Environmental sustainability: farmers’ views of housing systems for cattle

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ABSTRACT
In the establishment and maintenance of a housing system for cattle by farmers, their perception of housing systems plays an important role in their decision to choose the environmentally sustainable housing system. The aim of this study was to determine farmers’ attitudes towards their role, environmental sustainability, and perceived government support, to determine whether the role of cattle farmers influences their perceptions of different cattle housing systems, and to create a typology of cattle farmers based on these attitudes. The paper was based on online surveys (n = 306) and five focus groups with Slovenian cattle farmers (n = 42). Results show that the majority of participants placed a higher value on production than on the environment, but had adopted animal and environmentally friendly housing systems to achieve higher production and profits and to receive full direct payments. Four groups of cattle farmers based on the attitudes towards their role, environmental sustainability, and perceived governmental support were identified: Productivists, Traditionalists, Abandoners, and Environmentalists. Most respondents belonged to the Productivist group, who believed that environmental measures have a negative impact on agricultural development. A characteristic of the smaller Traditionalist group is that these farmers claimed to have an obligation to preserve or improve the environment for future generations. For Environmentalists, environmentally friendly agriculture is most important. The smallest group identified consists of farmers who indicated their role as a farmer was not important because they were likely to give up farming. Systematically planned communication aimed at different groups of farmers is needed to promote acceptance of changes in housing systems for cattle that reduce the greenhouse effect.

HIGHLIGHTS
- The majority of farmers placed a higher value on production than on the environment.
- They had adopted animal and environmentally friendly housing systems to achieve higher production and profits and to receive full direct payments.
- There were four groups of cattle farmers: Productivists, Traditionalists, Abandoners, and Environmentalists.

Introduction

The housing system for cattle is a key element of the farm as it influences sustainable agricultural production (Galama et al. 2020), i.e., ‘production which fulfills food security, environmental protection, and economic and social needs in rural areas’ (FAO 2016). Farmers play a crucial role in establishing and maintaining a housing system for cattle by trying to strike the optimal balance between ensuring good quality milk and meat, protecting the environment and ecosystem services, and considering animal priorities (animal well-being) (Kielbasa et al. 2018). This makes it important to know how they perceive the importance and the key attributes of housing systems for cattle.

Based on previous studies, Galama and his colleagues (2020) presented the development of a dairy cattle housing system from tie-stall barns (TS), which prevailed and remained in use until the 1970s, and has increasingly been replaced by cubicle housing systems (cubicle barn, CB), also called freestall barns, and a freewalk housing system without cubicles (FW) (e.g., the composting bedding system), which is gaining in popularity. The TS system is not ideal for work efficiency and animal welfare because of the lack of free movement, the limited space (m²) per cow, and the higher risk for teat and leg injuries (Galama et al. 2020). The development of milking parlour systems and other innovations, and easy separation of
lactating groups of cows are all factors that encourage the introduction of CBs. The need for cow comfort has been addressed through innovations, such as mattresses in the cubicle stalls, the use of deep sand, straw, and solid manure as bedding, innovative cubicle partitions (rigid vs. flexible) that reduce cow injuries, open sides of barns; curtains to regulate ventilation, higher and insulated roofs, and wider walking areas. Therefore, FW, especially compost-bedded pack barns (CBPs), has recently become of interest worldwide (Bewley et al. 2017; Beaver et al. 2020). The compost-bedded pack, a mixture of organic bedding and cattle excreta, is cultivated once or twice a day to incorporate fresh manure into the top layer of the organic pack and to bring air into the pack to stimulate an aerobic composting process. Studies show this housing system improves the comfort of animals while resting, and leads to better hoof and leg health and more natural animal behaviour than in conventional systems, such as CBs (Klopcic et al. 2021). A new development in FW housing is barns with permeable artificial floors which is still experimental. The working principle of the floor is based on the immediate separation of animal waste by several layers. On top is a special drainage fabric that lets urine pass through and keeps faeces above the floor (Ferraz et al. 2020; Galama et al. 2020). According to preliminary results, CBPs and FW barns with an artificial floor can reduce emissions of greenhouse gases and ammonia (Ferraz et al. 2020; Galama et al. 2020; Klopcic et al. 2021).

This study assumes that farmers hold no single view on the housing system for cattle. In fact, while farmers are attributed with different perceptions of environmental aspects and farm management production practices, the commercial available expansion strategies and practices tend to neglect the diversity of farmers (Vancay and Lawrence 1994). For example, one of the few studies on the perception, understanding, and use of sustainable nutrient management on the farm generally revealed differences in the introduction of sustainable food management in housing based on age, education, and education of farmers and the perceived expected profitability related to compliance with EU regulations (Kielbasa et al. 2018). In many cases, older farmers had adopted an intuitive approach to the problem of sustainable nutrient management, while younger and better-educated farmers had mainly focussed on short-term profits, but were willing to introduce changes and innovations if they anticipated positive income results from compliance with EU regulations. The results of this study are consistent with the findings of studies (Edwards-Jones 2006) showing that farmers do not change their behaviour by adopting more environmentally-oriented practices based strictly on economic principles, but principally on EU measures and rules.

A European study on farmers’ willingness to participate in animal welfare schemes and implement stricter animal welfare regulations (Bock and van Huik 2007) identified two groups of farmers according to the perception and importance of animal welfare: One group considered animal welfare important for its impact on animal production performance and thus on economic results; the second group, which participates in organic or specific animal welfare schemes, defined animal welfare in terms of the animals’ ability to express their natural behaviour and concentrated on the notion of freedom and comfort of animals. A study by Hyland et al. (2016) established that farmers’ self-identity influenced their willingness to implement environmental measures. Four types of Welsh beef/sheep farmers were identified. ‘The Productivist’ and ‘The Countryside Steward’ represent low awareness of climate change but vary in their motivation to adopt environment-friendly behaviour. Conversely, both ‘The Environmentalist’ and ‘The Dejected’ score points for increased environmental awareness. However, only ‘The Environmentalist’, who defined themselves as such and was the highest educated among the four clusters, also embodies a strong sense of responsibility for the environment. Given that farmers’ perceptions also differ according to conceptual, practical, and information barriers (Fleming and Vanclay 2010), it is important to understand farmers’ self-identity, their awareness/responsibility for an environmental issue, and their perception of external pressures to tailor initiatives to improve farming systems.

Since existing studies on cattle housing systems have usually neglected the farmers’ perceptions of housing systems, there is a particular need to investigate how housing systems are viewed by cattle farmers, especially in the context of environmental sustainability. Notwithstanding the growing professional interest in the perception of housing systems for cattle and the literature, most empirical research is based on qualitative studies (e.g. Drangert et al. 2017; Kielbasa et al. 2018; Beaver et al. 2019, 2020; Cardoso et al. 2019; Galama et al. 2020; Leso et al. 2020). A combination of quantitative and qualitative research and data in studying farmers’ perceptions allows for a holistic picture. Qualitative research offers a deep insight into farmers’ perceptions and the quantitative method offers a wide scope for obtaining results. Using a combination of qualitative and quantitative
data ensures that the limitations of one type of data are balanced by the strengths of the other (Creswell and Plano Clark 2011).

Slovenia is a typical Central Eastern European country with a tradition of small family farms, like in Poland, Croatia, Bulgaria, Romania, and other Balkan countries, because before 1991 the land maximum was 10 ha, which prevented the increase of family farms as seen in Western Europe. More than half of all dairy farms (from all 5,584 dairy farms) have TS barns and need to change their cattle housing system by 2028, according to the European Commission forecast (European Commission 2020).

To comprehensively understand the perception of housing systems for cattle in a European country, this study aimed to fill the research gap on farmers’ perceptions of housing systems by combining qualitative and quantitative approaches to (1) identify Slovenian farmers’ perception of farming/housing systems for cattle in terms of environmental sustainability; (2) determine their attitudes towards their role, environmental sustainability and perceived governmental support; (3) assess if the role of cattle farmers influence their perception of different cattle housing systems; (4) create a typology of Slovenian cattle farmers based on these attitudes. We hypothesise that the role of Slovenian cattle farmers is associated with their perception of different cattle housing systems.

The next section presents the mixed methods used in the study. This is followed by a presentation of the results, first, the results of a survey, followed by the results of the focus groups. The discussion explains the results in relation to existing studies and the situation in agriculture, and the Conclusion highlights the manuscript’s contributions to science and the study’s limitations.

Materials and methods

We used mixed methods because mixing quantitative and qualitative data within a single study allows for more complete and synergistic use of data than collecting and analysing quantitative and qualitative data separately (Creswell and Plano Clark 2011). A combination of an online survey, which provides generalised results, and online focus groups, which provide a deeper insight into participants’ views, was used.

Quantitative research

An online self-administrative questionnaire was relied on to establish how cattle farmers assess different housing systems for cows and young stock, how the role of cattle farmers is related to their assessment of the housing system, and to create a typology of Slovenian cattle farmers based on the attitudes towards their role, environmental sustainability and perceived governmental support attitude and assessment of the housing system.

An invitation with a link to the online survey was sent by e-mail on 1 November 2020 to all cattle-breeding associations and groups of cattle breeders (~1000 e-mail addresses) and via a social network (Facebook) to various groups of cattle breeders in Slovenia. Additional potential participants were also invited by the Chamber of Agriculture and Forestry of Slovenia, the main organisation for Slovenian farmers. The survey was active for 14 days and potential respondents were twice invited to participate.

The survey was completed by 306 respondents, 71.57% of whom were dairy farmers while 28.43% were suckler cow farmers. In terms of gender, 24.8% of the respondents were female and 75.2% were male. Their age ranged from 20 to 70 years (mean 41.4 years). Up to 66.6% of the respondents had completed secondary school, 22.5% held a university degree (bachelor’s degree), and 5.7% had a postgraduate degree (Master’s and Doctoral degrees). The majority of respondents worked in the conventional way of farming (defined as not in an organic way) and 19.3% of respondents were practicing an organic farming system. The majority of cattle farms (45.8%) cultivated 21–50 ha of agricultural land. In other words, on average the interviewed farmers had a total agricultural area of 32.41 ha. Most of the cattle farms managed 21–50 dairy or suckler cows (37.3%) and 11–20 dairy or suckler cows (36.3%). On average, the cattle farmers reared 44.61 cows. More than 50% of the farms use CBs, 47.1% TS, and 2.6% of the CBP Barn and other innovative barns with an artificial floor representing the farmers and farming situation in Slovenia (Breeding and milking systems on farms 2021).

The 23-item questionnaire was based on previous studies on housing systems (e.g. Sulemana and James 2014; Clark et al. 2016; Kühl, et al. 2019; Bournaris 2020; Haupt et al. 2021), on farmers’ perceptions of climate change (Hyland et al. 2016) and preliminary focus group results. The first part addressed how the different housing systems were assessed with regard to environmental sustainability. We used the model of livestock housing assessment by Kühl, et al. (2019) and manure management (Haupt et al. 2021) to create the assessment of housing systems. Respondents evaluated three housing systems (TS, BS, CBPs, FW with
artificial floor) by indicating statements on well-being, comfort, greenhouse gas emissions, and environmental aspects (see Table 1) on a 5-point Likert scale (from 1—absolutely appropriate to 5—absolutely inappropriate). This was followed by an assessment of statements about the respondent farmer’s identity (four statements on the farmer’s role and four statements on environmental responsibility) (Sulemana and James 2014) and four statements about the government support (on national and EU levels) for farmers (see Table 2) according to Bouranaris (2020), which were assessed by the respondents on a 5-point Likert scale (from 1—from strongly disagree to 5—strongly agree). The second part contained questions about the respondent’s level of education, age (as a continuous variable) and gender, the number of dairy cows, the land size in ha, and the housing system for different categories of cattle.

A pre-test was conducted with housing system experts and cattle farmers (N = 50) and Cronbach’s coefficient α was used to calculate the internal consistency coefficients of the questionnaire items. Results of the reliability analysis revealed the items held satisfactory discriminatory power in the scales of identity, awareness, and willingness to accept environmental measures given that α exceeded 0.75 for all items.

In addition to the basic descriptive analysis, Spearman’s correlation coefficient was calculated between attitudinal statements and the assessment of cattle housing systems with regard to environmental sustainability. Cluster analysis was used to group farmers in such a way that the farmers in one group were more similar to those in other groups (clusters) in terms of their perception of their role, environmental responsibility, and perceived government support. Since the main clustering methods (Ward’s method and the K-means method) are complementary because they optimise the same criteria function when using the Euclidean distance square (Everitt et al. 2011), we first used Ward’s method with a dendrogram to determine the most meaningful number of groups, and then the K-means method because the K-means algorithm requires that the number of clusters—k—be determined in advance. The dendrogram—a diagram

### Table 1. Spearman’s correlation between attitudinal statements and assessment of the housing systems in terms of environmental sustainability (n = 306).

| Attitudinal statements                                                                 | Housing systems |
|---------------------------------------------------------------------------------------|-----------------|
| As a farmer, production is the most important for me.                                  | 0.21            |
| As a farmer, I have an obligation to preserve or improve the environment for future generations. | 0.20**          |
| As a farmer, the most important for me is to farm in an environmentally-friendly way. | 0.26*           |
| My role as a farmer is not important as I will probably give up farming.              | 0.31            |
| Livestock farming contributes to climate change.                                      | 0.08            |
| The impact of livestock farming on climate change is neutral.                        | 0.05            |
| Environmental regulations are important for future farming.                          | 0.01            |
| Environmental measures have a negative impact on the development of agriculture.     | 0.06            |
| The government should financially support organic farming.                            | 0.08            |
| The government should financially support the market production of milk.              | 0.02            |
| The government should financially support Slovenian milk production and processing and limit imports of agricultural products. | 0.05            |
| The state should additionally support farming in mountain areas.                     | 0.09            |

Note: Spearman’s correlation significant at 0.01(**), 0.05(*)

### Table 2. Respondents’ attitude to their role, environmental responsibility and governmental measures (n = 306).

| Attitudinal statements                                                                 | Strongly disagree | Disagree | Unsure | Agree | Strongly agree |
|---------------------------------------------------------------------------------------|-------------------|----------|--------|-------|----------------|
| Role of the farmer                                                                   |                   |          |        |       |                |
| As a farmer, production is the most important for me.                                  | 0.0               | 2.0      | 1.6    | 35.0  | 61.4           |
| As a farmer, I have an obligation to preserve or improve the environment for future generations. | 1.0               | 3.6      | 3.9    | 29.1  | 62.4           |
| As a farmer, the most important for me is to farm in an environmentally-friendly way. | 1.3               | 2.0      | 8.2    | 39.5  | 49.0           |
| My role as a farmer is not important as I will probably give up farming.              | 10.1              | 24.8     | 20.6   | 25.8  | 18.6           |
| Environmental responsibility                                                          |                   |          |        |       |                |
| Livestock farming contributes to climate change.                                      | 25.8              | 29.7     | 25.8   | 17.0  | 1.6            |
| The impact of livestock farming on climate change is neutral.                        | 3.9               | 17.6     | 17.1   | 39.1  | 22.2           |
| Environmental regulations are important for future farming.                          | 0.0               | 9.8      | 18.6   | 44.1  | 27.5           |
| Environmental measures have a negative impact on the development of agriculture.     | 4.2               | 11.4     | 24.5   | 32.0  | 27.8           |
| Perceived governmental support                                                       |                   |          |        |       |                |
| The government should financially support farmers in adapting an environmentally friendly housing system. | 3.9               | 4.9      | 9.2    | 34.3  | 47.7           |
| The government should financially support organic farming.                           | 12.7              | 9.8      | 17     | 21.6  | 38.8           |
| The government should financially support the market production of milk.              | 1.0               | 3.3      | 8.2    | 29.1  | 58.5           |
| The government should financially support Slovenian milk production and processing and limit imports of agricultural products. | 1.6               | 2.3      | 3.6    | 14.7  | 77.8           |
| The state should support farming in mountain areas.                                   | 1.6               | 1.6      | 6.9    | 15.7  | 74.2           |
showing the hierarchical relationship between the items—was primarily used to verify the number of groups identified according to the preliminary focus group results, i.e. four clusters. In the second step, we used k-means clustering, which is a method of vector quantisation, originally from signal processing that aims to partition $n$ observations into $k$ clusters in which each observation belongs to the cluster with the nearest mean (cluster centres or cluster centroid), serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. K-means clustering minimises within-cluster variances (squared Euclidean distances). The data were coded and analysed using SPSS 24.0.

### Qualitative research

To explore the results of the quantitative analysis, to determine the in-depth perception of the cattle housing systems and the farmers’ reasons for them...
agreed to implement environmental measures, we conducted guided discussion in focus groups. This data collection method is useful for obtaining perceptions, opinions, beliefs, and attitudes on a topic in an interactive group setting (Collis and Hussey 2013).

The snowball sampling method for research recruitment was used from a sample of farmers who had previously participated in the survey. The participants of the focus groups were representative of the main sampling frame, reflecting a diversity of age, education, farm types, and housing systems. The initial group of participants was contacted via the professional contacts of the research team. Participants were initially selected as representatives of cattle farmers of all farm types (from 7.5 to 110 ha, from 3 to 110 dairy or suckler cows), accounting for all housing system types (tied-in, cubicles, composting-bedding pack barns, or other innovative barns with an artificial floor). Farmers came from different age groups (22–65 years) and had different levels of education (primary and secondary school, higher education, master’s, and doctorate). The participants were 80% dairy cow farmers and 20% suckler cow (cows with calves) farmers. Five online focus group interviews, each with 8–9 participants (n = 42), were conducted online in autumn/winter 2020 due to the Covid-19 situation.

Based on the literature review (e.g. Drangert et al. 2017; Kielbasa et al. 2018; Beaver et al. 2019, 2020; Cardoso et al. 2019; Galama et al. 2020; Leso et al. 2020), the researchers developed the questions focusing on the following: (1) Determinants of the choice of farming systems; (2) Farmers’ role; (3) Environmental responsibility; (4) Governmental support; (5) Acceptance of environmental measures; and (6) Reasons for (not)accepting environmental measures. The focus group participants were shown various housing systems for cattle on a screen. The discussions lasted about 2 h, were recorded with the participants’ consent and transcribed, and all discussions were analysed by all three researchers.

The material was analysed as is usual in qualitative data analysis. After familiarisation, the double-coding transcript was used, where two researchers code the same data and discuss their initial differences. The inconsistencies were resolved by reviewing the full texts; a third coder reviewed more challenging discrepancies, which were then discussed with a member of the coding pair until consensus was reached. In the next step, we organised and grouped similarly coded data into categories according to sharing some characteristics. When the majority categories were compared with each other and consolidated in various ways, we developed coherent thematic or conceptual content. The last two phases were mapping and interpretation with the analysis of individual citations and the construction of a relationship between categories and their citations and the links between the data as a whole.

Survey results

Assessment of the housing systems

Figure 1 (multiple responses) shows that most of the cattle farmers rated grazing as the most appropriate farming system in terms of the environment (83.0%; \( \bar{X} = 4.30, SD = 1.02 \)), followed by an innovative barn with an artificial floor (64.7%, \( \bar{X} = 3.82, SD = 0.95 \)), a compost-bedded pack barn (64.4%, \( \bar{X} = 3.74, SD = 0.99 \)), a deep straw housing system (63.4%, \( \bar{X} = 3.64; SD = 0.99 \)), a deep straw housing system with deep litter (62.9%, \( \bar{X} = 3.47, SD = 1.02 \)), a loose housing system (freestall) with cubicles on a concrete floor (60.8%, \( \bar{X} = 3.12, SD = 0.98 \)), a loose housing system (freestall) with cubicles on a slatted floor (40.8%, \( \bar{X} = 3.12, SD = 0.98 \)).
Table 2 shows the majority of respondents (strongly) agreed that production is the most important for them (96.4%), that they have an obligation to preserve or improve the environment for future generations (91.5%) and that farming is environmentally-friendly (88.5%).

The majority of respondents did not (strongly) agree that livestock farming contributes to climate change (55.5%) while 61.3% believed (strongly) that the impact of livestock farming on climate change is neutral. Regarding environmental requirements, the majority of respondents believed that environmental requirements and measures are important for future agriculture (71.6%), but also agreed (strongly) that they are hindering or preventing the development of agriculture (59.8%).

Most farmers participating in the survey also agreed (strongly) with the statement that the government should financially support farmers in shifting over to an environmentally-friendly housing system (82.0%), organic farmers (60.4%), the market production of milk (92.5%) and production and processing of Slovenian milk, and should restrict imports of agricultural products (92.5%), and support farming in mountain areas (89.9%).

Table 1 shows that the analysis of the relationship between attitudes to environmental responsibility, perceived government support, and the assessment of housing systems for cattle in terms of environmental sustainability shows no correlation between these variables. There is a weak ($r_s = 0.26$), statistically significant relationship ($p = .001$) between the role of farmers and the housing systems assessment. Namely, farmers who rated grazing and innovative housing systems (in absolute terms) as appropriate also (strong) believed that the most important thing for them is to farm in an environment-friendly way. Farmers who rated grazing as appropriate (in absolute terms) also (strong) believed that they have an obligation to preserve or improve the environment for future generations.

### Emerging farm and farmer types

The results of the cluster analysis show that most members of the identified groups came from the Productivist group ($n = 59\%$). They argued that milk and meat production was the most important for them. As far as environmental responsibility is concerned, they believed that environmental measures have a negative impact on the development of agriculture. They also claimed that the government should financially support the market production of milk (see Table 3).

A characteristic of the smaller group of Traditionalists ($n = 29.6\%$) is that these farmers claimed to have an obligation to preserve or improve the environment for future generations. They believed that industry contributes more to environmental pollution than livestock farming. The Slovenian government was expected to provide financial support for Slovenian milk production and processing and to limit imports of agricultural products.

The most important thing for Environmentalists ($n = 7.3\%$) is environmentally-friendly agriculture. They share responsibility for the environment and claimed that livestock farming adds to climate change. They expect the government to financially support organic farming.

The smallest group identified ($n = 4.1\%$) consists of farmers who indicated their role as a farmer was not important because they were likely to give up farming. Therefore, we named them Abandoners. They claimed that environmental regulations are important for future agriculture. The state should give additional support to agriculture in mountain areas.

### Focus groups

**Productivists**

The majority of the participants were Productivists ($n = 20$), belonging to all generations (see Table 4). Most were large farmers who had completed secondary school. Their defining characteristic was their fundamental rejection of the environment as a value and their preference for economic values, manifest in the importance of large-scale milk and meat production and a short- and long-term profit orientation. They had implemented environmental measures in the housing system for cattle only due to economic interests, mainly because of the need to fulfill cross-compliance requirements to receive full direct payments. This explains why most stated that they feel like ‘modern slaves’ or ‘dogs on a leash’. A typical statement was made by 56-year-old Andrej, who has a dairy cow barn with cubicles:

> These marginalists [environmentalists] are too strong. ... To get some direct payments we have to subordinate ourselves to them. We are like dogs on a leash. ... For us, environmental measures are a major obstacle to farming. ... State subsidies should only be given to those who produce for the market. Not like these eco farmers who only sow and plough ...
The farmers have to produce, if they do not, Slovenia will import even more food, which is actually garbage from Europe.

As the above statement shows, this group of farmers labels environmentalists the enemies of agriculture. According to them, agriculture is not responsible for GHG; further, intensive agriculture is more environmentally friendly than extensive or organic agriculture in terms of the amount of GHG per unit of product (per kg of milk or beef), and the state should therefore support intensive agriculture even more.

Society should be grateful to us farmers, the farmers of agricultural land, and they should pay us for the consumption of GHG, because with the intensity of farming we radically improve the ability of the soil to grow plants, because these plants produce two, three times more oxygen than the best forest (Damjan, 61 years, barn with cubicles).

They mainly have free barns with cubicles because they believe that good animal welfare saves them the cost of treatment, the cows produce more milk, which leads to a higher income. Biodiversity is not important for them because what counts for them is high-quality feed for the cattle, which they want as much as possible. ‘We do not want biodiversity on the meadows, we want enough quality feed. We do not want weeds’, said Karmen, aged 45 years, who has a CB.

### Traditionalists

A characteristic of a smaller group \((n = 11)\) of participants is that they accept the environment as a value if this is consistent with their idea of traditional agriculture as protection of the countryside and Slovenian cultural heritage. Most of these participants are middle-aged or older farmers with lower education. For them, it is important to preserve the way of farming for posterity. In their opinion, traditional cattle farming systems, such as grazing or TS are the only environment- and animal-friendly ones, as already known by their ancestors. Although some even declare themselves ‘true’ organic/eco farmers because they farm traditionally, production is also important to them. Still, when environmental values, e.g. coexistence with nature, do not match their perception of tradition, they are not considered. For example, they want to shoot all predators (bears and wolves) since they threaten their traditional way of farming. They do not believe that they should adopt agriculture to coexist with predators. These farmers demanded greater support from the state for mountain farms and permission to shoot predators. Marko, a 54-year-old, who’s mainly has a pastoral-based system, stated:

The best thing for the cows, the environment and finances is to graze, graze, graze … No other housing system comes into question. … If we don’t shoot these beasts, we won’t be grazing here anymore. And then everything will grow over. My ancestors already knew that. It’s just now it is something that people in the cities imagine that they shouldn’t be shot. I work like my father does and like my children will also.

As the above statement shows, environmentalists are, in their view, city dwellers who do not understand farming and are inappropriately committed to animals that endanger their cows. In their view, environmental measures restrict agriculture and limit its operation. Agriculture is absolutely not to blame for GHG emissions. In their opinion, the impact of livestock farming on climate change is positive or neutral: ‘The effects are neutral because our plants consume all greenhouse gasses’ (Andrej, aged 37, who mainly has a pastoral-based system).

Moreover, they have patriotic or even nationalistic values as it is very important for them that imports of foreign agricultural products be restricted and that Slovenians consume Slovenian food: ‘The government should do more to encourage consumers to buy locally. This has now been shown to be very important during the coronavirus pandemic. Slovenians will have to eat Slovenian food’, argued 51-year-old Matjaž who has a barn with a TS, where from April to November the cows graze.

### Environmentalists

One characteristic of the Environmentalists is that the environment is very important for them, certainly more important than large-scale production and short-term profits. They are mainly middle-aged farmers \((n = 9)\) and are generally included in organic or similar environment-friendly schemes. They clearly recognise that agriculture is partly responsible for the production of GHG and call for stricter environmental measures as they believe that the state is doing too little for the environment and animal welfare. Matjaž, a 38-year-old, who has a pastoral-based system, stated:

As far as greenhouse gases are concerned, agriculture is of course partly responsible. The principle applies: the fewer there are, the better. If we smell them, it’s not good. It must be improved. I do not understand how it is still permitted in Slovenia to spread manure and slurry that is so scattered that it does not have to be worked into the soil. That is not the case elsewhere. This must change.

They call for the state to reward those farmers who offer an environment- and animal-friendly housing system: ‘I think the state should list the housing systems
and that those farms which have systems that are more environmentally- and animal-friendly should simply be financially rewarded’ (Toni, aged 38, organic cheese production with a compost-bedded pack barn).

These farmers introduce new environment- and animal-friendly innovative technologies into the housing system, such as a freewalk housing system, compost-bedded pack barns, or an artificial floor based on the immediate separation of animal waste, and advocate for the government to recognise that modern technology can also be sustainable, as 37-year-old Simon with a barn with an artificial floor argued: ‘The government needs to be told that modern technology, such as an artificial floor consisting of several layers to separate urine and faces, without stalls or cubicles and allowing the cows to move freely, is also as sustainable as grazing’.

**Abandoners**

An essential characteristic of this small group of participants (n = 2) is that they will be unable to practice agriculture in the future and will sooner or later give up livestock breeding or even farming. In principle, they support the environment as a value but are not interested in realising it because they have enough problems with the survival of their farm and cannot afford to comply with an environmental standard. Therefore, they only see environmental measures as an additional restriction. Their statements reveal that production is also important to them, e.g. they argued that governmental support for mountain farmers should be linked to production.

They are farmers of different ages, with small farms and labour-intensive farming systems (TS barn with grazing), and work on difficult terrain or in such a way that they cannot expand so as to bring them a good income. They look for solutions in a complementary activity. Tomaž, aged 27, who has a TS barn and uses a pasture in the summer, said:

I don’t know what will happen if we don’t find a complementary activity on the farm like agro-tourism. We cannot rely on an intensive farming system because it is too steep here. … Environmental measures up or down, I don’t care, we have to survive. This is only important know-how … Mountain farmers should receive an appropriate higher level of state support for the production than farmers on low land. It’s not the same whether you’re on the lowlands or on hills with steep slopes, where you have to cut the grass by hand with a scythe. That is not fair. I don’t know, but we’ll stop farming and the agricultural land will overgrow, and they’ll see how tourism works!

As the above statement shows, these farmers call for more support from the state for the management of mountain farms or support for the introduction of complementary activities, in the absence of which they will have to stop farming.

**Discussion**

The results show that most of the cattle farms manage CBs and TS barns and that only a small number of respondents rely on CBP. It is difficult to compare these findings with cattle farming systems in other countries because, as according to a European Commission report (2017), the farming and housing systems for dairy and suckler cows vary widely and there are no global statistics on housing systems of cattle in the EU. For most of the analysed cattle farmers, grazing and an innovative housing system for cattle were rated as (best) environmentally friendly and the least TS, which is consistent with other studies (Bewley et al. 2017; Beaver et al. 2019; Galama et al. 2020), although environmental data (ammonia emissions in the barn, ammonia emissions on land, GHG) on innovative housing systems, such as artificial floor are not yet known. Such a large proportion of the tied housing system is largely due to the historical fact that Slovenia established a maximum of 10 ha of agricultural land between the 1950s and 1991, which restricted farms from developing, including the modernisation of housing systems (van Berkum 2007). Another probable reason is that most of the cattle farms are located in areas with limited factors or difficult conditions for farming that makes large farms impossible. A third reason could be that agricultural land in Slovenia is very expensive or among the costliest in Europe, and that cattle farms depend mainly on renting agricultural land, which is very expensive (Ferraz et al. 2020). Up to 37% of Slovenian territory is covered by Natura 2000, which further hinders the development of farms since a large part of the land is located in water protection areas (ARSO 2020). A fourth reason could be that milk and meat prices in Slovenia are some of the lowest in Europe (EU prices 2020). The high prices for agricultural land, the lower prices for milk and meat, coupled with the often difficult conditions for farming and the farms’ smallness are certainly the biggest obstacles to the development of cattle and other farms.

Our hypothesis that the role of farmers is associated with how they perceive different housing systems for cattle was partially confirmed as a weak, statistically significant relationship was found between the
role of farmers and housing systems assessment. Namely, farmers who rated grazing and innovative housing systems as appropriate also agreed that the most important practice for them is to farm in an environmentally-friendly way. Farmers who rated grazing as appropriate also believed that they have an obligation to preserve or improve the environment for future generations. This is to be expected since this conservative position is supported most by farmers from hilly and mountain areas, where Slovenia has the greatest opportunities for grazing. The reason for the positive assessment of the practice of animals grazing on farms can also be attributed to the fact that maintaining active farming on mountain and hill farms is extremely important for Slovenia to maintain jobs and rural settlements in these areas, to preserve biodiversity, the cultivated landscape, which is valuable from the tourism point of view, preventing the growth of agricultural land, stopping erosion on the slopes, maintaining the landscape’s balance and preserving traditional products, such as PDO/PGI-products and the supply of high-quality animal and other agricultural products (van den Pol-van Dasselaar et al. 2020).

The results show that over half the participants are Productivists who attributed greater importance to production than to the environment, but had adopted environmental measures and introduced animal- and environment-friendly housing systems (CBs) with a view to achieving higher production and profits and receiving full direct payments. Since they are fundamentally opposed to environmental measures, they dislike or even hate environmental groups and also claim that environmental measures are negatively impacting the development of agriculture. They demand financial support from the government for the market production of milk. This is in line with studies that show that most EU farmers consider animal welfare and environmentally-friendly farming methods important due to their impact on animal production performance and thus on economic outcomes (Bock and van Huik 2007; Fleming and Vanclay 2010; Hyland et al. 2016; Kielbasa et al. 2018).

More than one-third of the participants are Traditionalists who recognise the environment as a value if environmental ideas are consistent with their idea of traditional agriculture as a way of protecting the countryside, maintaining a healthy landscape, and Slovenian cultural heritage. They regard preserving the way of farming for posterity as important, and see traditional farming as the only environment- and animal-friendly form of agriculture. They wrongly claimed that the impact of livestock farming on climate change is neutral. They have nationalist tendencies or ‘defensive localism’ (Winter 2003), demanding that the government financially support Slovenian milk production and processing and limit imports of agricultural products. This discourse also finds strong support among farmers in Hungary and Poland (Bilewicz 2020).

Less than 10% of all participants are Environmentalists, for whom the environment is very important, as also shown by their participation in eco/organic or similar environment-friendly EU and national schemes. They clearly recognise that agriculture is partly responsible for the production of greenhouse gasses and call for stricter environmental measures as they believe that the state is doing too little for the environment and animal welfare. These farmers have introduced new environment- and animal-friendly innovative technologies into the housing system for cattle and are calling on the government to acknowledge that modern technology can also be sustainable. This is in harmony with a previous study which shows that for this group environment and animal welfare are important values in themselves and that they are composed of higher educated and younger farmers (Bock and van Huik 2007; Fleming and Vanclay 2010; Hyland et al. 2016; Kielbasa et al. 2018).

We called the smallest group, which accounts for <5% of all farmers, the Abandoners as they will not be able to practice agriculture in the future and sooner or later will give up cattle breeding or even farming. In principle, they support the environment as a value but are not interested in realising it because they have enough problems already with the survival of their farm and cannot afford to comply with an environmental standard. Therefore, they simply see environmental measures as an additional constraint. They are farmers of various ages, with small farms and labour-intensive farming systems (TS barns), and work on difficult terrain or in such a way that they cannot expand so as to give them a better income. This is in line with figures showing that the number of agricultural holdings shrank by 3.4% between 2013 and 2016 (Stat.si 2016). The profession of farmer is the least respected profession in Slovenia. There are many reasons for the abandonment of farms, including small and fragmented land parcels, a poor age structure (the average age of owners is 56 years), the lack of useful knowledge, and the weak cooperation between farmers and the Agri-Food industry (Glavan et al. 2017). Moreover, other Slovenian (Analysis of the state of land use 2020) and some EU studies (Perpina Castillo et al. 2018) show a trend of the abandonment...
of agriculture as reflected in the decline of agricultural land. Another indicator of this is the increasing number of overgrown areas, which negatively impact preservation of the agricultural landscape’s biodiversity.

In general, one may argue that while there are differences between the Productivists, the Traditionalists, and the Abandoners in the acceptance of environmental measures and the arguments for introducing different housing systems for cattle, all three groups support production values. We, therefore, confirm the findings of studies that there are two major pro-environmental and productivist identities (Sulemana and James 2014), with one productivist identity dominating the decision-making process of farmers and still being legitimised by government policies (van der Ploeg 2020).

The analysis of the focus group statements also shows that the choice of housing systems according to the environmental measures implemented depends on the farmers’ attitudes and values. Since attitudes guide the activities of farmers, they are very important while forming ideas about housing systems for cattle. One key element of shaping attitudes is valued, understood as ideas that stand for something positive, something desirable, something represented (Krech et al. 1962). Therefore, the statements of the focus group participants show why values play an important role while forming opinions about the suitability of housing systems for cattle. While the brief overview showed that the Productivists seem to have implemented environmental measures and the introduced environment- and animal-friendly housing systems based on the value of the environment, the analysis of the focus group statements revealed that their activity is primarily based on a preference for the economic value of large-scale production and profit orientation. They considered that housing systems that allow for greater animal welfare and health also lead to higher production and profits, and the introduction of environmental measures so as to meet cross-compliance requirements to receive full direct payments. This is consistent with studies that reveal that most EU farmers are changing their perceptions and practices towards more environmentally-oriented activities, mainly due to the pressure coming from the EU’s measures and rules (Bock and van Huik 2007; Fleming and Vanclay 2010; Hyland et al. 2016; Kielbas et al. 2018).

The analysis showed that the conflicts between animal- and environment-friendly farming and conventional/production farming, which have usually been resolved or at least reduced by demonstrating the financial benefits that improved plant and animal health and animal welfare can bring to both society and the individual farmer, are very strong for most farmers. The analysis revealed farmers’ mostly negative attitudes to environmental measures and the persons/groups trying to implement them in agriculture. Some scientists even argue that the adoption of environmental values and measures in agriculture is one of the biggest challenges to modern agriculture in the EU (Erjavec and Erjavec 2020; van der Ploeg 2020).

To strengthen the adoption of measures to combat climate change, protect natural resources, and promote biodiversity, and internalise the environment as an important value in agriculture for farmers, greater attention must be paid to communication and information for farmers. To support the work of the agricultural advisory service, farmers’ associations, and individual farmers, a carefully planned communication campaign with different communication channels is needed, focussing on both short- and long-term goals and benefits, to take account of environmental values and measures. However, the theory of cognitive dissonance (Festinger 1962) argues that a person cannot perceive conflicting beliefs, ideas, or values as experienced mental stress if they participate in an action directed against one or more of them and that a person may have a limited capacity to decide on how many issues they consider relevant. It is therefore important that the Productivists’ readjustment to the environment is consistently gradual and perhaps only in a specific area since the environment is a very complex issue.

Since previous approaches have failed, it may be that according to the social learning theory (Bandura and Walters 1963), which states that learning is a cognitive process that occurs in a social context and with participation, a knowledge-transfer approach and intensive social interactions would be useful for the Productivists and Traditionalists, for example, discussions within a group of farmers. Yet, this would not be useful for the Abandoners given that their only concern is the preservation of the farm. Therefore, systematically planned communication aimed at different groups of farmers may help promote acceptance of the environment as a key value in agriculture and positive changes in housing systems for cattle that reduce GHG.

Conclusions

Although the study filled the research gap on farmers’ perceptions of housing systems by identifying farmers’ attitudes towards their role, environmental sustainability, and perceived government support, assessing
whether cattle farmers’ role influences their perceptions of different cattle housing systems and creating a typology of cattle farmers based on these attitudes has some limitations. The main limitation of the study is the exclusion of farmers who are poorly equipped and poorly informed digitally. Although we intended to conduct a survey by mail and live interviews, this was not possible due to the Covid-19 pandemic, as public life in Slovenia was almost completely closed. Future studies should also include these farmers.

Results show that the majority of participants placed a higher value on production than on the environment, but had adopted animal and environmentally friendly housing systems to achieve higher production and profits and to receive full direct payments. The perception of farmers’ role is associated with how they perceive different housing systems for cattle. Namely, farmers who rated grazing and innovative housing systems as appropriate also agreed that the most important practice for them is to farm in an environmentally-friendly way and they also believed that they have an obligation to preserve or improve the environment for future generations.

The cluster and focus group analysis identified four groups of participants: Productivists, Traditionalists, Abandoners, and Environmentalists. Most respondents belonged to the Productivist group ($n = 59\%$). They argued that milk and meat production were most important to them. They believed that environmental measures have a negative impact on agricultural development. A characteristic of the smaller Traditionalist group ($n = 29.6\%$) is that these farmers claimed to have an obligation to preserve or improve the environment for future generations. They believed that industry contributes more to pollution than livestock farming. For Environmentalists ($n = 7.3\%$), environmentally friendly agriculture is most important. They consider themselves responsible for the environment and claimed that livestock farming contributes to climate change. The smallest group identified ($n = 4.1\%$) consists of farmers who indicated their role as a farmer was not important because they were likely to give up farming. The results thus show that most cattle farmers are Productivists who prioritise production over the environment but adopt an animal- and environment-friendly housing systems (CBs) out of pragmatism.

Systematically planned communication aimed at different groups of farmers may help promote acceptance of the environment as a key value in agriculture and positive changes in housing systems for cattle that reduce GHG.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

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**Data availability statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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