Farmers' motivations for implementing herpetofauna-friendly practices in Slovenia

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Abstract

Herpetofauna populations in the EU are still declining, with agriculture identified as a key pressure. Farmers, as stewards of cultural landscapes, play an important role in biodiversity conservation. Using Self-Determination Theory (SDT), we explored how different types of motivation influence implementation of nature-friendly practices. We surveyed 462 farmers from Central and NE (Pomurje) Slovenia about their knowledge and attitudes toward herpetofauna, implementation of beneficial practices for their conservation (e.g., hedgerows and fishless ponds), and their motivations for these practices. Structural Equation Modelling revealed that integrated regulation, the most autonomous extrinsic motivator, was the only significant positive predictor of conservation practices, suggesting that farmers implement these practices because they are embedded in their lifestyle and traditions. In an extended model including attitudes and nature connectedness, both intrinsic and integrated regulation had significant positive effects, with integrated regulation being twice as influential. Intrinsic motivation was shaped by attitudes and nature connectedness, while attitudes were also influenced by nature connectedness. These findings highlight the importance of focusing on traditional practices and internalization of conservation practices, rather than relying solely on financial incentives.

INTRODUCTION

Around 30 % of amphibian species and around 20 % of reptile species in EU are experiencing population decline (European Environment Agency, 2020). While there are still many knowledge gaps in regard to their conservation status, it has been established that agriculture through land-use change and intensification, the use of plant protection products, and other activities rep-resents a key pressure on these two groups. The herpetofauna also faces numerous other threats, such as traffic, urbanization, species trafficking, invasive alien species, changes in water regimes, and climate change (European Environment Agency, 2020). 35 % of aquatic amphibian recorded locations and 28 % of reptile recorded locations in Slovenia were found on agricultural land (Zamolo et al., in print). Agriculture can support the conservation of these species through nature-friendly practices, with farmers playing a key role (Pe'er et al., 2014). Farmers may differ in their motivations for implementing conservation practices, for example some are driven by economic incentives such as scheme payments, others by moral concerns, or by various other factors and combinations thereof (Raymond et al., 2016). Research shows that motivations and attitudes influence farmer's willingness to participate in Agri-Environmental Schemes (AES) (Greiner & Gregg, 2011; Greiner, 2015). Identifying what motivates farmers to adopt nature-friendly practices that are beneficial for herpetofauna helps tailor conservation strategies and could help design new schemes in Common Agricultural Policy (CAP) (de Snoo et al., 2013; Propper et al., 2020).

Self-Determination Theory (SDT) is a well-established framework for understanding human motivation, emphasizing a continuum from controlled to autonomous regulation of behaviour (Ryan & Deci, 2000; Deci et al., 2017). While intrinsic motivation reflects a natural tendency to explore and engage with the world out of interest, extrinsic motivation stems from external rewards or pressures, and amotivation represents a lack of intent. The degree of internalization varies across four types of extrinsic regulation – external, introjected, identified, and integrated – with the latter two considered more autonomous. Higher internalization, especially intrinsic, identified, and integrated motivation, is linked to greater well-being, persistence, and creativity, particularly when basic psychological needs (autonomy, competence, relatedness) are met. Though widely used, SDT is relatively new to environmental psychology (Cooke et al., 2016). Studies suggest that autonomous motivation is the one that promotes intention for pro-environmental behaviour (Aviste & Niemiec, 2023; Barszcz et al., 2023; Cooke et al., 2016), and in agriculture, Zhu & Chen (2024) found that internalized motivation encouraged the adoption of low-carbon production, except for integrated regulation, which had a weaker effect. Another important factor in studies of environmental behaviour is nature connectedness, which is grounded in the biophilia hypothesis (Wilson, 2007). This hypothesis suggests that humans have an innate tendency to seek connection with nature. However, individuals differ in how strongly they experience this connection, which may help explain variations in pro-environmental behaviour (Mayer & Frantz, 2004). Nature connectedness can also be seen as a way of fulfilling the SDT need for relatedness (Weinstein et al., 2009). We designed a theoretical framework (Fig 1) that proposes that both extrinsic and intrinsic motivation influence farmers' intention for conservation behaviour, with nature connectedness influencing intrinsic motivation directly and indirectly via positive attitudes.

METHODS

The study was conducted through surveys with farmers in two project regions: NE (Pomurje) and Central Slovenia. The survey followed a structured questionnaire consisting of six sections. The first section introduced the research purpose and ethical considerations, after which consent and farm identification number were obtained. The second

section assessed participants' knowledge and attitudes toward selected amphibian and reptile species using species identification tasks and Likert-scale evaluations of how comfortable they are when they encounter the given species. Questions on ecological knowledge and attitudes were adapted from Ríos-Orjuela et al. (2020) and Ghosh & Basu (2022). In the third section, farmers reported their implementation of 12 herpetofauna-friendly practices (such as hedgerows, ponds, compost piles, reduced use of pesticides). Motivations for these practices were assessed in the fifth section based on Self-Determination Theory. Scales adapted from Pelletier et al. (1998) and Zhu & Chen (2024) measured intrinsic motivation, amotivation, and various types of extrinsic regulation. Each construct included a set of statements (e.g., "I engage in herpetofauna-friendly practices because they help preserve the character of my local area"), rated on a 7-point Likert scale from "Does not apply at all" (1) to "Fully applies" (7). Nature connectedness was measured using the 11-item Commitment to Nature Scale (Davis et al., 2009). Numerous scales for measuring nature connectedness have been developed and compared (Tiscareno-Osorno et al., 2023), including the Commitment to Nature Scale. We selected this scale over others because it is relatively short and includes items that we considered more accessible and understandable for the farmers. The scale reflects a broader, general sense of emotional and attitudinal affiliation with nature, as opposed to the attitudes measured in our study, which were focused on herpetofauna. The final section gathered demographic and farm-related information.
Data was collected between April and June 2024. Surveys were conducted on-site at advisory offices following farm subsidy consultations. A total of 231 farmers from each region participated (462 farmers in total). While farms in our sample did not differ significantly in size when compared to the whole population of farmers in both areas, they on average had younger managers and had higher rates of enrolment in agri-environmental schemes.

Table 1: Socio-demographic characteristics of farmers in the sample and the total population (means and standard deviations (SD) are calculated, except where number and proportion (%) are indicated).

	Sample	**Population**	**p-value**
Number of farms (n)	462	8686	
Average age	56.69 (12.90)	63.80 (14.2)	**<0.001**
Average farm intensity	0.87 (1.05)	0.89 (10.2)	0.893
Average farm size (ha)	13.38 (17.38)	13.35 (79.3)	0.981
Gender (M)	327 (72.2 %)	5950 (70.3 %)	0.722
Livestock farms	273 (59.3 %)	5918 (58.1 %)	**<0.001**
Enrolment in AES	157 (34.7 %)	1794 (20.7 %)	**<0.001**
Enrolment in Eco	38 (8.3 %)	403 (4.6 %)	**<0.001**

We first screened the data and excluded respondents with more than 10 % missing values (9 participants). All non-normally distributed variables (attitudes, motivations, and nature connectedness) were transformed using the Box-Cox method. Remaining missing values were imputed using classification and regression trees. To create a measure of farmers' nature-friendly behaviour, we calculated the average number of points they reached in the questions on their practices that were measured on a scale from 1 to 3. For other constructs, we applied factor analysis to reduce dimensionality. Confirmatory factor analysis (CFA) was used for motivation types and nature connectedness, as these are established constructs (Kline, 2023). Exploratory factor analysis (EFA) was used for attitudes toward herpetofauna, where dimensionality was not pre-defined (Fabrigar & Wegener, 2011). To test the theoretical model (Fig 1), we employed Structural Equation Modelling (SEM), a multivariate technique that combines factor and path analysis to evaluate relationships among observed variables and latent constructs (Kline, 2023). SEM allowed us to assess both measurement models and structural paths, providing insight into how attitudes, motivations, and contextual factors influence the intention of conservation behaviour.

RESULTS

Implementation rates of nature-friendly practices on Slovenian farms varied significantly between practice types. While 83 % and 80 % of farms do not use plant protection products along the borders and in the garden, only 3 % have two or more fishless ponds. In addition to not using plant protection products, most farmers reported working exclusively during daylight hours. Although this question was not asked in the context of conservation, such timing along with being attentive to amphibians on the road may have implications for amphibian safety during migration periods. The practices that most farmers partially or occasionally implement include compost piles and the non-use of rodenticides. The presence of grassland strips and hedgerows and their management so that shrub undergrowth remains is more common than not having any. The presence of small structural elements such as piles of wood and rocks, grassland strips along hedgerows and fishless ponds are never implemented by most farmers (Table 2).
We analysed farmers' motivations using confirmatory factor analysis (CFA). Due to poor model fit, several items with low factor loadings were removed. The construct of amotivation showed low discriminant validity due to high negative correlations, especially with introjected regulation, and was therefore excluded from further analysis. With the exception of external regulation (M = 3.6, SD = 1.56), farmers showed high levels of autonomous motivation (intrinsic: M = 5.51, SD = 1.32; integrated: M = 5.63, SD = 1.49; identified: M = 5.56, SD = 1.32; introjected: M = 5.25, SD = 1.51). All standardized factor loadings in the measurement models (with and without the additional constructs: connectedness to nature and attitudes toward amphibians and reptiles, excluding snakes) were significant and above the recommended 0.60 threshold, with two exceptions still above 0.40. Convergent and discriminant validity were satisfactory, and both models showed good fit (Fig 1, Table 3).

Table 2: Frequency of implementation of herpetofauna conservation practices on the surveyed farms (n=462).

	Never/nowhere	Sometimes/somewhere	Always/everywhere
No usage of pesticides in the garden	6 %	15 %	80 %
No usage of pesticides near hedgerows	7 %	10 %	83 %
Working only during the day	7 %	14 %	79 %
Attention at animals on roads	5 %	23 %	72 %
Compost piles*	35 %	51 %	14 %
No usage of rodenticides	20 %	42 %	37 %
Maintaining hedgerows	39 %	30 %	31 %
Maintaining hedgerow undergrowth	46 %	31 %	23 %
Grassland strip	48 %	27 %	25 %
Piles of wood and rocks*	71 %	17 %	13 %
Grassland strip along hedgerows	51 %	27 %	22 %
Fishless ponds*	85 %	12 %	3 %

** In the case of compost piles, piles of wood and rocks and fishless ponds, the response categories for frequency were: "None", "One", and "Two or more".*

The first structural model showed good fit (χ^2 = 345.8, CFI = 0.946, TLI = 0.930, RMSEA = 0.071, SRMR = 0.069). Integrated regulation was the only significant positive predictor of conservation practices (Table 4). The second model, extended to include connectedness to nature and attitudes toward amphibians and lizards as predictors of intrinsic motivation (including a mediation effect), also fit well (χ^2 = 1641.0, $p < 0.001$, CFI = 0.910, TLI = 0.900, RMSEA = 0.065, SRMR = 0.091). Both intrinsic and integrated regulation significantly predicted conservation practices, with integrated regulation being twice as influential. Intrinsic motivation was positively influenced by both attitudes and nature connectedness, the latter having a four times stronger effect. Nature connectedness also had a positive effect on attitudes, through which it indirectly affected intrinsic regulation.

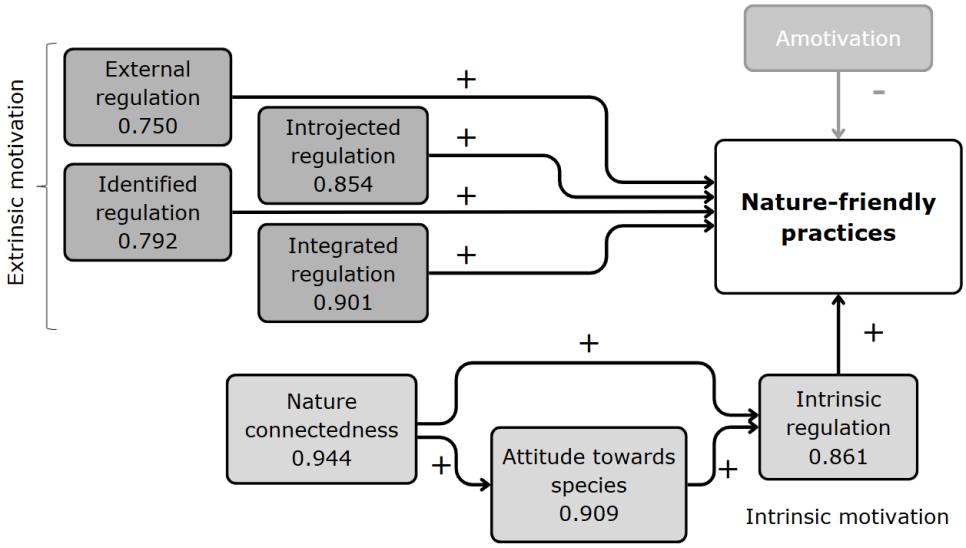

Figure 1: The theoretical framework developed for the study (Mayer & Frantz, 2004; Ryan & Deci, 2000; Weinstein et al., 2009; Zhu & Chen, 2024). The plus and minus signs indicate the expected polarity (negative/positive) of the effect. Composite reliability is written inside each construct. Amotivation showed low discriminant validity due to high negative correlations and was therefore excluded from further analysis.

Table 3: Discriminant validity of the latent constructs.

	Intrinsic	Nature connectedness	Attitudes	External	Introjected	Identified	Integrated
Intrinsic	0.78						
Nature connectedness	0.66	0.81					
Attitudes	0.30	0.25	0.79				
External	0.03	0.05	0.01	0.66			
Introjected	0.45	0.69	0.17	0.30	0.81		
Identified	0.44	0.66	0.17	0.24	0.73	0.74	
Integrated	0.38	0.58	0.14	0.03	0.64	0.57	0.87

Table 4: Results of structural model (regression paths) for the standard and extended model.

		Standard model			**Extended model**		
Dependent variable	Independent variable	coefficient	SE	p-value	coefficient	SE	p-value
Practices	External regulation	-0.01	0.02	0.369	-0.02	0.02	0.321
Practices	Introjected regulation	0.05	0.03	0.121	0.04	0.03	0.094
Practices	Identified regulation	-0.01	0.02	0.658	-0.01	0.02	0.637
Practices	Integrated regulation	0.07	0.03	**0.008**	0.06	0.02	**0.001**
Practices	Intrinsic regulation	0.02	0.04	0.496	0.03	0.01	**0.003**
Intrinsic regulation	Attitudes				0.20	0.06	**0.000**
Intrinsic regulation	Nature connectedness				0.84	0.08	**0.000**
Attitudes	Nature connectedness				0.26	0.05	**0.000**

Discussion

The results highlight that conservation behaviour among farmers in cultural landscapes is primarily driven by more autonomous forms of motivation—particularly integrated regulation and, to a lesser extent, intrinsic motivation. The current implementation of practices on Slovenian farms strongly depends on the complexity of the practice. Overall, farmers are partially driven by enjoyment and care for nature, but more strongly by external factors such as tradition and identity. This suggests that conservation practices are not merely seen as external obligations but are also often perceived as part of farmers' values and self-identity. External forms of motivation did not significantly predict conservation behaviour, which is in line with literature that states that farmers often see themselves as stewards of the land (Raymond et al., 2016), rather than as actors responding to external pressures or rewards.

The strong mediating role of nature connectedness and attitudes towards amphibians and lizards provides an important addition to motivational models. These findings suggest that affective and relational ties to nature may be critical in fostering deeper forms of motivation. Nature connectedness in particular emerged as a powerful driver, influencing not only attitudes but also motivation (Mayer & Frantz, 2004). Intrinsic motivation is fostered when three basic psychological needs are met: relatedness, autonomy, and competence (Ryan & Deci, 2019). Increasing intrinsic motivation – for example, through relationship-building – may help encourage the adoption of new practices.

From a practical standpoint, these insights imply that policies aiming to promote conservation in cultural landscapes should not rely solely on economic incentives, that could either increase or decrease motivations (de Snoo et al., 2013), but should also consider strengthening farmers' emotional and identity-based connections with nature. Environmental education, community-based conservation programs, and participatory approaches that validate local knowledge and identity may help reinforce these internal drivers (Admiraal et al., 2017; Šumrada et al., 2021; Zhu & Chen, 2024).

To conclude, farmers' implementation of nature-friendly practices such as hedgerows, ponds, and grassland strips appears to be primarily driven by autonomous motivation – both intrinsic and identified motivation – rather than by external rewards or pressure. Strengthening connections to nature and positive attitudes toward biodiversity may therefore support long-term conservation behaviour in cultural landscapes.

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