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Short Paper
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Sustainability Objectives of Non-Profit Sharing-Economy Activities: Assessing Achievement. A Case Study of the Mundraub Food-Sharing Poject

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Abstract

Web-based participation has received growing interest over recent years. Such participation includes both profit- and non-profit-oriented sharing-economy initiatives. Not-for-profit sharing-economy initiatives focus less on economic aspects and more on awareness-raising in society regarding sustainability objectives (e.g. sustainable production and consumption of goods). In the current discussions around climate change and sustainable lifestyles, awareness-raising is important and new ways of reaching the public are attracting more interest. The question now is not simply to what extent non-profit sharing-initiatives achieve their goals, but how to assess any achievement as, due to the nature of these projects, little information on the participants' background, perspectives and behaviour is available.

These questions are discussed with reference to the Mundraub project, which allows people to share information on plants (e.g. fruit and nut trees, berry bushes and herbs) in public urban spaces (primarily German cities) so that others can harvest the plants for free. To learn about how sustainability objectives are achieved, data for the sites where the plants that have been mapped to Mundraub are located were analysed statistically. The results indicate that the people who are reached by the Mundraub project are mostly those who are already interested and aware of sustainability-related topics. The assessment approach used is a first attempt towards a better understanding of the extent to which the sustainability objectives of non-profit sharing-economy activities have been reached and towards identifying how the achievement of objectives might be improved on.

Keywords:

sharing economy, non-profit sharing-activities, sustainability, participation, food

1 Introduction and Research Questions

The rapid advance of Information and Communication Technologies (ICT), the rise of the Internet, the emergence of social media, and the growth in Internet user numbers have triggered new modes of participation. These include the 'sharing economy', in which consumers grant each other temporary access to under-utilized physical assets, possibly for

money, enabled by web-based platforms. As it allows any kind of goods and services to be shared, the sharing economy covers sectors such as transportation, accommodation, the labor market and education, but also food (Frenken & Schor, 2017; Ganapati & Reddick, 2017). A distinction is made between sharing-economy activities run by companies to make a profit (e.g., Uber, Airbnb), and non-profit, voluntary projects (IICOM, n.d.).

Various objectives of the sharing economy are highlighted in the literature: reducing negative environmental impacts through decreasing the amount of goods to be produced and transported, lowering costs for consumers, and accelerating sustainable production. Moreover, non-profit sharing-economy initiatives in particular stress objectives such as raising people's awareness about sustainability, and changing their behaviour towards greater sustainability (Berchem, 2016; IICOM, n.d.; Rudenko, 2013). In what follows, these objectives are summarized under the umbrella term 'sustainability objectives'. Due to current discussions around climate change and movements promoting sustainable lifestyles, sustainability objectives are attracting increasing attention. In this context, the literature outlines that by involving people in different ways and at different levels, participatory approaches contribute significantly to increasing people's awareness and their positive attitudes toward environmental and public concerns (Bonney et al., 2009; Cohn, 2008; Newman, 2012).

Understanding to what extent non-profit sharing-economy initiatives actually reach the public and their own sustainability objectives is of interest but difficult to assess. This is because – as common in participatory projects and particularly non-profit sharing-economy activities – there is little data available on who participates. To register, for instance, users usually only have to provide a username and/or email in order to access the information being shared (see, e.g., Klein et al., 2019; Vogler et al., 2017). When data such as socio-demographic categories or land use is available on a site that makes available information about a resource to be shared, this information can help to characterize participants. The question is how useful this approach is to gain insights into the extent to which sustainability objectives are being met. This is discussed through the example of the not-for-profit sharing-economy project Mundraub (Box 1), which was chosen because food-related topics such as food sustainability and sovereignty, local and global food movements, and food-sharing activities are attracting more and more attention.

Box 1: The Mundraub project (Berchem, 2016; Keppler & Faust, 2017; Klein et al., 2019; Mundraub, n.d.)

Key data	The Mundraub project (initiated 2009; https://mundraub.org) is a food-sharing initiative with the aim of having the public share their knowledge on fruit and nut trees, berry bushes and herbs in the public spaces so that others can harvest them. Focus is on plants located in the urban environment in Germany. Similar projects are falling fruit (http://fallingfruit.org/) or na ovoce (https://na-ovoce.cz/web/) and initiatives like foodsharing (https://foodsharing.de/).
Providing and using information	Information on plants is provided by adding plants to an interactive online map embedded in the Mundraub platform and a mobile app. Information includes the location of the plant, the species, and taste rating. The plants are grouped into four categories: fruit (9 species) and nut trees (4 species), berry bushes (13 species), and herbs (7 species). Using the Mundraub map, others can access the information on plants, and thus find and harvest them. While the mapping of plants requires users to register, searching the map for plants can be done without registration. As with other non-profit participatory, sharing-economy initiatives, only limited personal data is required when registering on Mundraub: username, password and email.
Pecularities	To attract people's interest, local Mundraub groups exist and organize activities (harvest camps, sharing traditional recipes, etc.) which allow for personal, face-to-face contact of the people involved or interested in the project. City and/or community administrations are invited to add data to the Mundraub database (e.g. tree data available by tree cadastres).
Aims and Objectives	The Mundraub project has several non-profit aims and objectives which are particularly relevant to society: to have people discover and use edible landscapes, to connect people with nature, to raise their awareness of topics such as resources and their use, regionality and seasonality of food, food sovereignty and local food movements. Moreover, the project may trigger people to change their behaviour towards a more sustainable lifestyle and to increase their identification with the local environment. The project also serves as a channel for collaboration and participation, and to foster social interaction and partnership.

2 Workflow and methods

The approach used comprises four steps (Figure 1): (1) accessing Mundraub data; (2) identifying and accessing data for sites where plants that have been mapped to Mundraub are located (e.g. sociodemographic and land-use data, referred to from now on as 'explanatory data'); (3) preprocessing, and (4) analysing the Mundraub and explanatory data together.

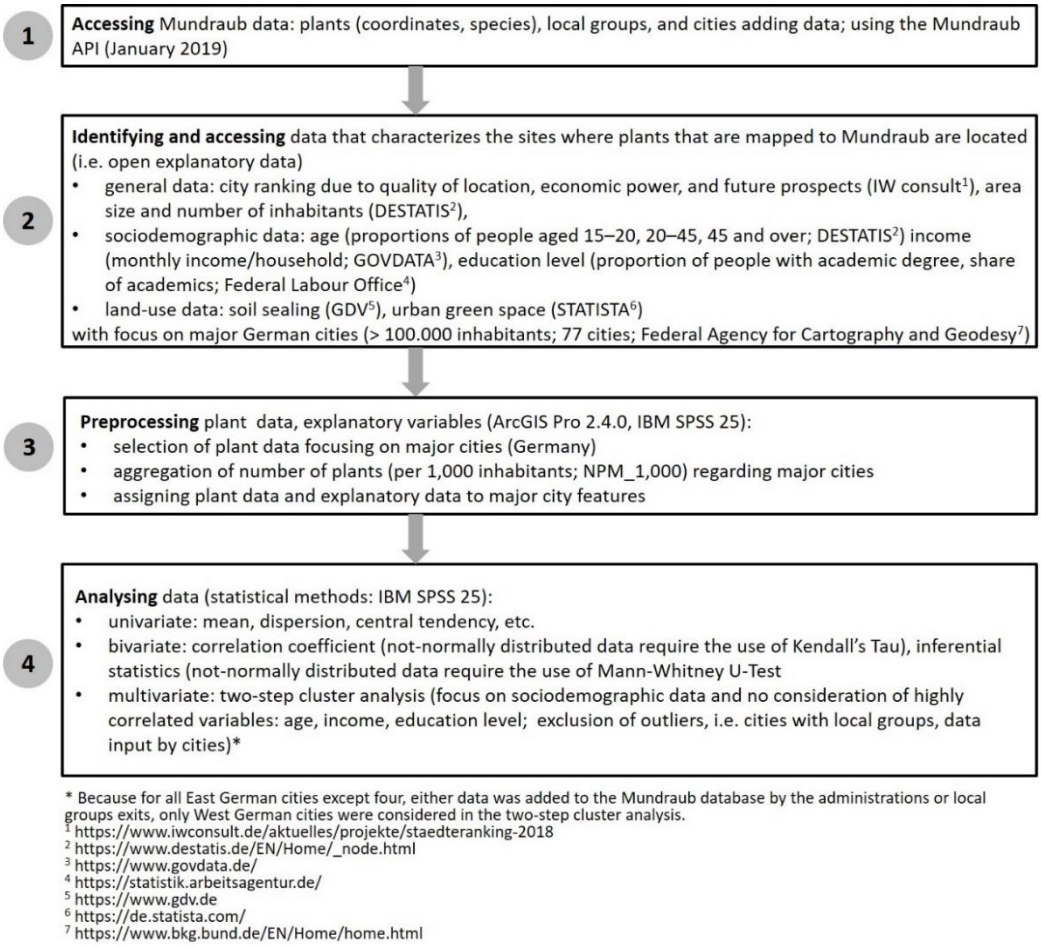


Figure 1: Workflow steps with data and tools, and methods used

The Mundraub project provides an Application Programing Interface (API) that allows accessing data from the Mundraub database. When HTTP requests are made to the Mundraub API, the data on plants (coordinates, species) and local groups (coordinates) are delivered in JSON format (status: January 2019).

Various aspects of the explanatory data were identified. Although a wide range of data for German cities and communities exists, explanatory data is not available to the same extent for all cities and their sub-districts. Consequently, focus was on major German cities (> 100,000 inhabitants; 77 cities) for which explanatory data was available as open data and/or free, and each city was considered as a whole.

The Mundraub data was aggregated at city level as number of plants and local groups per city. To improve readability and handling, the number of plants per city is referred to as number per 1,000 inhabitants (NPM_1,000; see, e.g., Klein et al., 2019).

The Mundraub data and the explanatory data were assigned to the corresponding city features. The data was analysed by applying uni-, bi- and multivariate statistical methods. The results from uni- and bivariate statistical analyses allowed decisions to be made on appropriate bivariate and multivariate statistical methods, as well as on which data it was appropriate to take into account.

3 Analysis results

The Mundraub database holds data on 47,519 plants, 98% of which (46,533) are located in Germany (Figure 2). 65% of the plants (31,084) have been mapped in German major cities. Of the 163 local Mundraub groups, 63 are located in 35 of these cities. The Mundraub data includes information provided by the public and data contributed by several city administrations. The city administrations of Berlin, Hamburg, Frankfurt/ Main, Leipzig, Bonn and Osnabruck have contributed data on trees located in their areas.

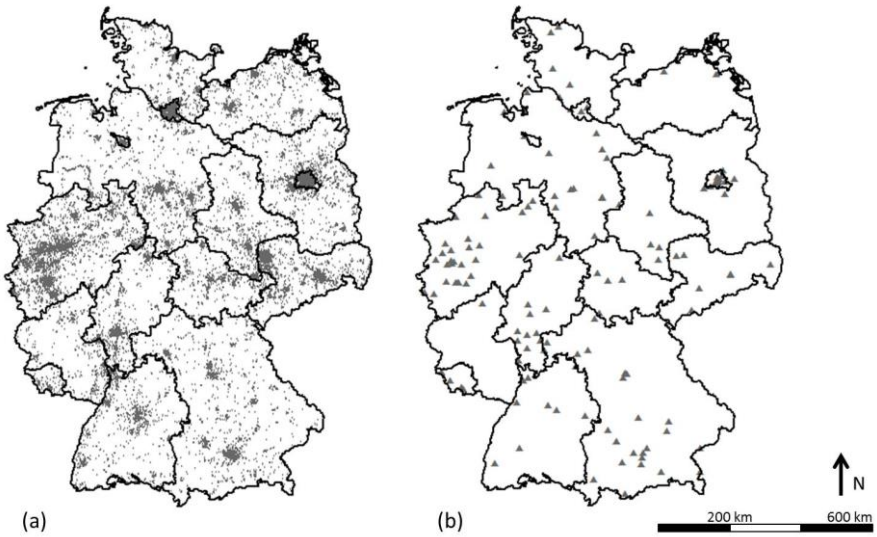


Figure 2: Mundraub data (Germany): (a) plants mapped; (b) local groups

With respect to NPM_1,000, the statistical results indicate differences between: (1) cities where city administrations contributed data on trees to the Mundraub database or not; (2) East and West German cities[1]; (3) cities with and without local groups. The significance of the

[1] There are notable differences between East and West German cities in terms of tree density, due to the different political and economic trajectories followed by the two German states after the Second World War. In West Germany, the rapid economic recovery after the war allowed people to buy fruit cheaply throughout the year. In East Germany, fruit trees were still being planted in housing estates in the 1990s, while in West Germany they had been replaced by ornamentals. These differences resulted in far-reaching consequences for green development in West and East German cities, which is also reflected in the Mundraub database (Larondelle & Strohbach, 2016).

differences between these cities (East/West German city; city data input/no city data input; city with/without local groups) was confirmed by inferential statistical tests (Mann-Whitney U-Test): the null hypothesis (no differences between the samples) was rejected for each group (Table 1). In a nutshell, East German cities, cities where the administration added data to the Mundraub database, and cities with local Mundraub groups have higher NPM_1,000 than West German cities, cities where the administration did not add data to the database, and cities without local Mundraub groups.

Table 1: Inferential statistical tests (Mann-Whitney U-Test) for different groups of cities

Groups of cities	Asymp. Sig. (2-tailed)	Sample size
City data input/no city data input	P=0.00 (p< 0.05)	Data input 6; no data input = 71
West/East Germany	P=0.00 (p< 0.05)	East Germany = 10; West Germany = 67
City with/without local groups	P=0.02 (p< 0.05)	Local group =34; no local group = 43

Running correlation analysis (Kendall's Tau) and two-step cluster analysis delivered additional information. Kendall's Tau results revealed relationships between the age-related demographics of a city and education level on the one hand, and NPM_1,000 on the other (Table 2):

- the smaller the proportion of people aged over 45, the higher the NPM_1,000
- the smaller the proportion of people aged 15–20, the higher the NPM_1,000
- the higher the proportion of people aged 20–45, the higher the NPM_1,000
- the higher the proportion of people with academic degree, the higher the NPM_1,000.

Table 2: Correlation analysis results (Kendall's Tau): sociodemographic/land-use data and NPM_1,000 (data sources: DESTATIS, Federal Labor Office, GDV, Govdata, IW consult, STATISTA; see Figure 1)

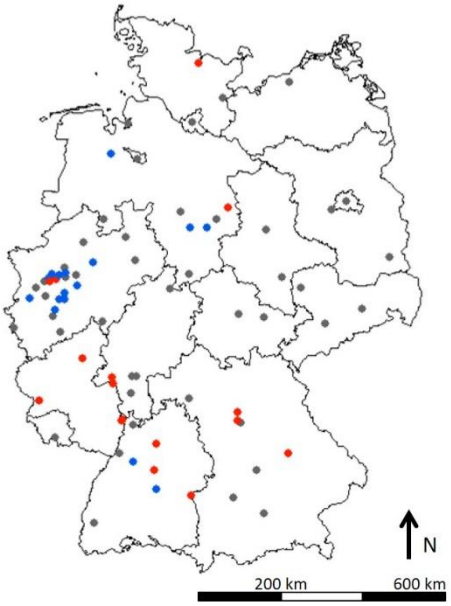
Variables	Correlation coefficient	Sample size
number of inhabitants (1,000)	0.141*	77
area (km²)	0.185*	77
aged 15–20 (share)	**-0.371**(2)**	70
aged 20–45 (share)	**0.293 (1)**	70
Aged over 45 (share)	**-0.205* (1)**	70
Income per household (1,000 €)	-0.118	72
academics (percentage)	**0.287** (1)**	73
city level ranking	-0.192*	71
soil sealing (percentage)	-0.043	50
urban green space (percentage)	-0.033	14

* significant, alpha = 0,05 (2-tailed); ** significant, alpha = 0,01 (2-tailed);
(1) weak relationship; (2) medium-strong relationship

The two-step cluster analysis identified two clusters (good cluster model quality; Figure 3):

- Cluster 1: cities with a smaller share of older (> 45 years) and younger people (15–20 years), higher monthly income per household, and higher share of academics have a higher NPM_1,000
- Cluster 2: cities with a higher share of older (> 45 years) and younger people (15–20 years), lower monthly income per household, and smaller share of academics have a lower NPM_1,000

The Mann-Whitney U Test (N = 32; p <=0,046 asymp. sig. 2-tailed) confirmed that there is a significant difference between the two clusters regarding NPM_1,000.



Cluster 1

Cluster 2

Other major cities (city inout, local groups)

Variable	Cluster 1 Mean Std. Deviation	Cluster 2 Mean Std. Deviation
age older 45 (share)	51 2.08	46.03 3.34
age 15–20 (share)	5.18 0.2	4.68 0.25
income/household (1.000 €)	20,235 2,172	23,298 3,555
academics (share)	12 3.02	20.52 5.50
NPM_1.000	0.2527 0.29	0.33 0.24

Figure 3: Cluster analysis results (data sources: DESTATIS, Federal Labor Office, Federal Agency for Cartography and Geodesy, Govdata; see Figure 1)

4 Discussion

At first glance, the number of plants (47,519) available in the Mundraub database seems high, but if we focus on the cities, a different picture emerges: in general, the individual cities are characterized by a small number of plants mapped (i.e. NPM_1,000). This also applies to cities where data on trees has been added by the city administrations – even though for these cities NPM_1,000 is higher in comparison to cities where no data on trees has been added by the city administrations (Table 3).

Table 3: Number of plants available in the Mundraub database (German major cities)

City	number of plants	NPM_1,000	number of (fruit/nut) trees per 1,000 inhabitants	number of herbs/shrubs per 1,000 inhabitants
Berlin	9,488	2.6	2.34	0.29
Hamburg	4,110	2.2	2.02	0.22
Frankfurt/ Main	2,564	3.4	3.18	0.25
Leipzig	2,456	4.2	3.42	0.81
Bonn	1,424	4.4	4.11	0.26
Osnabruck	346	2.1	1.86	0.25
Other cities (N = 71): median, min. – max.	*100, 0–766*	*0.45, 0–2.2*	*0.22, 0–1.86*	*0.19, 0–0.96*

In addition to the quantity of data, the number of people actively participating in a community related to a project is key for the achievement of participatory project objectives. Projects are often challenged by a low number of people contributing to, or interested in, the initiative (Hennig, 2019). Hakley (2013) notes that, generally, just a small share of committed users add the vast majority of data to an initiative. Thus, it can be assumed that of the 71,000 registered users, only a small number of individuals are actively contributing to and engaged in the Mundraub project. Here, it should be noted that a large but active community (e.g. including members who act as disseminators and role models; Hennig, 2019) would attract more people; this also has an impact on the number of people actually reached by a project and the extent to which objectives will be met.

Although participatory projects aim to involve people from a wide variety of backgrounds, participants often come from certain backgrounds only and/or belong to particular segments of society (King & Brown, 2007; Vogler et al., 2017). Regarding the Mundraub project, the analysis results show that cities with certain sociodemographic characteristics have a higher number of plants mapped (Figure 3): i.e. cities characterized by a higher monthly income per household, higher education levels (more academics), and fewer people aged over 45 or aged 15–20. This is in line with other studies outlining that people with higher educational levels and income are often among those engaged in plant foraging (Arrington et al., 2017; Synk et al., 2017). Generally speaking, these are also the people who are interested in sustainability and environmental topics (see, e.g., BMU & BfN, 2017). This suggests that not everyone in society is equally attracted by and aware of the Mundraub project: the project seems to reach mainly people who are already interested in, and aware of, sustainability objectives.

To improve the extent to which sustainability objectives are achieved, the results allow the following recommendations to be made:

- increasing synergies between the Mundraub project and other initiatives and organizations (e.g. other participatory initiatives such as OpenStreetMap; urban gardening initiatives) in order to increase, on the one hand, the amount of data available in the Mundraub database and, on the other hand, project publicity

- facilitating contacts between people involved and interested in the Mundraub project (e.g. through local groups and events)
- addressing those segments of society which so far have been reached scarcely or not at all; to promote the project and its aims, group-specific motivational factors and communication channels should be taken into account.

5 Conclusion and Outlook

The sharing economy is drawing growing interest, including in the form of non-profit initiatives such as the food-sharing project Mundraub. The project's objectives refer in particular to issues like awareness raising and changing people's behaviour with respect to sustainability. However, the extent to which these objectives are being achieved is difficult to ascertain since little data is available on participants (i.e. individuals who share data, or who use the shared data). Analysing the Mundraub data together with explanatory data (i.e. data characterizing the sites where plants have been mapped, with a focus on German major cities) shows that the project (including its objectives) seems to reach only a relatively small number of people – primarily individuals who are already interested in sustainability.

Using explanatory data and focusing on German major cities has certain limitations, due to considering the cities as wholes, and the use of just a few variables. The results give only an idea of the general situation (e.g. the sociodemographic characteristics of those interested). However, the results are in line with the results other studies and allow us to draw some initial conclusions regarding the extent to which sustainability objectives are being achieved, and to gain a better understanding of the situation. The approach could therefore be useful for other participatory and non-profit sharing-economy projects. Nevertheless, it needs to be improved: it would be useful to have access to data at the level of individual city neighbourhoods, and not only for major cities in Germany.

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