloted several times to improve the translations and the order of the statements. The final questionnaire was administered to a total of 200 respondents. In each district, we selected an Extension Planning Area (EPA) based on contacts and previous activities of the World Agroforestry Centre (ICRAF). In each EPA, 10 villages were selected using random numbers from a list of villages provided by staff from the EPA. In each village, 10 households were selected randomly from the lists of all farm households for each village. The head of the household was interviewed, in most cases this was a male, but in some cases, mostly due to divorce, death, separation or long term absence of the husband, the woman was the household head. If the head of the household was not available to be interviewed, another household was selected from the list using the random sampling procedure. In Chiradzulu district, the household survey was administered to 43 male-headed households and 57 female-headed households, whereas 76 male-headed households and 24 female-headed households were included in the survey in Mzimba. To complement the data collected in the household survey, handheld GPS units were used to measure the area of the land belonging to each respondent to establish land size and calculate the density of trees planted on a respondent's land.

2.4. Focus group discussions

Focus group discussions were carried out according to the methodology described by Hennink (2007). In each district, four focus groups were carried out with female participants and four with male participants, resulting in a total of 16 focus groups. Each focus group discussion consisted of 7–9 participants and lasted approximately two hours. After the villages had been selected, respondents were selected randomly from the list of all farming households provided by the EPA. Some participants of the focus group discussions had also participated in the household survey in the previous year. A discussion guide was developed and translated into both Chichewa and Tumbuka and the focus group discussions were conducted in the local language of each district.

The focus group discussions included several open discussion questions about people's experiences and opinions about tree planting. In addition, there were two, more structured, group exercises. The first was a pair-wise ranking exercise about household priorities. The respondents were asked to list the eight most important things for a household to invest in when given a small, but for a typical Malawian farmer significant, sum of money (MWK 5000 – about $15 at the time of the research). After the group had agreed on the eight main priorities, a pair-wise ranking exercise was carried out where each chosen priority was compared to the others to determine the relative importance of each priority. At the end of the exercise, the participants were asked to discuss the importance of investing in tree planting in relation to the other household priorities mentioned. The second exercise was also a pair-wise ranking exercise, this time to determine the most important barriers farmers face in relation to tree planting. The respondents were asked to list the six most important barriers

Table 1
Items of the attitude scale to evaluate the three TPB constructs: attitudes, subjective norms and the perceived behavioural control towards tree planting.

Salient beliefs	**Outcome evaluations**
Planting trees on my land will increase my income	For me to have more income is
Planting trees on my land is an important source of fruits for my household	For me to have more fruits is
Planting trees on my land will increase the availability of firewood	For me to have more firewood is
Planting trees on my land is an important source of poles and timber	For me to have more poles and timber is
Planting trees on my land will improve soil fertility	For my farm to have improved soil fertility is
Planting trees on my land increases pest outbreaks	For me to experience more pest outbreaks is
The shade provided by planting trees on my farm is impeding crop growth	For me to experience lower crop growth is
Planting trees on my land is taking up too much space	For me to have less space on my land is
Planting trees leads to scarcity of water on my land	For me to experience more scarcity of water on my land is
Normative beliefs	**Motivation to comply**
My spouse thinks I should plant trees on my land	Generally speaking, I want to do what my spouse thinks I should do
My farmer group thinks I should plant trees on my land	Generally speaking, I want to do what my farmer group thinks I should do
Extension workers think I should plant trees on my land	Generally speaking, I want to do what extension workers think I should do
The village chief thinks I should plant trees on my land	Generally speaking, I want to do what my village chief thinks I should do
Most of the people in my village are planting trees on their farm	Generally speaking, I want to be like the other people in my village
Control beliefs	**Power of control factors**
I often encounter termites on my land	If I encounter termites on my land, it is more difficult for me to plant trees
Rainfall is irregular and inadequate	If rainfall is irregular and inadequate, it is more difficult for me to plant trees
I often encounter livestock browsing on my land	If I encounter livestock browsing on my land, it is more difficult for me to plant trees
I have enough time to carry out all my farming activities	If I have enough time to carry out all my farming activities, it enables me to plant trees
Tree seeds and seedlings are easily available	If tree seeds and seedlings are easily available, it enables me to plant trees
Water is sufficiently available on my land	If water is sufficiently available, it enables me to plant trees

which impede tree planting in the area, after which a pair-wise ranking exercise was carried out to determine the relative importance of each barrier. The data from the pair-wise ranking exercises were used to develop a ranking score for each priority and barrier, which was the average of the number of times the particular item was preferred over another in a pair-wise comparison for the 16 groups. For the household priorities, the ranking scores for the priority items ranged from zero to seven, as the groups came up with eight priorities and, as a result, seven is the maximum number of times the item can be preferred over the other ones. For the barriers to tree planting, the scores ranged from zero to five, as the groups were asked to come up with six barriers.

2.5. Data analysis

The attitude scale included a total of 40 items to measure the three TPB constructs towards tree planting (Table 1). To obtain total attitude scores for each respondent, the two related components for each construct were multiplied and the results then summed, giving separate scores for attitude, subjective norm and perceived behavioural control. For the attitude construct, there were nine statement pairs (salient belief × outcome evaluation) which were multiplied and the results then summed. The subjective norm was constructed by five item pairs (normative belief × motivation to comply) and the perceived behavioural control consisted of six item pairs (control belief × power of control factor). This resulted in possible outcome scores ranging from −90 to 90 for attitude, −50 to 50 for subjective norm and −60 to 60 for perceived behavioural control.

Since the attitude, subjective norm and perceived behavioural control were measured on an ordinal scale, median and interquartile ranges (IQR) were used as measures of central tendency and dispersion, and non-parametric tests were used to detect correlations and differences between groups. The density of planted trees was transformed using a logarithmic transformation to obtain a normal distribution and t-tests were performed to test for differences between the two study sites and between male and female household heads. Mann–Whitney U tests were used to test if attitudes, subjective norms and perceived behavioural control were different for respondents who planted trees in the past five years and those who did not. A Spearman rank correlation was carried out to test the association between the TPB constructs on one hand and density of planted trees on the other. Spearman rank correlation tests were also used to test the association between the socio-economic variables and the TPB constructs. These tests were used to find out whether any correlation exists between the TPB constructs and socio-economic variables. This step was necessary because we had no prior knowledge of potential multicollinearity among the variables. We also constructed several multivariate models to explain variation in whether or not a respondent had planted trees in the past five years (Appendix A), looking at socio-economic variables (Table A.1), the TPB constructs (Table A.2) and socio-economic and TPB variables combined (Table A.3). The most parsimonious model describing tree planting is given in Table A.4. In all cases we used a mixed modelling framework with a random intercept where district is the subject. This framework assumes that observations within a district are correlated. Finally, we performed a hierarchical logistic regression in order to assess whether the TPB constructs explain significant variance in tree planting above and beyond socioeconomic and demographic factors. In the hierarchical logistic regression, ten socio-economic variables were entered as the first block and the three TPB constructs as the second block. We used a forward stepwise (Wald) selection method to eliminate variables. We could not apply more complicated multi-level models because this would have required a sample size larger than the current one. The outcomes of the group exercises conducted in the focus group discussions were analysed using descriptive statistics and cross tabulations using SPSS.

3. Results

3.1. Household characteristics of the study population

The average household size was 5 people (with a Standard Deviation (SD) of ±2) in both areas. The average total farm size was 0.69 ha (SD 0.64) in Chiradzulu and 2.23 ha (SD 2.29) in Mzimba, although the actual land size under cultivation was lower in both areas. Almost all households (99%) own land, and some

respondents (21%) said they rented additional land for farming. The main food crop planted in both districts was maize (*Zea mays*), while the main cash crops were pigeon pea (*Cajanus cajan*) in Chiradzulu (planted by 56% of households) and tobacco (*Nicotiana tabacum*) in Mzimba (planted by 17% of households).

3.2. Tree planting behaviour

On average, 76% of respondents indicated they have planted trees on their land in the past five years. The percentage was slightly higher in Chiradzulu (81%) compared to Mzimba (71%), but this difference was not statistically significant ($p = 0.098$). The proportion of respondents who reported they have planted trees on their land in the past five years did not differ between male-headed households (76%) and female-headed households (75%; $p = 0.850$). The most frequently encountered trees on farmers' land were mango (*Mangifera indica*), blue gum (*Eucalyptus* species) and wild loquat (*Uapaca kirkiana*). The average number of trees planted by respondents on their land was 45 (SD 77) in Chiradzulu and 42 (SD 116) in Mzimba. When the densities of planted trees were calculated using the area measurements for the land owned by each respondent, there were significant differences in the density of trees planted (number of trees per hectare) between Chiradzulu (average 77.7; SD 108) and Mzimba (average 25; SD 65; $p < 0.001$). The density of planted trees did not differ between male-headed households (average 51; SD 100) and female-headed households (average 52; SD 82; $p = 0.300$).

3.3. Attitudes towards tree planting and relationships with socio-economic variables

With a median attitude score of 20.5 (IQR 14-29), the attitude of respondents towards planting trees was generally positive. This means that positive outcomes were associated with carrying out the behaviour. The subjective norm towards tree planting was also positive with a median score of 22.5 (IQR 10.25-32), meaning that other people generally encourage respondents to plant trees. The perceived behavioural control was more variable, with both positive as well as negative scores in the sample. On average, behavioural control was perceived mostly positive (median score 7.5; IQR -2-17), meaning that most respondents encounter more factors which enable tree planting than factors which impede it.

The attitude, subjective norm and perceived behavioural control towards tree planting were affected by several socio-economic variables (Table 2). Respondents in Chiradzulu had more positive attitudes and subjective norms towards tree planting compared to respondents in Mzimba, but there was no difference for perceived behavioural control. The gender of the head of the household was not significantly associated with the attitude and the subjective norm towards tree planting, but the perceived behavioural control was more positive for male respondents compared to female respondents. A more positive attitude was associated with households with a matrilineal kinship structure, with higher levels of food security as expressed by the number of months that a household has enough maize from their farm to feed the household, and where the household head was a member of a farmers group. Young age of the household head, membership of a farmers group, matrilineal kinship structure, a higher number of household members, a smaller size of the landholding and a higher level of food security were associated with more positive subjective norms. The perceived behavioural control increased with a larger size of the landholding and a higher estimated annual income. The education level of the household head and the number of household members contributing to labour on the farm were not significantly associated with the attitude, subjective norm or perceived behavioural control in relation to tree planting.

3.4. Relationships between attitudes and tree planting behaviour

Respondents who reported to have planted trees on their farm in the past five years had a more positive attitude towards tree planting compared to respondents who indicated that they had not planted trees on their land (Mann–Whitney $U = 2221$; $p < 0.001$). Similarly, respondents who planted trees in the past five years experienced a more positive subjective norm (Mann–Whitney $U = 2820$; $p = 0.018$) and perceived behavioural control with regards to tree planting (Mann–Whitney $U = 4392$; $p = 0.033$) compared to respondents who had not planted trees. In addition, there were significant relationships between the density of trees planted and the attitude ($\rho = 0.227$; $p = 0.001$) and subjective norm ($\rho = 0.394$; $p < 0.001$) towards tree planting. The perceived behavioural control was not significantly related to the density of planted trees ($\rho = 0.015$; $p = 0.835$).

The hierarchical logistic regression analysis showed that tree planting significantly depended on membership of a farmers group and on the attitude towards tree planting (Table 3). The other variables were not statistically significant. Respondents who belong to farmers groups were more likely to have planted trees in the past five years. In addition, a more positive attitude towards tree planting was associated with having planted trees in the past five years. The addition of the TPB constructs in the second block increased the variation explained by the model. This was indicated by the increase in the Nagelkerke R^2 and the reduction in the log likelihood (Table 3).

Table 2
Correlation of socio-economic variables with the attitude, subjective norm and perceived behavioural control towards tree planting.

Variables	Attitude		Subjective norm		Perceived behavioural control	
	Coefficient	*p*	Coefficient	*p*	Coefficient	*p*
District (1 = Chiradzulu, 2 = Mzimba)	−0.316	***	−0.530	***	0.068	ns
Gender (1 = male, 2 = female)	0.122	ns	0.124	ns	−0.175	*
Age	−0.091	ns	−0.170	*	−0.001	ns
Education level	0.060	ns	0.077	ns	0.107	ns
Membership farmers group (0 = no, 1 = yes)	0.203	**	0.270	***	0.112	ns
Kinship (1 = matrilineal, 2 = patrilineal)	−0.269	***	−0.322	***	−0.010	ns
Household size	0.111	ns	0.147	*	−0.129	ns
Farm labour	0.087	ns	0.128	ns	−0.052	ns
Land size	−0.062	ns	−0.310	***	0.203	**
Estimated income	−0.048	ns	0.028	ns	0.189	*
Food security	0.264	***	0.326	***	0.118	ns

*, **, *** denoting significance at 0.05, 0.01 and 0.001 levels respectively and ns indicating non-significance.

Table 3
Results of a hierarchical logistic regression analysis, with socio-economic variables (block 1) and TPB constructs (block 2) as predictors of tree planting.

Block	Nagelkerke R^2	−2 Log likelihood	Variable	B	S.E.	Wald	*p*
0			Constant	−1.106	0.174	40.454	0.000
1	0.085	188.094	Constant	−3.691	0.960	14.767	0.000
			Membership farmers group	1.450	0.508	8.131	0.004
			Gender	NA			0.658
			Kinship	NA			0.348
			Education level	NA			0.558
			Age	NA			0.103
			Household size	NA			0.615
			Farm labour	NA			0.770
			Land size	NA			0.120
			Estimated income	NA			0.099
			Food security	NA			0.557
2	0.169	177.099	Constant	−2.290	1.053	4.726	0.030
			Membership farmers group	1.213	0.521	5.414	0.020
			Attitude	−0.052	0.016	10.029	0.002
			Subjective norm	NA			0.419
			Perceived behavioural control	NA			0.172

NA: Not available because the hierarchical logistic regression method in SPSS does not yield parameter estimates for non-significant variables in the model.

3.5. Household priorities

During the 16 focus group discussions, a total of 20 different household priorities were identified by the groups' participants (Table 4). The priorities which were mentioned most frequently were buying food, buying clothes, buying fertilizer, paying school fees, buying livestock and investing in a business. After the pairwise ranking exercise, buying food, buying fertilizer and paying school fees for children came out with the highest ranking scores (Table 4), indicating that these priorities were chosen most frequently. Buying tree seeds or seedlings was mentioned by five focus groups as something the household should invest in, however it only came in as the tenth most important priority for most households with an average score of 0.72 out of a range between zero and seven (Table 4). After ranking, investing in tree planting never came out as one of the top three priorities; it was only the fourth, fifth, sixth, seventh or eighth (last) priority in the various groups. Although the focus group participants all agreed that planting trees was an important activity, farmers considered other, more immediate needs, such as providing food for the household and sending children to school, as more urgent. The household priorities did not seem to differ much between Chiradzulu and Mzimba. Buying food was selected more often over other priorities by focus group participants in Mzimba compared to Chiradzulu (Table 4). In addition, buying fertilizer and investing in a business had higher scores for Mzimba than Chiradzulu whereas the reverse was true for paying school fees and buying livestock; however, none of these differences were statistically significant. Furthermore, there did not seem to be any significant differences in the ranking of the household priorities between the male and female groups (Table 4).

3.6. Barriers to tree planting

The 16 focus group discussions identified a total of 24 barriers which impede tree planting (Table 5). The barriers that were mentioned most frequently in the discussions were laziness, land scarcity, lack of tree seeds or seedlings, termites, lack of extension and training, and poverty. The barriers which had the highest ranking scores were laziness, land scarcity and lack of tree seeds.

Table 4
Results of pairwise ranking of household priorities by 16 focus groups by district and gender.

Priorities	Frequency	Ranking score	District		Gender	
			Chiradzulu (N = 8)	Mzimba (N = 8)	Male (N = 8)	Female (N = 8)
Food (maize)	15	4.63	3.44	5.81	4.44	4.81
Fertilizer	13	4.16	3.75	4.56	4.50	3.81
School fees	13	4.09	4.31	3.87	4.81	3.38
Business	11	2.88	2.63	3.13	2.31	3.44
Livestock	11	2.16	3.00	1.31	2.63	1.69
House construction	9	1.94	1.19	2.69	2.06	1.81
Farm implements	6	1.56	1.13	2.00	2.50	0.63
Clothes	14	1.16	0.69	1.63	1.25	1.06
Hiring informal labour	6	1.13	1.50	0.75	1.25	1.00
Buying tree seeds	5	0.72	0.94	0.50	0.38	1.06
Household utensils	6	0.69	0.38	1.00	0	1.38
Milling maize	2	0.50	1.00	0	1.00	0
Buying maize seeds	1	0.37	0.75	0	0.75	0
Buying land	1	0.31	0	0.63	0	0.63
Soap	7	0.28	0.44	0.13	0	0.56
Relish	1	0.22	0.44	0	0	0.44
School uniform	1	0.19	0.38	0	0	0.38
Groceries	2	0.06	0.13	0	0.13	0
Bicycle	1	0	0	0	0	0
Sleeping conditions	1	0	0	0	0	0

The frequency reflects the number of focus groups that selected the item as a household priority (groups could list up to 8 priorities). The average ranking scores represent the average number of times this priority was selected as more important in a pairwise comparison (scores range from 0 to 7).

Table 5
Results of pairwise ranking of barriers to tree planting by 16 focus groups by district and gender.

Barriers	Frequency	Ranking score	District		Gender	
			Chiradzulu (N = 8)	Mzimba (N = 8)	Male (N = 8)	Female (N = 8)
Laziness	14	2.44	1.75	3.13	3.25	1.62
Land scarcity	12	1.87	1.88	1.88	2.25	1.50
Lack of tree seeds/seedlings	11	1.75	1.75	1.75	2.13	1.38
Termites/pests	7	1.13	1.63	0.63	0.75	1.50
Lack of extension and training	4	0.75	0	1.50	1.00	0.50
Poverty	4	0.44	0.25	0.63	0.38	0.50
Not aware of benefits of trees	2	0.44	0.63	0.25	0.88	0
Poor soils	4	0.44	0.63	0.25	0.50	0.38
Deforestation	2	0.25	0.50	0	0.50	0
Lack of equipment	2	0.25	0.50	0	0.50	0
Rocky soils	2	0.19	0.13	0.25	0.38	0
Source of water is far	1	0.19	0	0.38	0	0.38
Population growth	1	0.13	0.25	0	0.25	0
Theft	2	0.13	0.25	0	0	0.25
It takes too long to see benefits	2	0.13	0	0.25	0.25	0
Livestock browsing	2	0.13	0.25	0	0	0.25
There are no procedures about tree planting	1	0.13	0	0.25	0.25	0
People perceive it as a difficult task	1	0.13	0	0.25	0.25	0
Government confiscates trees	1	0.06	0.13	0	0	0.13
Climate change/irregular rainfall	2	0.06	0	0.13	0.13	0
Bush fires	1	0.06	0	0.13	0.13	0
People do not want to plant	1	0.06	0	0.13	0	0.13
Death of tree seeds	1	0	0	0	0	0
Poor health	1	0	0	0	0	0

The frequency reflects the number of focus groups that selected the item as a barriers to tree planting (groups could list up to 6 barriers). The average ranking scores represent the average number of times this barrier was selected as more important in a pairwise comparison (scores range from 0 to 5).

Especially in Mzimba, laziness was selected most often as the most common barrier to tree planting; however, there were no significant differences in the ranking scores for the barriers between the two districts. In addition, male respondents seemed to find laziness and land scarcity more important barriers compared to female respondents; however, these differences were also not statistically significant.

4. Discussion

The results of this study suggest that farmers are aware of the benefits associated with planting trees and negative attitudes do not seem to be a reason why farmers are not planting trees in Malawi. The attitudes towards tree planting were mostly positive, meaning that farmers associated more positive than negative outcomes with tree planting. This confirms earlier findings that farmers in Malawi highly value trees within their farming landscapes (Dewees, 1995). The results of this study also provide partial support for the hypothesis that attitudes towards tree planting affect tree planting behaviour. Farmers who had planted trees in the past five years had a more positive attitude than those who had not planted trees on their land. Farmers with a more positive attitude towards tree planting also had a higher density of planted trees on their land. The hierarchical logistic regression analysis showed that attitudes towards tree planting were a significant predictor of whether or not a respondent had planted trees in the past five years. These findings correspond to the work of Sood and Mitchell (2004), who found that attitudes towards agroforestry were the second most important determinant of on-farm tree growing in the Western Himalayas.

The study also demonstrated that several socio-economic characteristics of the farmer influence the attitude components in relation to tree planting; however, of these socio-economic variables, only membership of a farmers group directly affected reported tree planting behaviour. The lack of a significant effect of socio-economic variables on behaviour is in line with previous studies of the TPB and environmental behaviour (Han et al., 2011; McGinty et al., 2008). The hierarchical regression analysis showed that a model comprising of both socio-economic variables and TPB constructs better explained tree planting behaviour than socio-economic variables alone. This supports the notion that both extrinsic and intrinsic factors play a role in explaining agroforestry adoption (Meijer, Catacutan, et al. 2015). Although most of the socio-economic variables studied here did not have a direct effect on tree planting behaviour, some of these were correlated to the attitude towards tree planting, and as such, they can affect tree planting behaviour indirectly. This provides further support for the idea that the role of these extrinsic variables are mediated through intrinsic socio-psychological variables (Meijer, Catacutan, et al., 2015). The findings of the multivariate models presented in the Appendix are in agreement with the outcomes of the hierarchical regression analysis, suggesting that our findings are robust. One could argue that the direction of the relationship between attitudes and reported behaviour is not defined; perhaps farmers who have planted trees on their land may have developed positive attitudes as a result. This is plausible as we measured reported behaviour that has taken place in the past. To a certain degree there will be a feedback effect where farmers who have planted trees on their land do develop more positive attitudes towards this behaviour as a result of the implementation of the behaviour (Fishbein & Ajzen, 1975).

The subjective norms in our study were also mostly positive, meaning that farmers feel encouraged by others, such as their spouse, village chief, farmers group, extension workers and peers, to plant trees. The perceived behavioural control was only moderately positive. This implies that farmers encounter factors which enable tree planting as well as those that hinder it. The subjective norms and perceived behavioural control were both significantly more positive for farmers who planted trees compared to those who had not planted trees in the past five years. This suggests that farmers who engage in tree planting behaviour feel more encouraged by important others to plant trees and also experience fewer hindrances when planting trees. However, in the hierarchical logistic regression, subjective norms and perceived behavioural

control were not significant predictors of tree planting. This does not conform to the theory behind the TPB (Ajzen, 1991) and with the findings in other studies (McGinty et al., 2008; Zubair & Garforth, 2006). Since we looked at past behaviour instead of the intention to carry out this behaviour in the future, we cannot rule out effects of subjective norms and perceived behavioural control on intention to plant in the future. There have been concerns that self-reporting of behaviour can be unreliable due to social desirability or self-presentational biases (Armitage & Conner, 2001). However, previous research has shown that intentions have a strong direct effect on actual behaviour (Bamberg, 2003). In addition, it has been suggested that past behaviour can influence future behaviour (Ajzen, 2002). The TPB has also been found to be a better predictor of self-reported behaviour than of actual behaviour (Armitage & Conner, 2001). Therefore, we assume that the self-reported behaviour used in this study is an appropriate proxy for intentions and future behaviour of tree planting.

Since most farmers in our study had positive attitudes towards tree planting and were aware of the benefits associated with it, attitudes are probably not barriers to tree planting in our study sites. The priority ranking exercise demonstrated that farmers consider household needs, such as buying food or fertilizer and sending children to school, more urgent than investing money in tree planting. These results reinforce findings from previous studies carried out in Malawi. For example, Walker (2004) carried out a comparable priority ranking exercise with similar results in two villages in central and southern Malawi and came to the same conclusion that "the overriding priority for most Malawian farmers is immediate food security" (p. 102). Sirrine, Shennan, and Sirrine (2010) evaluated the adoption potential of several agroforestry systems in southern Malawi and found that adoption was generally based on immediate livelihood benefits related to food security. In their study, pigeon pea was found to have the highest preference and adoption rate, mainly due to its ability to provide an immediate secondary food crop. Similarly, Pircher, Almekinders, and Kamanga (2013) explored the reasons behind low adoption of legume technologies to improve soil fertility for farmers from central Malawi and found that farmers adopted some of the improved grain legume cultivars, but hardly any of the non-grain legumes. These studies support our finding that the main priority for Malawian farmers is food security. Although tree planting can in fact contribute to enhancing food security by providing fruits, nuts and fertilizer for crops (Garrity, 2004; Garrity et al., 2010; Magcale-Macandog, Ranola, Ranola, Ani, & Vidal, 2010), it takes a relatively long time to see these benefits and, as a result, farmers rather spend their scarce capital on items which relieve food insecurity in the short-term.

Our findings suggest that poverty is an important limiting factor when it comes to tree planting in Malawi (Walker, 2004). These findings are also supported by studies from outside Malawi. For example, Jerneck and Olsson (2014) employed 'narrative walks' to analyse reasons for adoption and non-adoption of agroforestry for small-scale farmers in western Kenya. Their findings showed that agroforestry fails to be taken up by the 'poorest of the poor', whose main priority is to get food on the table and who cannot afford too much risk-taking by investing time and labour in new technologies which have uncertain benefits in the long term. In contrast, farmers who enjoy higher levels of food security are more likely to be 'opportunity seekers' and might be more inclined to venture into agroforestry. These findings also show that poverty and inequality are strong barriers against the adoption of new agricultural technologies (Jerneck & Olsson, 2014).

Farmers themselves identified laziness, land scarcity and lack of tree seeds as the main barriers to tree planting during the focus group discussions in this study. Poverty was also mentioned as a barrier, but only by four out of 16 focus groups. The barriers identified by the focus group discussions could be interpreted as a sort of perceived behavioural control, as these are the perceptions of external factors that can hinder tree planting behaviour. These barriers shed more light on which factors farmers perceive to be the main difficulties that deter people in their community from planting trees. Interestingly, laziness was identified as the main reason why other farmers are not planting trees. The focus group discussants explained that although some farmers might have been given the opportunity to plant trees, they have been discouraged because of low survival rates of tree seedlings in the past or because of theft of trees. In addition, participants explained that tree planting and caring for trees is labour intensive, and because of the many other responsibilities around the farm and house, it was felt that tree planting was sometimes not prioritized. The information from the focus group discussions helps to understand the perceived barriers to tree planting and complements the information obtained in the survey.

The study found some interesting differences between the two study districts. Farmers in Chiradzulu had more positive attitudes and subjective norms towards tree planting compared to farmers in Mzimba, and consequently more farmers were planting trees and the average density of planted trees was higher in Chiradzulu. Furthermore, farmers in Chiradzulu believe more strongly that tree planting will increase the availability of firewood, and value this outcome more positively than farmers in Mzimba. These findings could be explained by the different characteristics of the two districts. For example, the higher population densities and subsequent losses in tree cover in the south could have led farmers to plant more trees on their land to compensate for the lack of access to trees and tree products from the forest. The effects of higher population densities on agroforestry adoption are not clear from the literature. Franzel (1999) assessed the adoption of improved fallows in different settings in Africa and found that in eastern Zambia, where the population density is high and farmers experience a decrease in soil fertility, the potential for tree fallows is great. In contrast, agroforestry adoption was reported to decrease in areas with very high population pressure in southwest Cameroon, whereas it increased in areas with high fuelwood scarcity (Adesina, Mbila, Nkamleu, & Endamana, 2000). In our study, it appears that higher population densities have resulted in more pressure on forests and the subsequent decline in tree cover and firewood availability seems to have stimulated farmers to plant trees on their land. In addition to differences in population density and forest cover, the differences in attitudes and behaviour between the two study sites could also be explained by other characteristics of the two districts. One factor which contributes to higher density of trees in Chiradzulu is the fact that farm sizes are significantly smaller here compared to Mzimba. In addition, differences in kinship structures could play an important role, as kinship can affect attitudes towards tree planting and has been shown to be related to household decision-making systems and the outcomes in terms of trees planted (Meijer, Sileshi, et al., 2015). The results reported here suggest that the size of the landholding and kinship structure, as well as other socio-economic variables that are likely to differ between the two districts, influence the attitudes and consequently the behaviour in relation to farm-level tree planting. It is important to understand the subtle differences in attitudes and behaviour between farmers in both districts, so that communication and extension services can be appropriately targeted.

Tree planting attitudes and behaviour did not differ much between male and female farmers. The attitudes and subjective norms towards tree planting were not significantly different for male and female farmers in this study. However, there seemed to be a tendency for the attitudes and subjective norms to be more

positive for female farmers; potentially, the sample size was not large enough to detect significant differences. The perceived behavioural control was significantly more positive for male farmers than female farmers, suggesting that female farmers experience more difficulties when planting trees. One possible explanation for this is that relatively more female-headed households were affected by separation or death of a spouse than male farmers, making them more vulnerable to poverty and less able to plant trees. Similar to the findings for the attitudes, no differences were found between male and female farmers in the likelihood that they had planted trees, nor in the density of trees planted. This is somewhat surprising, as men and women have been shown to have different levels of participation when it comes to decision-making and implementation of tree planting and tree management, which in turn affects tree planting behaviour (Meijer, Sileshi, et al., 2015). Several studies examining agroforestry adoption have demonstrated that gender is an important factor affecting the uptake of agroforestry practices (Adesina et al., 2000; Ndayambaje, Heijman, & Mohren, 2012; Phiri et al., 2004; Wambugu, Place, & Franzel, 2011). Differences in technology uptake between male and female farmers could be linked back to gender differences in environmental concern, which has not been frequently studied and previous research has yielded ambiguous results on the relationship between gender and concern for the environment (Fransson & Gärling, 1999). It is therefore important to understand how perceptions, attitudes and behaviour differ between male and female farmers, to improve gender equity and women's participation in agroforestry activities (Kiptot & Franzel, 2012).

There are several limitations of this study. An important limitation is that attitudes are a difficult concept to understand and measure. Attitudes are a latent construct and as such, they cannot be directly observed (Milfont & Duckitt, 2010). The TPB on which this study was based has been subject to criticism over the years, which has varied from outright rejection of the theory or enquiries into its limiting conditions (Ajzen, 2011). For example, the theory has been criticized for being reductionist, and it does not take account of other, intervening variables which affect attitudes, behaviour and their relationship. The measurement of an attitude is inherently problematic for a number of reasons. There is a risk of social desirability bias where respondents have a tendency to answer questions in a manner that will be viewed favourably by the researcher or by others (Oppenheim, 1992). Farmers could have exaggerated their positive feelings towards tree planting to make themselves look good and give answers they think researchers want to hear. This is related to the acquiescence bias where respondents tend to agree with the statements in the attitude scale. This bias even extends to the reporting of tree planting behaviour, where respondents might report higher numbers of trees planted than they actually have, to impress the research team. We attempted to minimize these biases by taking them into consideration in the design and phrasing of the survey questions and statements, and by giving a detailed introduction to each respondent prior to the interview explaining that it is important for them to be honest and that there are no right or wrong answers. Another limitation of this study is that we only included household heads in our household survey, and there is a lack of knowledge on the views of women in male-headed households. We recommend that future studies incorporate both the perspectives of the household heads as well as their spouse to get a better understanding of within-household gender dimensions.

5. Conclusion

This work underlines the importance of incorporating socio-psychological factors, such as farmers' preferences and attitudes, for an effective design and implementation of agroforestry projects (Meijer, Catacutan, et al., 2015). The research reported here has demonstrated that positive attitudes towards agroforestry do lead to more trees being planted on farms, which suggests that providing farmers with more training and encouragement could further increase adoption levels. However, there might be other, intervening factors which affect the relationship between attitudes and behaviour, which have not been considered here. Moreover, the relationship between attitudes and behaviour might be non-linear and continued reinforced motivation is needed for tree planting interventions to be successful. Although the vast majority of farmers in this study had planted trees on their land, the extent to which trees were planted was relatively low. Therefore, training, extension and other types of incentives may be needed to further increase tree planting activities by farmers in Malawi.

Our findings also suggest that despite the fact that farmers recognize the benefits of tree planting and see it as a worthwhile investment, adoption of agroforestry technologies will be constrained by poverty until more immediate needs are met. The main priority for most Malawian farmers is to secure short-term food security. Agroforestry has the potential to contribute to both poverty alleviation and better food security, by increasing crop yields, providing fruits and nuts to complement diets, and increasing incomes. The main problem is that the benefits of tree planting are uncertain and long-term, whereas most farmers are concerned with fighting hunger in the short term. Therefore, it is crucial that, in addition to receiving assistance to address urgent issues such as hunger and poverty, farmers are given support to invest in sustainable interventions that will help them increase food security and diversify their livelihoods. This will help farmers to improve their living standards and develop a sustainable livelihood in the long term. Tree planting activities could be promoted by providing farmers with more training, better access to good-quality planting material and equipment, as well as better access to markets. One way of helping farmers invest in agroforestry technologies is through microfinance; however, such schemes need to be appropriately targeted to the local conditions and take into consideration that there is a time-lag between planting trees and realising the benefits.

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Appendix A

Table A.1
A multivariate mixed effects model relating variation in tree planting (yes/no) with socio-economic variables.

Effect	Estimate	Standard error	t value	Pr > |t|
Intercept	0.982	0.268	3.66	0.1698
Gender	0.026	0.067	0.38	0.7017
Education	−0.018	0.056	−0.33	0.7453
Kinship	−0.013	0.072	−0.18	0.8608
Household size	−0.009	0.013	−0.74	0.4614
Membership farmers group	0.187	0.069	2.70	0.0076
Land size	−0.001	0.018	−0.04	0.9718

Table A.2
A multivariate mixed effects model relating variation in tree planting (yes/no) with attitude, subjective norm and behavioural control.

Effect	Estimate	Standard error	t value	Pr > |t|
Intercept	1.453	0.090	16.11	0.0395
Attitude	−0.009	0.003	−3.30	0.0012
Subjective norm	−0.001	0.002	−0.51	0.6092
Perceived behavioural control	−0.003	0.002	−1.70	0.0911

Table A.3
A multivariate mixed effects model relating variation in tree planting (yes/no) with socio-economic variables, attitude, subjective norms and behavioural control.

Effect	Estimate	Standard error	t value	Pr > |t|
Intercept	1.3336	0.2750	4.85	0.1295
Gender	0.0166	0.0650	0.26	0.7982
Education	−0.0063	0.0543	−0.12	0.9074
Kinship	−0.0434	0.0646	−0.67	0.5033
Household size	−0.0077	0.0124	−0.62	0.5376
Membership farmers group	0.1294	0.0694	1.86	0.0640
Land size	0.0096	0.0173	0.55	0.5797
Attitude	−0.0094	0.0028	−3.29	0.0012
Subjective norm	−0.0008	0.0023	−0.34	0.7345
Perceived behavioural control	−0.0036	0.0022	−1.68	0.0944

Table A.4
The most parsimonious (reduced) multivariate model relating tree planting with the significant socio-economic variables and TPB constructs.

Effect	Estimate	Standard error	t value	Pr > |t|
Intercept	1.2168	0.1399	8.7	0.0729
Membership farmers group	0.1402	0.0662	2.1	0.0356
Attitude	−0.0083	0.0026	−3.6	0.0003
Perceived behavioural control	−0.0035	0.0021	−1.7	0.0922

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