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Insect-Friendly Path Margins and Diverse Stakeholder Perspectives - A Dialogue And Communication Strategy For The Agricultural Landscape On The Left Bank Of Rhine-Sieg District, Germany

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ABSTRACT

In intensively used agricultural landscapes, path margins are one of the few refuges and nurseries for wildlife. They provide e. g. food sources and overwintering opportunities for many insects, serve as migration corridors for animals, protect soil from erosion, increase its water-holding capacity, and increase soil organic carbon, contributing thus directly to biodiversity conservation and climate change mitigation. Path margins are often municipally owned but used and managed by agriculture. For a path margin to be functional, certain conditions must be fulfilled, such as the width, the botanical composition, and how it is managed through the seasons. Therefore, it must be managed under specific requirements. A multifunctional path margin can be achieved only through the commitment of all stakeholders (e.g., farmers, municipalities, conservationists, and civil society).

In this study, we assessed the different stakeholders' perspectives in implementing an insect-friendly path margins project in the agricultural landscape on the left bank of the Rhine between the Eifel and the Rhine in the German Rhine-Sieg district developing and implementing a communication strategy. Three main activities were implemented: (1) A Q-Study build the basis for a (2) local stakeholder dialogue workshop and (3) the development of social media materials to communicate project activities.Part of the communication strategy was the Q-Method. This method allowed us to identify the different positions of stakeholders regarding municipal blooming path margins. Through a literature review, 65 statements on insect protection in path margins were pre-selected (first stage), and an additional expert survey was implemented to validate this pre-selection. After the validation of experts and the merging of similar statements, a set of 35 statements was identified as the Q-Sample (second stage), further this 35-statement set was used in a stakeholder survey to rank and sort according to the own stakeholder's views (Q-Sort, third stage), data was analyzed using factor analysis (fourth stage). As a result, two main factors or perspectives were found: *A) perspective on insect-friendly protection measures and, B) perspective on the maintenance and avoidance of negative effects*. Finally, these different perspectives were presented and

discussed in a stakeholder workshop contributing to the project's communication activities and setting the basis to discuss further project activities taking into account the identified perspectives from local stakeholders.

INTRODUCTION

Effective stakeholder communication is essential to improve biodiversity conservation, and action, timely and clear communication of project activities are prerequisites to encourage participation (Maze et al. 2016; Robinson 2021). Stakeholder involvement in implementing biodiversity conservation plans can lead to better social and biodiversity outcomes (Young et al. 2013; Villamor et al. 2014; Jones-Walters und Çil 2011). Furthermore, consensus building through the participation of stakeholders plays a significant role in the biodiversity conservation practice. Therefore, the participation of stakeholders should be considered in the early stages of the biodiversity conservation processes integrating local and scientific knowledge (Jones-Walters und Çil 2011; Reed 2008). Using different communication outlets increases the chances of reaching a broader spectrum of stakeholders; one of these outlets is the stakeholder's participation in the construction of dialogues. *Stakeholder dialogues as* socially constructed processes enable parties to interact and allow the exchange of information to strengthen the relationships among the parties on a specific issue (Cuppen et al. 2010; Silva und Campos 2020; Robinson 2021). Another communication method is the use of information technology, specifically social media, which can play a relevant role in creating sustainable behaviors (Viglisnisi und Sabella 2011). Social media is an effective tool that allows two-way and real time interactions and provides broader opportunities to present information (e.g., photos, videos, chat interactions). In addition, to the classical communication methods (stakeholders surveys, meetings, and presentations) which are particularly relevant for the acceptance and building of stronger relationships in biodiversity conservation programs or projects (Bourne 2016).

Vernetztes Rainland

The project 'Vernetztes Rainland'[1] is a cooperation between three German partners: the Europäischer Tier- und Naturschutz (ETN e.V.), the International Centre for Sustainable Development (IZNE) of the Bonn-Rhein-Sieg University of Applied Sciences (H-BRS) and the Biological Station Rhine-Sieg-Kreis. Within the framework of this project, suitable areas in municipal ownership are to be made available for insect protection in cooperation with agriculture representatives, the municipalities, and other relevant stakeholders, through the implementation of insect-friendly measures in the path margin, including long-term management plans. In addition, the project aims to develop a model for insect protection in intensively used cultural landscapes with different utilization priorities, which not only directly helps the endangered species but also significantly increases the attractiveness of the landscape for the population living there.

The IZNE-H-BRS takes over the establishment of a communication concept to build up a dialogue between stakeholders. The Biological Station Rhein-Sieg-Kreis has the task of developing and testing measures that preserve and increase the biodiversity in the cultural landscape on the left bank of the Rhine between the Eifel and the Rhine in the Rhine-Sieg district (municipalities of Swisttal, Bornheim, Alfter, Rheinbach, Meckenheim, and Wachtberg).

In this study, we use the Q-Method as part of a communication strategy to explore the different perspectives of the relevant stakeholders, support dialogue for implementing insect-friendly measures in municipally owned path margins and identify points of consensus and further action.

[1] www.h-brs.de/de/vernetztes-rainland

METHODOLOGY

Communication strategy

A stakeholder communication strategy is a process of creating and interpreting messages. The goal is to create general knowledge, provide essential information, and raise awareness concerning the topic (Schroer et al. 2021; Sharma 2008). The communication package of this study included surveys for experts and stakeholders to feed into the Q-Study and parallelly inform about the project, the development of social media materials (Instagram and Facebook), and a stakeholder dialogue workshop where preliminary results of the Q-Study and field activities of the project were presented to discuss further action and have feedback on the presented results.

Q-Method as one part of the communication strategy

…The Q-Method is an instrument to study subjectivity objectively… (Brown 1993).

This research uses the Q-method to identify the stakeholder´s perspectives towards implementing insect-friendly path margins as part of a communication strategy to promote stakeholder engagement and awareness.

The Q-Method is an explorative and semiquantitative technique for exploring the different perspectives, opinions, and attitudes of people and consists of a series of stages explained below (Brown 1993) . William Stephenson originated the Q-Methodology[2] in 1935 (STEPHENSON 1935), and it is used in qualitative research to understand stakeholder perspectives in various natural resource situations (Ramlo 2016; Epstein et al. 2018). The Q-Method intends to identify patterns among individuals, revealing the diversity of voices and points of view of stakeholders of particular importance in stakeholder engagement processes (Barry und Proops 1999).

Concourse (first stage)

The first stage of the Q-Method is the identification of the "concourse," which represents the diversity of opinions and perspectives on the topic in question. The statements representing the concourse were defined by analyzing written narrative sources such as scientific publications, media reports, grey literature, and social media. Incorporating stakeholders´ perceptions and voices and their direct involvement in biodiversity management practices should lead to better positive outcomes for biodiversity conservation (Villamor et al. 2014). In this sense, the search of the different sources focused on topics such as agriculture and biodiversity conservation in Germany and perceptions towards municipally owned path margins. Key themes were identified and categorized, ideally representing a diverse discourse on the topic in question.

Expert survey – Q-Sample (second stage)

The Q-Sample collects items that participants select and sort according to their perceptions and personal views (Watts und Stenner 2005). In order to validate the pre-selected statements in the first

[2] The name derives from the distinction between person correlations/subjectivity (Q) as opposed to R methods, which focus on studying objectivity (McKeown und Thomas 1988).

stage, an expert survey was created. The experts were identified via the snowball approach; as experts, we considered people involved in biodiversity conservation, agriculture, academia, and local municipalities of the German Rhine-Sieg district. Next, experts were asked to express if the pre-selected statements represented the key themes and check for appropriateness in terms of language and clarity.

Stakeholder survey-Q-Sort (third stage)

The Q-Sort is the process where study participants rank-order the Q-Sample according to their perspectives and opinions using a condition of instruction (McKeown und Thomas 1988). Recruitment of participants was done using the snowball approach, ensuring the representation of all relevant stakeholder groups, and they were contacted via email. The target groups were farmers and land owners, municipal representatives dealing with biodiversity and municipal lands, and biodiversity conservation representatives. The Q-Survey was administered online using the Q-Sort Application (qmethodsoftware.com). The participants were asked to sort the statements according to their priority using a Q-Sort grid (Fig. 1). A 10-points scale was used for the ranking that went from -5 (low priority) to +5 (high priority). The survey also included questions regarding stakeholder cooperation to complement the Q-Sorting results.

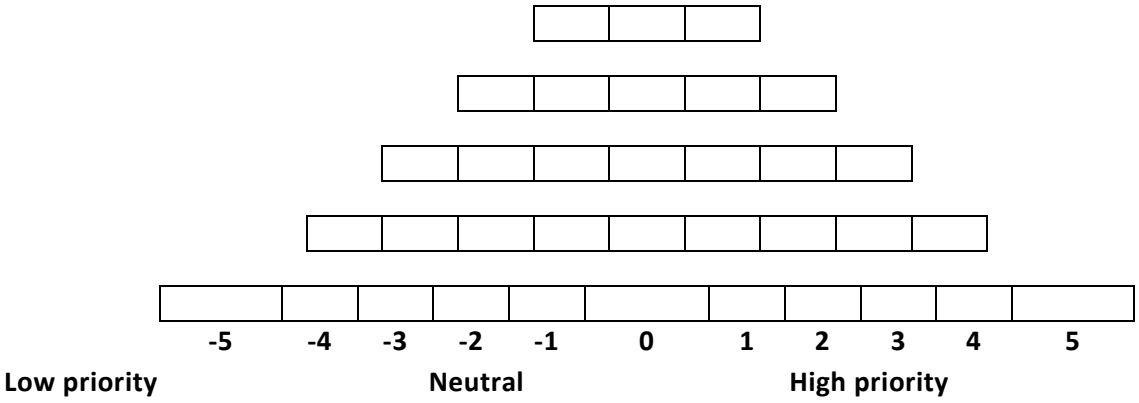

Fig 1. Q-Sort grid.

Factor analysis to determine stakeholders' perspectives-Data analysis (fourth stage)

In Q-Methodology, there are three essential procedures to analyze the data: the creation of a correlation matrix of the Q-Sort, representing similarities or discrepancies in the points of view of the respondents (McKeown und Thomas 1988; Forouzani et al. 2013), a factor[3] analysis and a factor score or interpretation. The data from the Q-Survey was analyzed using the Q-Method Software (Coogan und Herrington 2011).

Data was analyzed through correlation and principal component analysis. The factor analysis in this Q-Study was used to determine and group the participants' different perspectives or points of view in factors (Brown 1993). The criteria to select the different factors were based on the Kaiser-Guttman criterion, where the number of factors equals those with eigenvalues greater than 1.0 and at least two-factor loadings with a significance of $p < .01$ (Barry und Proops 1999; Forouzani et al. 2013; Epstein et al. 2018). Factors were rotated using a Varimax algorithm to maximize high- and low-value factor loadings and reduce the number of factors to be interpreted (Encyclopedia of Social Measurement 2005).

[3] A factor is the weighted average Q-sort of a group of respondents that responded similarly (Zabala und Pascual 2016.

RESULTS

In this study a preliminary set of sixty-five statements was extracted and organized into four recurring themes:

1. The impact of agriculture on insect biodiversity
2. Perspectives of insect conservation in agricultural landscapes
3. Cooperation among the stakeholders
4. The role of the path margins for the biological protection of species

After the validation from the expert´s survey, team review and merging of similar content, 35 statements (Table 1) were selected to proceed in the further stages of the study.

Table 1. Statements and the factor scores for each statement

#	Statement	Perspectives Factor score[a]	
		A	B
1	Insect populations are declining, especially in intensively managed agricultural landscapes.	2	-1
2	Enforcement of insect conservation threatens the livelihoods of many farmers and the profitability of their operations.	-5	0
3	The cooperation between agriculture, forestry and nature conservation functions well when it comes to insect conservation.	-2	-1
4	When it comes to insect conservation, it's not a matter of "if?" but "how?".	0	-2
5	Insects are an essential component of biodiversity and play a crucial role in our ecosystems. Many insect species provide elemental ecosystem services.	5	1
6	The costs of insect conservation have been shifted to farmers and land users.	-3	0
7	Habitat isolation resulting from homogenization of landscapes and fragmentation of natural habitats have negative impacts on biodiversity.	1	0
8	Farmers should be able to earn money from nature conservation.	-1	0
9	Insect conservation only works in cooperation with farmers.	1	3
10	High flexibility regarding the type and location of insect protection measures is particularly important.	0	4
11	Farmers incorporate path margins into the agricultural use of their fields to increase the usable area and minimize the pressure of insect pests and weeds on their land.	0	-3
12	Municipalities should develop and implement concepts with concrete measures for insect protection on municipal owned spaces.	2	2
13	Margins constitute areas that are too insecure to be legally considered as compensation and to be recorded in the land register.	-2	-2
14	Path margins along rural roads are habitats for insects, promote structural diversity in the agricultural landscape and improve landscape connectivity.	3	-2
15	The necessary personnel and financial capacities must be granted and strengthened for consistent ecological green space management at the state, district and municipal levels with appropriate maintenance measures.	4	3
16	The opinion of farmers is well represented by the media.	-4	-2
17	Path margins generally do not belong to farmers, so it is appropriate to require that agriculture does not interfere with path margins through fertilization, pesticides, use or mulching.	1	-4
18	Insect populations are also declining massively in protected areas due to diffuse nitrogen pollution, light pollution, exotic plant cultivation, excessive maintenance of green spaces, etc.	1	1
19	The valorization of existing path margins, for example by enriching them with regional seeds and adapted maintenance, should be recognized as a compensation measure for interventions in nature and landscape.	-1	2
20	Rotary mowers are an insect-friendly mowing technique.	-2	-3
21	The mowing technique, mowing time and mowing frequency have an effect on the composition of the species communities in pathways, i.e. individual species are favored, others are displaced.	4	-0
22	The wild herbs that coexist with the cultivated crops in the fields are important for the	3	1

	conservation of insects.		
23	Farmers have many opportunities to make their own lands along riparian corridors more insect-friendly through contracts for nature conservation, offset measures, or other offerings, and to receive compensation for doing so.	-1	-1
24	Path margins are generally necessary for agricultural operations (e.g., for turning maneuvers, to access adjacent land, etc.).	-2	-1
25	Agricultural policy provides a flexible framework and supports farmers in implementing insect-friendly measures.	-3	- 1
26	Conservation measures must not be associated with economic disadvantages for the farmers and must fit into the farm structure.	0	5
27	The rehabilitation of path margins should not be recognized as a compensation measure. The consequences of years of incorrect management must be assumed by the people responsible for the damage.	1	-4
28	Biotope connecting lines such as hedges, fringes and borders along paths, roads, watercourses, ditches, field and forest edges create the basis for a biodiverse landscape	3	-2
29	Balance must always be struck between the nature conservation objective and practicable implementation for farms.	-1	4
30	The integration of insect protection in landscape and urban land-use planning and in municipal bylaws is necessary for the promotion of insect protection on municipal land.	2	1
31	The maintenance of path margins is generally carried out in an insect-friendly manner.	-3	-3
32	Path margins must be designed in such a way as to avoid negative influences on the adjacent land, such as delaying ripening due to shading or the spread of ragwort.	-1	3
33	Even narrow path margins can make a valuable contribution to habitat connectivity.	2	2
34	Path margins in the open countryside must look tidy.	-4	-5
35	The maintenance of roadsides by farmers is welcomed by the municipalities.	0	1

[a]Short definition factor scores: positive factor scores indicate that the statement has a high priority for the participant, while negative scores indicate a low priority. The higher the absolute value, the higher the priority of the statement for the stakeholder. Each factor corresponds to a group of participants (stakeholders) with similar perspectives.

In order to represent all stakeholder groups and perspectives 54 persons were invited via email to participate in the online Q-Study. In total 11 participants (20%) representing all stakeholder groups (farmers/landowners, municipal administration, biodiversity conservation, and academia) participated in the Q-Study.

After the sort-ranking (Q-Sort) procedure, data was analyzed using the Q-Method Software. By convention Principal Component Analysis (PCA) was used to extract the factors (perspectives) in this study (Brown 2004), initially, eight factors were extracted from the PCA, (Table 2) of which two were selected for interpretation based on the following criteria to determine the optimal number of factors to interpret in Q-Studies (Gaebel et al. 2020; D'Amato et al. 2019):

i) Eigenvalues higher than 1.0, (Table 3)
ii) At least two Q-Sorts loading significantly (p value < 0.01) in the factor (Kügerl et al. 2023; Rittelmeyer 2020).

To determine the values of the second criteria (significant factor loadings at (p value < 0.01) Brown's equation was used (2.58 1/ ×(√n) where n indicates the number of statements. In this study, factor loadings higher than 0.44 were significant.

Table 2. Unrotated factor loadings [a] of all q-sorts.

Participant	Factor A	Factor B	Factor C	Factor D	Factor E	Factor F	Factor G	Factor H
1	**0.80395**	-0.1977	-0.16922	-0.23025	0.2616	-0.07385	-0.03339	0.08126
2	0.1365	-0.40088	**0.74907**	0.29041	0.05883	0.35976	-0.10886	-0.07038
3	0.21105	**0.56279**	-0.00544	0.26083	**0.69046**	0.0875	0.26638	0.01608
4	0.32443	**0.62219**	-0.28141	0.27964	-0.37366	0.30	-0.23305	0.1905
5	**0.60715**	-0.41352	-0.41354	0.31061	-0.05823	-0.05834	0.11302	-0.12063

6	**0.76405**	0.11048	0.12388	-0.13206	0.0407	-0.32406	-0.31424	-0.28989
7	**.52478**	**0.58427**	0.34495	-0.40394	-0.05142	0.00379	-0.04859	0.02196
8	**0.72003**	-0.29786	0.20083	0.06468	0.00187	-0.19282	0.01307	**0.5326**
9	**0.63052**	0.15322	0.23601	0.05282	-0.43436	-0.06934	**0.54187**	-0.12975
10	**0.54395**	-0.26803	-0.23372	**-0.49223**	0.04903	**0.54221**	0.07761	-0.04197
11	**.78817**	0.02123	-0.04349	0.39567	0.04346	0.08008	-0.17157	-0.1479

[a]The factor loadings describe each participant's association with each of the identified perspectives (factors)((Valenta und Wigger 1997; Brown 1993)

The two factors were then subjected to a Varimax rotation[4] to make data structure clearer (Zabala und Pascual 2016; Kamal und Grodzinska-Jurczak 2014). Each factor represents a shared perspective or point of view and together explains 49.89% of the total variance among all the Q-Sample. A Q-sort table (Table 1) was constructed for the two factors (perspectives) and the thematic interpretation is explained in the next section.

Table 3. Summary of general statistics

Factor characteristics	Factor A	Factor B	Factor C	Factor D	Factor E	Factor F	Factor G	Factor H
Eigenvalues[5]	3.87565	1.61271	1.17072	0.96648	0.88891	0.68336	0.58138	0.4713
% Explained variance	35.23316	14.66101	10.64293	8.78622	8.08102	6.21235	5.28523	4.28458
Eigenvalue >1	Yes	Yes	Yes	No	No	No	No	No
Significant Q-Sort loading (p value < 0.01)	Yes	Yes	No	No	No	No	No	No

Based on: (Beckner et al. 2019; Epstein et al. 2018)

Factor A – perspective on insect-friendly protection measures

Six participants from the municipal administration, nature and biodiversity conservation, and academic sectors "loaded" this factor. From their perspective, the collaboration between the municipal administration and farmers is a key aspect when implementing measures on the path margins and the role that path margins play in contributing to biodiversity conservation and providing habitat for different species. High-ranked statements relate to the role of insects in the ecosystems and the contribution of path margins to increase habitat connectivity*: "Insects are an essential component of biodiversity and play a crucial role in our ecosystems. Many insect species provide elemental ecosystem services"* and, *"Path margins along rural roads are habitats for insects, promote structural diversity in the agricultural landscape and improve landscape connectivity".* Participants also valued the development of clear concepts for the management and implementation of insect-friendly path ways: *"Municipalities should develop and implement concepts with concrete measures for insect protection on municipal owned spaces"* and, *the necessary personnel and financial capacities must be granted and strengthened for consistent ecological green space management at the state, district and municipal levels with appropriate maintenance measures".*

On the other hand, there is a general disagreement on the fact that insect-friendly measures are associated with negative impacts for the farmers-landowners *"Enforcement of insect conservation threatens the livelihoods of many farmers and the profitability of their operations"*, and the aesthetical

[4]A statistical procedure that minimizes the number of variables with high loadings, either positive or negative, for each factor to simplify factor interpretation Akhtar-Danesh 2017.

[5]Eigenvalues demonstrate which factors are statistically significant in Q-Studies (van Exel und Graaf 2005.

aspect of path margins was deemed as low priority for this perspective *"Path margins in the open countryside must look tidy".*

Factor B – Perspective on the maintenance and avoidance of negative effects

The most distinct feature of this perspective is the importance of the technical aspects such as the maintenance activities on the path margins and the avoidance of negative effects in the cropland such as delayed ripening and shadowing and the type of mowers used in the path margins. Five participants loaded onto this factor and came solely from the agricultural and water sector (farmers/landowners). The highest-ranked statements support that implementing measures in the path margins should not be associated with economic losses and negative consequences (e.g., the spread of unwanted weeds reducing crop productivity) for the farmers/landowners "*Conservation measures must not be associated with economic disadvantages for the farmers and must fit into the farm structure"*, "High flexibility regarding the type and location of insect protection measures is particularly important" and, "*Balance must always be struck between the nature conservation objective and practicable implementation for farms*". Generally, farmers consider the aesthetic value of the path margins to be a relatively low priority "*Path margins in the open countryside must look tidy"* and they opposed to the fact of not including the rehabilitation of path margins as a compensation measure: *"The rehabilitation of path margins should not be recognized as a compensation measure. The consequences of years of incorrect management must be assumed by the people responsible for the damage".*

Insect-friendly path margins "get into the conversation"

To reveal stakeholders' perspectives and points of view towards the implementation of the Vernetztes Rainland project, three main activities were implemented: (1) A Q-Study explained above) build the basis (2) for a local stakeholder dialogue workshop and (3) the development of social media materials to communicate project activities. At the start of the stakeholder workshop, project members presented the preliminary results of the Q-Study and the mapping and seeding of the first path margins, followed by a moderated discussion and derived recommendations that focused on further activities of the project. Workshop participants included farmers/landowners, municipal representatives, persons representing the nature and biodiversity conservation sector, and academia. Stakeholders positively endorsed the whole project and its first results, and it was possible to start a lively and constructive conversation and discussion between the different present actors and raise awareness about the project. Regarding social media, engagement shows that Instagram reached 470 accounts, and 56 accounts have actively engaged in content in the last three months. The obtained results of the communication strategy incl. the Q-Study supported the process of raising awareness and strengthen the cooperation among involved project parties.

CONCLUSION AND DISCUSSION

In this study, the Q-method was used to support stakeholder dialogue due to its bottom-up and open-ended approach. Findings suggest that this method can inform and support environmental decision-making and set the basis of stakeholder dialogue and consensus (Barry & Proops, 1999; Cuppen et al., 2010). The 4-Stage Q-Study was further developed by including an expert survey that validated the selection of the concourse and framed it into the local context. The interpretation of the stakeholder's perspectives (factors) serves as recommendations to highlight the importance of cooperation among stakeholders when implementing insect protection measures in agricultural landscapes. The potential negative impacts (e.g., economic losses due to loss of cropland, shadowing, etc.) of planned actions must be assessed thoroughly depending on the specific characteristics and farm structure. Trade-offs should be considered on a specific-

case basis. Stakeholders acknowledge the vital role biodiverse path margins play, and innovative compensation systems should be considered for further action. Finally, the communication strategy activities such as social media offer an opportunity to reach a broad group of interests and provide an entry to communicate and engage in real-time with different stakeholders and set the local dialogue.

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