The Role of Social Norms and Economic Incentives in Encouraging the Adoption of Native Gardens

Curtis Rollins [a], Claire Doll [a], Katrin Rehdanz [b], Jürgen Meyerhoff [c], Michael Burton [a], and David Pannell [a]

Curtis.rollins@uwa.edu.au, Lecturer

Claire.doll@uwa.edu.au (corresponding author), Research Fellow

rehdanz@economics.uni-kiel.de, Professor

Juergen.Meyerhoff@hwr-berlin.de, Senior Researcher

Michael.burton@uwa.edu.au, Associate Professor

David.pannell@uwa.edu.au, Professor

[a] School of Agriculture and Environment, The University of Western Australia, Crawley, Australia

[b] Department of Economics, Kiel University, Kiel, Germany

[c] Department of Business and Economics, Hochschule für Wirtschaft und Recht Berlin (HWR), Berlin, Germany

Abstract

Various policy interventions can be implemented to motivate individuals to adopt pro-environmental landscaping behaviours. Here we compare the influence of economic incentives and social norms on urban landowners' adoption of native gardens. First, we model the relationship between social norms and landowners' actual land-use decisions. We then estimate adoption intention under different support programs using a choice experiment, also considering social norms. We find social norms can play a significant role in the adoption of native gardens, comparable to relatively expensive financial incentives. Therefore, social norms may enhance the performance of incentives to increase rates of land conservation.

doi:10.3368/le.101.4.061524-0051R1

Key words

Choice experiment, willingness-to-accept, social norms, adoption, urban biodiversity, land conservation

1. Introduction

Social norms are recognized as important influences on pro-environmental behaviour (Farrow et al., 2017; Grilli & Curtis, 2021; Madrian, 2014; Thaler & Sunstein, 2008). These norms reflect a shared understanding of appropriate or customary behaviours in society, and operate when individuals observe or receive information about the behaviour of others (Dannenberg et al., 2024). There is growing evidence that norms can be effective in driving pro-environmental behaviours (Farrow et al., 2017). Examples can be found in the contexts of reducing household water consumption (e.g., Ferraro et al., 2011), conserving energy (e.g., Allcott, 2011), and promoting climate-friendly food choices (e.g., Griesoph et al., 2021). Still, there is uncertainty regarding the relative influence of social norms and economic incentives in motivating individuals to adopt pro-environmental behaviours.

In this paper, we investigate the influence of social norms and economic incentives on urban landowners' adoption of native gardens. This form of gardening can serve as an important part of climate adaptation strategies in water-scarce cities. Native gardens require less water in their maintenance than irrigated lawns, which are common in suburban landscapes (Doll et al., 2024; Ligtermoet et al., 2022). In addition, native plant species in urban areas can provide direct biodiversity benefits, and indirectly play a role in supporting the diversity and abundance of animal species, including native birds (Ikin et al., 2013) and bats (Threlfall et al., 2016). Our research centres on native-garden adoption on verges (also commonly referred to as nature strips or boulevards), an area of land that is located between streets and residential property boundaries. They are positioned at the front of properties, running along roads and walking paths, and so are highly visible to other community members. The positioning of verges along roads also implies they may provide ecosystem connectivity benefits. Verges are a common feature of streetscapes in North American, Australian, and South African cities; providing a considerable extent of greenspace in urban

areas (Marshall et al., 2019). Because of their extent and potential to provide diverse ecological benefits, many environmental managers are interested in increasing residents' adoption of native verge gardens.

The act of converting verges to native gardens includes land preparation (e.g., removing existing land covers, preparing soil, weed control) and planting. Accordingly, time, materials, labour, and transaction costs are amongst the relevant costs of adopting ecological landscape designs (Johnston et al., 2022). Partially or fully covering these costs through programs offering direct payments to potential adopters may be required to motivate change from conventional land-use practices towards more environmentally beneficial alternatives (Siebert et al., 2006). Using public funds for this compensation may be justified based on the positive externalities (i.e., public water-saving and biodiversity-enhancement benefits) that can result from conversions to native gardens.

Whether taken in isolation or in combination with economic incentives, social norms may be relevant to native-garden adoption behaviour. Activating social norms can be an effective way to encourage the adoption of this pro-environmental behaviour at relatively low cost to governments (Savari et al., 2023). Examples of social-norm-based interventions that rely on activating social norms include establishing 'model' early-adopters to demonstrate a socially desirable behaviour change, and providing information to potential adopters about the opinions and preferences of others in their network (Abrahamse & Steg, 2013). These social norm-based interventions motivate action through individuals' reactions to community expectations (Perry et al., 2021).

Where ecological landscape designs are present in a neighbourhood, the desire to conform with neighbourhood norms has been found to have a positive influence on individuals' decisions to establish and maintain these landscapes (Ahn et al., 2024; Goddard et al., 2013; Nassauer et al., 2009). Referred to as a mimicry effect, studies have

demonstrated strong autocorrelations in spatial structures of vegetated areas, suggesting that residents are more likely to adopt pro-environmental landscape management behaviours if they are observed on nearby properties (Hunt et al., 2022; Zmyslony & Gagnon, 1998). However, social norms can also serve as a barrier to adoption when individuals mainly observe more resource-intensive land covers (i.e., lawns) in neighbourhoods (Peterson et al., 2012). Social factors can therefore either benefit or impede the adoption of pro-environmental behaviours, depending on the local context of what constitutes acceptable or customary behaviour (Farrow et al., 2017).

This paper builds on the existing pro-environmental behaviour adoption literature by examining the influence of both economic incentives and social norms in the same context (native-garden adoption on residential verges). Similar comparisons have been made in agricultural settings, for example, in comparing subsidies and social network effects in disease-preventing livestock vaccination decisions (Sok et al., 2018). However, such comparisons are less common in urban contexts.

Our analysis is based on self-reported actual adoption of native verge gardens (by estimating an *Actual Adoption* model), and stated adoption intention based on hypothetical choices in a choice experiment (with an *Adoption Intention* model). We consider the relationships between two aspects of social norms on both adoption intention and actual adoption behaviour: consideration of others when making landscape management decisions, and nearby neighbours' adoption of native verge gardens. In addition, we examine interactions between the two social norm measures, for both actual adoption and adoption intention. We also investigate the influence of three economic incentives on adoption intention: rebates, discounted materials, and labour supports, and compare the effects of these economic incentives to the potential influence of our social norm measures.

The research helps fill a gap in the literature about adoption of pro-environmental behaviour by exploring relationships between social norms and both actual adoption practices and adoption intentions (Niemiec et al., 2020). Another contribution of this work is linking the influence of social norms on pro-environmental behavioural change to estimates of monetary-equivalent values. Further, our results assist in communicating to policy makers the relative influence of economic incentives and social norms in the adoption of pro-environmental behaviour. The results can be useful when devising future policy interventions aimed at increasing citizens' adoption of ecological landscape designs under constrained budgets.

2. Study context

In Perth, Western Australia, our study site, verges are owned by the government but managed by the resident(s) of its adjoining property. Many local governments in the region offer incentive programs aiming to motivate residents' adoption of native verge gardens. These programs rely on economic policy instruments, and most often involve offering discounted native plant seedlings (typically 50% off, and sometimes free). (Examples of rebates and subsidies in Perth, Australia, can be found in Ligtermoet et al. (2021).) In partnership with the state Water Corporation, a rebate of up to $500 (AU), available upon completion of the verge garden, can also be claimed by residents in some Local Government Areas. This rebate is passed on to residents through a credit to their account with the water utility provider. Despite these incentive programs, uptake of these programs and adoption of native gardens on verges in the region remain low. In addition, not all councils have the financial capacity to offer such programs in general, or at the levels that would be required to motivate behavioural change. As a result, there is interest in investigating how social norms can be harnessed to further drive the adoption of ecological landscape designs.

Encouraging citizens' adoption of pro-environmental behaviours is highly relevant in the case study site because of ongoing concerns about biodiversity loss (Murphy & van Leeuwen, 2021) and rising exposure to water scarcity (Government of Western Australia Department of Water and Environmental Regulation, 2019). In Western Australia, climate change and water consumption patterns have been driving declines in groundwater levels over the past 50 years (Government of Western Australia Department of Water and Environmental Regulation, 2021). One key driver of consumption is the use of groundwater to irrigate verges and other public open spaces. Beyond water-conservation drivers, calls to encourage more native plant covers in private landscape management have been motivated by the need to provide food and habitat resources that support local biodiversity (Garbuzov & Ratnieks, 2014) and enhance human well-being (Davies et al., 2009).

There have historically been widespread cultural norms to have watered lawns dominate residential land covers (Larson et al., 2017; Larson & Brumand, 2014). Despite its Mediterranean climate with hot and dry summers, this norm remains prevalent in Perth, where substantial water resources are used in lawn maintenance. To meet water-saving and biodiversity-enhancement objectives, there is now increased interest in encouraging landscape changes from lawns to more biodiverse yards and gardens featuring native plants (Doll, Burton, et al., 2023). Planting gardens with Australian native plants, which have evolved to grow in local climatic conditions, can assist in conserving water resources as, once established, they often do not require regular watering (Hurd et al., 2006; Mayer & Lander, 2015; Vickers, 2006).

3. Methods

In this paper, we examine the relationships between: individuals' adoption of native gardens on verges, neighbours' adoption decisions, and individuals' concern with their neighbours' opinions. This analysis is based on data collected in a household survey. We estimate

relationships between native garden adoption and normative factors based on current adoption behaviour (*Actual Adoption* model), and through a choice experiment investigating how policy changes could encourage non-adopters to plant a native verge garden (*Adoption Intention* model).

3.1 Choice experiment

Choice experiments (Hanley et al., 1998) are a stated preference approach. They allow for the investigation of preferences for alternative policy interventions, with a focus on trade-offs across policy characteristics, including compensation levels. We conducted choice experiments with the goal of understanding the program characteristics under which individuals may be incentivized to adopt a native garden on their verge.

Our survey included two choice experiments: one with willingness-to-pay (WTP) framing, and one with willingness-to-accept (WTA) framing. Each respondent was shown both choice experiments (four WTP questions and four WTA questions). WTP and WTA questions were grouped together, but the order in which they appeared was randomized. An in-depth analysis of public preferences for different possible components of verge conversion programs (including financial and non-financial supports) that local governments could introduce is presented in Doll, Rollins, et al. (2023). Through latent-class analysis, different segments of the population were found to assign different values to different potential program components, including native plant seedling subsidies, landscaping support, having control over plant species selection, and reserving portions of verges for parking (Doll, Rollins, et al., 2023).

In this paper, we focus on the WTA framing of the choice experiment because it is better aligned with current programs and policies, and therefore more comparable with real adoption behaviour. It is not currently possible for homeowners to pay their local government to convert their verge to a native garden, but governments do offer various financial, labour,

and material supports to encourage native gardens as outlined in the WTA tasks. Further, responses to the WTP tasks were significantly affected by the order effects, while WTA responses were not: respondents were willing to pay more to convert their verge if they saw the WTP tasks first, relative to those who saw the WTA tasks first. We also change the sample considered, by dropping from the stated preference sample those who have already adopted a verge garden.

We compare revealed-preferences (actual verge garden adoption behaviour) and stated-preferences from the choice experiment with native garden adoption. Our focus is on the relationship between social norms and neighbour effects. In the revealed-preference model, we are unable to measure whether an individual was the first to plant a garden on their street, or whether they may have been influenced by a neighbour. Therefore, we are likely to over-estimate the impacts of neighbours' behaviour on adoption. However, by excluding adopters from the stated-preference model, we ensure that the neighbours who planted a verge garden were the initial adopters who may have influenced the potential adopters whose data are being analysed. An overview of the attributes and levels presented in the choice experiment is presented in Table 1, and Figure 1 displays an example choice card.

Prior to being presented with the choice experiment questions, respondents were told that some councils are encouraging residents to plant native verge gardens to support local biodiversity and help conserve water. Respondents were also given information about the steps involved in establishing a native verge garden, and the costs that may be incurred in the process. The full script presented to respondents before the choice experiment is provided in Appendix A. We implemented an experimental design with the full-factorial of 48 choice sets, and used Ngene (Rose & Bliemer, n.d.) to create 12 blocks of four choice questions. Therefore, each respondent answered four of the possible 48 WTA choice cards.

<<Table 1 about here>>

<<Fig 1 about here>>

3.2 Survey development and data collection

An online survey was prepared for distribution to members of the public residing in the Perth metropolitan region. This survey was developed between March and August 2022, in consultation with subject-matter experts from local and state government. We further tested the survey in four one-on-one interviews with members of the general public, each lasting approximately one hour. The survey collected sociodemographic information from respondents, along with information on verge use and current landscape management practices on respondents' own and respondents' neighbours' verges. We collected information on self-reported adoption of native verge gardens for our *Actual Adoption* model.

Our target for data collection was longer-established neighbourhoods, which in Perth typically have larger verges and therefore present an opportunity for greater environmental gains through the establishment of native-verge gardens. Given that target postcodes were under-represented in online market research panels, survey recruitment was accomplished using a mail-out postcard. Two postcards (an initial send-out and a reminder) inviting households to complete an online survey was distributed to select Perth neighbourhoods in August 2022.

The postcard design and distribution methods followed advice by Dillman (2007) in the postcard design, language used, and inclusion of a reminder postcard. Because of budget limitations, we could only send out a generalized invitation, rather than addressing the resident of each household individually. In addition, our incentives took the form of a draw for those who completed the survey, rather than including an individual incentive with each postcard distributed, regardless of whether the survey was completed. Across a random selection of postal runs within 13 postcodes, a total of 20,583 postcards were distributed. These postcodes spanned across nine local government areas in the Perth metropolitan

region: the City of Subiaco, City of Nedlands, Town of Claremont, Shire of Peppermint Grove, Town of Cottesloe, City of Stirling, and City of Bayswater, Town of East Fremantle and the City of Melville (Figure 2). Most local governments in our study area are relatively small, covering only a few square kilometres with approximately 10,000 residents in each. For those areas that are larger (Stirling and Bayswater in the north, and Melville in the south), we only recruited respondents from postal runs located nearest to the centre of our overall study area, which covered approximately one-quarter of each of these local government areas.

<< Fig 2 about here>>

Of the 891 complete responses to the online survey, 734 came from households that were deemed to have control over decisions to plant a native garden on their verge by meeting three criteria: owning their home, living in any dwelling type except for an apartment or high-density complex, and having a verge in front of their property.

We analyze actual adoption and adoption intention using two different samples. For the *Actual Adoption* model, we include the full set of 734 households that were considered to have control over their verge. For the *Adoption Intention* model, we include only those respondents who had not already established a native verge garden (634 respondents). This restriction allows for a clearer portrayal of the influence of social norms on adoption decisions, as it is not confounded by whether an individual was themselves an early adopter in their neighbourhood, potentially influencing the landscaping decisions of other nearby homeowners.

4. Modelling approaches

We analyze the relationships between economic incentives and social norms with adoption decisions, considering both adoption intent and actual adoption. For the purpose of our analysis, social norms are defined as care and consideration of others' in decision-making.

In the survey, information was collected to build a generalized measure of respondents' consideration of their neighbours when making decisions. Respondents' concern about neighbourhood norms is assessed based on their stated agreement with the following two statements, each having 5-point ordinal response scales ranging from *Strongly Disagree* to *Strongly Agree*: *I care what my neighbours think about my verge*; and *When making decisions about my verge, I consider what my neighbours might think*. Respondents indicating either "Agree" or "Strongly Agree" to both questions are said to be concerned about neighbourhood social norms and were assigned a value of 1 for consideration of local norms (*Concern*). This specification was chosen for the ease of interpreting the variable, since it allows us to compare concerned and unconcerned individuals. However, another specification, in which *Concern* is measured as a latent construct (e.g., Walker & Ben-Akiva, 2002), is included in Table B4 of Appendix B, and provides results consistent with the dummy variable specification. We did not have an initial hypothesis of how *Concern* might influence adoption of native gardens. On one hand, it may lead to a lower likelihood of adoption if homeowners are worried about breaking conformity on a street with few native gardens. On the other hand, it may lead to higher adoption rates due to a wish to conform with their neighbours on a street where native gardens are present.

To assess the relationship between neighbours' decisions and the adoption of native verge gardens, respondents were asked how many of their nearby neighbours (defined as up to five properties to the left, up to five properties to the right, and up to five properties across the street) had a native verge garden. *Neighbour* is a binary variable taking a value of one for respondents who said *some*, *most,* or *all* of their neighbours have a native verge garden, and zero otherwise. We treat *neighbour* as a binary variable because less than 3% of our sample indicated that *most* or *all* of their neighbours have a native garden. We hypothesised that homeowners with a neighbouring native verge garden would be more likely to have one

themselves. Finally, we include an interaction term of whether respondents were concerned about neighbourhood social norms and had any neighbours with a native verge garden (*Conc. x Neighb.*). This interaction allows us to understand whether the influence of neighbours differs depending on whether a respondent states that they consider their neighbours' opinions when making decisions about their verge. Presumably, those who stated that they are concerned with their neighbours' opinions would be influenced by their neighbours more strongly than those who did not.

4.1 Actual adoption (revealed preference)

The entire sample (n= 734 responses) is included in the *Actual Adoption* model. Whether individuals had adopted a native verge garden – a binary choice – is modelled using a logit model, outlined in equation 1.

$$U = \beta H + \alpha_1 Concern + \alpha_2 Neighbour + \alpha_3 Conc.x\ Neighb. + \varepsilon \quad (1)$$

$$\text{where } y = 1\ if\ U > 0,$$

$$\text{and } y = 0\ if\ U \leq 0$$

The utility (U) underlying the observed decision to adopt (y) is a function of household characteristics H, which consists of: a constant; personal characteristics (age, gender, and education); verge-specific attributes (size and whether it is used for parking); and regional control variables (Local Government Area). In addition, relationships between social norms and adoption are modelled. Specifically, we include consideration of neighbours when making decisions and presence of nearby native verge gardens in respondents' neighbourhoods, along with the interaction between the two factors. We assume that people will adopt a native verge garden ($y = 1$) if it offers positive utility, and will not adopt if it native garden adoption would not improve utility ($y = 0$).

Using the results from the *Actual Adoption* model, we estimate how the probability of adoption differs according to social norms. Predicted probabilities of adoption are estimated on average, and for the four combinations of the binary *Concern* and *Neighbour* variables: unconcerned with no neighbouring gardens, unconcerned with neighbouring gardens, concerned with no neighbouring gardens, and concerned with neighbouring gardens. Predicted probabilities of adoption are computed using the estimated coefficients of the *Actual Adoption* model, where all other variables are set at mean levels, and standard errors are estimated using the delta method.

4.2 Adoption intention (stated preference)

We use choice-experiment responses to model adoption intention, including only respondents who had not yet adopted a native verge garden (n=634). We analyze the series of choices respondents made of whether they would choose to adopt a native verge garden under alternative program characteristics, which varied in the levels of the attributes presented (an overview of attributes and levels is presented in Table 1), and in their respective utility levels. Individuals are assumed to choose the alternative that maximizes their utility, and choices of whether to indicate intention to adopt a native garden are modelled as a function of the choice experiment attributes, along with the influence of social norms.

With data on repeated choices made by individuals, it is possible to capture heterogeneity in preferences for factors driving intention to adopt native verge gardens. Preference heterogeneity can be accounted for using a mixed logit model, where, rather than assuming fixed parameters, variation in preferences between respondents are modelled using random parameters (Hensher & Greene, 2003). In our model, social norm variables are interacted with the ASC, the cost parameter is specified to be random with a lognormal distribution, and all other choice attribute parameters are specified as normally distributed random parameters. The variance-covariance matrix between all random parameters is

estimated, relaxing the assumption that there is no correlation for preferences between the different policy attributes.

To compute monetary values, the *Adoption Intention* model is estimated in WTA space (Daly et al., 2012), representing how much more or less an individual would have to be paid to be willing to convert their verge to a native garden. WTA estimates are provided for different verge conversion program attributes, along with the changes in WTA estimates that arise with changes in the social norm characteristics. Models were estimated using Stata 16 (StataCorp, 2019). The model specification is outlined in equation 2, where the utility person *i* gets from option *j* (U_{ij}) is a function of the rebate in thousands of dollars, a parameter representing the effect of the rebate on utility (γ), the policy attributes and alternative-specific constant (X_{ij}), parameters reflecting the effects of policy attributes on utility measured in thousands of dollars (ω), and a random error term (ε_{ij}).

$$U_{ij} = \gamma\left(rebate_{ij} + \omega X_{ij}\right) + \varepsilon_{ij}$$
$$\text{and } \omega_{ASC} = (\mu_{ASC} + \sigma_{ASC} + \alpha_1 Concern + \alpha_2 Neighbour + \alpha_3 Conc.x\ Neighb.) \quad (2)$$

The distribution of preferences for the monetary rebate attribute follows a lognormal distribution to ensure the marginal utility of money is strictly positive and that moments of welfare-estimate distributions are finite (Daly et al., 2012). A mean (μ_{rebate}) and standard deviation (σ_{rebate}) of a normally distributed variable underlying the lognormal distribution are estimated. Since the model is estimated in WTA-space, means (μ_a) and standard deviations (σ_a) of WTA values for all other attributes (ω_a) are directly estimated. For the alternative-specific constant (ASC) representing the option of adopting a native verge garden, a mean and standard deviation of the WTA required to convert a verge are estimated. In addition, the ASC is interacted with *Concern, Neighbour,* and an interaction of *Concern* and

Neighbour to estimate the dollar-equivalent values representing the relationship between social norms and native garden adoption.

5. Results

5.1 Summary statistics

Key summary statistics are presented in Table 2, broken down between the samples used in the *Actual Adoption* model (all respondents, n=734) and in the *Adoption Intention* model (respondents who had not already adopted a native verge garden, n=634). All variables are binary, with the exception of respondent age. For the sample used in the *Actual Adoption* model, 14% of the sample had adopted a native verge garden. Regarding verge specifics, 49% of respondents in the *Actual Adoption* model sample and 51% of respondents in the *Adoption Intention* model sample used their verge for parking, either for themselves or for visitors. Most verges were medium-sized, allowing space to park one vehicle. Verges were considered small if they did not allow space to park any vehicles.

<< Table 2 about here>>

5.2 Actual adoption model results (revealed preference)

Table 3 presents estimation results of the actual adoption model (logit model, *Actual Adoption*). Appendix B includes two additional *Actual Adoption* model specifications: 1) without the *Conc. x Neighb.* interaction, and 2) with all social norm variables, but without the other control variables. In both cases, the signs and relative influence of the social norms are consistent with the results reported in Table 3. We find that those who are concerned with their neighbours' opinions, but do not have any nearby native verge gardens, are significantly less likely to have a native garden themselves (parameter α_1). Those with a neighbouring verge garden, but who are not concerned with their neighbours' opinions, are more likely to adopt one themselves (parameter α_2), but only at the 10% level. The *Conc. x Neighb* interaction is positive and significant. This result suggests that in locations with no native

verge gardens, concern for neighbours has a negative relationship with adoption. However, if a nearby neighbour adopts a native verge garden, this negative relationship is mitigated ($\alpha_1 + \alpha_2 + \alpha_3 = 0.23$; SE = 0.33), and those who are concerned are no longer less likely to be adopters themselves.

<< Table 3 about here>>

Regarding the other control variables included in the model, individuals who use their verge for parking are less likely to have already adopted a native verge garden, while older individuals are more likely to have adopted a native garden. The series of dummy variables corresponding to different local government areas were used to control for geographic, neighbourhood, and policy factors that may influence native garden adoption. Residents in the Bayswater, Cambridge, and Subiaco areas are more likely to have a native verge garden, relative to the reference group comprised of the least represented Local Government Areas in our sample (the Town of Cottesloe, the Shire of Peppermint Grove, and the Town of East Fremantle). These effects may be tied to the strength of their incentive programs and their marketing and communication of these programs, which centre on native plant seedling discounts, by geographic factors, or by other factors relating to neighbourhood-level attitudes.

Various other house- and person-specific characteristics were significant predictors of adoption. The oldest group of respondents (70+ years) were more likely to plant a native garden, relative to the youngest group (under 50), as were members of environmental organisations. Homeowners who hire gardeners for most gardening jobs were less likely to have adopted a native garden. Many other factors, including gender, education, verge size, whether the house was detached (versus a townhouse or villa home), and length of time living in the residence were not significant determinants of adoption.

The links between normative factors and native garden adoption are illustrated in Figure 3, where predicted odds of adoption are presented based on whether respondents'

neighbours have a garden (*Neighb*) and whether they care about their neighbours' opinions (*Conc*). These predicted probabilities are derived using the *Actual Adoption* model parameter estimates and the mean levels of demographic and control variables that are not explicitly considered. The predicted likelihood of adoption for the average respondent is 13%, which is similar to the observed adoption rate of 14% for the entire sample (see Table 2). A similar proportion, 14%, of those with no neighbouring gardens and who are unconcerned with their neighbours' opinions (*Conc* = 0 and *Neighb* = 0) were predicted to adopt a native garden. In comparison, only 3% of homeowners who consider their neighbours' opinions but have no neighbours with a native garden (*Conc* = 1 and *Neighb* = 0) are predicted to have one themselves. Homeowners whose neighbours have planted a native garden are more likely to have one themselves: 18% of those who are not concerned with their neighbours' opinions (*Conc* = 0 and *Neighb* = 1), and 16% of those who are concerned with their neighbours' opinions (*Conc* = 1 and *Neighb* = 1), are predicted to adopt one themselves. Therefore, homeowners with a neighbouring native garden are 7% (0.21 – 0.14 = 0.05; SE = 0.02; p = 0.029) more likely to adopt one if they are not concerned with their neighbours' opinions, and are 14% (0.16 – 0.03 = 0.13; SE = 0.04; $p < 0.001$) more likely to adopt one if they are concerned with their neighbours' opinions, compared to homeowners with no neighbouring native gardens.

<<Fig 3 about here>>

5.3 Adoption intention model results (stated preference)

Table 4 presents estimation results of adoption intention in WTA space (mixed-logit model, the *Adoption Intention* model). The monetary variable is normalized to $'000. Negative (positive) parameter estimates represent how much more (less) a homeowner would have to be paid to convert their verge to a native garden. Therefore, positive coefficients are linked to a higher propensity to adopt a native garden, and therefore a lower amount of financial

support that must be provided to encourage adoption. Here the alternative specific constant (ASC) represents how much governments would have to pay someone to convert at least half their verge to native vegetation, and is estimated at $730 (2022 AUD; for an individual with sample-mean social norms, and all the other attributes are set to zero). Relative to the baseline of converting at least half of their verge to a native garden, the average landowner would require an additional payment of $940 for their entire verge to be converted. This base case involves the government preparing the land. Where households are responsible for the labour to prepare the land themselves, the payment required to motivate the adoption of verge gardens increases by an additional $860. However, with discounts for seedlings, this required payment level decreases: by $590 with programs offering 50% off seedlings, and by $860 for programs offering free native plant seedings.

<< Table 4 about here >>

Relationships between neighbouring and normative factors and native garden adoption are consistent between the *Adoption Intention* and the *Actual Adoption* models. For those without any neighbouring native verge gardens, being concerned with neighbours' opinions is linked with a lower likelihood of planting a native garden. For homeowners who have no nearby neighbours with a garden, those who are concerned with their neighbours' opinions would need to be paid an additional $430 to plant a garden ($\alpha_1$), relative to those who do not care about their neighbours' opinions. Individuals appear to be significantly influenced by neighbouring gardens, regardless of whether they say they are concerned with their neighbours' opinions. People with at least one neighbour who planted a native garden would have to be paid $720 less than people with no neighbouring gardens. Those who are concerned with their neighbours' opinions and have a neighbour with a native garden are more open to planting a garden themselves, and would have to be paid $920 less ($\alpha_1 + \alpha_2 + \alpha_3$; SE = $124) than a person who is unconcerned with their neighbours' opinions and have

no neighbouring gardens. Understandably, the influence of neighbours' behaviour is greater for those who are concerned with their neighbours' opinions. For these individuals, the planting of a nearby garden shifts them from being less likely to plant a native garden to being more likely. The effect equates to a $1350 (SE = $140) reduction in payment required to convince them to plant a native garden ($(\alpha_1 + \alpha_2 + \alpha_3) - \alpha_1 = \alpha_2 + \alpha_3$).

As with the *Actual Adoption* model, Appendix B presents the results of the *Adoption Intention* model without the *Conc. x Neighb.* interaction. The sign and relative influence of *Concern* and *Neighbour* are consistent with the results reported in Table 4.

6. Discussion and conclusion

This study investigates how economic incentives and social norms influence actual adoption, and intentions to adopt pro-environmental behaviour. Our approach, which includes both stated- and revealed-preference analyses, allows us to compare non-market value estimates derived from a choice experiment to the influence of social norms on actual adoption patterns.

Our work reinforces the importance of economic incentives and social norms in encouraging pro-environmental behaviour. We show that individuals value both seedling discounts and landscaping assistance when making decisions about whether to adopt a native verge garden. However, we also demonstrate strong spatial correlations in stated and revealed preferences for native garden adoption among neighbours. If these spatial correlations are driven by normative influences, our results suggest that social norms may have a similar effect on adoption as those gained from economic and material incentives. Through the *Adoption Intention* (stated preference) model, we were able to measure the monetary equivalent impact of social norms and neighbour effects, and find their value is similar to many costly material and monetary supports that governments can offer. Further, the results

suggest the influence of social norms are complex, especially in early phases of adoption. Initially, when homeowners have no neighbours with a native garden, being concerned about neighbours' opinions had a negative correlation with native garden adoption. However, this negative relationship was mitigated once one neighbour plants a native garden (revealed preference model). In the stated preference model, those who were concerned with their neighbours' opinions and had at least one neighbour who planted a native garden stated they were more willing than average to plant one themselves. Together, these findings further support existing evidence that social norms for gardening may be changing from preferences for monocultured, watered lawns, towards preferences for more native, waterwise plants (Doll et al., 2024; Hurd et al., 2006; Larson et al., 2017; Larson & Brumand, 2014; Shaw et al., 2017). We find that social norms may help encourage pro-environmental landscaping behaviour, as long as an early native verge garden adopter has emerged in a neighbourhood to help normalize the alternative landscape design.

Prior to this study, there was limited evidence of the influence of social norms, estimated as in monetary-equivalent terms, on the adoption of pro-environmental behaviour. Burkhardt et al. (2022) provided one example, using hedonic pricing methods to estimate the monetary-equivalent value of deviating from neighbourhood landscaping conformity. They estimated a monetary loss in average home sales prices of deviating from conformity to be $1750 US. Our estimates (in AUD) are smaller, but of a similar magnitude to those identified by Burkhardt et al. (2022). We estimate the influence of caring and considering neighbours' opinions in native verge adoption decisions, and having a nearby neighbour who has already adopted a native garden to be approximately $1350, implying potential savings to local governments interested in encouraging more pro-environmental verge landscaping behaviour. This estimate of the influence of social norms on driving pro-environmental behaviours findings suggests that the cost of encouraging adoption may decline over time due to

normative and neighbouring influences, as more homeowners have neighbours with a native garden.

Placed into context, the values associated with social norms often exceed the cost of council and State government programs that offer more conventional supports like subsidized plant seedlings and rebates. As a comparison against the cost to governments of providing financial support through conventional economic policy instruments, recall that a rebate of $500 is currently offered upon the completion of a verge conversion to an ecological landscape design. When compared against the cost of councils offering discounted seedlings to residents, the value of social norms also exceeds conventional council expenditure. For example, if we assume a 30m^2 verge, and planting 3 plants/ m^2 at a cost of $3/seedling, the cost to governments of offering free seedlings comes to $270 per verge, or $135 per verge for a discount of 50% the cost of seedlings. These values fall below the monetary-equivalent value estimates for social norms, which range between approximately $700 and $1350, and are similar to value estimates for the choice experiment attributes, which individually range between $590 and $860.

Furthermore, while programs centred on offering financial incentives for behavioural change may appeal to adopters, they also impose high costs on local governments (Doremus, 2003). In addition, these programs typically require effective communication strategies to ensure public awareness of the schemes. Other alternatives to encouraging adoption of pro-environmental behaviours include information campaigns, which are not always effective (Lucas et al., 2008), and legal regulations, which require costly monitoring and enforcement (Steg & Vlek, 2009), and which may not be politically palatable (Banerjee et al., 2021). Therefore, economic or regulatory policy instruments are not always the preferred tools of governments.

Governments have many options to consider when looking at ways to encourage the adoption of pro-environmental landscaping behaviour. The focus therefore shifts to finding the most cost-effective ways to encourage behavioural change. We suggest that more costly policy interventions involving financial incentives be used to encourage early adopters of ecological landscape designs across a wide geographic spread. For example, it would be useful to more heavily incentivize early adopters on each residential street. Early adopters then expose more individuals to the pro-environmental behaviours, at which point social norms can begin to take effect. This approach could be strengthened using information campaigns designed to increase individuals' care and concern about their neighbours' opinions of their verge when making verge landscape management decisions. Once norms are established, governments may be able to reduce investments in programs offering financial assistance, and shift to the strength of social-norm based drivers of adoption that do not require ongoing financial support.

Given the importance of early adopters of native verge gardens across neighbourhoods, future research could focus on gaining a better understanding of the characteristics and motivations of early adopters. In this study, while we could assess whether one had a native verge garden but no neighbours with native gardens, we did not identify those that were the first in their neighbourhood to establish a native verge garden, that may have encouraged their neighbours to follow in adoption. It would be helpful to learn more about the personal characteristics of these individuals, and whether they used any strategies to help their neighbours follow-through with adoption, such as through involvement in community organizations or direct conversations with neighbours about gardening practices. Furthermore, an in-depth understanding of the psychological and economic theories underpinning the drivers of social norms and native garden adoption could be beneficial in understanding how to best leverage these social influences in policy design. Past research has

found that social norms driving pro-environmental behaviour operate through fast, intuitive, and emotional heuristics (Farrow et al., 2017). However, decisions to plant native verge gardens operate over longer time periods (of approximately six months, including weeding, land preparation, and planting), suggesting alternative mechanisms are at play in the case of verge garden adoption. Better understanding the psychological and economic mechanisms underlying social norm impacts on pro-environmental behaviours may assist policy makers and environmental managers in better designing program offerings.

We acknowledge some limitations to this study. First, we cannot confirm that effects of norms and neighbouring effects are not driven by other unobserved spatial factors. Although our dummy variable for Local Government Area helps control for some potential omitted variable bias (e.g., location-based characteristics and policies), we acknowledge that other factors that vary at finer geographic scales (i.e., sub-neighbourhood heterogeneity) may partly explain the influence of neighbours' adoption decisions on an individual's likelihood of adoption. Based on the data we collected, we cannot strongly infer causation between social norms and verge garden adoption. Instead, we provide evidence of spatial correlation in adoption patterns, and we believe norms are a likely driver of this correlation. Future experiment-based research could focus on isolating causal social norm effects in verge-garden adoption. Second, we did not collect information on whether a respondent was the first to adopt a native garden on their street. Therefore, we do not know whether they may have been the person who influenced their neighbours, or were influenced themselves, so it is possible that the *Neighbour* effect is over-stated in the revealed-preference model. However, the consistent results between revealed- and stated-preference data, and the robustness checks included in Appendix B, provide evidence consistent with our interpretation of the relationships between social norms, neighbours' decisions, and adoption decisions. Third, the choice experiment was non-incentivised and purely hypothetical. To mitigate issues of

hypothetical bias, we worked closely with policy experts to create salient and believable choice tasks, which resulted in 94% of respondents believing the survey was at least somewhat consequential. However, it is possible that consequentiality could incentivise some homeowners to respond strategically to influence future policies or programs, which could exacerbate hypothetical bias.

Like previous work on the topic, we find that norms can play an important role in influencing the adoption of pro-environmental behaviours (Steg et al., 2014), and that normative effects may have a similar relationship with adoption as offering financial and material supports worth hundreds of dollars or more. We build on existing knowledge surrounding social norm effects by showing that these effects are consistent between actual adoption and adoption intention. Results support the notion that early adopters of native gardens encourage others to follow (Goddard et al., 2013), and we find that having a diverse geographic spread of early adopters may potentially provide substantial cost savings to local governments trying to increase the adoption of native verge gardens. Based on these results, we believe governments could encourage adoption of highly visible pro-environmental behaviours by ensuring a diverse geographic spread of early adopters of native verge gardeners across different neighbourhoods. This spread can be achieved through an approach that establishes early adopters as models of the pro-environmental behaviour, as a social norm-centred policy interventions (Abrahamse & Steg, 2013). Altogether, these results reinforce the idea that policies to encourage more pro-environmental behaviour, like native verge gardens, can rely on positive influences of norms (Thaler & Sunstein, 2008). Building on existing interventions that rely on economic incentives, and taking advantage of social norms in verge garden adoption may help lead to better environmental outcomes, at a lower financial cost to communities.

Funding acknowledgement

This article draws on research supported by the University of Western Australia Research Collaboration Award and the German Federal Ministry for Education and Research Green Talents program.

Ethics approval

Approval to conduct this research has been provided by the University of Western Australia, in accordance with its ethics review and approval procedures (UWA Human Ethics Reference #: 2020/ET000032).

References

Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environmental Change*, *23*(6), 1773–1785. https://doi.org/10.1016/J.GLOENVCHA.2013.07.029

Ahn, S., Luo, Q., Mendoza, S., & Norwood, F. B. (2024). Rethinking the traditional American lawn: Perspectives of U.S. households in a nationwide survey. *Urban Forestry & Urban Greening*, *99*, 128460. https://doi.org/10.1016/j.ufug.2024.128460

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics*, *95*(9–10), 1082–1095. https://doi.org/10.1016/j.jpubeco.2011.03.003

Banerjee, S., Savani, M., & Shreedhar, G. (2021). Public support for 'soft' versus 'hard' public policies: Review of the evidence. *Journal of Behavioral Public Administration*, *4*(2). https://doi.org/10.30636/jbpa.42.220

Burkhardt, J., Chan, N. W., Bollinger, B., & Gillingham, K. T. (2022). Conformity and Conservation: Evidence from Home Landscaping and Water Conservation. *American*

Journal of Agricultural Economics, *104*(1), 228–248. https://doi.org/10.1111/AJAE.12224

Daly, A., Hess, S., & Train, K. (2012). Assuring finite moments for willingness to pay in random coefficient models. *Transportation*, *39*(1). https://doi.org/10.1007/s11116-011-9331-3

Dannenberg, A., Gutsche, G., Batzke, M. C. L., Christens, S., Engler, D., Mankat, F., Möller, S., Weingärtner, E., Ernst, A., Lumkowsky, M., von Wangenheim, G., Hornung, G., & Ziegler, A. (2024). The Effects of Norms on Environmental Behavior. *Review of Environmental Economics and Policy*, *18*(1), 165–187. https://doi.org/10.1086/727588

Davies, Z. G., Fuller, R. A., Loram, A., Irvine, K. N., Sims, V., & Gaston, K. J. (2009). A national scale inventory of resource provision for biodiversity within domestic gardens. *Biological Conservation*, *142*(4). https://doi.org/10.1016/j.biocon.2008.12.016

Doll, C., Burton, M., Pannell, D., & Rollins, C. (2023). Are greenspaces too green? Landscape preferences and water use in urban parks. *Ecological Economics*, *211*, 107896. https://doi.org/10.1016/j.ecolecon.2023.107896

Doll, C., Rollins, C., Burton, M., Pannell, D., Rehdanz, K., & Meyerhoff, J. (2023). Encouraging ecological landscape designs on underutilized urban lands: Homeowner preferences for verge conversion programs. *Urban Forestry & Urban Greening*, *87*, 128049. https://doi.org/10.1016/j.ufug.2023.128049

Doll, C., Rollins, C., Burton, M., Pannell, D., Rehdanz, K., & Meyerhoff, J. (2024). Public preferences for water-conserving groundcovers on verges. *Water Resources and Economics*, *46*, 100239. https://doi.org/10.1016/j.wre.2024.100239

Dillman, D.A. (2007). *Mail and Internet Surveys: The Tailored Design Method* (Second Edition). John Wiley & Sons.

Doremus, H. (2003). A policy portfolio approach to biodiversity protection on private lands. *Environmental Science and Policy*, *6*(3). https://doi.org/10.1016/S1462-9011(03)00036-4

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social Norms and Pro-environmental Behavior: A Review of the Evidence. In *Ecological Economics* (Vol. 140). https://doi.org/10.1016/j.ecolecon.2017.04.017

Ferraro, P. J., Miranda, J. J., & Price, M. K. (2011). The Persistence of Treatment Effects with Norm-Based Policy Instruments: Evidence from a Randomized Environmental Policy Experiment. *American Economic Review*, *101*(3), 318–322. https://doi.org/10.1257/aer.101.3.318

Garbuzov, M., & Ratnieks, F. L. W. (2014). Quantifying variation among garden plants in attractiveness to bees and other flower-visiting insects. *Functional Ecology*, *28*(2). https://doi.org/10.1111/1365-2435.12178

Goddard, M. A., Dougill, A. J., & Benton, T. G. (2013). Why garden for wildlife? Social and ecological drivers, motivations and barriers for biodiversity management in residential landscapes. *Ecological Economics*, *86*, 258–273. https://doi.org/10.1016/J.ECOLECON.2012.07.016

Government of Western Australia Department of Water and Environmental Regulation. (2019). *Waterwise Perth Action Plan*. https://www.wa.gov.au/system/files/2020-06/Waterwise-perth-action-plan.pdf

Government of Western Australia Department of Water and Environmental Regulation. (2021). *Gnangara Groundwater Allocation Plan: Draft for Public Comment*.

Griesoph, A., Hoffmann, S., Merk, C., Rehdanz, K., & Schmidt, U. (2021). Guess What …?—How Guessed Norms Nudge Climate-Friendly Food Choices in Real-Life Settings. *Sustainability*, *13*(15), 8669. https://doi.org/10.3390/su13158669

Grilli, G., & Curtis, J. (2021). Encouraging pro-environmental behaviours: A review of methods and approaches. In *Renewable and Sustainable Energy Reviews* (Vol. 135). https://doi.org/10.1016/j.rser.2020.110039

Hanley, N., Wright, R. E., & Adamowicz, V. (1998). Using Choice Experiments to Value the Environment. *Environmental and Resource Economics*, *11*(4), 413–428.

Hensher, D. A., & Greene, W. H. (2003). The mixed logit model: The state of practice. *Transportation*, *30*(2), 133–176. https://doi.org/10.1023/A:1022558715350/METRICS

Hunt, S., Maher, J., Swapan, M. S. H., & Zaman, A. (2022). Street Verge in Transition: A Study of Community Drivers and Local Policy Setting for Urban Greening in Perth, Western Australia. *Urban Science 2022, Vol. 6, Page 15*, *6*(1), 15. https://doi.org/10.3390/URBANSCI6010015

Hurd, B. H., St. Hilaire, R., & White, J. M. (2006). Residential landscapes, homeowner attitudes, and water-wise choices in New Mexico. *HortTechnology*, *16*(2). https://doi.org/10.21273/horttech.16.2.0241

Ikin, K., Knight, E., Lindenmayer, D. B., Fischer, J., & Manning, A. D. (2013). The influence of native versus exotic streetscape vegetation on the spatial distribution of birds in suburbs and reserves. *Diversity and Distributions*, *19*(3), 294–306. https://doi.org/10.1111/j.1472-4642.2012.00937.x

Johnston, R. J., Ndebele, T., & Newburn, D. A. (2022). Modeling transaction costs in household adoption of landscape conservation practices. *American Journal of Agricultural Economics*. https://doi.org/10.1111/AJAE.12319

Larson, K. L., & Brumand, J. (2014). Paradoxes in Landscape Management and Water Conservation : Examining Neighborhood Norms and Institutional Forces Paradoxes in Landscape Management and Water Conservation : *Cities and the Environment*, *7*(1).

Larson, K. L., Hoffman, J., & Ripplinger, J. (2017). Legacy effects and landscape choices in a desert city. *Landscape and Urban Planning*, *165*. https://doi.org/10.1016/j.landurbplan.2017.04.014

Ligtermoet, E., Ramalho, C. E., Foellmer, J., & Pauli, N. (2022). Greening urban road verges highlights diverse views of multiple stakeholders on ecosystem service provision, challenges and preferred form. *Urban Forestry & Urban Greening*, *74*, 127625. https://doi.org/10.1016/j.ufug.2022.127625

Ligtermoet, E., Ramalho, C. E., Martinus, K., Chalmer, L., & Pauli, N. (2021). *Stakeholder perspectives on the role of the street verge in delivering ecosystem services: A study from the Perth metropolitan region.* www.nespurban.edu.au

Lucas, K., Brooks, M., Darnton, A., & Jones, J. E. (2008). Promoting pro-environmental behaviour: existing evidence and policy implications. *Environmental Science and Policy*, *11*(5). https://doi.org/10.1016/j.envsci.2008.03.001

Madrian, B. C. (2014). Applying insights from behavioral economics to policy design. *Annual Review of Economics*, *6*. https://doi.org/10.1146/annurev-economics-080213-041033

Marshall, A. J., Grose, M. J., & Williams, N. S. G. (2019). From little things: More than a third of public green space is road verge. *Urban Forestry & Urban Greening*, *44*, 126423. https://doi.org/10.1016/J.UFUG.2019.126423

Mayer, P., & Lander, P. (2015). Outdoor Water Efficiency Offers Large Potential Savings, But Research on Effectiveness Remains Scarce. *Journal of the American Water Works Association*.

Murphy, H., & van Leeuwen, S. (2021). *Australia state of the environment 2021: biodiversity*.

Nassauer, J. I., Wang, Z., & Dayrell, E. (2009). What will the neighbors think? Cultural norms and ecological design. *Landscape and Urban Planning*, *92*(3–4), 282–292. https://doi.org/10.1016/j.landurbplan.2009.05.010

Niemiec, R. M., Champine, V., Vaske, J. J., & Mertens, A. (2020). Does the Impact of Norms Vary by Type of Norm and Type of Conservation Behavior? A Meta-Analysis. In *Society and Natural Resources* (Vol. 33, Issue 8). https://doi.org/10.1080/08941920.2020.1729912

Perry, G. L. W., Richardson, S. J., Harré, N., Hodges, D., Lyver, P. O. B., Maseyk, F. J. F., Taylor, R., Todd, J. H., Tylianakis, J. M., Yletyinen, J., & Brower, A. (2021). Evaluating the Role of Social Norms in Fostering Pro-Environmental Behaviors. *Frontiers in Environmental Science*, *9*. https://doi.org/10.3389/fenvs.2021.620125

Peterson, M. N., Thurmond, B., McHale, M., Rodriguez, S., Bondell, H. D., & Cook, M. (2012). Predicting native plant landscaping preferences in urban areas. *Sustainable Cities and Society*, *5*(1), 70–76. https://doi.org/10.1016/J.SCS.2012.05.007

Rose, J., & Bliemer, M. (n.d.). *Ngene*. http://www.choice-metrics.com/download.html

Savari, M., Damaneh, H. E., Damaneh, H. E., & Cotton, M. (2023). Integrating the norm activation model and theory of planned behaviour to investigate farmer pro-environmental behavioural intention. *Scientific Reports*, *13*(1). https://doi.org/10.1038/s41598-023-32831-x

Shaw, A., Miller, K. K., & Wescott, G. (2017). Australian native gardens: Is there scope for a community shift? *Landscape and Urban Planning*, *157*. https://doi.org/10.1016/j.landurbplan.2016.07.009

Siebert, R., Toogood, M., & Knierim, A. (2006). Factors affecting european farmers' participation in biodiversity policies. *Sociologia Ruralis*, *46*(4). https://doi.org/10.1111/j.1467-9523.2006.00420.x

Sok, J., van der Lans, I. A., Hogeveen, H., Elbers, A. R. W., & Oude Lansink, A. G. J. M. (2018). Farmers' Preferences For Bluetongue Vaccination Scheme Attributes: An Integrated Choice and Latent Variable Approach. *Journal of Agricultural Economics*, *69*(2). https://doi.org/10.1111/1477-9552.12249

StataCorp. (2019). *Stata Statistical Software: Release 16*. StataCorp LLC.

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An Integrated Framework for Encouraging Pro-environmental Behaviour: The role of values, situational factors and goals. In *Journal of Environmental Psychology* (Vol. 38). https://doi.org/10.1016/j.jenvp.2014.01.002

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3). https://doi.org/10.1016/j.jenvp.2008.10.004

Thaler, R. H., & Sunstein, C. R. (2008). Nudge: Improving decisions about health, wealth, and happiness. In *Nudge: Improving Decisions about Health, Wealth, and Happiness*. https://doi.org/10.1016/s1477-3880(15)30073-6

Threlfall, C. G., Williams, N. S. G., Hahs, A. K., & Livesley, S. J. (2016). Approaches to urban vegetation management and the impacts on urban bird and bat assemblages. *Landscape and Urban Planning*, *153*, 28–39. https://doi.org/10.1016/j.landurbplan.2016.04.011

Vickers, A. (2006). New directions in lawn and landscape water conservation. In *Journal / American Water Works Association* (Vol. 98, Issue 2). https://doi.org/10.1002/j.1551-8833.2006.tb07586.x

Walker, J., & Ben-Akiva, M. (2002). Generalized random utility model. *Mathematical Social Sciences*, *43*(3), 303–343. https://doi.org/10.1016/S0165-4896(02)00023-9

Zmyslony, J., & Gagnon, D. (1998). Residential management of urban front-yard landscape: A random process? *Landscape and Urban Planning*, *40*(4), 295–307. https://doi.org/10.1016/S0169-2046(97)00090-X

Table 1 Choice experiment attributes and levels

Attribute	Levels
Extent of verge that must be converted	Entire, At least half (base case)
Entity responsible for preparing verge	Household, Landscaper (base case)
Plant seedling discount offered	100% off, 50% off, None (base case)
One-time compensation level	$0, $500, $1000, $1500

Table 2 Summary statistics (n=734 for the Actual Adoption model, n=634 for the Adoption Intention model)

Variable	Description	Actual Adoption (mean)	Adoption Intention (mean)
Adopt	Has adopted a native verge garden	0.14	0.00
Social norms			
Concern	Is concerned about neighbourhood norms	0.40	0.42
Neighbour	Has at least one neighbour with a native verge garden	0.57	0.55
Conc. x Neighb.	Is concerned about norms and has a neighbour with a native garden on their verge	0.23	0.23
Verge specifics			
Parking	Uses their verge to park	0.49	0.51
Medium Verge	Has a medium-sized verge (relative to small)	0.61	0.62
Large Verge	Has a large-sized verge (relative to small)	0.28	0.27
Personal and house characteristics			
Woman	Gender identity of respondent	0.58	0.58
Age <50	Respondent is less than 50 years old	0.29	0.30
Age 50-59	Respondent is 50-59 years old	0.27	0.26
Age 60-69	Respondent is 60-69 years old	0.25	0.26
Age 70+	Respondent 70 years or older	0.19	0.18
University	Has a university education	0.80	0.80
Env. Org.	Member of environmental organisation	0.11	0.09
Hire Gardener	Hires for most gardening jobs	0.10	0.11
Years in home <5	Lived in their home for under 5 years	0.22	0.22
Years in home 5-20	Lived in their home for 5-20 years	0.43	0.43
Years in home 20+	Lived in their home for 20+ years	0.35	0.35
Detached	Live in a detached (standalone) home	0.92	0.91
Local Government Area			
Bayswater	Lives in the City of Bayswater	0.18	0.17
Cambridge	Lives in the Town of Cambridge	0.15	0.15
Melville	Lives in the City of Melville	0.20	0.21
Subiaco	Lives in the City of Subiaco	0.10	0.10
Stirling	Lives in the City of Stirling	0.09	0.09
Claremont	Lives in the Town of Claremont	0.08	0.08
Nedlands	Lives in the City of Nedlands	0.10	0.09
Peppermint Grove	Lives in the Shire of Peppermint Grove	0.03	0.03
Cottesloe	Lives in the Town of Cottesloe	0.05	0.06
East Fremantle	Lives in the Town of East Fremantle	0.02	0.02

Table 3 Actual Adoption (revealed preference) logit model results, where the adoption of a native garden is the dependent variable

Variable	Estimate	SE
Constant	-3.99***	0.89
Social norms		
Concern (α_1)	-1.66***	0.64
Neighbour (α_2)	0.51*	0.30
Conc. x Neighb. (α_3)	1.38**	0.70
Verge specifics		
Parking	-0.53**	0.21
Medium Verge	0.00	0.39
Large Verge	0.45	0.42
Personal and house characteristics		
Woman	0.33	0.24
Age 50-59	0.44	0.33
Age 60-69	-0.05	0.37
Age 70+	0.86**	0.39
University	-0.09	0.30
Env. Org.	1.15***	0.31
Hire Gardener	-1.09**	0.56
Time Res. 5-20	-0.09	0.31
Time Res. 20+	-0.07	0.37
Detached	0.91	0.57
Local Government Area		
Bayswater	1.45***	0.55
Cambridge	1.41**	0.57
Melville	0.58	0.58
Subiaco	1.18**	0.60
Stirling	0.50	0.68
Claremont	0.89	0.70
Nedlands	0.91	0.62

*p<0.1; **p<0.05; ***p<0.01
n= 734

Table 4 Results of the Adoption Intention (stated-preference choice experiment) mixed-logit model estimated in willingness-to-accept space

	Mean		Standard Deviation	
Variable	Estimate	SE	Estimate	SE
ASC	-0.73***	0.11	1.27***	0.11
Choice attributes				
Entire	-0.94***	0.09	1.09***	0.12
50% off seeds	0.59***	0.12	0.70***	0.14
Free seeds	0.86***	0.13	0.72***	0.15
You prepare	-0.86***	0.09	0.74***	0.08
Rebate ('000s)	1.12***	0.15	0.94***	0.19
Social Norms				
Concern (α_1)	-0.43***	0.14	-	-
Neighbour (α_2)	0.72***	0.13	-	-
Conc. x Neighb. (α_3)	0.63***	0.18	-	-
Covariance – Choice attributes				
50% off seeds X Free seeds	0.21	0.15	-	-
ASC X 50% off seeds	-0.87***	0.18	-	-
ASC X Free seeds	-0.45**	0.22	-	-
ASC X Entire	-0.47***	0.15	-	-
ASC X You prepare	0.13	0.15	-	-
ASC X Rebate	0.19	0.16	-	-
Entire X 50% off seeds	0.15	0.13	-	-
Entire X Free seeds	0.54***	0.17	-	-
Entire X You prepare	0.12	0.10	-	-
Entire X Rebate	0.01	0.15	-	-
50% off seeds X You prepare	-0.13	0.09	-	-
50% off seeds X Rebate	-0.13	0.12	-	-
Free seeds X You prepare	-0.23***	0.09	-	-
Free seeds X Rebate	-0.32***	0.12	-	-
You prepare X Rebate	0.63***	0.17	-	-

*p<0.1; **p<0.05; ***p<0.01
n = 634 (2536 choices)
Monetary values are in thousands of 2022 Australian Dollars

Figure 1 Example choice card for the willingness-to-accept choice tasks, where respondents were presented with different policy supports to facilitate planting a native verge garden

Figure 2 Local Government Areas (left) where postcards were distributed in Western Australia (right)

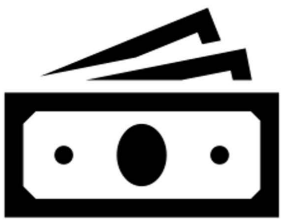
Figure 3 Predicted probabilities of native garden adoption for the average respondent, and based on whether a respondent has a neighbour with a garden (Neighb) and whether they are concerned with their neighbours' opinion of their verge (Conc)

Suppose you were offered the following set of conditions by your council:

Your **entire verge** must be converted to a native garden

You prepare and plant your verge

Native plant seedlings are **free**



You **receive $1000** one time

Would you accept these conditions to convert your verge to a native garden?

Please remember to only consider what is offered above, and not information from other questions, when making your decision.

- ❍ Yes
- ❍ No