Entrepreneurial bottom-up sustainability action – a spatial and scalar analysis at the local level

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Abstract

Purpose – The purpose of this paper is to assess common traits and spatial, inter-scalar and temporal patterns in sustainability-oriented entrepreneurial grassroots action. The region of Vorarlberg (Austria) is used as a case study.

Design/methodology/approach – Cases of grassroots action were identified through a review of grey literature. The retrieved cases were analysed using a set of variables that define key characteristics of spatial, inter-scalar, temporal and collective action. Spatial and temporal patterns were derived through geographic information system analysis and by statistically assessing the interrelations between contextual factors and grassroots action.

Findings – Results show that grassroots action in Vorarlberg is mostly undertaken in urban environments where right-wing politics dominate. Groups are primarily small but part of trans-local arrangements. Change has intensified in the 2010s. Spatially speaking, the phenomenon has mostly spread from one municipality to adjacent ones. Different patterns are observed, however, for different types of networks. Interest in waste management and food production largely explains the increases in grassroots action in the 2010s.

Originality/value – This paper presents one of the few spatio-temporal analyses of local-level grassroots action conducted to date. This includes an assessment of understudied geophysical and socio-political factors which impact the spatial distribution of grassroots movements. Therefore, it opens up unexplored research pathways that are crucial for more objectively defining strategies to support grassroots-led changes in different contexts.

Keywords Grassroots, Change, Vorarlberg, Spatial patterns, Inter-scalar organisation, Temporal patterns

Paper type Research paper

1. Introduction

Entrepreneurial sustainability-oriented grassroots initiatives are projects initiated by individuals within local communities to develop solutions for sustainability (Feola and Nunes, 2014). As common hallmarks, they share participative decision-making procedures, flat hierarchies, and a voluntary contribution by their members. Different types of initiatives can be distinguished according to the goal that they pursue. These include community energy projects (e.g. Pellicer-Sifres, 2020), sustainable consumption communities (e.g. Signori and Forno, 2019) and permaculture communities (e.g. Ulbrich and Pahl-Wostl, 2019). Initiatives embracing a wide range of sustainability themes also exist. The Transition Towns Movement

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(Feola and Nunes, 2014) stands as a paradigmatic case of such an initiative, widely recognized for its successful worldwide diffusion.

Evidence for the performance of entrepreneurial grassroots initiatives reveals significant effects at community level. Transformative ideas can be introduced (Schreuder and Horlings, 2022) which are capable of bringing about fundamental change in the way people behave, think and act (Henfrey *et al.*, 2023). The effects observed include: a reduction in the ecological footprint of members (Vita *et al.*, 2020); enhancements in social cohesion and in the knowledge and empowerment of members (Sihotang *et al.*, 2024); and behavioural changes associated with social learning (Signori and Forno, 2019). Environmentally speaking, Vita *et al.* (2020) estimated an average reduction of 16% in the carbon footprint of members of European grassroots initiatives compared to non-members. Lockyer (2017) reported that a grassroots initiative in the USA reduced electricity consumption, water use and solid waste production by up to 82%, 77% and 82%, respectively. These reductions are consistent with high well-being (Lockyer, 2017; Vita *et al.*, 2020). These effects are promising in a context where regulations have stagnated and top-down sustainability discourses focus on economic growth (Crowley *et al.*, 2021; Henfrey *et al.*, 2023). This requires academic endeavour to offer knowledge and to enable environments that unlock the widely recognized transformative potential of these initiatives (Crowley *et al.*, 2021). An area where research is needed concerns the spatial diffusion of the phenomenon (Kratzer *et al.*, 2022; Seyfang and Longhurst, 2016). Assessing spatial and inter-scalar patterns can improve our understanding of how local and global grassroots movements interconnect, while also revealing common enablers and barriers across different geographical areas (Ulbrich and Pahl-Wostl, 2019). This can shed light on both suitable contexts for the development of different initiatives as well as providing strategies to adapt to place and to spread change.

Numerous scholars have developed frameworks to analyse the diffusion of innovations and change (e.g. Kamaludin *et al.*, 2024; Pálvölgyi and Horváth, 2023; Sekliuckiene and Kisielius, 2015). Two widely used frameworks are the multi-level perspective (Geels, 2002) and strategic niche management (Schot and Geels, 2008). The multi-level perspective defines innovation diffusion as the result of the alignment of developments in three nested levels: the micro-level of niches, where innovations emerge; the meso-level of regimes, where the stability of the status quo is fostered; and the macro-level of landscape, consisting of slowly changing external factors (Geels, 2002). Strategic niche management proposes the creation of protected spaces (i.e. niches) as a strategy for change. In these spaces, radical innovations can take place. This requires three processes to occur: articulation of expectations, building of social networks and learning processes (Schot and Geels, 2008). Especially noteworthy is the concept of the global niche level. This concept describes how small local projects expand to projects that affect more than a few local areas (Schot and Geels, 2008). A spatial component was added to the concept by Sengers and Raven (2015). Knowledge production, actor networks and power are connected to the spatial dimension (Sengers and Raven, 2015).

The emergence of frameworks for examining the spatial diffusion of innovations has, however, had a limited impact on the scientific literature on entrepreneurial grassroots-led change (Kratzer *et al.*, 2022; Seyfang and Longhurst, 2016). Among the few scientists that have analysed the spatial diffusion of grassroots actions are: Feola (2016); Feola and Butt (2017); Feola and Nunes (2014); Kratzer *et al.* (2022); and Nicolosi *et al.* (2018). The evaluation of inter-scalar patterns has received the most endeavour (e.g. Apostolopoulou *et al.*, 2022; Feola and Nunes, 2014; Kratzer *et al.*, 2022). Contrastingly, a more limited number of studies (e.g. Feola, 2016; Nicolosi *et al.*, 2018) have addressed diffusion patterns

in space and/or over time. Attention has been mostly restricted to specific networks of initiatives or thematically-focused actions. The researched themes encompass plastic pollution (Kratzer *et al.*, 2022), food production (Vlasov *et al.*, 2018), and action for radical change (Apostolopoulou *et al.*, 2022). The efforts of Feola (2016), Feola and Butt (2017) and Feola and Nunes (2014) to assess the diffusion of the Transition Towns Movement are significant. Equally noteworthy is the rare analysis of socio-economic and political traits of the places in which initiatives emerge. This is despite the fact that, to determine suitable contextual conditions for change, it is essential to conduct such analysis (Håkansson, 2018). An exception is the work of Nicolosi *et al.* (2018). Remarkably, existing studies have not had the goal of revealing the factors that favour grassroots initiatives at the local level, as far as the authors of this paper are aware. As this is the place where initiatives typically emerge, to evaluate on this scale is crucial (Feola and Nunes, 2014). This reflects limited understanding about favourable contextual conditions and diffusion strategies for grassroots action.

The objective of this paper is to assess common traits and spatial, inter-scalar and temporal patterns in entrepreneurial grassroots action for sustainability in the region of Vorarlberg (Austria). The following aspects are explored: spatial distribution of different types of initiatives; geophysical and socio-political conditions supporting the development of initiatives; most common local, regional, national and international networks and interdependencies in grassroots action; and patterns in their spatial and inter-scalar diffusion. Unlike most previous studies, the analysis includes all identified entrepreneurial grassroots initiatives in the selected study area that address environmental sustainability-related issues. The assessment pays particular attention to change at the, so far, little-investigated local scale. It evaluates divergences in contextual factors for grassroots-led change at this scale. After detailing the methodological approach (Section 2), the results of the analyses are presented in Section 3 and lessons discussed in Section 4. Finally, conclusions are drawn about the most significant contributions for practice (Section 5).

2. Methodology

2.1 Study area

Vorarlberg is a NUTS-2 region in western Austria (Central Europe) (see Eurostat, 2024). It lies at the confluence of 4 countries, where Austria meets Germany (to the north), Liechtenstein (to the west) and Switzerland (to the west and south). With a total surface area of 2,600 km2, it stands out for its cultural singularity within the country. A strong relationship has been forged between the region and the neighbouring Swiss, Alsatians and Swabians. Contrastingly, until recent decades it was predominantly isolated from the rest of the country. This is explained by its abrupt topography in the east. Two thirds of the region lies above 1,000 m, with peaks of 3,000 m separating Vorarlberg from the rest of Austria (Vorarlberg Tourismus, 2022). The region is open to the north and the west through the Rhine Valley and lake Constance. The population of Vorarlberg was 405,654 inhabitants (in 2022) (Statistik Austria, 2022b) and is mainly concentrated in the Rhine Valley. With 50,995 inhabitants, Dornbirn is the largest town, followed by Feldkirch (35,683), and the regional capital city, Bregenz (29,587) (Figure 1). Despite the relatively small population of its towns, the population density in the Rhine Valley (425 inhabitants/km^2) is the second largest in the country, after the capital city, Vienna. Vorarlberg has also the youngest population in Austria (Statistik Austria, 2022a). The region ranks among Europe's strongest and most innovative economies (Land Vorarlberg, 2022)—a status that is driven by a strong focus on new products, processes, and services. Additionally, it boasts a notably civic-minded population, with over half of its inhabitants engaged in volunteering (Statistik Austria, 2022b). These traits make the region a singular entity within the country (Table 1).

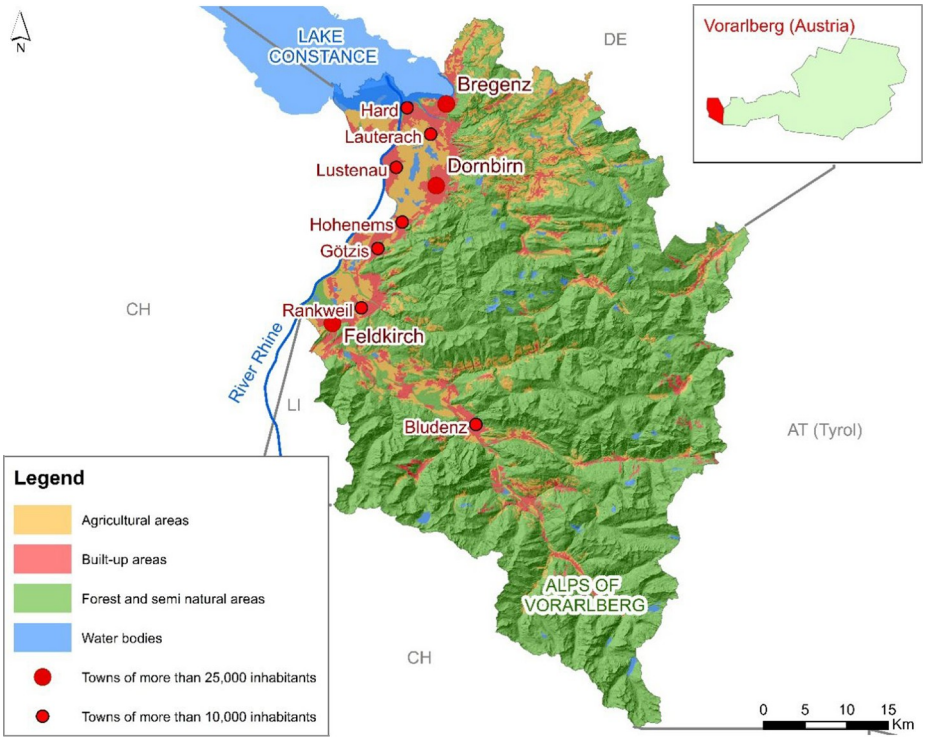

Figure 1. The study area: the region of Vorarlberg (Austria)
Source: Authors' own work based on cartographic data in Geoland (2021) and Copernicus (2012)

2.2 Methodological procedure

A similar approach to that used in Nicolosi *et al.* (2018) and Feola and Butt (2017) was adapted to collect and process the data on entrepreneurial grassroots action in Vorarlberg. This consisted of:

- Firstly, a Web-based search in databases that report entrepreneurial grassroots initiatives and characteristics of the municipalities of Vorarlberg. The aim was to create a group inventory and populate it with data on their traits and municipal features potentially connected to their existence (see Section 2.2.1).
- Secondly, all collected data were processed through categorization, analysis of statistical significance and a geographic information system (GIS) analysis (see Section 2.2.2).

2.2.1 Data collection. International, national and regional online databases reporting cases of grassroots action on a wide range of sustainability themes were scrutinized in January and February 2022. These databases are Transition Towns, ChangeX, Smart Village Network and Solidarity Farming (SoLaWi) (international databases); Transition Austria (national databases); and Wandeltreppe (regional databases). The objective was to identify entrepreneurial grassroots groups developing sustainability-focused actions in Vorarlberg. Particular attention was paid to finding as many groups as possible to gain as accurate an

Table 1. Regional physical and socio-economic characteristics of Vorarlberg and their comparison to Austrian national averages

Information category	Key characteristics	Vorarlberg*	Austria*
Altitude above sea level	Area at an altitude of more than 1,000 m above sea level (in percent)	≈ 60	≈ 40
Urban – rural divide	Population living in a city with more than 1,000,000 inhabitants (in percent)	0	21.7
	Population living in city with more than 100,000 inhabitants (in percent)	0	31.6
	Population living in a city with more than 10,000 inhabitants (in percent)	54.4	48.2
	Population density (inhabitants/km^2)	156	108
Socio-demographic traits	Average population age (in years)	42.1	43.2
	Inhabitants under the age of 15 (in percent)	15.9	14.5
	Foreign citizens (in percent)	19.7	18.7
	Inhabitants with higher education (third level) (in percent)	13.2	16.6
Economic activity and unemployment rates	Employees in the primary sector (in percent)	1.5	3
	Employees in the secondary sector (in percent)	31.5	22.5
	Employees in the tertiary sector (in percent)	67	74.5
	Unemployment rate (in percent)	4.5	5.6
Volunteering	Inhabitants conducting voluntary work (in percent)	53.1	49.4

Note(s): *Data extracted from Statistik Austria (2022a, 2022b)

insight into the reality of the region. The search was limited to cases of action on the ecological/technical side of sustainability (e.g. energy management). Cases of development of alternative economic models (e.g., alternative currencies) were also considered.

Where available, the website of each group was checked afterwards. This included a scrutiny of additional online publications, such as blogs. The Google search engine was used to verify whether the groups with broken website links existed or had dissolved. As a result of these searches, it was possible to sort the groups into existing, dissolved or those in the founding phase. Additional cases of grassroots action were also gathered. Similar to Feola (2016), the following data were compiled for each group: objectives; thematic focus; number of participants; starting (and ending) year; membership in networks of grassroots action; location where the initiative was developed (town); and scale addressed (local, regional, national or international). This enabled us to uncover the purpose and the spatial and inter-scalar organisation of each group.

Additionally, geophysical and socio-political data were collected for each municipality in Vorarlberg from the databases of Statistik Austria (see Statistik Austria, 2022b). The database of the regional government of Vorarlberg (see Land Vorarlberg, 2020) was also examined to collect data about the results of municipal elections in the years 2000–2020. Similar to Nicolosi *et al.* (2018), data on the following local contextual factors were gathered: average altitude above sea level (in metres); number of inhabitants in the year 2022; percentage of inhabitants under the age of 15; percentage of foreign citizens; unemployment rate; percentage of inhabitants with higher education (third level); and dominant political parties (left-wing or right-wing) in municipal elections in the years

2000–2020. It should be noted that these factors correspond to average characteristics of each municipality. They may differ from those of grassroots members. The collection of this data for grassroots members goes beyond the scope of this paper. Rather, the aim is to typify potential favourable local conditions for entrepreneurial grassroots-led change.

2.2.2 Data processing. A four-phase procedure was used. Firstly, all collected data on each group and municipality were tabulated in an Excel file. Data were classified according to the considered variables at the municipal level and at the level of each group (see Section 2.2.1). Data on each variable were additionally categorized for later graphical representation. This involved representing common traits of grassroots groups (as per the variables in Section 2.2.1) and the interrelations between these traits (e.g., thematic focus according to the number of participants). It also included scatter plots showing interrelations between the considered contextual local factors, and these local factors and the number of groups in each locality.

Secondly, the spatialized niche model of Sengers and Raven (2015) was applied to the data. This framework supports the assessment of inter-scalar linkages in the spatial diffusion of protected spaces for innovations (i.e. niches) on their journey from a localized to a global phenomenon. It posits that local initiatives achieve global impact through three processes: the mobilization of knowledge and actors, the formation of networks representing broader interests, and the establishment of transnational linkages (Sengers and Raven, 2015). In this paper, Sengers and Raven's framework is used as a lens to assess how the inter-scalar organization of grassroots-led change in Vorarlberg has evolved. Whether change remains localized or achieves global reach is shaped by how much that change aligns with the principles of the framework. This determines the impact of change on the prevailing regime (i.e. the status quo).

Thirdly, data about the number of entrepreneurial grassroots groups per municipality and their temporal evolution were additionally entered and mapped in a GIS. The software ArcMap was used for this purpose. This enabled us to assess spatial patterns in the distribution of groups both at the present time (year 2021) and over time. The spatial autocorrelation was assessed using Moran's I statistic in ArcMap, testing the null hypothesis of complete spatial randomness. Similar to Feola and Butt (2017), the aim was to examine whether similarities prevail between neighbouring municipalities in terms of the number of groups. Sharing boundaries and edges was used as a criterion for conceptualizing spatial relationships. Additionally, Local Indicators of Spatial Association (LISA) were also calculated in ArcMap. This made it possible to determine the extent to which municipalities are surrounded by other municipalities with a similar number of groups. The results show whether there are neighbouring municipalities with a similarly high ("high-high") or low ("low-low") number of groups and neighbouring municipalities with discordant numbers of groups ("high-low" or "low-high"). It should be noted that data about groups developing initiatives at a local scale were singled out for this analysis. This also applies to the analysis of contextual local factors. All remaining analyses (i.e. analysis of inter-scalar patterns, other temporal changes, and common purpose and degree of execution) were conducted using all the collected data.

Fourthly, the scatter plots were scrutinized to identify potential influences of local contextual factors on the number of groups per municipality, as well as interdependencies among the factors themselves. The statistical significance of the influence of local contextual factors on grassroots action was then quantified using the Kruskal–Wallis test in R. This test was chosen because of the non-normal distribution of the data, which precludes an analysis of variance. The number of groups per municipality and each contextual local factor considered (see Section 2.2.1) were used as the dependent and the independent variables, respectively. The test enables us to check the null hypothesis that all categories of municipalities have the same central tendency. Prior to the analysis, categories of

municipalities for each numerical independent variable were defined. This was based on the observed trends in the scatter plots. The defined categories are as follows: <1,000, 1,000–1,500, >1,500 (average altitude above sea level – in metres); <5,000, 5,000–10,000, >10,000 (number of inhabitants); <15, 15–20, >20 (percentage of inhabitants under the age of 15); <15, >15 (percentage of foreign citizens); <4, >4 (unemployment rate); and <10, >10 (percentage of inhabitants with higher education). The categories "traditionally right-wing" and "others (including the few traditionally left-wing municipalities)" were used for the contextual factor "dominant political parties in municipal elections." The statistical significance of differences between pairs of categories of municipalities was calculated using the Pairwise Wilcoxon Rank Sum test (post-hoc test). The *p*-value adjustment method used was "Bonferroni."

3. Results

The Web-based search returned information on a total of 92 entrepreneurial grassroots groups that had developed sustainability-related initiatives. This translates into an average of 0.95 groups per locality.

3.1 Common purpose and degree of execution of the initiatives

The majority of the groups (85.9%) have developed their initiatives while aiming to put into practice one or more sustainability solutions. In some cases, this is combined with creating places for either the education about (5.43%) or the discussion of (16.3%) sustainability solutions. Groups focusing on creating spaces for education or discussion represent 29.3% and 15.2% of the groups, respectively. Work on a wide range of fields has been undertaken. The fields of waste management and food production stand out. These two areas form the focus of action for almost two thirds of the groups found. The different aspects of waste management and food production are covered quite exhaustively. This includes initiatives addressing each of the "Rs" in the 3 Rs hierarchy (i.e. reduce, reuse and recycle). Examples are the creation of: open fridges and tools to incentivize less packaging (reduce); repair cafés and second-hand markets (reuse); and festivals to generate new products from old ones (recycle). In the area of food production, the principles of ecological farming, inclusion and alternative economic models are adopted. This is done by implementing, e.g. community-based systems of production, permaculture gardens and community gardens. Work on waste management and food production is followed by work on the areas of consumption (14.1%), communal housing (10.9%), communication (9.8%) and governance/empowerment (7.6%) [Figure 2(a)]. No groups were found only working in the fields of energy, water and ecosystem management. This might be connected to ongoing actions from the top-down. Examples of these include the development of two pilots for energy autonomy in the sub-region of Vorderwald and the municipality of Bezau. These actions may have led to a perceived lack of need to develop grassroots initiatives in these areas. The validity of this hypothesis should be the subject of future research.

Analyses of the degree of execution of the initiatives reveal that most initiatives have been brought to fruition (88%). Only a minority are in the start-up process (10.9%) or have been dissolved (1.1%). For the subset of 37 groups where participant data were available, the analysis revealed a predominance of small sized groups, with only 29.7% of the groups exceeding 30 members. Regarding thematic areas, the waste management and communal housing fields are mostly the focus of groups with a maximum of 30 participants. Contrastingly, the pursuit of e.g. alternative finance and new governance approaches are the focus of the largest groups, comprising more than 120 participants. No clear patterns can be observed regarding the food production and consumption fields [Figure 2(b)].

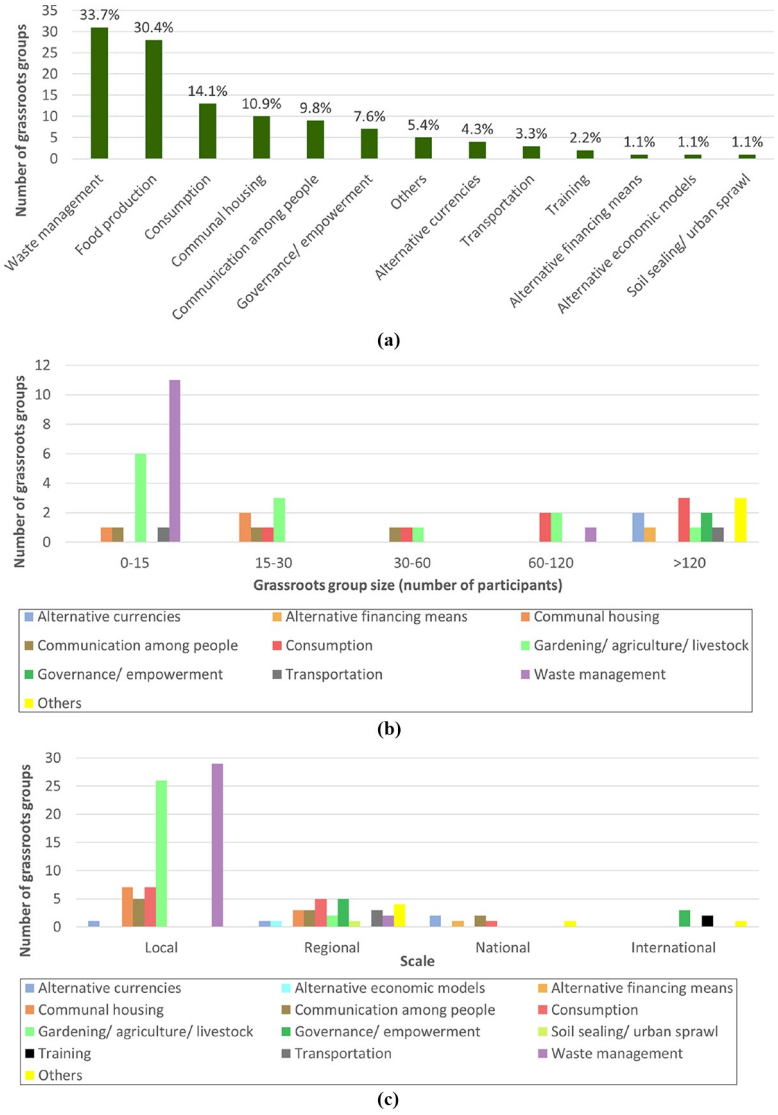

Figure 2. (a) Thematic focus of entrepreneurial grassroots groups, (b) number of participants and thematic focus according to group size* and (c) scale of action and thematic focus according to scale
Note(s): * Data are only displayed for groups for which group size information could be collected
Source: Authors' own work

3.2 Inter-scalar organization

Most groups focus their action at the local level (75%). The regional (18.5%) national (5.4%) and international (3.3%) scales are rarely targeted. The areas of waste management and food production are those primarily addressed on a local scale. Activities impacting the regional,

national and international scale cover a more diverse range of topics. Proof of that are the 11 subject areas addressed by the 17 groups working at the regional level. This contrasts to the six subject areas addressed by the 69 groups working at the local level [Figure 2(c)].

Despite the emphasis on local communities, networking is extending the effects of action to larger areas. Seventy-four per cent of the groups participate in a grassroots network. Most of these groups (62%) are part of regional networks. This is followed by participation in national (34%), international (24%) and local (10%) networks, indicating that most initiatives operate beyond the purely local scale. Grassroots-led niches have been fostered at regional, national, and international levels. Networks are seen in all the best represented thematic areas. Five networks are especially noteworthy. These are the networks: Repair Cafés (Reparaturführer) and open fridges (for waste management, both are regional networks); community-supported agriculture (for food production, which is an international network); Weiterwohnen (for communal living and a regional network); and ALLMENDA (for a wide range of topics and a national network). The former is additionally connected to RepaNet (on the national scale), "Reparatur-Initiativen" and Repair Cafés (on the international scale).

3.3 Spatial patterns

The spatial distribution of entrepreneurial grassroots groups is not random. The Moran's I statistic (0,085290) is just significant (at 10% level; p-value = 0.093431). Grassroots activities are concentrated particularly in the most densely populated western part of the region (in the Rhine Valley). Contrastingly, they remain residual in the eastern more scarcely populated areas (Figure 3(a). The LISA results further reinforce these conclusions. Neighbouring municipalities with a similarly high number of groups are concentrated in the Rhine Valley ("high-high" clusters). Municipalities with discordant numbers of groups ("high-low" or "low-high" clusters) are found throughout the region. This is because of variations among municipalities regarding the number of groups in the entire region. No statistically significant spatial autocorrelations were detected for the vast majority of municipalities [Figure 3(b)].

As for town size, groups can be found in all towns with more than 10,000 inhabitants and in the majority of towns with more than 5,000. The average number of groups in these towns corresponds to 4 groups and 1 group, respectively. Similar figures can be observed for the number of thematic areas addressed and the number of groups belonging to a network [Figure 3(c) and (d)]. Regarding thematic areas, initiatives in the areas of waste management, food production, consumption, communal housing and communication have all emerged in towns of more than 10,000 inhabitants. Action is concentrated on waste management and food production in the remaining municipalities.

The statistical significance of the relationship between increases in the number of groups and increases in town size (p-value = 0.000000001242) underscores that urban areas are action hubs. The number of groups differs significantly across all three town size categories (Table 2). It should be noted, however, that the most populated municipality in the region only has just over 50,000 inhabitants. This makes a contrasting analysis to compare large and small cities impossible.

The other geophysical and socio-political variables showing a statistically significant relationship are as follows: average altitude above the sea level (p-value = 0.002039), percentage of foreign citizens (p-value = 0.01937), percentage of inhabitants with higher education (p-value = 0.01937) and dominant political parties in municipal elections (p-value = 0.0007754) (Table 2). Arguably, these differences are connected to the characteristics of the largest towns. They have not led to widespread action in less populated

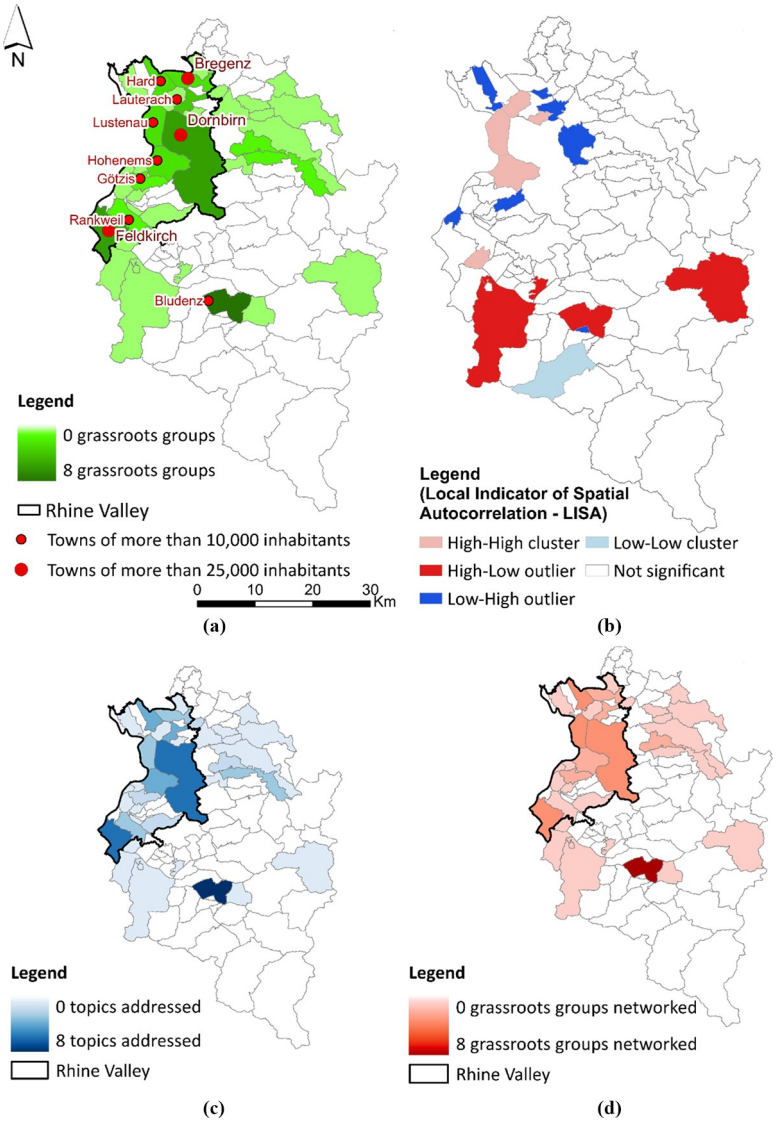

Figure 3. (a) Spatial patterns in the distribution of the number of entrepreneurial grassroots groups, (b) the Local Indicator of Spatial Autocorrelation (LISA) results, (c) the number of thematic areas that the groups address and (d) the number of groups belonging to a grassroots network
Source: Authors' own work based on cartographic data in Geoland (2021)

towns. The following traits characterize the largest towns: they tend to be located at an altitude of less than 1,000 metres above sea level; the proportion of foreign and university graduate (higher education – third level) residents is above the regional average; and right-wing parties dominate in municipal elections. No distinctive patterns are shown by these

Table 2. Results of the Kruskal–Wallis test and the pairwise comparisons using the Wilcoxon rank sum test (post-hoc test). Statistical significance of: interdependencies between the number of grassroots groups per municipality and local contextual factors; and differences in the number of groups between pairs of categories of municipalities for each factor

Variable	Kruskal–Wallis chi-squared	Degrees of freedom	*p*-value	Pairwise comparisons using Wilcoxon rank sum test (*p*-value)
Average altitude above sea level	12.39	2	0.002039***	<1,000 m versus 1,000–1,500 m: 0.1230 >1,500 m versus 1,000–1,500 m: 0.2378 >1,500 m versus <1,000 m: 0.0043***
Number of inhabitants	41.014	2	0.000000001242***	<5,000 inhabitants versus 5,000–10,000 inhabitants: 0.0022*** >10,000 inhabitants versus 5,000–10,000 inhabitants: 0.0359** >10,000 inhabitants versus <5,000 inhabitants: 9.2e-09***
Percentage of inhabitants under the age of 15	1.028	2	0.5981	–
Percentage of foreign citizens	5.4677	1	0.01937**	There are only Two categories of municipality ("<15%" and ">15%"). They are statistically significantly different from each other
Unemployment rate	0.61331	1	0.4335	–
Percentage of inhabitants with higher education (third level)	9.1928	1	0.00243***	There are only two categories of municipality ("<10%" and ">10%"). They are statistically significantly different from each other
Dominant political parties during the municipal elections (in the years 2000–2020)	11.299	1	0.0007754***	There are only two categories of municipality ("traditionally right-wing" and "others"). They are statistically significantly different from each other

Note(s): **Statistically significant at 5 % level; ***Statistically significant at 1 % level

municipalities regarding unemployment rates and the proportion of residents under 15 years of age. Regarding the local political context, the insignificant power of traditionally left-wing parties (SPÖ, GRÜNE, KPÖ) needs to be considered. This makes it impossible to identify the potential influence of municipalities dominated by traditionally left-wing parties and those dominated by traditionally right-wing parties (ÖVP, FPÖ, NEOS).

3.4 Temporal patterns

Information about the year of foundation was collected for 77 groups. Groups appear to have mostly been set up after the year 2010 [Figure 4(a)]. The latter might denote a boom in action in the last decade. Further evidence of possible failed cases in previous decades should, however, be collected, to confirm this hypothesis.

A hypothetical boom in action is connected to the emergence of groups working on the areas of food production and waste management. The former applied until 2017, when the number of groups involved in food production began to stabilize. The latter applied after 2017, which saw a sharp increase in the area of waste management [Figure 4(c)]. The initiatives started before the 2010s primarily emphasize the development of alternative currencies and more sustainable consumption habits.

If the temporal evolution in the spatial distribution of groups impacting the local level is considered, we notice that the first group that still exists emerged in Langenegg in 2008. This is a town of approximately 1,000 inhabitants. The towns of Bludenz and Feldkirch (two of the most populous towns), however, soon became clear hubs of action. Since then, action has remained mostly concentrated in the most urban environments (largest towns and adjacent municipalities), located in the Rhine Valley. No clear changes over time have been observed in the spatial patterns of entrepreneurial grassroots movements (Figure 5). This might be a sign of good momentum in the parts of the region where groups have emerged, but also of resistance in those parts that lack initiatives. The Moran's I statistic reveals, nonetheless, a random spatial distribution of the groups until recent years. Its value is equal to −0.009604 (p-value = 0.913668), −0.073556 (p-value = 0.189859) and −0.012361 (p-value = 0.973039) for the years 2009, 2014 and 2019, respectively. It only becomes statistically significant for the year 2021 (see Section 3.3). This is probably due to the small number of groups that existed until recently and the long existence of groups in a few municipalities scattered throughout the region.

Different activities/networks denote different spatial diffusion patterns. This is mirrored by the evolution of the most prominent networks. An analysis of, e.g. the spatial patterns of the "open fridge" network shows a distribution concentrated in the most populous towns and adjacent municipalities. The first group was founded in 2018 in Dornbirn (the largest town). Since then, the initiative has expanded predominantly to municipalities in the Rhine Valley and, particularly, to some of its most populous ones. This stands in sharp contrast to the reality of the "community-supported agriculture" network. The first group was founded in Zwischenwasser in 2012. This is a town of 3,000 inhabitants. Groups have afterwards emerged in other towns of similar size and, more recently, in towns of approximately 10,000 inhabitants.

Differences also emerge between networks regarding the evolution of the number of groups. These appear to be related to the network size and maturity. Exponential increases are observed for the recently created (2017) and relatively big (nine groups) network of open fridges. Contrastingly, an S-shaped curve is characteristic for the network of repair cafés (first group in 2012). The remaining smaller (four to six groups) three networks show a flatter curve [Figure 4(b)].

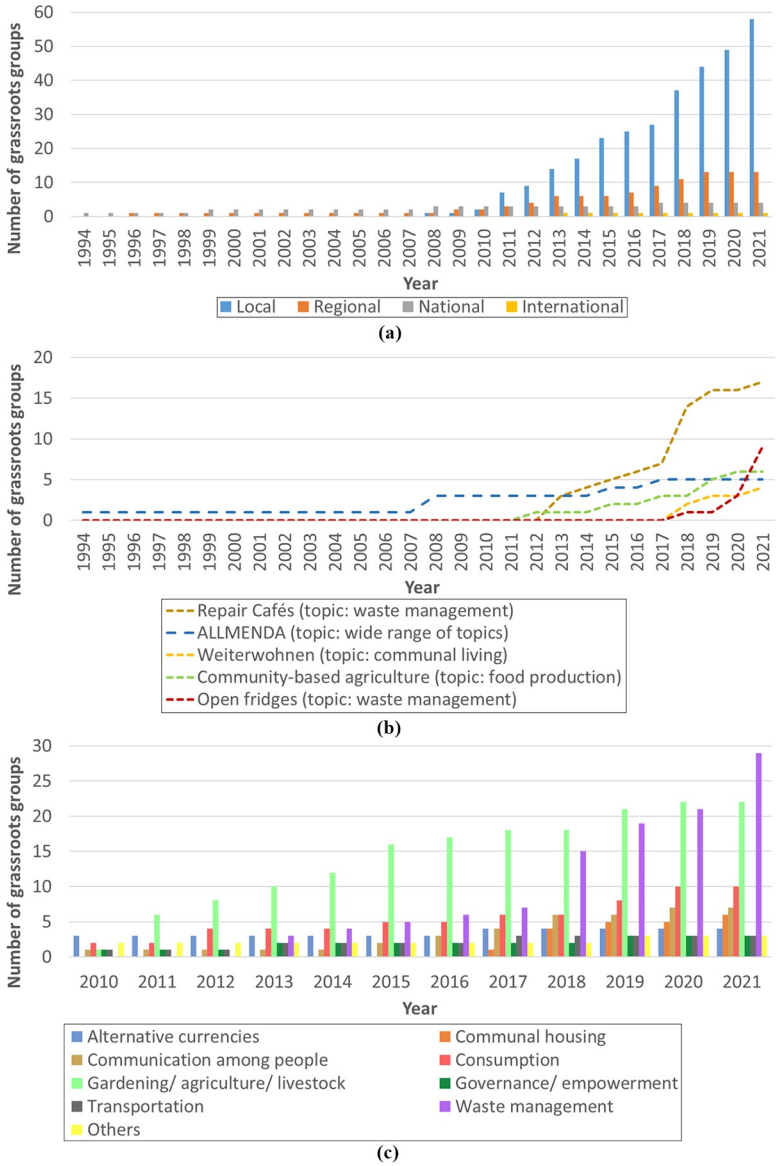

Figure 4. Temporal evolution of the number of entrepreneurial grassroots groups, (a) the targeted scale of their actions since 1994, (b) their evolution in the five most prominent networks of grassroots action and (c) a focus on their thematic focus since 2010*

Note(s): * Only the thematic areas with more than one grassroots group are shown

Source: Authors' own work

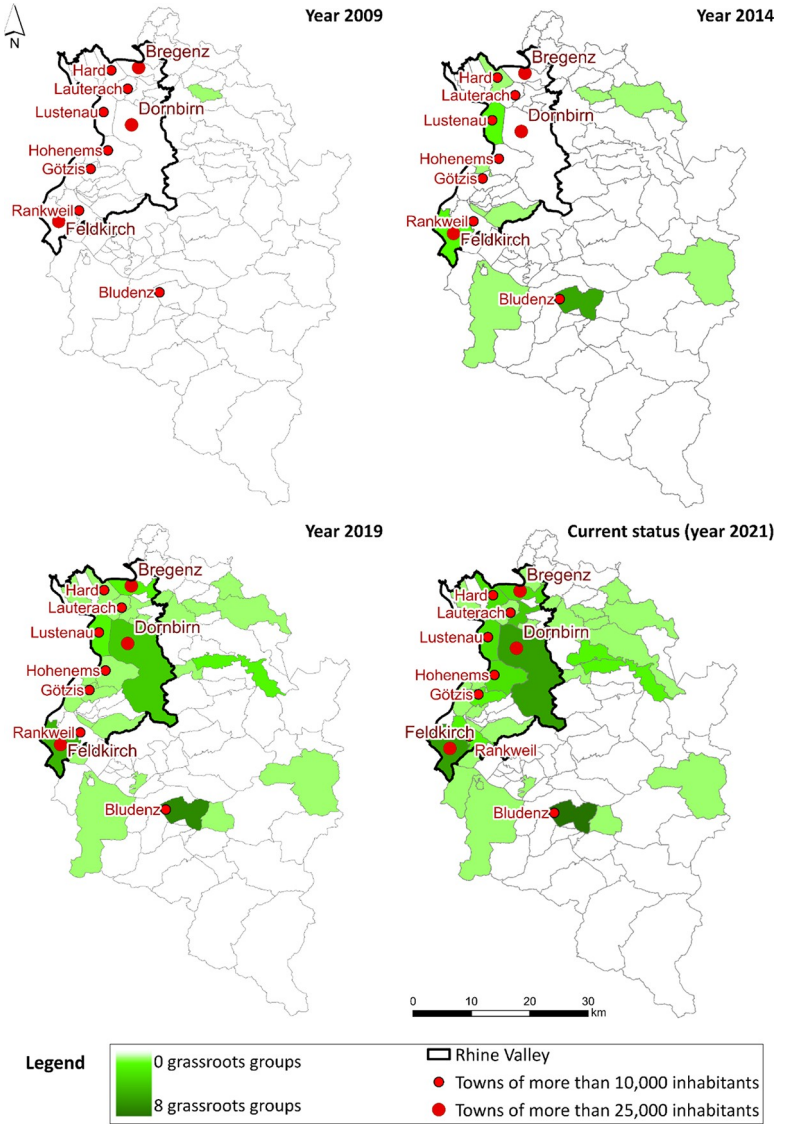

Figure 5. Temporal evolution in the spatial distribution of the number of entrepreneurial grassroots groups impacting the local level

Source: Authors' own work based on cartographic data in Geoland (2021)

If the "spatialized niche perspective" is used to analyse the evolution of grassroots-led change, the following is observed: initially, small grassroots groups create a niche to locally respond to a problem. Success stories related to this niche and the grassroots members involved usually become mobile afterwards. This forms the basis for other groups to develop

the same or similar niches. As a result, field-specific networks of local niches emerge for knowledge exchange. These networks generate specific territorial structures. In Vorarlberg, these do not usually extend beyond the regional level. Despite this fact, these structures turn local niches into genuine alternatives to the regime, with effects extending beyond the affected locations. An example is the "open fridge" network. The niche was started by a group of five people. Its success led to interest from the media and some society groups. This resulted in the mobilization of the initiators and their accumulated knowledge through participation in public events and the preparation of media reports. This sparked interest in the niche among groups from other localities, who eventually adopted it. A regional, sector-specific structure (network) emerged for the exchange of experiences. As a result, a shift occurred from an initially local niche to one with regional impact.

4. Discussion

4.1 Common traits and spatial, inter-scalar and temporal patterns in entrepreneurial grassroots action

Entrepreneurial sustainability-oriented grassroots action in Vorarlberg shows a spatio-temporal pattern. This is connected to local contextual factors and trans-local interrelations (Vlasov *et al.*, 2018). Feola (2016) analysed the spatiality of grassroots movements in England, France, Germany, Italy and Wales. They uncovered a concentration of initiatives in three capital cities and the traditionally left-wing province of Bologna. The most densely populated regions are also centres of action in the USA. Additionally, initiatives are more likely to be located in regions that have greater economic resources and a younger, less foreign and more highly educated population (Nicolosi *et al.*, 2018). These results partially mirror the reality in Vorarlberg. Action is primarily concentrated in the most urban municipalities. These are at the same time low-lying municipalities with a more highly educated population. However, unlike in Feola (2016), Feola and Butt (2017) and Nicolosi *et al.* (2018), municipalities containing groups are dominated by right-wing politics. This reinforces the finding in Nicolosi (2020) and Smith (2017) that right-wing environments can also trigger grassroots actions rather than only preventing them (Jacquet *et al.*, 2014).

Initiatives do not necessarily spread from urban centres to rural areas. In Vorarlberg, municipalities with low population densities have sometimes taken on the role of starters and spreaders in the transformation. In fact, many grassroots movements appear to have started in small towns (Kohl, 2021). One example is the Transition Towns Movement. This movement initially emerged in small towns in the UK and Ireland (Nicolosi and Feola, 2016); meanwhile, it has currently spread in smaller and larger towns alike (MacKenzie and Lewis-Hunstiger, 2017). This differs from patterns in the diffusion of technological and educational innovations observed e.g. in Hungary (see Lengyel *et al.*, 2020; Pálvölgyi and Horváth, 2023).

Moments of network and innovation expansion tend to coincide with a change in the spatial distribution of grassroots action (see Feola and Butt, 2017) and innovation adoption (see Lengyel *et al.*, 2020). In Vorarlberg, network expansion has to date corresponded to a diffusion to relatively adjacent municipalities. Similar to the Transition Towns Movement in Italy (see Feola and Butt, 2017), no substantial changes have occurred over time in the spatial patterns. The regional diffusion model described in Wang *et al.* (2020) seems to apply. According to this model, groups in one municipality are more likely to launch an initiative if groups in nearby municipalities have already done so. Stagnation in the spatial patterns suggests continued momentum in the parts of the region where actions have emerged. As argued by Kenis and Mathijs (2014), this might also be an indicator of the unequal distribution of social, environmental and financial capabilities among municipalities.

The number and variety of initiatives is steadily increasing (Schreuder and Horlings, 2022). In Vorarlberg, this appears to have been particularly true since the early 2010s. As observed by Feola and Butt (2017) and Wang *et al.* (2020), S-shape curves characterize the growth of networks that have existed for longer periods of time. Contrastingly, steady and even exponential increases are common for more recent networks. Driving forces for the increases in initiatives are often the development of awareness of the power of initiatives to bring about change; and the negative impacts of climate and global environmental change (MacKenzie and Lewis-Hunstiger, 2017).

Apart from contextual factors, the characteristics of the developed innovation and the group of adopters also influence the possibilities for diffusion (Dearing and Cox, 2018). Networking among groups is important for the diffusion success of entrepreneurial grassroots-led sustainability activities (Rocha *et al.*, 2021; Seyfang and Longhurst, 2016). Networking provides the groups unequal access to resources, such as ideas and knowledge about sustainability challenges and solutions (Vlasov *et al.*, 2018). Grassroots-led change today is a trans-local phenomenon. It involves: acquiring global and local resources; and attuning practices and resources to the needs of each place (Vlasov *et al.*, 2018). Schmid *et al.* (2021) identified different types of trans-local processes of knowledge transfer for initiative creation and diffusion. In some cases, initiatives are adopted from other groups and spread to other places under a common label. In other cases, groups are inspired by others and develop similar forms of organization (Schmid *et al.*, 2021). These two diffusion processes are characteristic of the networks of Repair Cafés, open fridges and Weiterwohnen; and community-supported agriculture and ALLMENDA, respectively. The presence of these networks in Vorarlberg corroborates the existence of diverse diffusion processes in the region.

Networking also enables influence to take place on different scales. Examples of that are the initiatives ALLMENDA and TALENTE. Their proponents have managed to scale up their actions from the local/regional level to the national and even international scale. This multi-scale potential is, however, often unused in Vorarlberg. Apostolopoulou *et al.* (2022) and Kratzer *et al.* (2022) noted that groups typically respond to perceived local challenges, at least in the initial stages. The recent boom in grassroots action in Vorarlberg might, thus, be one factor explaining the prevailing focus on the local scale. Effects on the regional scale are, however, already visible. Similar to the case of Bus Rapid Transit reported by Sengers and Raven (2015), group networking at the regional level leads to the emergence of alternatives to the regime at this level. The small size of most groups suggests that these alternatives, however, do not pose a serious threat to the regime (i.e. the status quo).

Greenhalgh *et al.* (2004) identified several internal group characteristics that affect the diffusion of innovations. These are: openness towards local perspectives, a learning culture, visionary group members, adaptive and decentralized decision-making, availability of methods for innovation assessment and proper resource allocation (Greenhalgh *et al.*, 2004). These characteristics generally apply to entrepreneurial grassroots groups. Grassroots groups use participative decision-making procedures and make decisions based on local needs and visionary ideas. Additionally, they use low-tech solutions and empowering approaches that can be easily used by groups in different locations (Seyfang and Longhurst, 2016). Their innovations generally meet the principles of simplicity, compatibility, and observability that Dearing and Cox (2018) identified as fundamental for innovation diffusion. In Vorarlberg, the fact that initiatives correspond to easy-to-implement alternatives may explain why many have been successfully replicated elsewhere in the region.

4.2 Limitations of the method and future research

The aim of this research was to understand the characteristics and spatio-temporal and inter-scalar patterns of entrepreneurial grassroots-led sustainability changes in Vorarlberg. However, some initiatives might have been neglected or assessed based on outdated data. This is due to the analysis relying on web-based information, so bias due to websites not being updated is possible. For example, the method might omit cases where initiatives had failed. Arguably, the number of cases of failure reported in this study is limited. The approach is satisfactory to gain a first insight about the spatial spreading of entrepreneurial grassroots-led change at a local scale. However, interview analyses and suchlike should be conducted in the future. This would enable a more accurate picture of the groups and their profiles to be discovered. Profile data are crucial to better understand the context-based emergence and diffusion of action (Dearing and Cox, 2018; Feola, 2016). This study constitutes a foundational step. Subsequent research should explore the underlying causal mechanisms and social dynamics. This might explain the emergence of action in particular contexts and thus shed light on interrelations between groups and contextual factors. It might also facilitate the identification of pathways for change.

Another limitation to acknowledge is that only one region was analysed. Municipalities with over 50,000 inhabitants were rare in Vorarlberg as were municipalities with a foreign population of over 30% and traditionally left-wing municipalities. This adds to regional socio-cultural and economic singularities (see Section 2.1). This requires an extension of the analyses to other regions. The objective should be to embrace municipalities representative of a wider range of political and socio-economic contexts. Only then would it be possible to assess more objectively the impact of the selected variables on change. Future research would also benefit from local-scale interregional analyses by revealing regional singularities. This includes singularities in contextual factors and in the number of groups and their profile. Hotspots of entrepreneurial grassroots-led change could be more accurately identified and strategies to support change in different contexts more objectively suggested.

5. Conclusions

This paper contributes to the understanding of spatial, temporal and inter-scalar patterns as crucial aspects for entrepreneurial sustainability-oriented grassroots-led change. The focus is on the crucial but little-researched local level. The region of Vorarlberg (Austria) was used as a case study.

Results reveal spatio-temporal and inter-scalar patterns in entrepreneurial grassroots sustainability-oriented action in Vorarlberg. The following can be noted. Its validity in other contexts should be the focus of future research:

- Action is concentrated in the most populated municipalities. Right-wing environments appear suitable for grassroots-led change.
- Change is fundamentally undertaken by small groups that respond to particular sustainability challenges on a targeted scale. The responses are largely small-scale.
- Trans-local arrangements are characteristic of the phenomenon. This primarily involves networking between groups within the region.
- Activities expand from urban and rural settings alike.
- Interest and perceived ability to bring about change have intensified since the early 2010s. They have developed especially for the areas of waste management and food production.

This leads to the definition of four key areas on which work is needed to further encourage entrepreneurial grassroots-led change in the region. These are the need to broaden the thematic focus of groups beyond food production and waste management; intensify networking with groups outside the region; encourage the up-scaling of actions; and promote change in less favourable contexts. The promotion of networking with groups in other contexts appears particularly important to bring about improvements in all these areas. These groups can bring new ideas about how to address both not yet covered and already covered sustainability issues under various contextual conditions. This includes knowledge about strategies for the advent, survival and up-scaling of initiatives. Equally helpful can be the creation of spaces for reflection and conflict resolution. Through them, groups are provided with tools for collaborative problem-solving. This can facilitate the resolution of in-group tensions and contribute to the long-term survival of the initiatives.

Policy can be crucial in generating favourable institutional environments. Long-term, stable and predictable technical, labour and financial support programmes should be set up. Their aim should be to help entrepreneurial grassroots groups build capacity, communicate and coordinate. The exchange of expertise with a confidential team of professionals can pave the way for groups to address topics with which they are unfamiliar. It can equally promote action in less favourable contexts. Such structures can also improve access to communication, coordination, and other tools and programmes. This can increase organizational resilience and external visibility and boost opportunities for new membership and networking. As a result, it can support the replication and scalability of the initiatives. Top-down support in awareness raising and citizen empowerment can equally contribute to the scalability of change. This is due to the capacity of top-down actors to reach citizens as well as the potential of these campaigns to increase the motivation and felt capability of participants to contribute to change. Above all, policy measures should be developed together with grassroots groups, to align them with their everyday needs.

Researchers are also called to play a role in promoting entrepreneurial grassroots-led change. Local-scale interregional analyses should be targeted in future research, carried out across a wide range of political and socio-economic contexts. This should include evaluations of grassroots profiles, contextual factors and spatio-temporal and inter-scalar patterns in grassroots action. Studies should not only rely on Web-based data but also use interview data (or similar) that reveal the dynamics of interactions between grassroots groups and other stakeholders. Only then will it be possible to objectively define strategies for change. These strategies should target both established socio-political structures and organizational aspects of grassroots groups. The transferability of these strategies among similar contexts could also be more precisely hypothesized. Importantly, academics will need to be open to share their knowledge with the groups and involve the latter in research. This can boost the pace of scientific data acquisition and help the groups overcome the barriers that they face.

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