

# The farmer as a landscape steward: Comparing local understandings of landscape stewardship, landscape values, and land management actions

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**Abstract** We develop a landscape stewardship classification which distinguishes between farmers' understanding of landscape stewardship, their landscape values, and land management actions. Forty semi-structured interviews were conducted with small-holder (<5 acres), medium-holders (5–100 acres), and large-holders (>100 acres) in South-West Devon, UK. Thematic analysis revealed four types of stewardship understandings: (1) an environmental frame which emphasized the farmers' role in conserving or restoring wildlife; (2) a primary production frame which emphasized the farmers' role in taking care of primary production assets; (3) a holistic frame focusing on farmers' role as a conservationist, primary producer, and manager of a range of landscape values, and; (4) an instrumental frame focusing on the financial benefits associated with compliance with agri-environmental schemes. We compare the landscape values and land management actions that emerged across stewardship types, and discuss the global implications of the landscape stewardship classification for the engagement of farmers in landscape management.

**Keywords** Conservation behavior · Social values · Environmental management · Pro-environmental behavior · Production behavior

## INTRODUCTION

Recent global research efforts have been devoted to identifying principles of landscape stewardship using a variety of approaches in order to better understand human capacity to manage or regulate ecosystem services, among other landscape attributes (e.g., Folke et al. 2009; Raymond et al. 2013; Seastedt et al. 2013). For example, the stewardship

theme features prominently in the Future Earth research agenda that aims to develop the knowledge required to address risks and opportunities of global environmental change and novel ways of supporting transformations to global sustainability (Future Earth 2015).

Broadly, landscape stewardship can be defined as “efforts to create, nurture, and enable responsibility in landowners and resource users to manage and protect land and its natural and cultural heritage” (Brown and Mitchell 2000, p. 70). However, multiple conceptualisations of stewardship are present in the natural resource and environmental management literatures. Stewardship can be understood as an essential aspect contributing to human preference for visual landscape character and quality (e.g., Coeterier 1996; Natori and Chenoweth 2008; Ode Sang and Tveit 2013). It has been defined as the presence of order and care (Tveit et al. 2006), with care indicated by the level of management of vegetation and the status and condition of man-made structures in the landscape (Ode et al. 2008). From a primary production perspective, stewardship refers to an ethic toward “the responsible use (including conservation) of natural resources in a way that takes full and balanced account of the interests of society, future generations, and other species, as well as of private needs, and accepts significant answerability to society” (Worrell and Appleby 2000, p. 263). In the context of social–ecological systems, stewardship is expressed as actively shaping trajectories of systems in order to enhance ecological resilience and support human well-being through the provision of ecosystem services (Kofinas and Chapin 2009; Chapin et al. 2011). It emphasizes an understanding of cross-scale interactions (Folke et al. 2011) and constructive ways of creating synergies across knowledge systems (Tengö et al. 2014). Landscape stewardship has also been used as a way to brand policies and incentive schemes that encourage

sustainable production. For example, Entry Level Stewardship and Higher Level Stewardship are two core pillars of the UK Government's approach to agri-environmental schemes, which are payments to farmers aimed at encouraging or enforcing the production of environmental goods, such as soil protection or the restoration of native vegetation (Robinson 2008).

Here, we consider landscape stewardship with respect to the discourses presented in landscape planning. The landscape planning literature emphasizes that the management of the environment must be considered in parallel to societal values, such as human well-being and cultural heritage (Setten et al. 2012; Plieninger et al. 2015a, b). Further, ecosystem services, particularly cultural services, should not be externalized using monetary valuations, but rather embrace a range of understandings of human–environment relationships (Raymond et al. 2013). To thoroughly understand the discourse, the terms 'landscape' and 'stewardship' first need to be understood separately. Landscape is seen as a holistic dimension where physical elements, socio-economical qualities, and institutional components interact with value systems, tradition, and knowledge (Conrad et al. 2011; Setten et al. 2012). It includes a mosaic of different rural and urban environments and habitats, and it is an area in which physical, immaterial, and social–cultural aspects interact (Fry 2001; Lindborg et al. 2008). A commonly agreed characteristic of landscape is spatial variation. Setten et al. (2012) state that “a landscape can be described as an arena where various societal projects and land-use interests coincide in space and time with physical structures and nonhuman flows” (p. 307).

Landscape planners view the stewardship concept in a holistic manner. It broadly refers to a set of management activities which support individual species, as well as the surrounding landscape, land-use history, and landscape structure (Lindborg et al. 2008; Nassauer 2011; Plieninger et al. 2015b). Therefore, analysis of landscape stewardship gives equal regard to an assessment of measurable values like biodiversity, as well as more intangible values such as aesthetic qualities and 'sense of place.'

A way to classify stewardship is to consider the relationships between farmers' understandings of stewardship, their landscape values, and land management activities. Landscape values are those that people attach to things such as ecosystem services, activities, and places (Brown 1984; Lockwood 1999). They reflect a person's perception of the landscape under valuation, their held values and associated preferences, and the context of the valuation. Landscape values are also tied to patterns of land-use and management activity as noted by Zube (1987) who discusses three concepts of human–landscape relationships: “the human as an agent of biological and physical impact on the landscape; the human as a static receiver and

processor of information from the landscape; and the human as an active participant in the landscape – thinking, feeling and acting” (p. 37). For example, a farmer could assign values to places on his/her property for aesthetics (a sensory connection), for the recreational activities pursued there (activity-based value), or the values associated with reshaping the landscape to meet production needs (an economic value). A variety of studies have highlighted the importance of considering landscape values in natural resource management (e.g., Raymond and Brown 2006; Fagerholm and Käyhkö 2009; Brown 2012); however, previously they have not been used to inform ideas about stewardship.

The aim of this study is to develop an integrated understanding of landscape stewardship as perceived by farmers in South-West Devon, UK. Specifically, we develop a landscape stewardship classification which combines small- (<5 acres,  $n = 13$ ), medium- (5–100 acres,  $n = 14$ ), and large-holders' (>100 acres,  $n = 13$ ) understandings of landscape stewardship, their landscape values, and land management actions. This understanding could inform future environmental policy development in Europe, such as the tailoring of agri-environmental schemes to different types of farmers.

## MATERIALS AND METHODS

### Research approach

The paper draws upon both grounded theory (Strauss and Corbin 1990) and applied thematic analysis techniques (Guest and MacQueen 2012). We used grounded theory analysis to firstly identify the range of meanings of landscape stewardship across all respondents. We translated these meanings into themes, resulting in the four types of understandings. We then used applied thematic analysis to identify the range of landscape values which farmers held for their property and South-West Devon region, and the types of activities they undertook to manage them. In applied thematic analysis, coding is the primary process for developing themes within the raw data by recognizing important moments in the data and encoding it prior to interpretation (Boyatzis 1998). The interpretation of these codes can include comparing theme frequencies, identifying theme co-occurrence, and graphically displaying relationships between different themes (Guest and MacQueen 2012). The themes and sub-themes of value and activity were associated with the four types of understanding of landscape stewardship. Finally, we quantified the frequency at which each landscape value and land management activity theme was mentioned, and translated these frequencies into presence or absence counts.

## Study area

The study area is situated in South-West Devon, a county in the South-West of England. The physical geographic boundaries are the Dart River on the eastern boundary, the watershed of the Dartmoor upland to the north, the Tamar Valley to the west, and the English Channel to the south (Bieling and Bürgi 2014). Urban areas such as Plymouth were excluded from the study.

We chose this study area because South-West Devon supports a variety of farming approaches (e.g., organic, community supported agriculture, and traditional commercial farming) and land uses. Agriculture accounts for 57 % of the land in the greater area of Devon. Dairy, lowland cattle, and sheep farming account for more than half of the registered land management by holding, followed by upland cattle and sheep farming (15 %) and mixed agriculture (11 %). Cereals and other cropping accounts for 9 %; the rest is used for horticulture, pigs, and poultry. The upland area of Dartmoor is a National Park, and as such is subject to administration by the Dartmoor National Park Authority. The Southern area, up to and including the coastline, is contained within a designated Area of Outstanding Natural Beauty (Bieling and Bürgi 2014).

## Sampling

A snowball sampling strategy was used to identify participants for the study. Local contacts were asked to generate an initial list of 10 farmers based upon farm size. Specifically, the local contacts were asked to identify three small-holders (<5 acres), three medium-holders (5–100 acres), and four large-holders (>100 acres) to be involved in the study, and for them to have differing levels of involvement in agri-environmental schemes and differing affiliations (e.g., linkages to local government, commoners associations, farm industry groups). Of those, four from the original list were interviewed, representing two small-holders, a medium-holder, and a large-holder. We then invited each interviewee to provide the names and contact details of up to five additional participants. These interviewees were then asked to provide the names and contact details of up to five additional farmers to be involved in the study.

During the course of the field work, we selected interviewees to address gaps in our respondent list based upon the aforementioned land-ownership classification. Filter questions were asked during the initial phone call to select participants on this basis. However, we had no knowledge of their understanding of landscape stewardship, landscape values, or land management activities going in to the interviews.

This sampling strategy resulted in 13 interviews with small-holders (32.5 % of sample), 14 interviews with medium-holders (35.0 %), and 13 interviews with large-holders (32.5 %). Eight of the 13 large-holders were hill farmers managing a combination of free-hold, leased, and common land in Dartmoor National Park. While the sample is not representative of all farmer types in the region (due to a small sample size) the proportions of small, medium, and large farmer sub-groups interviewed (as noted above) reflect regional farm distributions: i.e., Agricultural Census Data for 2013/2014 (after removing very small farmer and very large farmer classes) indicates an actual farm size distribution of small (268 254 acres, 37.1 % of total area), medium (216 407 acres, 30.0 % of total area), and large (237 661 acres, 32.9 % of total area) for the South-West Devon region (DEFRA 2014).

## Interview technique

Forty (average 45 min) semi-structured interviews were conducted at farmer residences in South-West Devon between October and December 2014. Each interview followed an interview script which was developed and tested in partnership with local stakeholders. We piloted the interview script with one small-holder, medium-holder, and large-holder from the region and then made some refinements to the interview questions. The final script included sections on (1) background to interviewee and their farm; (2) understanding of landscape stewardship; (3) three most important landscape values on the property, and; (4) how the interviewee manages these three values. To gain a more detailed understanding of landscape stewardship, interviewees were asked what they thought stewardship meant in a broader sense if they first defined it in the context of an ‘agri-environmental scheme.’ Each interview was recorded using an audio recorder and then transcribed verbatim into MS Word in readiness for analysis.

## Analyses

Respondent characteristics were analysed using descriptive statistics and cross-tabulation. We then conducted in-depth analysis of stewardship types by exploring the language used to define landscape stewardship, including the underpinning discourses. Given the absence of a coherent set of definitions for understanding stewardship, we drew upon a grounded theory approach (Strauss and Corbin 1990) to discover the different types of meaning of stewardship assigned by farmers. An open coding approach was used first to find the core understandings of stewardship. Selective coding techniques were then used to relate data coded at an earlier date to the core understandings of stewardship.

To obtain a richer perspective of landscape stewardship, we compared and contrasted the landscape values which farmers assigned to their property and the types of management activities by stewardship type. Applied thematic analysis techniques were used to identify the presence or absence of values by stewardship type (Braun and Clarke 2013). In this approach, the process of coding occurs without trying to fit the data into a pre-existing model or frame. It emphasizes pinpointing, examining, and recording patterns (or ‘themes’) within data. Applied thematic analysis was performed through a process of (1) reading and familiarization with the interview transcripts; and (2) complete coding to identify anything and everything of interest to answering the research question of whether there are differences in landscape values and land management activities across stewardship types. In the complete coding phase, all data extracts were coded in as many ways as fits the purpose. For each individual code, we then collated together all instances of text where that code appeared in the dataset. Themes were developed when codes clustered together. Each theme was linked to the underpinning code and then reviewed and revised, checking to ensure the themes fitted well with the data. The themes were then revised by coding and collating more data from the original interview transcripts. Finally, each theme was analysed for its presence or absence by stewardship type. The proportion of participants was also analysed, both overall and by stewardship type.

## RESULTS

### Respondent characteristics

Overall, proportionately more males (73.7 %) were interviewed than females, and 46.2 % of the sample had attained a technical or tertiary level of education. The majority (69.2 %) had earned a profit from their farm enterprise last financial year (2013–2014) and 42.4 % had >90 % equity in their farm business, where equity represented the proportion of the property owned outright (no mortgage) relative to the current market value of the property. Respondents had a mean age of 52.2 years (SD = 13.9), had lived in the region for an average of 39.8 years (SD = 22.1) and had owned property in the region for 23.4 years (SD = 18.2). Most respondents (90.0 %) had family owning property in the region. The average length of family ownership was 108 years (SD = 149.3). Family was considered in the context of how many years the farm had been passed down through the same family lineage (i.e., from parent to child). This is a common understanding of family within the UK farming context.

Compared with small-holders, medium- and large-holders were more likely to have made a profit last financial year (>84.6 vs. 35.7 %), had lived in the region a significantly longer period of time (>47.0 vs. 25.4 years, SD = 22.1,  $F = 5.9$ ,  $p = 0.006$ ), and owned property for a significantly longer period of time (>30.1 vs. 11.2 years, SD = 18.2,  $F = 5.8$ ,  $p = .007$ ). Large-holder families owned property in the region twice the length of time compared with medium-holders (188.3 years, SD = 216.4 vs. 92.5 years, SD = 100.7), and medium-holders had owned property twice the length of time compared with small-holders (92.5 vs. 44.4 years, SD = 56.9), but the differences were not statistically significant ( $p > 0.05$ ). Many small-holders were first generation farmers who had moved into the region after enjoying other careers.

We also identified land-use differences by land-holder type. The majority of large-holders were hill farmers in that they grazed cattle or sheep within Dartmoor National Park, or estate owners/managers who leased their land to a range of different farming enterprises but retained a strong influence on management decisions. The majority of medium-holders were dairy or cattle grazing enterprises, sometimes experimenting with maize crops as a point of diversification. Organic vegetable growers producing for Riverford (a large organic grocery company in the UK) were also represented in this group. Small-holders ranged from non-commercial holders producing food on a not-for-profit basis for family and friends (e.g., apple cider from an on-farm orchard) through to more intensive and niche organic enterprises providing vegetables or meat boxes through a local food network (e.g., community supported agriculture schemes).

### Understanding of landscape stewardship

We identified four types of understandings of landscape stewardship using grounded theory analysis: ‘Environmental,’ ‘Production,’ ‘Holistic,’ and ‘Instrumental’ frames. Each of these frames is described below. Table 1 provides a breakdown of respondents by land-holder type and stewardship type. Ten interviewees aligned with the environmental frame, six with production, 13 with holistic, and 11 with instrumental. No small-holders identified with a production frame of stewardship and similar proportions of small-holders identified with environmental and holistic frames (>40.0 %). The majority of large-holders identified with a production frame (66.6 %) and only one identified with an environmental frame. Respondents who framed stewardship using an environmental lens owned or managed less land than production and holistic respondents. They were also younger, more formally educated but less financially secure than respondents espousing a production-oriented or instrumental understanding. Respondents whose

**Table 1** Number of interviews by land-holding size and stewardship type

	Environmental	Production	Holistic	Instrumental	Total
Small-holder	4 (40 %)	0 (0 %)	6 (46.2 %)	3 (27.2 %)	13
Medium-holder	5 (50 %)	2 (33.3 %)	3 (23.1 %)	4 (36.4 %)	14
Large-holder	1 (10 %)	4 (66.6 %)	4 (30.7 %)	4 (36.4 %)	13
Total	10	6	13	11	40

family had owned the farm for a longer period of time were more likely to have production or holistic understandings of landscape stewardship. It is unclear whether these correlations are statistically significant due to the small sub-group sizes.

Approximately half of all respondents defined landscape stewardship in the context of preserving some form of landscape value for future generations. Environmental respondents discussed intergenerational equity in the context of conserving wildlife values, whereas production respondents discussed it in the context of enhancing production values. The value of social relations [the most frequently cited landscape value across all respondent sub-groups (Table 2)] did not explicitly feature in respondent definitions of stewardship.

#### *Environmental frame*

‘Environment’ was contextualized in different ways by study participants, including looking after the land in an environmental way, looking after the environmental features, stewarding the environmental features for future generations, and taking care of the environment and putting into place measures that encourage wildlife. In each of these frames, environment was defined by drawing upon concepts of wilderness, ecosystem health, and ‘saving wildlife,’ highlighting the intrinsic value of native species and communities to current and future generations. Definitions reflect an action-oriented approach of saving, conserving, or restoring wildlife for future generations. One respondent noted: “Well stewardship means looking after your land in an environmental way, keeping it preserved for the next generation and look out for the wildlife and what you can do to save wildlife.” Another respondent noted: “Stewardship, to my mind, is basically taking care of the environment and putting into place measures that encourage wild life and a healthy environment.” Unlike production respondents’ understanding of stewardship, most interviewees who drew upon this environmental framing of stewardship either overlooked or under-rated the economic impacts of land management, but emphasized wildlife values. For example, a respondent noted: “I place a lot of value on how rich it [the property] is in wildlife, and so it’s not explicit but I just subconsciously

know that I want to encourage that as much as I can rather than doing anything to its detriment, do you see what I mean?”

#### *Production frame*

In contrast to the environmental frame, some respondents defined stewardship only in the context of keeping land productive or the preservation of traditional farming techniques. They under-rated or did not mention the wildlife conservation goals of the environmental frame respondents. Key discourses communicated as part of this framing include: to keep the land in good productive condition for future generations and to preserve traditional farming techniques. Farmers discussed stewardship in the context of ‘land management,’ and ‘maintaining its productivity.’ One respondent noted “I’d say I’m a landscape steward because my influence on the landscape with my farm – I’ve got a responsibility to deliver or to keep it as it is and hand it on as good as if not a better condition that I got it at.” Unlike all other frames noted here, production frame respondents had the lowest proportion of participation in agri-environmental schemes (<10.0 %). They felt that the regulation associated with entry or high-level stewardship was burdensome and in some cases noted that they did not need to be involved in schemes to make the enterprise profitable.

#### *Holistic frame*

Respondents espousing a holistic understanding of landscape stewardship recognized the interactions, and sometimes the interdependencies, between ecological and production systems. They also highlighted the important role of maintaining or enhancing landscape diversity by supporting a patchwork of different land uses. One respondent noted: “To me, landscape stewardship is to keep what we’ve got, i.e., the patchwork fields, the hedgerows, the natural hedgerows that people think are natural but they’re not, they’re man made. The overall look of the place, if you like, yet still be actively farming with that. And also look after all the wildlife within that landscape as well. This nonsense of the environment or farming, it’s not like that; the two sit together and one works

**Table 2** The presence or absence of landscape values by each stewardship type (✓ denotes the presence of theme in interview transcript and X denotes the absence)

Landscape values—Property	All interviewees (N = 40)		Environmental	Production	Holistic	Instrumental
	# respondents per theme	%	(N = 10) %	(N = 6) %	(N = 13) %	(N = 11) %
Social relations	25	23.1	25.8	22.2	20.0	26.3
Sense of place or ‘Home’	8	7.4	✓	✓	✓	✓
Sense of community	12	11.1	✓	✓	✓	✓
Educating people/creating food culture	5	4.6	✓	X	✓	X
Quality, local food production	19	17.6	22.6	11.1	20.0	10.5
Producing quality food	6	5.6	✓	✓	✓	X
Producing local food	10	9.3	✓	X	✓	✓
Development of niche food markets	3	2.8	✓	X	✓	✓
Biodiversity	17	15.7	16.1	0.0	17.5	26.3
Native communities (e.g., woodlands)	8	7.4	✓	X	✓	✓
Native species	9	8.3	✓	X	✓	✓
Cultural heritage	16	14.8	12.9	11.1	20.0	10.5
Diversity of landscape types	11	10.2	✓	✓	✓	✓
Ancient feeling - protecting the past	3	2.8	X	✓	✓	X
Heritage buildings and archaeology	2	1.9	X	X	✓	✓
Recreation, tourism, and lifestyle	11	10.2	9.7	16.7	10.0	5.3
Rural lifestyle	9	8.3	✓	✓	✓	✓
Delivers my income	2	1.9	X	✓	✓	X
Care for animals or land	10	9.3	0.0	22.2	7.5	15.8
Care for animals	7	6.5	X	✓	✓	✓
Caretaker of land for future generations	3	2.8	X	✓	✓	X
Aesthetic and inspiration	10	9.3	12.9	16.7	5.0	5.3
Beautiful views	5	4.6	✓	✓	✓	✓
Clean and tidy landscape	5	4.6	✓	✓	✓	X
Total	108	100.0	100.0	100.0	100.0	100.0

with the other, and if you haven’t got the environment right, the farm won’t be right, and if the farm’s not right, the environment won’t be right. It’s this mix.”

Other respondents discussed the interactions between landscape, ecology, and the land over different temporal scales, and the possibility for co-benefits stemming from the interactions between ecological and production systems. One respondent noted: “I mean that we should leave the land in a good heart, we shouldn’t take the fertility away, we should try to maintain the fertility of our land, we should try and keep our hedges and wooded areas in good repair so as we’ve got wildlife habitat and it’s useful to us as farmers to have those facilities.” Another respondent discussed these interactions in the context of a deep connection to land and giving and receiving from the land: “So stewardship, I think... kind of means more that kind of deep connection that allows you to be able to understand the land better and then do best by it in order for it to do best by you.”

### *Instrumental frame*

A number of interviewees defined stewardship in the context of a government policy or incentive scheme, despite prompting for a wider definition of stewardship. Stewardship was considered as a formal government scheme to support environmental actions. Emphasis was placed on environmental agreements and farmers being paid to do something to support the natural environment.

One respondent noted: “I would say at the moment in England it would be our environmental agreements which would be Higher Level Stewardship, Uplands Entry Level Stewardship and Entry Level Stewardship.” Another respondent noted that stewardship relates to the “concept of farmers being paid some money to do things, which would in most cases help the natural environment.” This instrumental framing focuses on the monetary benefits associated with following rules prescribed by national government. It is important to note that a number of

respondents espousing an instrumental frame conducted environmental activities to receive payments, even though they did not agree with them. For example, reducing stocking rates on Dartmoor in order to receive Higher Level Stewardship payments even though they believed Dartmoor required more grazing to maintain the open spaces, diversity of habitat types, and public access.

While instrumental frame respondents had a different understanding of landscape stewardship to production frame respondents, they shared similar farming histories. Both groups had lived in the South-West Devon region for a long period of time (>44.5 years,  $SD = 21.2$ ) and families had been farming for multiple generations (>122.0 years,  $SD = 103.3$ ). Like production frame respondents, some instrumental frame respondents yearned to build the primary production capacity of their enterprise, but they felt constrained by agri-environmental schemes which ‘forced’ them to protect or enhance wildlife values.

### Comparing landscape values across landscape stewardship types

We asked each farmer to identify the three most important landscape values for their property. Across all interviewees, values related to social relations were most frequently cited (23.1 %, Table 2). Respondents valued the strong connections which they had to place or ‘home,’ and the strong sense of community reflected through high levels of reciprocity, trust, and care within their geographic locale. Environmental and holistic respondents noted the opportunities which their enterprise provided to educate people about producing quality, and in many instances, local food; however, this theme was not salient to production or instrumental respondents. Producing quality or local food was the next most frequently cited theme across all interviewees. All respondent types, with the exception of instrumental, valued their property because it provided the conditions to produce quality food. All respondent types, with the exception of production, also highlighted the importance of producing local food and the development of niche markets for their produce. ‘Local’ was frequently described as the parish boundary in which the farm operated. This view was particularly salient among farmers representing small organic enterprises, such as community supported agricultural schemes. Despite being identified by all sub-groups, aesthetic and inspiration values were least cited overall, suggesting that the beautiful views linked to one’s property are less salient overall than social relations and the ability to produce quality and/or local food.

Interestingly, value differences emerged across understandings of landscape stewardship. Overall, holistic

respondents cited the highest number (i.e., all) of social, cultural, production, and environmental themes (Table 2), highlighting that they value their properties for a range of different reasons. Like holistic respondents, environmental respondents frequently cited biodiversity values relating to ecological communities (e.g., woodlands) and native species; however, they did not recognize many of the cultural heritage, recreation, and care for animal sub-themes. Instrumental respondents shared similar values to environmental respondents with the exception of education and local food production values. While production respondents cited the least number of values overall, they cited important values not raised by environmental respondents, including the pride they have in caring for their animals, and being a caretaker of land for future generations.

### Comparing land management actions by landscape stewardship type

We then compared respondents’ land management actions by landscape stewardship type (Table 3). Overall, the greatest range of actions were noted by holistic respondents (11/11 or 100 % actions noted), followed by environmental (90.9 %), instrumental (54.5 %), and production (36.4 %). All interviewees most frequently cited soil protection actions (37.7 %), particularly actions related to keeping organic matter in the soil, grazing regimes, or crop rotations. Biodiversity management actions, particularly those related to trimming hedgerows on greater or equal to two year cycles was the next most frequently cited theme (33.3 %). Other actions related to animal care/husbandry (7.2 %), supporting local green food (4.3 %), water quality management (2.9 %), and heritage building protection (2.9 %) were less frequently cited.

No differences in land management actions emerged across environmental and holistic respondents (out of those listed in Table 2), with the exception that the environmental sub-group did not identify any heritage building protection actions. Instrumental respondents were more likely to cite soil protection actions than production respondents, whereas production respondents were more likely to cite animal care/husbandry actions than all other sub-groups. Interestingly, both instrumental and production respondents did not cite any wildlife conservation actions. Instead, their actions were restricted to hedgerow management. Despite valuing the production of local food (Table 2), instrumental respondents did not note any actions related to supporting a local, green food movement (Table 3). Further, heritage building protection was not identified by this sub-group.

**Table 3** The presence or absence of land management actions by stewardship type (✓ denotes the presence of theme in interview transcript and X denotes the absence)

Management actions	All Interviewees ( <i>N</i> = 40)		Environmental ( <i>N</i> = 10)	Production ( <i>N</i> = 6)	Holistic ( <i>N</i> = 13)	Instrumental ( <i>N</i> = 11)
	<i>n</i>	%	%		%	%
Total number of actions	11		90.9	36.4	100.0	54.5
Soil protection	26	37.7	38.5	40.0	36.0	54.5
Keeping organic matter in the soil	9	13.0	✓	X	✓	✓
Grazing regimes or crop rotations	8	11.6	✓	✓	✓	✓
Minimal use of fertilizers and chemicals	6	8.7	✓	X	✓	✓
Minimal use of tractors	3	4.3	✓	X	✓	X
Biodiversity	23	33.3	34.6	20.0	36.0	27.3
Hedgerow management ≥ 2 year cycles	17	24.6	✓	✓	✓	✓
Wildlife conservation	6	8.7	✓	X	✓	X
Social relations	8	11.6	11.5	0.0	16.0	9.1
Educating others to work with nature	8	11.6	✓	X	✓	✓
Other	12	17.4	15.4	40.0	12.0	9.1
Animal care/husbandry	5	7.2	✓	✓	✓	✓
Supporting local, green food	3	4.3	✓	X	✓	X
Water quality management	2	2.9	✓	X	✓	X
Heritage building protection	2	2.9	X	✓	✓	X
	69	100.0	100.0	100.0	100.0	100.0

## DISCUSSION

### Understandings of landscape stewardship

In this study, we identified discrete understandings of landscape stewardship, which are in many cases associated with different types of landscape values and land management actions. These understandings share both similarities and differences to those identified and operationalized in the literature. One may question whether the stewardship types presented here are dynamic and context dependent, or transcend specific situations. Social identity theory suggests that individuals have multiple social identities that correspond to widening circles of group membership (Turner et al. 1994). The resilience literature also suggests that individuals can adapt their identities to address changes within the social–ecological context (Folke et al. 2005). In this light, farmers may take on different understandings of stewardship depending upon their land management needs and social context at a given place or time.

An alternative view is that the stewardship types reflect higher level, landscape management orientations, or stewardship ethics, which the farmer adopts as guiding principles in their life, and therefore they are stable and enduring across farming contexts. Evidence for this view comes from the basic human values literature. A discrete set of

basic human value orientations have been empirically identified and validated across cultures over the past two decades (e.g., Schwartz and Bardi 2001; Milfont et al. 2010). Schwartz and Bilsky (1987, p. 551) define these values as a) concepts or beliefs, b) about desirable end states or behaviors, c) that transcend specific situations, d) guide selection or evaluation of behavior and events, and e) are ordered by relative importance. These values include more than just ethical principles and also include things that can be characterized as desirable end states, such as ‘a varied life,’ ‘family security,’ or ‘mature love.’

A third, balanced perspective is that each stewardship type reflects a higher level orientation, but within each orientation farmers select a discrete mix of landscape values and land management activities aligned with those values. Within any given stewardship orientation, there is the potential for a farmer to hold multiple landscape values which in some situations may conflict with one another. For example, environmental respondents identified both quality food and biodiversity values, and production respondents identified both aesthetic values and quality food values. The extent to which these values become salient, or activated in behavior, may depend upon the institutional and decision contexts in which an individual is situated. This third view is most consistent with the data presented in this paper.



### Relationships between landscape stewardship, landscape values, and land management actions

The value of social relations (including sense of place, sense of community, and creation of a local food culture) was most frequently cited by all respondent sub-groups (Table 2), but it did not feature in respondents' definitions of landscape stewardship. This finding suggests that social relations may be an independent driver of landscape stewardship. Indeed, both 'sense of place' and social cohesion are able to promote social capital and, thereby, social–ecological resilience and the sustainable management of landscapes (Pretty 2003; Folke et al. 2005). 'Sense of place' has also been found to be an important driver of stewardship of ecosystems in urban (Andersson et al. 2007) as well as rural landscapes (Raymond et al. 2011). An alternative view is that the value of social relations is an implicit property and unifying feature of all understandings of landscape stewardship, and may be embedded in respondents' comments about intergenerational equity. To better understand this alternative view, future research could further explore the value of social relations and its association with the concepts of intergenerational equity and landscape stewardship.

Another interesting finding relates to the lack of attention paid to the management of uncertainty in the framing of landscape stewardship. The socio-ecological systems literature discusses stewardship of ecosystem services, managing uncertainty, and building ecological resilience (Folke et al. 2004), whereas environmental frame respondents mainly referred to stewardship in the context of conserving biological communities or native species/wildlife. Indeed, one environmental frame respondent had identified and tracked the number of native species of invertebrates in a single hedge over a three year period. Over that time, he had found over 2000 species in that hedge. This finding suggests that the ecosystem service concept does not resonate with this sub-group and there is a preference to consider ecosystem management in the context of managing native species or communities. It may be partly explained by the historical emphasis of agri-environmental schemes on the protection of rare or threatened species or communities (Robinson 2006), as opposed to the management of ecosystem services or risks associated with global environmental change. This finding may also partly be explained in terms of connection to place as people can create a sense of place by closely observing ('knowing') local species.

Production framing respondents regularly discussed landscape stewardship in terms of the 'responsible use of land' (i.e., management of land in a way that provides food and fiber for future generations), which is consistent with definitions within the sustainable production literature

(e.g., Worrell and Appleby 2000). Wider analysis reveals that production respondents were principally large-holders involved in grazing or dairy production systems. Most large-holders who managed land outside Dartmoor National Park did not rely on any agri-environmental scheme for income support and indeed called for the opening up of agriculture to the 'free-market' in order to be able increase production and commodity returns. The longevity of their production enterprise was forefront of mind, and in some cases wildlife assets (including woodlands) were seen as obstacles to their primary production goals. Most large-holders within Dartmoor National Park, self-identified as 'hill farmers,' were opposed to the perceived destocking of Dartmoor imposed by stewardship schemes; however, income received from the schemes was perceived as essential to the future viability of their farm enterprise given the low profitability of hill farming per se. While farm profitability might be associated with the typology of stewardship understandings, this research has not analysed such interaction. The interactions among income, agro-environmental subsidies, and farmers' understanding of stewardship are indeed an important area for future research.

Holistic framing respondents noted most of the core concepts presented in the multi-functionality literature (e.g., linking production and conservation, cultural heritage, recreation) (Daugstad et al. 2006; Renting et al. 2009; Primdahl et al. 2013), in addition to other important aspects in the landscape visualization literature such as 'the presence of order and care' (Tveit et al. 2006; Ode et al. 2008) was expressed in terms of maintaining beautiful views or a clean and tidy landscape (e.g., regularly manicured hedge rows). Care for animals and land and creating a local food culture through education and awareness raising also featured prominently in the holistic framing. We found that holistic farmers tended to wear multiple hats in the community; for example, they were involved in local progress associations, agriculture unions, local government boards, commons associations, health or education advisory boards, and the like. In this way, they could discuss a range of issues, and the links between the management of primary production assets, biodiversity, and cultural diversity.

We also found differing perceptions of landscape diversity across stewardship types. Holistic farmers identified a diverse range of landscape values and management actions, suggesting that they manage for heterogeneity in the farm, whereas instrumental and production farmers identified a narrower range, suggesting that they manage for homogeneity. Our stewardship classification therefore caters for a range of management styles, and provides options for researchers and policy makers to design and tailor stewardship schemes to a range of desirable landscape futures, as preferred by local actors.

We acknowledge the potential for overlap in understandings of stewardship. For example, there is some potential overlap between the environment and production frame. It is unclear what respondents mean by leaving the land in ‘better condition.’ The farmer may have also been referring to improving the condition of native species. Additionally, we consider definitions related to ‘care for land’ in the context of caring for aspects of the agro-ecosystem, including crops and livestock. It is possible that some respondents were referring to broader elements of care, including care for native plants and animals. Additionally, there is an overlap between respondents using an environmental frame and instrumental frame as highlighted by the high proportion of values assigned to biodiversity by each sub-group (Table 2). Both groups saw the need for conserving native wildlife; however, further analysis of the interview scripts suggests that the underpinning motivations of each sub-group were different. Instrumental respondents were driven by an economic incentive (i.e., stewardship scheme payment) to be involved in wildlife conservation actions, whereas environmental frame respondents were driven by moral concerns, such as the right to exist for native species. Other cross-overs and limitations are likely given that typologies are unable to represent every variation of landholders in a community (see Emtage et al. 2006).

Linking understandings of stewardship to landscape values and land management actions, as done here, provides an alternative way of understanding the bio-cultural context of stewardship which not only links multiple practices, but also farmers’ landscape values and understandings of stewardship. Important cognitive and place-based value dimensions need to be considered in future programs aimed at engaging different types of farmers in landscape management. Rather than targeting farmers based on their farm system type, we recommend that environmental agencies consider engaging them based on their understandings of stewardship, landscape values, and land management actions. We recognize that this type of targeting has a cost implication for governments because data would need to be generated on a regular basis by environmental agencies across multiple study regions. One possibility to cut costs is to consider incorporating data on understandings of stewardship and landscape values into the annual National Farm Survey in the UK, among other national agricultural assessments in the European Union. An alternative option would be to collate these data every 5 years at a national scale through a separate commissioned project. A third, less costly option would be to extrapolate stewardship types, landscape values, and land management activities to a national level using landscape character classification (see Brown and Brabyn 2012). However, we urge caution in the reliance on extrapolated models for

land-use decisions. The relationships between understandings of stewardship, landscape values, land management activities, and landscape characteristics in one region may not hold in another region.

## CONCLUSIONS

This study presents a new classification of landscape stewardship based upon South-West Devon farmers’ understanding of stewardship, their landscape values, and land management actions. The classification provides for a holistic understanding of stewardship (including consideration of primary production, biodiversity, and cultural diversity value dimensions) and it integrates multiple conceptualisations of stewardship articulated in the natural resource management literature. We argue that it is crucial to view farmers’ landscape values and land management actions in the context of their understanding of stewardship. Respondents who framed stewardship holistically (from both production and conservation perspectives) identified the greatest diversity of landscape values and land management actions on their property, whereas those respondents who framed stewardship from a production perspective identified the least diversity. We encourage policy makers to tailor landscape management programs to farmers at the place-specific scale based on their understanding of landscape stewardship, their landscape values, and land management actions.

The content and structure of farmers’ understandings of landscape stewardship warrants further investigation prior to including in management decisions. The first challenge is to quantify these understandings by using survey research methods. Another important challenge that emerged from this research is to better understand how the value of social relations could contribute to defining landscape stewardship in different rural contexts.

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## REFERENCES

- Andersson, E., S. Barthel, and K. Ahrné. 2007. Measuring social-ecological dynamics behind the generation of ecosystem services. *Ecological Applications* 17: 1267–1278.
- Bieling, C., and M. Bürgi. 2014. List and documentation of case study landscapes selected for HERCULES. EU-Project Deliverable GA No. 603447. Accessed Online 10 February, 2015, from [http://www.hercules-landscapes.eu/tartalom/HERCULES\\_WP3\\_D3\\_1\\_ALUFR\\_final.pdf](http://www.hercules-landscapes.eu/tartalom/HERCULES_WP3_D3_1_ALUFR_final.pdf).

- Boyatzis, R.E. 1998. *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, CA: Sage Publications.
- Braun, V., and V. Clarke. 2013. *Successful qualitative analysis: A practical guide for beginners*. London: Sage Publications.
- Brown, T.C. 1984. The concept of value in resource allocation. *Land Economics* 60: 231–246.
- Brown, G. 2012. Public Participation GIS (PPGIS) for regional and environmental planning: Reflections on a decade of empirical research. *URISA Journal* 24: 7–18.
- Brown, G., and L. Brabyn. 2012. An analysis of the relationships between multiple values and physical landscapes at a regional scale using public participation GIS and landscape character classification. *Landscape and Urban Planning* 107(3): 317–331.
- Brown, J., and B. Mitchell. 2000. The stewardship approach and its relevance for protected landscapes. *The George Wright Forum* 17: 70–79.
- Chapin, F.S., S.T.A. Pickett, M.E. Power, R.B. Jackson, D.M. Carter, and C. Duke. 2011. Earth stewardship: A strategy for social–ecological transformation to reverse planetary degradation. *Journal of Environmental Studies and Sciences* 1: 44–53.
- Coetier, J.F. 1996. Dominant attributes in the perception and evaluation of the Dutch landscape. *Landscape and Urban Planning* 34: 27–44.
- Conrad, E., M. Christie, and I. Fazey. 2011. Understanding public perceptions of landscape: A case study from Gozo, Malta. *Applied Geography* 31: 159–170.
- Daugstad, K., K. Rønningen, and B. Skar. 2006. Agriculture as an upholder of cultural heritage? Conceptualizations and value judgements—A Norwegian perspective in international context. *Journal of Rural Studies* 22: 67–81.
- DEFRA. 2014. Farm Business Survey. Data collected by Rural Business Research on behalf of, and financed by, the Department for Environment, Food and Rural Affairs (DEFRA). Accessed Online 30 May 2015, from <http://www.farmbusinesssurvey.co.uk/DataBuilder/>.
- Emtage, N., J. Herbohn, and S. Harrison. 2006. Landholder typologies used in the development of natural resource management programs in Australia—A review. *Australasian Journal of Environmental Management* 13: 79–94.
- Fagerholm, N., and N. Käyhkö. 2009. Participatory mapping and geographical patterns of the social landscape values of rural communities in Zanzibar, Tanzania. *Fennia* 187: 43–60.
- Folke, C., F.S. Chapin, and P. Olsson. 2009. Transformations in ecosystem stewardship. In *Principles of ecosystem stewardship: Resilience-based natural resource management in a changing world*, 103–125. New York: Springer.
- Folke, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson, and C.S. Holling. 2004. Regime shifts, resilience, and biodiversity in ecosystem management. *Annual Review of Ecology Evolution and Systematics* 35: 557–581.
- Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social–ecological systems. *Annual Review of Environment and Resources* 30: 441–473.
- Folke, C., Å. Jansson, J. Rockström, P. Olsson, S.R. Carpenter, F.S. Chapin, A.-S. Crépin, G. Daily, et al. 2011. Reconnecting to the Biosphere. *Ambio* 40: 719–738.
- Fry, G.L.A. 2001. Multifunctional landscapes – towards transdisciplinary research. *Landscape and Urban Planning* 57: 159–168.
- Future Earth. 2015. About Future Earth. Accessed Online <http://www.icsu.org/future-earth>.
- Guest, G., and K.M. MacQueen. 2012. Introduction to applied thematic analysis. In *Applied thematic analysis*, ed. G. Guest, K.M. MacQueen, and E.E. Namey. UK: Sage.
- Kofinas, G.P., and F.S. Chapin. 2009. Livelihoods and human well-being during social–ecological change. In *Principles of ecosystem stewardship: Resilience-based natural resource management in a changing world*, 55–75. New York: Springer.
- Lindborg, R., J. Bengtsson, Å. Berg, S.A.O. Cousins, O. Eriksson, T. Gustafsson, K.P. Hasund, L. Lenoir, et al. 2008. A landscape perspective on conservation of semi-natural grasslands. *Agriculture, Ecosystems & Environment* 125: 213–222.
- Lockwood, M. 1999. Humans valuing nature: Synthesising insights from philosophy, psychology and economics. *Environmental Values* 8: 381–401.
- Milfont, T.L., J. Duckitt, and C. Wagner. 2010. A cross-cultural test of the value–attitude–behavior hierarchy. *Journal of Applied Social Psychology* 40: 2791–2813.
- Nassauer, J.I. 2011. Care and stewardship: From home to planet. *Landscape and Urban Planning* 100: 321–323.
- Natori, Y., and R. Chenoweth. 2008. Differences in rural landscape perceptions and preferences between farmers and naturalists. *Journal of Environmental Psychology* 28: 250–267.
- Ode Sang, Å., and M.S. Tveit. 2013. Perceptions of stewardship in Norwegian agricultural landscapes. *Land Use Policy* 31: 557–564.
- Ode, Å., M.S. Tveit, and G. Fry. 2008. Capturing landscape visual character using indicators: Touching base with landscape aesthetic theory. *Landscape Research* 33: 89–117.
- Plieninger, T., T. Kizos, C. Bieling, L. Le Dû-Blayo, M.-A. Budniok, M. Bürgi, C.L. Crumley, G. Girod, P. Howard, and J. Kolen. 2015b. Exploring ecosystem-change and society through a landscape lens: Recent progress in European landscape research. *Ecology and Society* 20(2): art. 5.
- Plieninger, T., C. Bieling, N. Fagerholm, A. Byg, T. Hartel, P. Hurley, C.A. López-Santiago, N. Nagabhatla, E. Oteros-Rozas, C.M. Raymond, D. van der Horst, and L. Huntsinger. 2015a. The role of cultural ecosystem services in landscape management and planning. *Current Opinion in Environmental Sustainability* 14: 28–33.
- Pretty, J. 2003. Social capital and the collective management of resources. *Science* 302: 1912–1914.
- Primdahl, J., L.S. Kristensen, and A.G. Busck. 2013. The farmer and landscape management: Different roles, different policy approaches. *Geography Compass* 7: 300–314.
- Raymond, C.M., and G. Brown. 2006. A method for assessing protected area allocations using a typology of landscape values. *Journal of Environmental Planning and Management* 49: 797–812.
- Raymond, C.M., G. Brown, and G.M. Robinson. 2011. The influence of place attachment, and moral and normative concerns on the conservation of native vegetation: A test of two behavioural models. *Journal of Environmental Psychology* 31: 323–335.
- Raymond, C.M., G.G. Singh, K. Benessaiah, J.R. Bernhardt, J. Levine, H. Nelson, N.J. Turner, B. Norton, et al. 2013. Ecosystem services and beyond: Using multiple metaphors to understand human–environment relationships. *BioScience* 63: 536–546.
- Renting, H., W.A.H. Rossing, J.C.J. Groot, J.D. Van der Ploeg, C. Laurent, D. Perraud, D.J. Stobbelaar, and M.K. Van Ittersum. 2009. Exploring multifunctional agriculture. A review of conceptual approaches and prospects for an integrative transitional framework. *Journal of Environmental Management* 90: S112–S123.
- Robinson, G.M. 2006. Canada’s environmental farm plans: Transatlantic perspectives on agri–environmental schemes. *Geographical Journal* 172: 206–218.
- Robinson, G.M. 2008. Sustainable rural systems: An introduction. In *Sustainable rural systems: Sustainable agriculture and rural communities*, ed. G.M. Robinson, 3–40. Basingstoke: Ashgate.
- Schwartz, S.H., and A. Bardi. 2001. Value hierarchies across cultures—Taking a similarities perspective. *Journal of Cross-Cultural Psychology* 32: 268–290.

- Schwartz, S.H., and W. Bilsky. 1987. Toward a universal psychological structure of human values. *Journal of Personality and Social Psychology* 53: 550–562.
- Seastedt, T.R., K.N. Suding, and F.S. Chapin. 2013. Ecosystem stewardship as a framework for conservation in a directionally changing world. In *Novel ecosystems: Intervening in the new ecological world order*, 326–333. New York: Wiley.
- Setten, G., M. Stenseke, and J. Moen. 2012. Ecosystem services and landscape management: Three challenges and one plea. *International Journal of Biodiversity Science, Ecosystem Services & Management* 8: 305–312.
- Strauss, A.L., and J. Corbin. 1990. *Basics of qualitative research techniques and procedures for developing grounded theory*. Thousand Oaks: Sage.
- Tengö, M., E.S. Brondizio, T. Elmqvist, P. Malmer, and M. Spierenburg. 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: The multiple evidence base approach. *Ambio* 43: 579–591.
- Turner, J.C., P.J. Oakes, S.A. Haslam, and C. McGarty. 1994. Self and collective: Cognition and social context. *Personality and Social Psychology Bulletin* 20: 454–463.
- Tveit, M., Å. Ode, and G. Fry. 2006. Key concepts in a framework for analysing visual landscape character. *Landscape Research* 31: 229–255.
- Worrell, R., and M.C. Appleby. 2000. Stewardship of natural resources: Definition, ethical and practical aspects. *Journal of Agricultural and Environmental Ethics* 12: 263–277.
- Zube, E.H. 1987. Perceived land use patterns and landscape values. *Landscape Ecology* 1: 37–45.

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