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RESEARCH ARTICLE OPEN ACCESS

Understanding Among Societal Groups as a Prerequisite for Constructive Conflict Handling in Sustainable Land Use Change

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Correspondence: Judith-Maria Maruschke (judith.maruschke@posteo.de)**Received:** 28 March 2024 | **Revised:** 10 February 2025 | **Accepted:** 27 February 2025**Funding:** This work was supported by Bundesministerium für Bildung und Forschung, (033L211A).**Keywords:** cluster analysis/K-Means | environmental understanding | land use conflicts | multinomial logistic regression | SDG indicator | sustainable development | understanding profiles

ABSTRACT

Understanding the other's point of view is key to expanding sustainable agriculture beyond its current niche status in the context of climate change mitigation. This paper aims to identify societal groups based on their understanding of the agriculturally shaped environment and investigates associations between sociodemographic characteristics and understanding among these groups. The empirical data stem from a large-scale population survey in Western Pomerania, Germany, a prime example of a region with manifold land use conflicts. Cluster and regression analyses were applied. Three understanding profiles are identified: alienated from the agriculturally shaped environment, knowledge about sustainable land use, and conventional agriculture. Significant associations between sociodemographic characteristics and understanding profiles exist and are discussed, as well as the transformational potential between the understanding profiles. In conclusion, understanding profiles can serve as a basis for creating appropriate actions to overcome barriers to sustainable development and enable the transformative potential at the societal level.

1 | Introduction

Agriculture has been responsible for approximately 20% of global greenhouse gas emissions in 2018 and is a critical transformation field to achieve sustainable development and sustainable natural resource management by simultaneously addressing climate change and providing food for the global population (Kotykova et al. 2022; Marković et al. 2020; Wrzaszcz and Zieliński 2022; FAO 2020). As agriculture needs to contribute to and adapt to climate change, it is important to support sustainable agricultural niches or sub-regimes, thus establishing a new and more sustainable agricultural regime, as defined in the multilevel perspective (Geels 2002; Ingram et al. 2015; Löbmann et al. 2022). Regarding land use change, various perspectives, experiences, and knowledge exist among different groups in society (Azadi et al. 2017). These transformation processes often lead to land

use conflicts caused by changing framework conditions, such as political systems, economic crises, natural disasters, and climate change. Such conflicts can impede sustainable development, but they can also act as a catalyst for sustainable land use change (Izakovičová et al. 2018; Temper et al. 2018; Wehrmann 2008; Young et al. 2022).

In this context, a better understanding of the mutual points of view is expected to be a key for constructively promoting sustainable development (Maruschke et al. 2024; Emerson et al. 2009; Klinkosz et al. 2021). Addressing sustainable resolutions of land use conflicts at the regime level and making those involved more receptive to change is crucial. Thereby, society contains invisible power to change narratives and policy (Temper et al. 2018). Raising awareness among the broader public can increase the knowledge and skills of practitioners, land managers,

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policymakers, and society (Fraser 2019). Therefore, this study focuses on the societal level to make the current regime of conventional agriculture more compatible with sustainably oriented niches and promote sustainable development by capturing the understanding of the agriculturally shaped environment among different societal groups regarding land use change.

Research has shown that governance mechanisms are often inadequate to address the complexities of land use changes. This indicates that both policymakers and local communities may lack the necessary information to navigate these challenges effectively, leading to further confusion and conflict over land use (de Jong et al. 2021). Additionally, Wang and Zhang (2024) point out that while tangible economic and environmental conditions are important, the psychological states, knowledge levels, and social perceptions of groups significantly influence land use decisions. This suggests that many societal groups may lack critical knowledge about how these factors affect sustainable practices. The societal regulatory factor is one of the barriers to sustainable land use change (Azhar et al. 2024). Despite the importance of these aspects, there is still limited research on the different expressions of understanding dimensions with regard to sustainable land use among societal groups. In this paper, we are addressing this research gap by providing an information base for the example of Western Pomerania that could enable practitioners to derive appropriate measures to promote a sustainable land use change at the societal level.

The research aim is to gain information about societal groups regarding the understanding of the agriculturally shaped environment and relating it to societal niche and regime structures to detect potential conflict lines between these groups. The characterization of these groups is essential for providing a foundation for appropriate interventions for specific societal groups. Increasing the understanding among these groups is a potential way to overcome conflicts and integrate diverse perspectives to find appropriate solutions for a successful sustainable land use change. We do this with two research objectives: Firstly, we identify which groups of society exist concerning the understanding of the agriculturally shaped environment. Secondly, we examine associations between sociodemographic characteristics and understanding groups. This paper applies cluster and regression analysis and uses a multidimensional construct of understanding with emotional, cognitive, and opinion levels. The study area is Western Pomerania, a prime example of a rural region with current land use conflicts in which a large-scale population survey has been conducted that provides the data for this paper.

2 | Theory

2.1 | Niche and Regime—In the Context of a Change Toward Sustainable Agriculture

Progress toward the 2030 Agenda's goals is currently insufficient, and achieving them by 2030 seems unrealistic on a business-as-usual basis (FAO et al. 2020; United Nations 2019). Sustainable agriculture can directly contribute to achieving sustainable development, particularly SDG 2 (Malini et al. 2023; Muhie 2022). Progress in this field has been limited primarily due to poor implementation of novel approaches and practices

for sustainable agriculture. In this paper, the term “sustainable development” is utilized with a focus on climate change and the reduction of greenhouse gas emissions. Since agricultural land use accounts for a large proportion of greenhouse gas emissions, the focus lies on the need for sustainable land use change in agriculture as a prime example (FAO 2020).

Sustainable transformation is used here in the context of land use change and is oriented to the Multi-Level Perspective (MLP) (Geels 2011). The MLP provides a comprehensive approach to aligning various societal levels (regime, niche, and landscape) to facilitate transitions toward sustainability. This framework emphasizes the interplay between established practices and emerging innovations, highlighting the need for systemic change to address environmental challenges effectively.

The regime represents the currently dominating practices and often resists change among others due to established norms and economic interests, a lack of government support, consumer understanding, appreciation of the farming profession, information, as well as disconnection from nature, which can hinder sustainable land use practices (Abson et al. 2017; Laurett et al. 2021; Moore et al. 2014).

A change to a sustainable regime would directly or indirectly remove many of the barriers to sustainable agriculture. This is because a regime entails specific infrastructures, support policies, and complex configurations of artifacts, institutions, and actors (Ingram et al. 2015). For instance, mass-producing specific agricultural equipment for organic farming would reduce its cost and establish knowledge of its usage. This would minimize the required effort and increase recognition of the practices by society. Laws and regulations would also facilitate and encourage their implementation. In the context of sustainable land use change, the current agricultural regime is a conventional one, that is, with a focus on intensification, production potential (economies of scale), and commercialization (Ingram et al. 2015; Järnberg et al. 2018; Zegar and Wrzaszcz 2017). Associated agricultural practices such as the use of agrochemicals, soil nutrients, and growth hormones in livestock production have been shown to hinder sustainable development (Rukhsana and Alam 2022).

In contrast, a niche is the micro-level in the MLP representing a protected space where radical innovations can develop in response to pressures from the landscape, offering alternative solutions for sustainable land use (Deviney et al. 2023; Geels 2002).

While the organic farming sector continues to grow rapidly due to consumer demand and established market frameworks, sustainable farming remains a niche largely due to challenges in consumer awareness, market structure, economic barriers, and policy support (Järnberg et al. 2018; Santhoshkumar 2017).

Niche–regime interactions are further complicated by the involvement of various groups in society (e.g., stakeholders), who engage in learning processes that can either reinforce or challenge the existing regime and lead to conflicts (Costa et al. 2022).

The “landscape” represents a macro-level in the MLP model in which regimes and niches are embedded. It consists, for example, of external factors, such as climate change and social

movements, which create pressures that can catalyze shifts in the regime, promoting sustainable practices (Linnér 2019). Society has the invisible power to change the conventional agricultural regime (Temper et al. 2018). A regime is decisively created by social norms and thus society (Heiberg et al. 2022; Marković et al. 2020). It is a set of system states and is anchored in a dynamic “landscape” (Folke et al. 2010). To achieve sustainable change, it is necessary to address key elements such as beliefs, norms, values, practices, and rules, including procedures and laws, as well as the flow and distribution of resources, authority, and power within social systems (Moore et al. 2014). Civil society can influence and shape certain infrastructures, supporting policies and rules (Abson et al. 2017; Meadows 1999).

To achieve a sustainable transformation, it is important to have actors who are willing to engage in this transformation (Bogedain and Hamm 2020). To this end, it is necessary to raise awareness among the broader public in order to increase the knowledge and skills of practitioners, land managers, policy-makers, and society (Löbmann et al. 2022; Rieckmann 2018). Göpel (2016) acknowledged two individual levels in the MLP. One takes place at a meta-level through narratives, paradigms, and visions, and the mini-level means individuals who make up for institutions. This idea was expanded by environmental psychologists Wullenkord and Hamann (2021) by including, in an exemplary way, basic premises of the Self-Determination Theory and concepts related to the Self-Efficacy Theory. Individuals constantly shape the meta-level (e.g., narratives) (Göpel’s extended MLP) and thus contribute to a paradigm shift in the long term. The meta-level is influenced by individuals via the regime (social practice) (Wullenkord and Hamann 2021).

Land use conflicts play a significant role in the process of transforming the agricultural regime into a more sustainable one. They often arise in times of change. Studies emphasize the importance of identifying and mediating land use conflicts to achieve green development goals (Dong et al. 2023; Wang et al. 2022).

To drive sustainable development, sustainable agriculture must move beyond the niche (Šeremešić et al. 2021). Niches are more likely to succeed if they are compatible with existing regimes and not too distant (Ingram et al. 2015). For this reason, it is important to address the sustainable resolution of land use conflicts in the context of sustainable development at the regime level and to make it more receptive to sustainable change through appropriate interventions. Therefore, this paper follows the third form of niche–regime interaction identified by Smith (2007) in the food system: bringing the regime closer to the aims of the niche or vice versa. Thus, niche elements that are closer to the current regime (e.g., sustainable crop rotation, flowering strips) can be relatively easily adopted by the mainstream and can form a first step toward slightly more sustainable reforms (e.g., paludiculture, see Section 3.1).

2.2 | The Role of Different Groups in Society in Times of Change

Conflicts usually arise from different opinions or interests and underlying emotional aspects (fears, desires) where uncertainty is central (Stepanova et al. 2020; Wehrmann 2008; Zick and

Sandal-Önal 2023). In cases of land use conflicts, multiple actors with varying interests, knowledge, and values are typically involved, connected to a range of political and administrative contexts and levels (Stepanova et al. 2020). In this context, it is important to consider social polarization. This phenomenon can occur in various contexts, such as in relation to cultural or environmental issues or concerning the coronavirus pandemic (Borbáth et al. 2023; Hutter and Weisskircher 2022). Polarization is evident not only in electoral participation but also in non-electoral social movements and protests. In social polarization, the Social Identity Theory and therefore, the in-group–out-group phenomenon is essential (Hutter and Weisskircher 2022). Group conflicts are marked by the uncertainty of one group regarding the aims and values of another group (Zick and Sandal-Önal 2023). Mutual understanding might assist in solving conflicts by mitigating the distance between groups resulting from this uncertainty (Klimecki 2019).

Accordingly, society is relevant for the establishment of a sustainable regime. Different actors perceive the same land use conflict differently. Different groups, such as conventional farmers, environmental activists, researchers, and practitioners, hold varying experiences, knowledge, and opinions. Such actors can be any actor who is involved in land use as well as land use decision-makers. All these actors are part of society. Therefore, it is important to provide an information base for actors to implement measures that promote understanding among these groups. For example, environmental activists hold sustainable attitudes and some knowledge. Social movements such as Fridays For Future (FFF) and Extinction Rebellion (XR) advocate for listening to scientists but do not provide concrete sustainable solutions for policymakers (de Moor et al. 2021).

Kenis and Mathijs (2012) mention that there is no exception in environmental social movements with regard to the lack of coherence in knowledge and action (knowledge/attitude-behavior gap). Holton (2015) argues that leaders of change must be humble enough to recognize the needs of the current system. In this case, it is advisable to involve groups of people who have experience with impact-related behavior regarding environmental issues, such as farmers. Farmers have practical experience in agricultural strategies and are familiar with the root causes of the problems and challenges they face (Kenis and Mathijs 2012).

It means that nobody or no one group alone has the knowledge, experiences, and attitudes to create the best solutions for sustainable development. Despite the advantages of moral high ground in environmental protection, the dark side of this should be considered. Moral superiority can lead to deterioration into conflicts and discrimination due to the suppression of dialogue (Ide 2020). As called for by other scientists, we too argue that in order to find appropriate sustainable solutions, it is important to include several kinds of groups and use their different knowledge and experiences to handle complex challenges like climate change (Holton 2015). With a more cooperative attitude being a prerequisite and therefore openness to another point of view, the understanding of the agriculturally shaped environment needs to be increased by focusing on where there are shortcomings in terms of understanding within specific groups. This forces people to change their values and identities, making the system more open to change (Folke et al. 2010).

TABLE 1 | The four dimensions of the empirical understanding construct.

Understanding dimension	Meaning
Emotional dimension I (ed I)	General contact with the agriculturally shaped environment
Emotional dimension II (ed II)	A strong contact with agriculture
Cognitive dimension (cd)	Contextual knowledge about sustainable land use
Opinion dimension (od)	Conservative or conventional (profit-oriented) opinions related to agriculture

2.3 | A Multidimensional Construct of Understanding as a Key to Sustainable Transformation

Before a conflict can be resolved at the concrete level (e.g., by mediation, moderation, or arbitration), it can also be addressed at the level of the frame conditions of the conflict, that is, at the regime level. Here, as previously demonstrated, society is a crucial element. For conflict resolution, the conflict parties must have a cooperative attitude or a willingness to forgive. This can be achieved by understanding the interests and demands as well as the underlying feelings and emotions of all conflict parties (Wehrmann 2008).

Therefore, a multidimensional understanding of the agriculturally shaped environment was theoretically derived and empirically tested in a previous study, using Western Pomerania as an example region. The understanding construct focuses on the agriculturally shaped environment, recognizing the crucial role of agriculture in sustainable development. The construct has an emotional level that is about affective experiences, a cognitive level about sense acquisition, and an opinion level that entails a first assessment. In the empirical testing, two emotional dimensions emerged (see Table 1, and for further information see Maruschke et al. 2024).

The understanding of the agriculturally shaped environment is a multidimensional construct. Each person has a specific combination of the four understanding dimensions. It is not practicable for practitioners to find suitable measures for the complex understanding expression of each individual. Rather, it makes sense to group the population into understanding groups and then find the appropriate measures for each group. Furthermore, it is assumed that different understanding groups also differ in terms of sociodemographic characteristics.

3 | Methods

3.1 | Western Pomerania—Area of Study

The situation in the German region of Western Pomerania (see Figure 1) is exemplary of land use conflicts in the context of sustainable agriculture and thus sustainable development, which is why the construct of understanding the agriculturally

shaped environment was developed here in a previous study (Maruschke et al. 2024).

The region of Western Pomerania consists of two districts (Vorpommern-Rügen and Vorpommern-Greifswald) and is part of the federal state of Mecklenburg-Western Pomerania, which borders Poland. It is one of the economically weakest regions in Germany, with a relatively low population density (65 inhabitants per km²) (LAIv 2021).

This paper focuses on some of the most relevant land use conflicts in the region: On the one hand, the region's socialist past (GDR) has resulted in the development of a large-scale, rather unsustainable agricultural landscape that is nowadays strongly oriented toward economies of scale (Besser et al. 2017; Choi et al. 2010). On the other hand, compared to other German counties, a comparatively high proportion of land in this region is managed organically (BMEL 2022). This already reveals some different requirements for land use.

Due to transformation processes in agriculture in areas of the former GDR, an alienation from agriculture has developed in many places since the German reunification. Among the reasons for this are the loss of the social functions of the agricultural cooperatives and rationalization (loss of jobs) (Besser et al. 2017; Bunkus and Theesfeld 2018). Simultaneously, there has been a general alienation from nature (El-Kamel Bakari 2014; Riechers et al. 2022; Soga and Gaston 2016).

Another important issue facing Mecklenburg-Western Pomerania is managing drained peatlands. These are the region's largest single greenhouse gas emitters. Through the agricultural use of wetted or rewetted peatlands for the cultivation of biomass (paludiculture) (Wichtmann and Joosten 2007), greenhouse gas emissions will be significantly reduced (Tanneberger et al. 2020). A broad acceptance of paludiculture and an understanding of its climate impact on the population could assist with such conversations—not least at the political level, which can create supportive frameworks.

Social polarization also occurs in Western Pomerania (e.g., FFF, “Moorbündnis,” right-wing populism). Western Pomerania is therefore an ideal example of typical land use conflicts in the context of sustainable development.

3.2 | Data

The data for this paper were collected through a postal population survey in Western Pomerania. A total of 12,496 adults residing in the study area were contacted using a stratified sample by municipality level to capture the region in its entirety, resulting in 2084 participants with a response rate of 16.7%. The average age of participants was 57.4 years, with a standard deviation of 16.5. The sample included 1074 females and 981 males, representing the sex distribution. Older individuals were slightly overrepresented in the sample.

A selection of the questions from a questionnaire about the demands of the population regarding their agriculturally shaped environment is utilized. The questionnaire is structured in three thematic blocks: one about individual utilization, another about



FIGURE 1 | Study area, *Source: Stephan Busse.*

cognitive understanding, and the third about demands on the agriculturally shaped environment in Western Pomerania. A final section asks about sociodemographic characteristics. The content is oriented toward the main conflict lines in Western Pomerania, which include attitudes and contextual knowledge about conventional and organic agriculture, paludiculture, and regional product value chains, but also cultural ecosystem services that people receive from the environment, their everyday experiences with the agriculturally shaped environment, and their direct contact with agriculture. Among the sociodemographic variables, net income and life satisfaction were summarized into three and five categories, respectively, for easier interpretation. For more details about the questionnaire see Maruschke et al. (2024).

The four dimensions of the construct of understanding of the agriculturally shaped environment have been revealed for each case in a previous study as output data (Maruschke et al. 2024 and Table 1) on a metric data level (see also Section 1.4). Partial

measurement invariance between the sexes has already been balanced. Similarly, the original ordinal items from the questionnaire were inverted where necessary so that all ordinal items have the same direction of agreement in the content directions. It should be noted that despite the z-transformation, the means and standard deviations are not all equal and thus it is not a perfectly standard normal distribution. Generally, the higher the level of understanding, the higher the expression in that dimension.

3.3 | Statistical Analyses

3.3.1 | K-Means Cluster Analysis

To identify the understanding profiles, a cluster analysis was conducted using SPSS 28.0 (*IBM SPSS Statistics for Windows*, 2021). Because the input data are not perfectly normally distributed, and because of the large sample size and plausible

outliers and correlations between the understanding dimensions (Maruschke et al. 2024), a K-Means cluster analysis is used here (Backhaus et al. 2021). The four dimensions of understanding of the agriculturally shaped environment served here as input data: emotional dimension I, emotional dimension II, cognitive dimension, and opinion dimension.

Data were checked for outliers by box plot analysis. Only plausible content-related outliers exist. The general settings are iteration: 100 and convergence: 0.0001. Euclidean distance was used. Two to 10 cluster solutions were tested. For this, the main sample was randomly divided into two subsamples. Using the following test statistics: SSE (square sum error used for the SCREE Plot), ETA^2 , PRE (relative improvement compared to the previous solution), and F-MAX (ratio of declared to unexplained dispersion) (Bacher 2001), and further cross-checking with theory-driven cluster center interpretation, the number of clusters was specified predominantly to a three-, but sometimes to a four-cluster solution.

Two robustness checks were performed testing the three- and four-cluster solutions: first, checking the stability of cluster centers (weaker criterion) (Bacher 2001). The K-Means cluster analysis has a risk of a local maximum or minimum (Steinley and Brusco 2007). To avoid this, the main sample was randomly divided into 11 pairs of subsamples. Then the interpretations of the cluster centers were compared, as well as a comparison with the main sample. The main interpretation directions of the three- and four-cluster solutions were repeated each time. However, there was a greater difference in the cluster center interpretation between subsample 1 and the main sample in the four-cluster solutions. Therefore, the three-cluster solution fits best with the theoretical interpretation.

By comparing the square sum errors (the lower the better) within the three- and four-cluster solutions of each subsample, the best subsamples for each cluster solution emerged. These subsamples were used for the second robustness check: the stability of the classification of cases (stricter criterion) (Bacher 2001). The classification of cases for the second subsample was estimated by Nearest Neighbor and the cluster membership of the related first subsample. Cohen's Kappa was calculated through crosstabs for subsample two in the next step. Possible inverted cluster membership was considered. Received Cohen's Kappa is 0.824 with $p < 0.001$, which means there is excellent compliance in the classification of cases between subsamples one and two. This procedure was repeated in reverse by estimating the classification of cases for subsample one by subsample two (Cohen's Kappa = 0.801, $p < 0.001$). Therefore, the two robustness criteria were met by a three-cluster solution.

K-Means tends to produce relatively even cluster sizes. Therefore, any heterogeneity of variance can be neglected if the cases per cluster are approximately equal in number. This happens when the ratio of a cluster's largest to smallest cases is less than 1.5 (Stevens 1999). In the three-cluster solution, the ratio is 1.313.

The validity check was conducted by analyzing suspected associations between the clusters and external criteria, followed by the statistical analysis of the second research objective regarding

the associations between the understanding profiles and socio-demographic characteristics.

3.3.2 | Multinomial Logistic Regression

In order to analyze the associations between the three clusters (understanding profiles) and sociodemographic characteristics, the first step was to conduct association measures, both between the independent variables and also between the independent and dependent variables (Table 2 and Appendix S1). In addition to cluster membership, the following sociodemographic variables were used for these analyses based on the theoretical considerations (see Section 2.5): "sex," "age groups," "highest level of education," "employment status," "net income," "Children," "residence type," and "life satisfaction" measured by Beierlein et al. (2015). The variable "residence type" contains three sub-categories: 1. Native population—this means people who are born and have always lived in Western Pomerania without interruption, 2. Returnees—these are people who were born in Western Pomerania, but have left and then returned, and 3. Incomers—people who have moved to Western Pomerania from other places. For the analyses, SPSS 28.0 was used. It has been checked for multicollinearity (see Appendix S1).

To gain further insights into the associations between understanding profiles and sociodemographic characteristics, a regression was used to control the influence of the independent variables and to lead to more precise effects and more accurate comparisons. Since the dependent variable, cluster membership, is nominal with three expressions and the independent variables have nominal and ordinal data levels, it was suitable to employ a multinomial logistic regression (MLR). Furthermore, logistic regressions have less strict assumptions (e.g., predictors do not need to be normally distributed) (Tabachnick and Fidell 2013). The independent variables were simultaneously entered into the model by forced entry because of the assumption in Section 2.5 that these independent variables all influence the expressions in the understanding profiles (Field 2020). All independent variables were treated as factors, not covariates. Finally, the reference category was examined (last category). In order to understand each association combination in the

TABLE 2 | Associations between independent variables and the understanding profiles.

Associations with understanding profiles	Cramer's V/Phi	df
Sex	0.059*	1
Age groups	0.102***	2
Highest level of education	0.107***	2
Employment status	0.107***	2
Net income	0.073***	2
Children	0.065*	1
Residence type	0.117***	2
Life satisfaction	0.075**	2

Note: Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE 3 | Cluster centers of the K-Means cluster analysis.

Cluster centers of the final solution						
	Cluster 1 (<i>n</i> = 776, 38%)		Cluster 2 (<i>n</i> = 591, 29%)		Cluster 3 (<i>n</i> = 688, 33%)	
ed I	−0.83558	Below one SD	0.51044	Within one SD	0.50399	Within one SD
ed II	−0.79144	Within one SD	0.01627	Within one SD	0.8787	Above one SD
cd	−0.33233	Within one SD	1.04781	Above two SD	−0.52524	Within one SD
od	0.16946	Within one SD	−0.98703	Below one SD	0.65674	Above one SD

Note: Values based on z-transformed data.

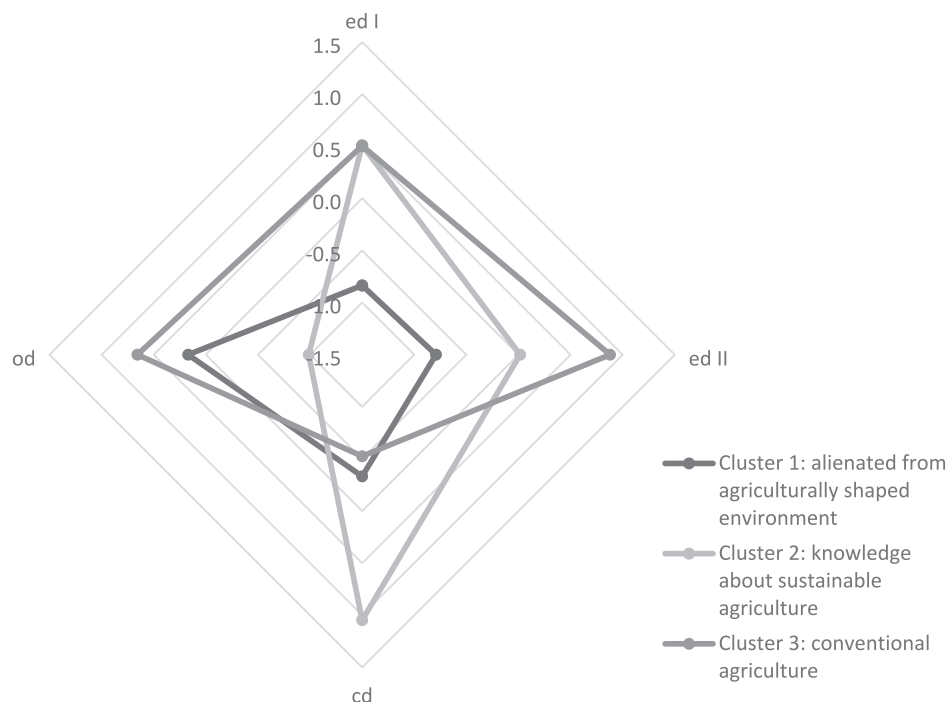


FIGURE 2 | Expressions in the understanding dimensions of the three clusters.

odds ratios, the reference category of the dependent variable was changed (with no change in the reference categories of the independent variables).

4 | Results

4.1 | Understanding Profiles

The first objective of the research is to identify understanding profiles that can be answered using the three clusters revealed by the K-Means cluster analysis. The first cluster has normal expressions in the understanding dimensions and less contact with the agriculturally shaped environment. The second cluster has a strong sustainable knowledge dimension and more contact with the agriculturally shaped environment than Cluster 1. The third cluster has a high expression of conservative opinions regarding topics surrounding the agriculturally shaped environment and high levels of contact with agriculture itself.

The K-Means cluster analysis results in a three-cluster solution with a relatively equal distribution of cases within each cluster. The cluster centers are shown in Table 3 and

graphically represented in Figure 2. The values of the clusters are described as “normal” or “average” if the cluster centers are within one standard deviation of the average values for the whole sample.

Cluster 1 has a below-average expression in the emotional understanding dimension I (ed I) (below one standard deviation). This means less general contact with the agriculturally shaped environment and can be deemed to indicate alienation from it. The emotional understanding dimension II (ed II) expression is within one standard deviation, meaning that when compared to the whole sample, people in this cluster have average contact with agriculture. Additionally, the cognitive understanding dimension (cd) is within one standard deviation. Therefore, people have average contextual knowledge about sustainability in the context of the agriculturally shaped environment. Similarly, od expression is within one standard deviation. Thus, people in Cluster 1 have an average level of opinions about issues surrounding the agriculturally shaped environment. Cluster 1 is called the *alienated* from the agriculturally shaped environment *cluster* because they are alienated by having less contact with the agri-environment and having indifferent knowledge about it; these aspects are mutually dependent (Figure 2).

TABLE 4 | Key findings of the regression.

	Key findings
Sex	<ul style="list-style-type: none"> • Men have a greater chance of being in the conventional agriculture cluster • Women are more often alienated from the agriculturally shaped environment
Age groups	<ul style="list-style-type: none"> • Mid-range ages have a greater chance of having more knowledge about sustainable agriculture and sustainable attitudes than high ages • The high ages are more likely in the conventional agriculture cluster
Highest level of education	<ul style="list-style-type: none"> • People with a high school degree as their highest level of education tend to belong to the cluster with outstanding high knowledge and a positive attitude toward it • The lower the education level the higher the chance of belonging to the conventional agriculture cluster rather than to the knowledge about sustainable agriculture cluster
Employment status	<ul style="list-style-type: none"> • Full-time employees have a strong tendency to belong to the conventional agriculture cluster compared to most of the other options of employment status
Net income	<ul style="list-style-type: none"> • No significant effects in the regression
Children	<ul style="list-style-type: none"> • No significant effects in the regression
Residence type	<ul style="list-style-type: none"> • The native population tends to belong to the conventional agriculture or alienated cluster • Incomers tend to belong to the cluster with high knowledge about sustainable agriculture → Conflict potential between these two groups <ul style="list-style-type: none"> • Returnees might act as mediators
Life satisfaction	<ul style="list-style-type: none"> • A very high level of life satisfaction increases the chance of belonging to the cluster with high knowledge about sustainable agriculture

The *second cluster* has an expression in ed I within one standard deviation, indicating a normal level of general contact with the agriculturally shaped environment. Ed II is also within one standard deviation, but is higher than cluster 1. This demonstrates that people in Cluster 2 have a normal expression in terms of their contact with agriculture. Cluster 2's cd is significantly high (above two standard deviations). People have outstanding contextual knowledge about sustainability regarding issues surrounding the agriculturally shaped environment. Therefore, the second cluster is called *Knowledge about Sustainable Agriculture*. Conversely, people in Cluster 2 have a low expression in the opinion understanding dimension (od) (below one standard deviation), showing that their opinions regarding the agriculturally shaped environment are less conservative (Figure 2).

In contrast, *Cluster 3* has an above-average level in od (above one standard deviation), meaning that people have a distinctly conservative opinion about topics related to the agriculturally shaped environment. In addition to a high level of contact with agriculture (ed II above one standard deviation), there is a normal expression in ed I concerning general contact with the agriculturally shaped environment (within one standard deviation). Conversely, the cd is average but less distinct than in clusters one or two (within one standard deviation) (Figure 2). Cluster 3 is called the *conventional agriculture cluster*.

4.2 | Associations Between the Understanding Profiles and Sociodemographic Characteristics

The second research objective is addressed by an association analysis and a multinomial logistic regression, which showed

that expressions in the sociodemographic characteristics influenced the memberships of the understanding profiles (see Table 4), but such expressions do not fully explain the variance, so it is assumed that several other factors influence the memberships of the understanding profiles.

The association analyses by *Cramer's V* have shown that each association between sociodemographic variables within the cluster cases is significant but weak the strongest association is between residence type and the cluster membership (Cramer's $V=0.117$, $p<0.001$) (Table 2).

Some interesting findings are visible in the associations of age groups and residence type with cluster membership: The younger the people the greater the probability of being in the alienated cluster, the older the greater the chance of belonging to the conventional agriculture cluster, whereas the middle-aged tend to be in the cluster with high knowledge about sustainable agriculture (see Appendix S2). In Appendix S2, it can be determined that the group of the native population and that of the incomers are diametrically opposed in their potential for cluster alignment, whereas the group of returnees shows a balanced distribution.

The results from the *multinomial logistic regression* show more differentiated insights into the associations (see Appendix S4). The model is highly significant ($p<0.001$) with modest explanatory power (Nagelkerke = 0.109) (see Appendix S3). The pseudo- R^2 is acceptable, so it can be disregarded because the focus was on analyzing (the strength of) associations between the independent and dependent variables, not on predicting or fully explaining the dependent variable. Odds ratios are reported only when they show significant associations ($p<0.05$).

Concerning the variable *sex*, men have a greater chance than women of being in Cluster 3 rather than Cluster 1 (see Appendix S4).

Regarding the variable *age groups*, the mid-range age group (35–54 years old) has a higher chance than higher ages (75+ years old) of being in Cluster 2 than in Cluster 3 (see Appendix S4).

The variable “highest level of education” shows participants with less than a high school diploma or those who completed an apprenticeship are less likely to be in Cluster 2 than in Cluster 3 compared to participants with a university degree. People whose highest education level is a high school degree (in Germany *Abitur*) have a higher chance of belonging to Cluster 2 rather than Cluster 3 compared to those with a university degree (see Appendix S4).

Results for the *employment status* variable full-time employees compared to part-time employees are more likely to be in Cluster 2 than Cluster 3. Jobseekers are more likely to be in Cluster 2 than Cluster 3 compared to full-time workers. Compared to full-time workers, retirees are more likely to be in Cluster 2 than Cluster 3 (see Appendix S4).

Regarding the *residence time* variable, the native population of Western Pomerania is less likely to be in Cluster 2 than in Cluster 3 compared to incomers. They also have a lower chance of being in Cluster 2 than in Cluster 1 than the incomers (see Appendix S4).

People with an average level of *life satisfaction* are less likely to be in Cluster 2 than in Cluster 1 compared to people with a very high level of life satisfaction. Similarly, people with average levels of life satisfaction have a higher chance of being in Cluster 2 than in Cluster 3 compared to those with very high levels of life satisfaction. People with high levels of life satisfaction are less likely to be in Cluster 2 than in Cluster 1 compared to those with very high levels of life satisfaction (see Appendix S4).

5 | Discussion

5.1 | Three Understanding Profiles

The research aim of this paper has been to provide an information base about the understanding of the agriculturally shaped environment among different societal groups as a basis for appropriate interventions to foster sustainable development. Additionally, niche and regime structures have been identified among these societal groups. Another goal has been to identify potential lines of conflict between these groups. To do this, the first research objective was to identify which groups of society exist regarding the understanding of the agriculturally shaped environment. Three groups have been found based on the combination of the four understanding dimensions in the population of Western Pomerania by a cluster analysis. To characterize these three groups according to the second research objective, associations with sociodemographic characteristics were examined. In the following, the three understanding groups are characterized by sociodemographic characteristics and will be discussed.

Regarding the groups of understanding in society, it can be stated that there is a knowledgeable group with a good grasp of sustainable agriculture, mostly comprising middle-aged

individuals. They have contact with agriculturally shaped environments and agriculture (Cluster 2) (see Figure 2). This group might be related to the niche of sustainable agriculture.

Concerning Cluster 3, the results confirm the assumption that this group is more prevalent among men and the elderly, as well as among the native population. This group is related to the current agricultural regime.

Cluster 1 is alienated from nature or an agricultural environment; this is associated with less sustainable attitudes and less interest in acquiring knowledge about sustainable agriculture. In terms of the social transformation process toward sustainable agriculture, this group symbolizes the silent mass whose indifference hinders sustainable transformation. Indifference can lead to limited citizen response, apathy, and a lack of engagement in initiatives essential to sustainable development (Herrera 2019).

In the following, specific characteristics of the clusters are discussed in more detail. The cognitive and opinion dimensions (cd and od) in the first cluster are normal. However, the cluster has low expressions in the general contact with the agriculturally shaped environment and comparatively lower expressions in the specific contact with agriculture. This makes sense because association analysis showed that younger people (18–44) tend to be in Cluster 1 (see Appendix S2). This is in line with findings in the literature on the trend of alienation from nature and agriculture among younger people (Besser et al. 2017; Soga and Gaston 2016). Cluster 1 contains the most participants with 778 in total. Thus, it can be assumed that alienation from nature and agriculture is also a relevant issue in the rural area of Western Pomerania. This leads to a great lack of understanding of issues related to the agriculturally shaped environment as well as to agriculture itself and, in a broader context, hinders the development of sustainable attitudes (Rosa et al. 2020). At the same time, younger people will naturally be more affected by climate change and its environmental consequences, which explains why they tend to worry more about environmental issues and are more likely to identify with social movements like FFF. Although sociodemographic differences are also dynamic, there is evidence that younger people generally have more sustainable attitudes, but not intentions or behaviors (Meyer et al. 2022). Therefore, there might be potential to further increase sustainable attitudes. If this does not occur, there might be less change, and it could cement the existence of two groups of younger people: people who are concerned about environmental issues and those who are indifferent.

Women are more likely to be in Cluster 1 than in Cluster 3. These results can be explained by the fact that more men are employed in agri-food value chain jobs and are therefore more exposed than women (Boogaard et al. 2011; Graskemper et al. 2021; Kuntke et al. 2022). Likewise, women's attitudes toward the environment are less conservative; on the contrary, they tend to have more pro-environmental attitudes combined with a greater connectedness to nature (Odhiambo 2019; Rosa et al. 2020; Swim et al. 2020).

People in Cluster 2 have more general contact with the agricultural environment and more exposure to agriculture than

people in Cluster 1. Similarly, they have an outstandingly high contextual knowledge of the agriculturally shaped environment in terms of sustainability and a low expression of conservative opinion. The chance of being in Cluster 2 (vs. Cluster 3) increases as the person's education level increases. This statement is supported in part by the growth of sustainability principles in higher education (Žalėnienė and Pereira 2021). One exception is people with a high school diploma who are more likely to be in Cluster 2 than in Cluster 3. The idea that younger people might be creating this effect by being more affected by climate change does not hold true because of controlling for age (Meyer et al. 2022). An interaction effect between age and educational level was also tested but found to be insignificant. These findings support the assumption of two groups in younger generations: the sustainable cognition group and the indifferent, alienated group.

Full-time employees have a strong tendency to belong to the conventional agriculture cluster when compared to the other employment status options. Time spent in nature is associated with increased pro-environmental attitudes and behaviors (DeVillle et al. 2021; Usman et al. 2023; Wamsler et al. 2021).

Incomers are more likely than the native population to be in Cluster 2 rather than Cluster 1 or 3. This has been controlled for age; thus, a possible explanation could be that the attitudes of incomers concerning sustainability differ from those of the native population, as indicated by the findings from Severin (2020). Thus, a different background (not seeing agriculture mainly as an income source, having less contact with agriculture or having more idealized thoughts about idyllic rural areas) can lead to different attitudes, interests, and knowledge concerning the agriculturally shaped environment. Likewise, it is not clear whether the population of incomers is from an urban area or another rural one. Thus, the assumptions and findings that greater connectedness to nature leads to more sustainable attitudes need to be differentiated (Rosa et al. 2020). Further research can examine these associations in more detail to gain more insight in order to prevent potentially destructive conflicts between incomers and native populations (diametrically opposed understanding profiles).

The group of returnees contains nearly equally distributed cluster memberships—maybe because of experiences of different residence “environments,” meaning that this group has the potential to mediate between the native and incomer populations (see Appendix S2).

People with a very high life satisfaction are more likely to be in Cluster 2 than in Cluster 1 or 3 compared to those with a middle level of life satisfaction. The preference for being in Cluster 2 rather than Cluster 1 can be explained by the difference in the levels of contact the individual has with the agriculturally shaped environment and agriculture. Contact with nature has a positive effect on an individual's well-being (Liu and Green 2023; Ningtyas et al. 2023; Nisbet and Zelenski 2020). Similarly, connectedness to nature can help moderate the appropriation of natural elements (Fleury-Bahi et al. 2023). Individuals in Cluster 3 also have a lot of contact with nature, but their attitudes differ, which could contribute to the different levels of life satisfaction. Literature findings confirm a positive relationship between

sustainable attitudes and well-being (Dombrovskis et al. 2023). Since conventional agriculture is strongly related to economies of scale, the materialistic values could be higher in Cluster 3; this is something associated with lower well-being (Nisbet and Zelenski 2020).

Regarding the variables children and income, the unclear findings in the literature tend to support the insignificance of these variables because the results show no significant effects (see Appendix S4, Gibson et al. 2011; Milfont et al. 2020). The relative sizes of the understanding profiles found here must be treated with the inherent caution applied when using K-Means.

5.2 | Transformational and Understanding Potentials in and Between the Understanding Profiles

Crucial points like alienation from nature, the attitude–behavior gap—when considering knowledge without considering the affective dimension—and misunderstandings due to sometimes diametral differences and the resulting social polarization with regard to the understanding of the agriculturally shaped environment reflect the conflict potential between a conventional agricultural regime and a sustainable land use niche, and can lead to land use conflicts or barriers that prevent agriculture from developing sustainably (El-Kamel Bakari 2014; Schäufele and Janssen 2021).

Based on the empirical results, conflict potential exists especially between people in Cluster 2 (lots of knowledge about sustainable agriculture) and Cluster 3 (conventional attitudes toward agriculture). This reflects typical conflict lines between a conventional agriculture regime and a sustainable land use niche, which could result, for example, in farmers' protests and further social polarization (Matthews 2024). This is also reflected by differences between incomers, who tend to belong to the sustainable knowledge Cluster 2, and the native population, who tend to belong to the conventional agriculture Cluster 3. This potential conflict line has a higher chance of occurring between older, less educated, and full-time employed people (Cluster 3) on the one side and middle-aged, highly educated people as well as people with a higher life satisfaction (Cluster 2) on the other side.

Another conflict potential can occur between people who tend to be alienated from the agriculturally shaped environment (Cluster 1) and people who tend to be in Cluster 2 or 3. This can happen, on the one hand, because people from Cluster 1 are not able to appreciate the work of farmers (low expressions in the emotional understanding dimensions) and thus, farmers do not feel that their work is appreciated (Graskemper et al. 2021; Matthews 2024). On the other hand, there exists a conflict potential between radical ecologists/environmentalists who probably are related to Cluster 2 and indifferent people (related to Cluster 1). While radical ecologists (e.g., FFF or XR) advocate for transformative social, economic, and spiritual approaches to address ecological crises, indifferent people often prioritize short-term interests, neglecting the urgency of sustainable practices (Pośluszna 2020).

Similarities in the expressions of the understanding dimensions between the three clusters can be seen as understanding

potential, leading to improved understanding, communication, and conflict resolution, thereby enhancing relationships (West et al. 2014). Constructive handling of conflicts in the context of sustainable development addresses an important obstacle to reach sustainability. Likewise, increasing the understanding of the agriculturally shaped environment at the societal level can lead to changing values and attitudes as well as knowledge regarding sustainable land use. Through this, the invisible power of society through influencing policy by narratives can work (Temper et al. 2018). Meanwhile, knowing that the sustainable land use Cluster and the conventional agriculture Cluster have similarities in the emotional dimensions could be a starting point for mutual understanding. It could allow for those in the group to understand the respective other group's underlying feelings, demands, and interests, and bridge other differences. Metaphorically, this might also apply to the current regime of conventional agriculture and the niche of sustainable agriculture.

In general, it may be useful to design interventions that encourage interaction between the groups and lay the groundwork for them to have constructive conversations with each other (Tjosvold 2008). Farm visits could, for instance, be an intervention for people in Cluster 1 to increase their emotional understanding and reduce their alienation from the agriculturally shaped environment, but also to receive knowledge about sustainability, which addresses the cognitive dimension. In this cluster, it might be a challenge for practitioners to motivate people for sustainability topics. Thus, educational offers could start at a lower and entertaining level. For people in Cluster 2, interventions like round tables with farmers to improve the understanding of realities in agricultural practice and concrete challenges could be a way forward. Those in Cluster 3 might require more knowledge about sustainable topics to enable them to think also about sustainable solutions.

The conflict lines between conventional and sustainable agriculture and thus between a conventional agricultural regime and a sustainable land use niche, the lack of appreciation of farmers' work, and the alienation from nature and the agriculturally shaped environment as well as the indifferent and radical point of view regarding sustainability issues are general problems in many countries of the global north (Bashan et al. 2021; Besser et al. 2017; Bunkus and Theesfeld 2018; El-Kamel Bakari 2014; de Moor et al. 2021; Pośluszna 2020; Riechers et al. 2022; Soga and Gaston 2016). Therefore, farm visits, offers to gain knowledge and affective experiences about sustainable land use, and round tables with farmers are general suggestions for measures to increase the understanding of the agriculturally shaped environment. Regarding the specific content for the measures, adaptations might be useful because regional affectedness can reach people more than general examples by reducing psychological distance (Tang and Chooi 2023). For example, in Western Pomerania, the issue of paludiculture is important, while in Saxony-Anhalt it may be the drought and the melting of the permafrost in Siberia that are relevant (Filho et al. 2023; Maruschke 2018; Tanneberger et al. 2020).

To foster sustainable development, policymakers, for example, educational institutes, or local agencies can undertake adequate measures to improve the understanding of the agriculturally shaped environment as an important prerequisite for societal

change. The existing regimes move closer to sustainable agricultural niches by affecting the current regime at a societal level by increasing the understanding of the agriculturally shaped environment and thus activate the invisible power in society to change narratives and influence policy through a change in values in a more supportive direction of sustainable land use (Temper et al. 2018). These niches are then more likely to succeed or even replace the existing regime (Ingram et al. 2015).

6 | Conclusion

Based on the example of Western Pomerania, this paper provides a basis of information for actors to derive appropriate interventions for specific sociodemographic groups to increase the understanding dimensions in society, especially sustainable land use. We did this based on two research objectives: Firstly, we identified which groups of society exist concerning the understanding of the agriculturally shaped environment. Secondly, we examined associations between sociodemographic characteristics and understanding groups. The results show three understanding profiles. The cluster that is alienated from the agriculturally shaped environment more often contains younger people and slightly more females. The cluster of people with comparatively high contact with the agriculturally shaped environment and comparatively high contextual knowledge about sustainable land use has a higher chance of consisting of females and can be related to the niche in the MLP model. A third cluster, which is characterized by intensive contact with agriculture, has stronger expressions of conventional opinions regarding agricultural land use and consists more often of older people and slightly more males. This cluster can be related to the regime in the MLP model. Main conflict lines exist between attitudes toward conventional versus sustainable agriculture, alienation from the agriculturally shaped environment, environmental radicalism, and the feeling of farmers that their work is not appreciated. Increasing the understanding dimensions supports a mutual understanding between groups of different attitudes, experiences, and knowledge regarding a sustainable land use change and thus contributes to an important prerequisite of constructive conflict solution. Likewise, the invisible power in society can be activated by the change in attitudes, values, and narratives by increasing the understanding dimensions in society.

This can contribute to establishing a more sustainable regime, in particular by fostering sustainable agriculture, which is one of the most important factors when it comes to dealing with climate change. All statements refer to the sample, and the results are comparable to the populations in regions with a similar focus on land use conflicts and similar expressions in sociodemographic characteristics.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.