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Runhaar, H., Buijs, A., & Runhaar, P.

This is a "Post-Print" accepted manuscript, which has been Published in "NJAS - Wageningen Journal of Life Sciences"

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Please cite this publication as follows:

Runhaar, H., Buijs, A., & Runhaar, P. (2019). What explains citizens' valuations of and attitudes towards agricultural biodiversity? Results of an exploratory survey of Dutch students. *NJAS - Wageningen Journal of Life Sciences*, [100303].
<https://doi.org/10.1016/j.njas.2019.100303>

You can download the published version at:

<https://doi.org/10.1016/j.njas.2019.100303>

What explains citizens' valuations of and attitudes towards agricultural biodiversity?

Results of an exploratory survey of Dutch students

Abstract

Citizens' valuation of agrobiodiversity is important for retaining political interest in the subject, for legitimising agri-environment schemes and other conservation initiatives and for their own willingness to contribute to agrobiodiversity conservation. Still little is known about whether and how citizens value agrobiodiversity, how these valuations can be explained and what they imply for citizens' preparedness to contribute to the enhancement of agrobiodiversity. We report on the findings of an exploratory survey aimed at uncovering the above mechanisms among a specific subgroup of Dutch citizens: students. We conclude that (a) students appreciate the intrinsic and aesthetic values of agrobiodiversity to some extent, but not its instrumental value; (b) valuations correlate with students' fundamental values; (c) students' attitudes correlate strongly to how they value agrobiodiversity. We recommend follow-up research among a more representative sample of Dutch citizens, with the aims to further test the mechanisms, assess valuations of agrobiodiversity by Dutch citizens in general *and* explore whether and how these valuations can be enhanced by the provision of information about the intrinsic and aesthetic values of agrobiodiversity.

Key words: nature conservation; agriculture; assigned values; attitudes; the Netherlands.

1. Introduction

Agriculture, the largest land use worldwide, is associated with urgent ecological problems (Tanentzap et al., 2015; see World Bank, n.d., for data at country-level). Conversion of forests and other natural habitats into farming land, intensive farming styles but also land abandonment have contributed to ongoing biodiversity loss (e.g. Tscharrntke et al., 2005; Bos et al., 2013; Sanderson et al., 2013; Tanentzap et al., 2015). Illustrative is the continuous decline in farmland birds and pollinators and other insects, in Europe and elsewhere (e.g. Ollerton et al., 2014; Hallmann et al., 2017; Egli et al., 2018). The decline in biodiversity in agricultural landscapes (i.e. species richness and abundance; hereafter: 'agrobiodiversity') particularly puts Sustainable Development Goal 15 (life on land) at risk.

The decline in agrobiodiversity has attracted not only the interest from researchers from the natural sciences (e.g. Ollerton et al., 2014) but also from social scientists. Social scientific research focuses on the actors involved, particularly on *farmers* and their perceptions of the decline in agrobiodiversity and attitudes towards conservation. This research has provided valuable insights into the motivations of farmers to engage in conservation (Perry-Hill and Prokopy, 2014; Runhaar et al., 2017; 2018), social enablers of nature conservation by farmers (Roep et al., 2003; Pretty, 2008; Westerink et al., 2017) as well as a deeper understanding of the barriers to conservation (Roesch-McNally et al., 2017). The role of *governments* and other actors that aim to promote nature conservation by farmers has been analysed in studies on the effectiveness of agri-environment schemes (Runhaar et al., 2017) and in studies about the politics of integrating agrobiodiversity objectives into agricultural policies (e.g. Lowe et al., 2010). Thus far few social scientific studies on *citizens'* perceptions of and attitudes towards

agrobiodiversity have been conducted (Runhaar, 2017). Yet these perceptions and attitudes matter for retaining political interest in the subject, for support for continued public funding for agri-environment schemes, for legitimising other public and private conservation initiatives, for the legitimacy of the agricultural sector and for estimating citizens' own willingness to contribute to agrobiodiversity conservation, as voters, consumers, volunteers, activists etc. (Stilma et al., 2009; Pascucci et al., 2016; Runhaar, 2017). In this paper we aim to get a better insight into this subject by uncovering the mechanisms between valuations of agrobiodiversity, underlying factors and the implications for the willingness of citizens to contribute to the enhancement of agrobiodiversity.

Focusing on a specific category of citizens, namely students in the Netherlands, this paper addresses the following research questions:

1. How do students value agrobiodiversity and what factors account for these valuations?
2. What is the willingness of students to contribute to the enhancement of agrobiodiversity, and how can this be explained?

Students are often used in research on environmental attitudes and behaviour (e.g. Rikhardsson and Holm, 2008; Opdam et al., 2015; Paço and Lavrador, 2017). Although students are not representative of Dutch citizens in general, they do represent young citizens (Runhaar et al., 2019) and relatively easy to access. They are not representative of Dutch citizens in general, which is not problematic in view of the exploratory nature of our study but obviously does limit the generalisability of our findings in terms of how citizens value agrobiodiversity.

We build on and complement previous, related studies in three ways. One, the *broad interpretation* of valuations of agrobiodiversity. Some of the few other studies have focussed on very specific dimensions of citizens' valuations of agrobiodiversity, such as the economic valuation of ecosystem services in agricultural landscapes by Bernués et al., 2014). In our study we include not only economic but also other (e.g. intrinsic) values of agrobiodiversity, which allows for a comparison of valuations. Two, we connect valuations to students' (*intended*) behaviours, such as their willingness to pay a bit more for food that has been produced in a 'nature-friendly' way. And three, we explore *explanations* for students' valuations and attitudes. With this approach we hope to provide a basis for follow-up research among a more representative group of (Dutch) citizens.

The remainder of the paper unfolds as follows. In section 2 we outline the materials and methods employed. In section 3 we present our results. A summary of our main conclusions and a reflection on the methodology and the results is described in section 4.

2. Methods

2.1 Theoretical framework

Attitudes can be understood as dispositions towards a particular object after evaluation (Ajzen, 2005). Literature on pro-environmental behaviour includes several models for conceptualising attitudes and their formation, including the value-belief-norm theory (Stern, 2000), or the Theory of Planned Behaviour (Ajzen and Fishbein, 1980). Most of these models are based on a 'cognitive hierarchy', suggesting that attitudes are informed by higher order cognitions, such as fundamental values and

value orientations (Fulton et al., 1996). The models have been applied across different fields in environmental psychology, especially related to pro-environmental behaviours (see Steg and Vlek, 2009 for an overview).

A specific body of literature has been developed on people's attitudes towards conservation related issues, such as biodiversity (Johansson and Henningsson, 2011), agrobiodiversity (Junge et al., 2009) or wildlife conservation attitudes. Variables that have been taken into account include values, beliefs and personal norms (Johansson et al., 2013), environmental knowledge (Kaltenborn et al., 2016), aesthetic appreciations of biodiversity (Qiu et al., 2013) and political and cultural positions (Seippel et al., 2012).

More recently, Ives and Kendell (2013) used a conceptual model combining fundamental values and assigned values to understand attitudes towards peri-urban agricultural land. They argue that assigned values mediate between fundamental values and attitudes and thus need to be added to the 'cognitive hierarchy'. Assigned values are the values that individuals assign to e.g. natural places such as agricultural landscapes and the services they provide, including the ethical consideration towards protecting such landscapes (Lockwood, 1999). In line with the cognitive hierarchy (Fulton et al., 1996), the relationship between relatively stable fundamental values and the highly volatile and context-dependent attitudes is not considered a direct relationship, but one that is mediated by assigned values (Seymour et al., 2010). These three variables form the core of our theoretical framework.

We distinguish between three types of *assigned values* related to agrobiodiversity: intrinsic, aesthetic and instrumental values (Chan et al., 2016; Brown, 1984; Raymond et al., 2009). Intrinsic values are about the value of agrobiodiversity for its own sake, including the value of biodiversity (Buijs, 2009). Aesthetic values relate to the assigned aesthetic quality of agrobiodiversity and the landscapes in which it is situated (Plieninger et al., 2013). Instrumental values relate to the value of 'functional' agrobiodiversity, such as natural pest control, pollination and other ecosystem services (Wratten et al. 2012).

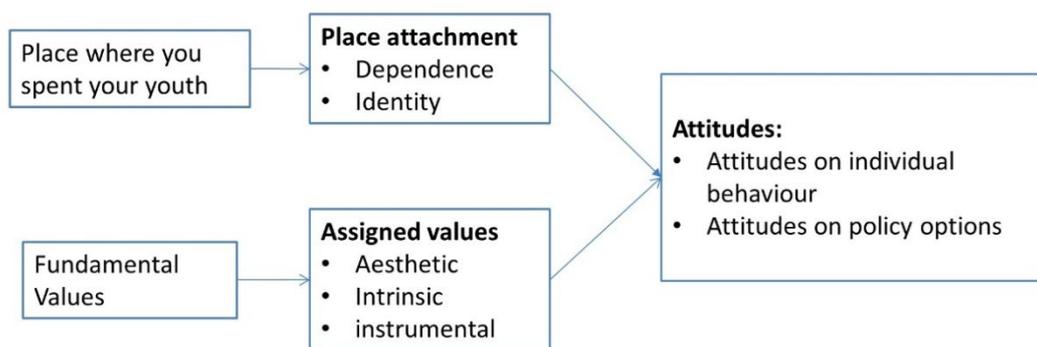
Fundamental values are defined as trans-situational goals and principles that guide human behaviour, which form the basis of pro-conservation attitudes (cf. Ives and Kendal, 2013; Stern and Dietz, 1994; Steg and Vlek, 2009). Several typologies have been developed to identify the range of fundamental values people may adhere to. One of the most commonly used is the typology by Schwartz (1992). Based on the two dimensions "openness to change versus conservatism" and "self-enhancement versus self-transcendence", Schwartz distinguishes ten fundamental values, ranging from hedonism to conformity and from security to self-direction (Ibid.). Previous studies suggest that particularly universalism is related to pro-conservation behaviour (Schultz and Zelezny, 1999; Manfredi et al., 2017). Universalism relates to a general concern for the welfare of others in the society at large. It also includes topics such as "unity with nature", "social justice" and "natural beauty" (Schwartz, 1992).

Attitudes are dispositions towards to a particular object after evaluation; in our case agrobiodiversity (Ajzen and Fishbein, 1980). Attitudes can relate both to what people (potentially) do themselves (e.g. support farmers who combine farming with nature conservation by buying their food products) or to their (lack of) support for what others do (e.g. public policies aimed at greening agriculture; Langers and Goossen, 2014).

In addition to the above variables, Raymond et al. (2011) suggest that socio-psychological models for understanding conservation-relevant attitudes and behaviour should also take into consideration people’s *emotional connections to places* (see also Williams and Vaske, 2003). This concept of ‘place attachment’ is usually conceptualised as a combination of ‘place identity’ - the symbolic importance of a place as a repository for emotions and relationships that give meaning and purpose to life - and ‘place dependence’ - “*the importance of a place in providing features and conditions that support specific goals or desired activity*”, such as recreation in the countryside (Williams and Vaske, 2003: 831).

Finally, a relevant variable is the environment in which respondents had spent their youth (rural or in the city). We hypothesised that people born in the countryside have stronger attachments to agricultural landscapes and its biodiversity and recognise the instrumental values of agrobiodiversity more than people born in cities, who are at a larger distance from the countryside and probably have less affinity with farmers. Figure 1 summarises our conceptual model.

Figure 1: Conceptual framework



2.2 Data collection method

The data collection was based on an online survey that was conducted Fall 2017. We approached students from four universities and one university of applied sciences. We targeted students from a wide range of programmes, environmental and non-environmental, agricultural and other, in order to include a wide variety of fundamental values. We ended up with mix of students from different programmes and different educational levels (with a majority of university students); see Section 2.2.3. Invitations were sent to students via programme coordinators, programme administrators and teachers, via emails, announcements on Electronic Learning Environments and in general mailings.

2.2.1 Geographical delineation

Our research focuses on the Netherlands, where agrobiodiversity has declined substantially and more than elsewhere in Europe (EEA, 2015). In the Netherlands a variety of public and private governance arrangements for nature conservation in agricultural landscapes is present (Runhaar et al., 2017). This allows analysing students’ attitudes towards who they think is responsible for protecting and enhancing agrobiodiversity.

2.2.2 Survey set-up

Assigned values (i.e. intrinsic, aesthetic and instrumental values of agrobiodiversity) were measured on the basis of four items for each value (see Supplementary material S1). Explorative factor analyses per scale showed that all four items loaded on one single factor. However, reliability analyses showed that one of the items of instrumental values had to be removed in order to reach sufficient reliability. The reliability of the scales for intrinsic and aesthetic values were good (Cronbach's alpha was $\alpha=.78$ and $.76$, respectively) and moderate for the scale used to measure instrumental values ($\alpha=.64$).

Attitudes were measured by means of items concerning one's own behaviour (e.g. 'I am prepared to pay a bit extra for food products that have been produced in ways that respect nature') and items related to policy measures (e.g. 'I think stricter preconditions should apply to nature conservation by farmers in return for the income support they receive'). The items were based as much as possible on existing scales. Explorative factor analyses per scale showed that for each scale, the five items loaded on one single factor. The reliability of the two scales were also good ('attitude-own behaviour': $\alpha=.86$; 'attitude-policy': $\alpha=.88$). The score on the two subscales was calculated using the mean for all items of the subscale. For more details see Supplementary material S1.

Fundamental values were measured using the well-established Schwartz scale (1992) through presenting personal characteristics to respondents and asking them to indicate on a 7 point scale the extent to which they recognised themselves in the descriptions (varying from 1 = 'doesn't seem like me at all' to 7 = 'seems extremely like me'; see supplementary material S1).

Place attachment (consisting of the subscales 'place identity' and 'place dependence'; see Section 2) was operationalised using items used by Williams and Vaske (2003). Again see Supplementary material S1. Explorative factor analyses showed that both four items loaded on one single factor. Reliability for both sub scales was good (place identity: $\alpha=.93$; place dependence: $\alpha=.85$). The score on the two subscales was calculated using the mean for all items of the subscale.

The *environment in which respondents had spent their youth* was measured by means of three items (in urban (cities of over 100,000 inhabitants), peri-urban areas (towns of over 10,000 inhabitants) or in rural areas (villages with less than 10.000 inhabitants)). For analysing mediating effects of this variable, it recoded into urban or peri-urban areas (1) and rural areas (2).

Because of our sample (students), the background variables of age and educational level showed little variance. We also checked for gender, which had no significant relationship with the most important independent variables (place where people spend their youth and fundamental values, except for security). Gender was therefore excluded from further analysis.

The survey was pilot pretested among 39 students of different courses from Wageningen University and Research. Based on the outcomes of reliability and factor analyses, some items were adjusted.

The eventual survey (online) was hosted by Qualtrics. Reminders were sent after about 1 week. After about 6 weeks, all participants received a short summary of the preliminary findings.

2.2.3 Response and representativeness

Through email, newsletters and announcements on Electronic Learning Environments, approximately a bit over 4,000 Dutch students from four different universities and one university of applied sciences were invited to participate (see Supplementary material document S2). In total, 342 students (248 from universities and 94 from a university of applied sciences) participated in the survey, resulting in a relatively low response rate of app. 9%. Although we targeted a wide variety of students from a diversity of programmes (environmental and non-environmental), whether the responding students represent the same diversity is not known to us.

We did not aim for a representative sample of Dutch citizens in general in view of the exploratory nature of our study (see Introduction). We nevertheless compared our sample with the Dutch population in general regarding some of the variables for which data were available (see Supplementary material document S3), showing how the student sample is different from the average Dutch citizen.

2.2.4 Analysis techniques

Correlation, multiple regression and ANOVA analyses were conducted in order to examine how the study variables related to each other. In the multiple regression analyses we used the stepwise procedure, with $P_{in}=.05$ and $P_{out}=.10$. All analyses were done with SPSS – version 22. In order to examine the mediating effects, we used the procedure as proposed by Baron and Kenny (1986): if an effect of an independent variable disappears (or diminishes) after the addition of another variable in the next step, a (partly) mediating role of that variable can be confirmed.

3. Results

3.1 Values assigned to agrobiodiversity and attitudes towards agrobiodiversity

Table 1 shows students' scores on the three assigned values and on attitudes related to their own behaviour and to policies. Intrinsic values of agrobiodiversity resonate most among students (average score 5.1 (the mean), meaning most students "agree a little bit" with statements about this assigned value), followed by aesthetic values (average score 4.9). Instrumental values are commonly not appreciated much. See Supplementary material document S4 for scores per item. When looking at the median instead of the mean, a similar picture arises (with slightly higher valuations). Students do not have outspoken attitudes towards agrobiodiversity conservation, either. They are willing to contribute to conservation to some extent, but seem rather indifferent towards policies aimed at promoting conservation by farmers by means of stricter requirements. Again the median shows a similar picture as the mean. Zooming in on the items by means of which we measured attitudes, a remarkable finding is that students do indicate to be willing to pay more for food that has been produced in 'nature friendly' ways (score 5.17 equalling "agree a little bit"). This is not completely consistent with their willingness to buy organic products however (see Supplementary material document S5).

Table 1: Students' scores on assigned values and attitudes

	Mean	Std. deviation	Std. error	Median
Intrinsic values	5.07	1.14	.061	5.25
Aesthetic values	4.88	1.15	.062	5.00
Instrumental values	3.61	1.24	.067	3.67
Attitude – own behaviour	4.40	1.64	.089	4.60
Attitude - policy	4.15	1.61	.087	4.20

Note: values were measured by means of items on an 7-point scale (1 = completely disagree; 2 = disagree; 3 = disagree a little bit; 4 = neither disagree nor agree; 5 = agree a little bit; 6 = agree; 7 = completely agree (a “do not know” category was also included).

3.2 Factors affecting attitudes

Respondents' attitudes strongly and significantly relate to place dependence and to assigned values ($R^2_{Adj}=.361$). When we look at respondents' attitudes towards policy measures (see Table 2), we conclude that policy attitudes are best explained by assigned values. Intrinsic and aesthetic values are positively related to attitudes. Although intrinsic values have the strongest single correlation with attitudes (model 1), aesthetic values have the strongest contribution to attitudes in the final regression model (model 4). Contrary to our theoretical framework, instrumental values relate negatively to attitudes on policy measure. This negative relationship is found both with students who grew up in the countryside as well as with students who grew up in the city. In addition to assigned values, also place dependence significantly relates to attitudes on policy measures, albeit in a negative manner. In other words, students who appreciate the intrinsic or aesthetic value of agrobiodiversity support policy measures that promote agrobiodiversity significantly more than students who appreciate instrumental values of agrobiodiversity and/or who value the countryside for leisure activities (i.e. place dependence).

Looking at attitudes related to students' own behaviour, we see a very similar pattern, with an even higher explanatory power ($R^2_{Adj}=.579$). The only noticeable difference is that instrumental values do not contribute significantly to the understanding these of attitudes (see Table 3).

Table 2: Multiple regression with attitudes on policy measures as dependent variable and assigned values and place attachments as independent variables

Variables	Dimensions	Regression models*			
		Model 1	Model 2	Model 3	Model 4
		AdjR ² =.288, F=139, df=1, p<.001	AdjR ² =.337, F=87.7, df=2, p<.001	AdjR ² =.351, F=62.4, df=3, p<.001	AdjR ² =.361, F=49., df=4, p<.001
			R ² Change=0.51, Fchange=26.1, df=1, p<.001	R ² Change=0.15, Fchange=8.11, df=1, p<.01	R ² Change=0.12, Fchange=6.62, df=1, p<.05
Assigned values	Intrinsic value	B=.761, SE=.065, β=.539	B=.511, SE=.079, β=.539	B=.303, SE=.107, β=.539	B=.243, SE=.109, β=.172
	Instrumental value	-	B=-.371, SE=.073, β=-.287	B=-.374, SE=.072, β=-.289	B=-.306, SE=.076, β=-.236
	Aesthetic value	-	-	B=.269, SE=.094, β=.192	B=.342, SE=.098, β=.243
Place attachment	Place dependence	-	-	--	B=-.142, SE=.055, β=-.129
	Place identity	-	-	-	-

Note *: for each dependent variable (intrinsic value, instrumental value and aesthetic value), separate regression analyses were conducted (method stepwise). This resulted in only one step (model 1) for intrinsic value and two steps (model 1 and model 2) for instrumental and aesthetic values.

Table 3: Multiple regression with attitudes towards students' own behaviour as independent variable explained by assigned values and place attachments as dependent variables

Variables	Dimensions	Regression models*		
		Model 1	Model 2	Model 3
		AdjR ² =.526, F=379, df=1, p<.001	AdjR ² =.566, F=223, df=2, p<.001	AdjR ² =.579, F=157, df=3, p<.001
			R ² Change=0.42, Fchange=32.8, df=1, p<.001	R ² Change=0.14, Fchange=11.6, df=1, p<.01
Assigned values	Intrinsic value	B=1.046, SE=.065, β=.726	B=.962, SE=.053, β=.668	B=.738, SE=.084, β=.512
	Instrumental value	-	-	-
	Aesthetic value	-	-	B=.275, SE=.081, β=.192
Place attachment	Place dependence	-	B=-.240, SE=.042, β=-.212	B=-.280, SE=.043, β=-.248
	Place identity	-	-	-

Note *: for each dependent variable (intrinsic value, instrumental value and aesthetic value), separate regression analyses were conducted (method stepwise). This resulted in only one step (model 1) for intrinsic value and two steps (model 1 and model 2) for instrumental and aesthetic values.

3.3 Factors affecting assigned values and place attachment

We hypothesised that assigned values can be explained through fundamental values, particularly the value of universalism. Multiple regression analysis shows that all three assigned values strongly relate to the value of universalism; intrinsic and aesthetic values positively, while instrumental value relates

negatively with universalism (see Supplementary material S7-2). In addition, the value of security relates positively to instrumental value, and the value of self-direction relates positively to aesthetic value.

Place attachment in turn is related to the place where people were born. Students who grew in rural areas show a higher place identity and place dependence than students who grew up in peri-urban areas, who in turn show a higher place identity and dependence than people who grew up in urban areas. Tukey's b shows that both place dependence and place identity significant differ between each subset. See Supplementary material S7-1.

As a final step, we tested whether assigned values and place attachment indeed mediate between our independent variables and attitudes. Mediation analyses using stepwise regression confirms that the relationship between the independent variables and dependent variables (attitudes) are indeed mediated by assigned values and place attachment: the influence of fundamental values on attitudes is mediated by assigned values, and the influence of the place where people grew up on attitudes is mediated by place attachment (most notable place dependence). (See Supplementary Material S7-1 and S6-2 for detailed analyses). Nevertheless, the direct relationship between the two independent variables and attitudes remains significant, although much weaker than the explanatory power of assigned values and place attachment on both types of attitudes. For example, the relationship between place where people grew up and attitudes towards policy diminishes from $\beta = -.244$ to $\beta = -.144$ when place dependence ($\beta = -.220$) is added to the equation (Supplementary Material S7-1). This confirms the hypothesis of our theoretical framework (Figure 1) on the mediating role of assigned values and place attachment in understanding students' attitudes.

4. Discussion

4.1 Reflections on conceptual framework and results

With this study we aimed to uncover the mechanisms between valuations of agrobiodiversity and factors that affect these valuations, as well as how these valuations, whether or not mediated by other factors, influence people's willingness to contribute to the enhancement of agrobiodiversity, either actively or passively (e.g. by supporting policies). Data provided by our student sample yielded some interesting results, that are not representative of the Dutch population in general in terms of *how much* citizens value agrobiodiversity. The data nevertheless provide some first insights into the above mechanisms that *explain* valuations and attitudes. We hypothesise that these mechanisms are representative for other groups of Dutch citizens.

The importance of assigned values to understand attitudes towards agrobiodiversity is clearly supported by the outcomes. The three types of values of agrobiodiversity that we identified in this paper – intrinsic, aesthetic and instrumental – all correlate to attitudes. As theoretically hypothesised, intrinsic and aesthetic values correlate strongly with attitudes towards policies that prescribe stricter conservation requirements to farmers. In addition, these assigned values mediate between fundamental values and attitudes. However, instrumental values, described as the functional benefits of agrobiodiversity for farmers and agricultural productivity, correlate negatively to these attitudes (Table 2). One possible explanation for this outcome contrary to our theory is that it is in farmers' own

interest to employ 'functional' agrobiodiversity and that they thus do not need to be stimulated to take care of such agrobiodiversity (either by public policies or by consumers). The fundamental value of universalism correlates negatively with instrumental values. Universalism refers to a general concern for the welfare of others, including nature (see Section 2). Apparently an anthropocentric approach to agrobiodiversity (i.e. instrumental) logically does not fit in this fundamental value.

In addition to assigned values, also place attachment correlates to attitudes, although much weaker than the assigned values. Moreover place attachment, and most notably place dependence had a negative relationship with attitudes. Students who grew up in the countryside feel more attached to the countryside and its farmers, and have lower support for policies that require farmers to contribute to nature conservation. A possible explanation is that this finding is related to closeness to farmers, but this requires further research.

4.2 Methodological limitations

There are several limitations to our study. First, because of the relatively low response rate, we cannot guarantee that our sample is representative of all Dutch students at institutes for higher education in terms of valuations of agrobiodiversity. Students who are not interested in agrobiodiversity are probably under-represented. We observe an over-representation of students who grew up in rural areas; we imagine these students are more interested in agrobiodiversity than students who grew up in (peri)urban settings. Second, the cross-sectional data did not allow us to draw firm conclusions regarding causal relationships. The mechanisms that we explored and that were discussed above therefore need further testing. Future studies could use measurements over time to detect causes and effects. Third, whereas most scales we used had a good reliability, the scale used for measuring instrumental values had a moderate reliability. Future research should include other items to measure this variable (e.g. insurance as an additional form of instrumental biodiversity; Finger and Buchmann, 2015).

4.3 Practical implications

We conclude that among students who participated in our survey, there is a low to modest appreciation of agrobiodiversity, a low to modest support for stricter conservation requirements for farmers (e.g. coupled with the income support from the EU Common Agricultural Policy) and a low to modest willingness to contribute to the conservation of agrobiodiversity themselves, except for paying somewhat extra for nature-friendly food. These findings are problematic in terms of support for voluntary nature conservation by farmers and for public and private policies that promote nature conservation.

Institutes for higher education can contribute to students' awareness of the need for more biodiverse agriculture by incorporating the subject in courses and curricula. They can create learning situations in which students can develop capabilities to think critically, ethically, and creatively about environmental issues and make informed decisions about how to cope with environmental problems (Wals et al. 2014). The strong correlation between aesthetic values and intrinsic values and attitudes suggests possibilities for attitude change towards increased support for agrobiodiversity, not only for institutes for higher education but also for governments and NGOs. Relating measures that farmers can implement to these values, and showing the results on the aesthetic quality and its contribution

to biodiversity may increase students' support for public and private policies that promote agrobiodiversity. The aesthetic dimension of biodiversity, especially through flowers, smells and sounds, is usually highly appreciated by people (Stilma et al., 2009). This opens up opportunities for a strategy of "Show, don't tell". A factor that was not taken into account however is the baseline information that students have about agrobiodiversity and their awareness of both the decline in agrobiodiversity and why this matters (cf. Runhaar, 2017). Although a simple 'knowledge deficit' model is too a simplistic view on people's attitudes on biodiversity conservation attitudes (Buijs et al., 2008), knowledge and understanding of biodiversity has been shown to influence people' views and attitudes towards biodiversity protection (Kaltenborn et al., 2016). Moreover, a recent survey commissioned by WWF Netherlands showed that 91% of the 1,005 respondents did not know that food production globally is the main cause of loss of biodiversity and that among young adults (18-24 years) 10% even stated not to know that our current food production system harms biodiversity (WNF, 2018).

4.4 Conclusions

In this paper we addressed the following research questions:

1. How do students value agrobiodiversity and what factors account for these valuations?
2. What is the willingness of students to contribute to the enhancement of agrobiodiversity, and how can this be explained?

Regarding the first question, we found that students appreciate intrinsic and aesthetic values of agrobiodiversity to some extent. Instrumental values generally are not considered important. All three assigned values strongly relate to the value of universalism; intrinsic and aesthetic values positively, while instrumental value relates negatively with universalism (Table 2).

Regarding the second question, we found that students are willing to contribute to agrobiodiversity conservation to some extent, but seem rather indifferent towards policies aimed at promoting conservation by farmers by means of stricter requirements. Students however do indicate to be willing to pay more for food that has been produced in 'nature friendly' ways. Students' attitudes strongly and significantly relate to place attachment and assigned values. Policy attitudes are best explained by assigned values. Intrinsic and aesthetic values are positively related to attitudes, instrumental values are negatively related to attitudes. Students who appreciate the intrinsic or aesthetic value of agrobiodiversity support policy measures that promote agrobiodiversity significantly more than students who appreciate instrumental values of agrobiodiversity. Looking at attitudes related to pro-nature behaviour, we see a very similar pattern.

We recommend follow-up research among a more representative sample of Dutch citizens, with the aim of both assessing valuations of agrobiodiversity by Dutch citizens in general and whether and how these valuations can be enhanced by the provision of information about the intrinsic and aesthetic values of agrobiodiversity. In view of the ongoing decline in agrobiodiversity, in the Netherlands and elsewhere, it is important that awareness and a sense of urgency is created, not only among farmers, representatives of the agri-food industry, governments and NGOs, but particularly also among citizens, who at present do not seem to be very actively involved in the societal debate about agrobiodiversity.

Acknowledgements

The authors would like to thank Machiel Bouwmans (HU University of Applied Sciences Utrecht) and Simon Vink and David Kleijn (Wageningen University and Research) for their input and feedback on the research design.

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Supplementary material

- S1: Scales and items to measure assigned values and attitudes
- S2: S2: Overview of student populations invited to participate in the survey
- S3: Analyses of the representativeness of the students' response group
- S4: Students' scores on values assigned to agrobiodiversity – responses to items
- S5: Students' scores on attitudes towards agrobiodiversity – responses to items
- S6: Students' scores on place identity and place dependency – responses to items
- S7: Mediating variables

S1: Scales and items to measure assigned values, attitudes and other variables

Fundamental values

- It is important to him that everybody in the world is treated equally. He desires fairness for everybody, even for people he does not know. [Universalism]
- He strongly believes people have to take care of nature. Mitigating climate change is very important to him. [Universalism]
- To him it is very important to help people in his area. He feels responsible for helping other people. [Benevolence]
- He is looking for an adventure and enjoys taking risks. He wants to have an exciting life. [Stimulation]
- He seizes every opportunity to have fun. For him it is important to do things he likes. [Hedonism]
- To him it is important to show what he can. He likes people to admire him for what he does. [Achievement]
- Invent new ideas and being creative are important for him. He likes to do things in his own way. [Self-direction]
- To him it is important to be in charge and to tell others what to do. He likes other people to listen to him. [Power]
- To him it is important that his country is safe from threats from within or outside. He thinks it is important that today's society is protected. [Security]
- To him it is important to behave nicely. He wants to prevent doing things that other people disapprove of. [Conformity]
- He thinks it is important to not want more than you already own. He believes that people should be satisfied with what they have. [Tradition]

Items were measured on a 7-point scale (1 = doesn't seem like me at all; 2 = doesn't seem like me; 3 = doesn't seem much like me; 4 = seems a bit like me; 5 = seems like me; 6 = seems very much like me; 7 = seems extremely like me).

Assigned values

- Intrinsic:
 - To me it is important to protect nature in arable agricultural land, for our children and for future generations.
 - To me it is important to protect rare species in the countryside.
 - On each field, strips should be kept free for wild plants and animals.
 - Farmers should protect nature on their fields as much as possible.
- Aesthetic:
 - I find it important to see more birds in the countryside.
 - Farmers have to sow flower-rich field strips in order to make the landscape more beautiful.
 - I really enjoy a beautiful and varied countryside.
 - To me it is important to hear buzzing bees and singing birds in the countryside.

- Instrumental:
 - Only useful insects that for instance pollinate or control pests have to be protected.
 - Farmers only have to protect nature if that enhances productivity.
 - I would regret it if farmers earn less money because fertile pieces of arable land are reserved for nature.

The following item was removed from the measurement of the instrumental values because it did not correlate enough with the other items: Farmers have to sow flower rich field margins for birds and animals that predate on pest species.

Items were measured on a 7-point scale (1 = completely disagree; 2 = disagree; 3 = disagree a little bit; 4 = neither disagree nor agree; 5 = agree a little bit; 6 = agree; 7 = completely agree).

NB: 'the countryside' is a translation of the Dutch term 'platteland' which refers to that part of the countryside that consists of farmed land.

Attitudes

- Own actions:
 - I am prepared to pay more for vegetables and fruit that has been produced in a nature-friendly way.
 - I buy organic dairy products.
 - I buy organic meat.
 - I buy products from nature-friendly farmers.
 - I stimulate friends and family to buy nature-friendly products.
- Policy:
 - I think stricter nature conservation requirements should be set for income support to farmers.
 - I think the government should implement stricter rules for nature conservation and environmental protection for farmers.
 - I am prepared to donate to organizations who protect nature in the countryside.
 - In my voting behaviour it is important what political parties want to do for nature in agricultural landscapes.
 - I am prepared to sign a petition in order to protect nature in the countryside (e.g. on Facebook).

Place attachment

- Place identity
 - I feel very much connected to the countryside.
 - The countryside means a lot to me.
 - I identify myself much with the countryside.
- Place dependence
 - The countryside is the best place for leisure activities.
 - I prefer to recreate in the countryside.
 - For relaxation I prefer the countryside over nature reserve areas.

Items were measured on a 7-point scale (1 = completely disagree; 2 = disagree; 3 = disagree a little bit; 4 = neither disagree nor agree; 5 = agree a little bit; 6 = agree; 7 = completely agree).

Place where respondents had spent their youth

- 1=mainly in a large city of over 100,000 inhabitants.
- 2=mainly in a small town or village of 10,000 to 100,000 inhabitants.
- 3=mainly in the countryside with less than 10.000 inhabitants.

S2: Overview of student populations invited to participate in the survey

Universities:

Aeres University of Applied Sciences: ca. 200

Utrecht University: ca. 2,000

Delft University of Technology: ca. 900

Radboud University Nijmegen: 20

Wageningen University: ca. 900

TOTAL 4,020

Level:

Bachelor: ca. 3,000

Master: ca 1,020

TOTAL 4,020

Programmes:

Technical: ca. 1,250

Environmental/ecological: ca. 1,000

Agricultural: ca. 270

Educational: ca. 190

Planning: ca. 345

Earth sciences: ca. 900

Languages: ca. 65

TOTAL 4,020

Figures are estimates. Part of the invitations were sent via course coordinators who did not always know how many Dutch students were enrolled in their courses. The same applies to colleagues who sent out invitations via programme-wide mailing lists.

S3: Analyses of the representativeness of the students' response group

Comparison on fundamental values

Especially 'universalism' shows significant correlations with assigned values (see Results). In the table below we compare students' scores on the fundamental value of universalism with those of the Dutch population as a whole based on data from the European Social Survey (ESS). This comparison reveals that students have substantially higher scores on universalism and that students thus are not representative. The scales used in the ESS and our survey do not completely match however (see Tables below).

UNIVERSALISM It is important to him that everybody in the world is treated equally. He desires fairness for everybody, even for people he does not know.	ESS	Our survey
Very much like me (our survey: very much like me/very, very much like me)	26.5	38.9
Like me	45	30.4
Somewhat like me	22.2	19.6
A little like me (onze survey: not so much like me)	3.3	7.9
Not like me	2.0	2
Not at all like me	.9	1.2
UNIVERSALISM He strongly believes people have to take care of nature. Mitigating climate change is very important to him.	ESS	Our survey
Very much like me (our survey: very much like me/very, very much like me)	22.5	45.1
Like me	43	22.2
Somewhat like me	25.5	19.3
A little like me (onze survey: not so much like me)	6.2	7
Not like me	2	5
Not at all like me	0.5	1.5

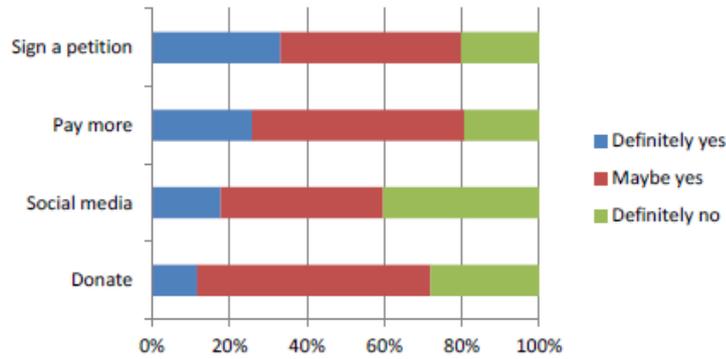
Data from European Social Survey. Dataset: ESS7-2014, ed.2.1. Data obtained from: <http://nesstar.ess.nsd.uib.no/webview/>
Data weighted for sampling error and non-response bias. Date of access 20-11-2017.

Comparison on attitudes

Langers and Goossens (2014) conducted a survey among 1,055 Dutch citizens ≥ 18 years on meadow bird conservation, a specific category of agrobiodiversity. Although the focus of our survey and the one by Langers and Goossen is not the same (meadow birds versus agrobiodiversity more generally) and also different scales were used, we can make some tentative comparisons.

With regards to attitudes concerning citizens' own behaviour they asked about citizens' preparedness to pay more for food products from farmers who actively protect meadow birds, to sign petitions for the conservation of meadow birds and to donate to conservation organisations (see Figure S2-1). Signing a petition, i.e. the easiest form of behaviour, was mentioned most often in terms of 'definitely yes'. By contrast, we found that students show the highest willingness to pay a bit more for food products produced in ways that respect or contribute to agrobiodiversity (see S4). This means their attitudes differ. Because of differences in which the *degree* of willingness was measured, we cannot assess whether or not students are also *more* willing than the average Dutch citizen to pay a bit more (and how much more).

Figure S2-1: Willingness of citizens to contribute to meadow bird protection.



Source: reproduced with permission and translated from Langers and Goossen, 2014: p. 18.

Regarding attitudes towards policy measures, Langers and Goossen (2014) observe that less than 10% of Dutch citizens supports stricter rules for farmers regarding meadow bird conservation, whereas some 60% ‘maybe agrees’. In our survey we found that these scores are higher for students (although we employ different scales). This means students are not representative in this respect, either.

Comparison on demographic characteristics

170 students were male (49.7%); mean age was 23.6 (84% was younger than 26; sd = 8,7). 19 percent grew up in a large city, 38.3% in a small town or village and 42.7% in a the countryside. Given that in the Netherlands a majority of people live in urban areas (ca. 80%) our sample is not representative in terms of where they grew up.

S4: Students' scores on values assigned to agrobiodiversity – responses to items

	Intrinsic value				Aesthetic value				Instrumental value		
	To me it is important to protect rare species in the countryside	To me it is important to protect nature in arable agricultural land, for our children and for future generations	Farmers have to protect nature on their fields as much as possible	On each field strips should be kept free for wild plants and animals	I really enjoy a beautiful and varied countryside	To me it is important to hear buzzing bees and singing birds in the countryside	I find it important to see more birds in the countryside	Farmers have to sow flower-rich field strips in order to make the landscape more beautiful	I would regret if farmers earn less money because fertile pieces of arable land are reserved for nature	Only useful insects that for instance pollinate or control pests have to be protected	Farmers only have to protect nature if that enhances productivity
Mean	5.36	5.24	4.56	4.34	5.64	5.07	4.98	3.85	4.56	3.44	2.82
N	342	342	342	342	342	342	342	342	342	342	342
Standard deviation	1.316	1.418	1.775	1.841	1.132	1.483	1.453	1.836	1.775	1.671	1.413

Note: values were measured by means of items on an 8-point scale (1 = completely disagree; 2 = disagree; 3 = disagree a little bit; 4 = neither disagree nor agree; 5 = agree a little bit; 6 = agree; 7 = completely agree; 8 = not applicable).

S5: Students' scores on attitudes towards agrobiodiversity – responses to items

	Attitude – own behaviour					Attitude - policy				
	I am prepared to pay more for vegetables and fruit that has been produced in a nature-friendly way	I buy organic dairy products	I buy organic meat	I buy products from nature-friendly farmers	I stimulate friends and family to buy nature-friendly products	I think stricter nature conservation requirements should be set for income support to farmers	I think the government should implement stricter rules for nature conservation and environmental protection for farmers	I am prepared to donate to organizations who protect nature in the countryside	I am prepared to sign a petition in order to protect nature in the countryside (e.g. on Facebook)	In my voting behavior it is important what political parties want to do for nature in agricultural landscapes
Mean	5.17	3.72	4.09	4.12	3.66	4.82	4.38	4.02	4.52	4.26
N	342	342	342	342	342	342	342	342	342	342
Std. dev.	1.496	2.246	2.415	1.841	1.973	1.947	2.064	1.922	2.152	1.927

Note: values were measured by means of items on an 8-point scale (1 = completely disagree; 2 = disagree; 3 = disagree a little bit; 4 = neither disagree nor agree; 5 = agree a little bit; 6 = agree; 7 = completely agree; 8 = not applicable).

S6: Students' scores on place identity and place dependence - responses to items

	Place identity			Place attachment		
	I feel very connected with the countryside	The countryside means a lot to me	I strongly identify myself with the countryside	The countryside is the best place for recreational activities	I prefer to recreate in the countryside	For relaxation I prefer the countryside over nature reserve areas
Mean	5.07	4.96	4.33	4.36	3.54	3.41
N	342	342	342	342	342	342
Std. dev	1.729	1.670	1.942	1.574	1.624	1.759

Note: values were measured by means of items on an 8-point scale (1 = completely disagree; 2 = disagree; 3 = disagree a little bit; 4 = neither disagree nor agree; 5 = agree a little bit; 6 = agree; 7 = completely agree; 8 = not applicable).

S7: Mediating variables

Theoretically, assigned values are considered *mediating variables* between fundamental values and attitudes. In addition, place attachment is considered a mediating variable between place where people grew up and attitudes. We tested on these mediation effects through regression analyses with only the variables significantly related to attitudes (see tables S5-1 and S5-2). In the first step, the independent variable were included (either fundamental values or place where people grew up), in the second step, the mediating variable was added to the analysis. Results suggest that place dependence indeed partly mediates the relationship between the place where one was born and attitudes towards policy and own behaviour (β values decrease from $-.244$ to $-.144$ and from $-.332$ to $-.191$ after inclusion of place dependence; see Table S6-1). Table S5-2 suggests that intrinsic value partly mediates the relationship between the fundamental value of universalism and attitudes towards policy (β value decreases from $.575$ to $.390$ after it was entered into the equation) as well as the attitude towards own behaviour (β value decreases from $.658$ to $.329$). In the same line, instrumental values partly mediate between the fundamental values universalism and security and both types of attitudes. Finally, aesthetic value mediates the effect of the fundamental value of self-direction on both types of attitudes.

Table S6-1: Mediating effects of place attachment in the relationship between the place where one grew up and attitudes towards policy and own behaviour

		Attitude towards policy		Attitude towards own behaviour	
Mediating Variable -->		Place dependence		Place dependence	
Place where one grew up	Urban vs rural	-.244**	-.144*	-.332**	-.191**
Place attachment	Place dependence		-.220**		-.308**
	Place identity				
R ²		.059**	.098**	.110**	.185**
R ² -Change			.039		.075**

NB: on behalf of clarity we only included the Beta values, the significance of the effect and the (change in) R². **=p<.01; *=p.<.05

Table S6-2: Mediating effects of assigned values in the relationship between fundamental values and attitudes towards behaviour

		Attitude on policy							
Mediating Variable -->		Intrinsic value		Instrumental value		Aesthetic value		Intrinsic value	
Fundamental Values	Universalism	.575**	.390**	.568**	.429**	.568**	.441**	.658**	.329**
	Security			-.132**	-.082*				
	Self-direction					.080	.049		
Assigned values	Intrinsic value		.290**						.516**
	Instrumental value				-.278**				
	Aesthetic value						.256**		
R ²		.331**	.381**	.348**	.404**	.337**	.385**	.433**	.591**
R ² -Change			.050		.056		.048		.058

NB: on behalf of clarity we only included the Beta values, the significance of the effect and the (change in) R². **=p<.01; *=p.<.05