Title:

Dynamic trajectories and maturity of farmer collaboration for biodiversity sensitive farming – Insights from the FRAMEwork Farmer Clusters

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Abstract

CONTEXT: Building on the Farmer Cluster (FC) approach, which has emerged over the past decade in England to address ecosystem degradation and biodiversity loss at the landscape scale, FRAMEwork, a Horizon 2020 project, established a network of eleven FCs across Europe.

OBJECTIVE: To test the effectiveness of the FRAMEwork FCs, a new level of technological and scientific support was offered to the FCs providing a facilitated space for collaboration, co-production of knowledge, co-innovation, peer-to-peer learning, and monitoring.

METHODS: We provide an overview of the eleven FCs and a comparative case study analysis to understand the dynamic trajectories and levels of maturity shaping the outcomes of the FCs. Expanding from the 'success criteria' of collaboration for sustainable agriculture by

Velten et al. (2021), we identified five formative dimensions – governance, leadership, facilitation, group characteristics and context – influencing the outcomes of FCs, before analysing these dimensions in more detail.

RESULTS AND CONCLUSIONS: We found that the five dimensions are interdependent and dynamic, affecting the functioning of the FCs, and leading to different levels of maturity. Comparing the situation of each FC regarding the five dimensions and the level of maturity we found that the FCs started in distinct contexts with diverse initial conditions across Europe – from favourable to unfavourable. This led to different dynamic trajectories on a pathway to biodiversity sensitive farming.

SIGNIFICANCE: The maturity assessment matrix offers a valuable tool for FCs to reflect on their progress and capacity in achieving their goals, guiding future efforts for effective FC management.

Keywords:

collaborative governance, agri-environmental management, landscape-scale, living labs, farmland biodiversity, maturity assessment matrix

1. Introduction

Agricultural intensification and landscape homogenisation have been identified as major drivers of biodiversity loss in agricultural landscapes (IPBES, 2019; Stoate et al., 2009). To address this problem, the European Union (EU) adapted its Common Agricultural Policy (CAP) over the last three decades and introduced various instruments to reduce the negative environmental impacts of agriculture and to achieve higher agricultural sustainability across Europe. Voluntary agri-environment and climate schemes (AECS) are a key mechanism for motivating farmers to improve biodiversity and ecosystem services on agricultural land. However, while agri-environment schemes (recently renamed to AECS to include climate measures) have evolved over the past three decades in response to

changing policy priorities and experiences gained from their implementation, biodiversity is still declining in many agricultural landscapes (Concepcion et al., 2008; Lawton et al., 2010; Pe'er et al., 2014). Despite some positive environmental effects (Batary et al., 2015; Zingg et al., 2019), it is widely recognised that further improvements are needed to support farmers in transitioning towards biodiversity sensitive farming (Kleijn et al., 2011; Pe'er et al., 2020, 2022).

A landscape-scale approach to biodiversity sensitive farming that matches the spatial scale of habitats and landscape structures, such as hedgerows and water systems, has been identified as critical to ensure the survival of many species (Dutton et al., 2008; Kleijn et al., 2006). However, to make sure that a landscape-scale approach – which considers landscapes as whole management units in contrast to individual farm holdings – is successful, requires some form of collaboration between farmers and land managers to deliver spatially coherent agroecosystem management (Franks, 2011, 2019; Prager et al., 2012; Prager, 2015a, b, 2022; Westerink et al., 2015; 2017).

In England, triggered by the seminal Lawton report "Making Space for Nature" (Lawton et al., 2010), the FC concept has developed over the past decade. In brief, a FC is composed of a group of neighbouring farmers who work together, share knowledge, support, and motivate each other to improve biodiversity and the ecological health across their farms, i.e. at the landscape-scale (DEFRA, 2020). The Game and Wildlife Conservation Trust (GWCT, 2025) piloted the FC concept from 2013 to March 2015 across 15 areas, and five of these pilots received funding from Natural England (the government's advisor for the natural environment in England) and a further ten were set up with GWCT involvement (Thompson et al., 2015).

The need to support "groups of farmers or groups of farmers and other land-managers" (Regulation EU) No 1305/2013, article 28, sub-clause 2) has also been acknowledged at EU level via the CAP, which enables member states to compensate groups of farmers/land-mangers for the delivery of agri-environmental services. From 2015 onwards, the Countryside Stewardship Facilitation Fund (CSFF), co-financed by the European Agricultural Fund for Rural Development, provided support for farmer groups in England via a paid

facilitator (Prager, 2022). In the Netherlands, agri-environmental farmer collectives have been established since 2016 and evolved from local environmental cooperatives, which already started in the 1980s in response to agri-environmental policy. In France, Environmental and Economic Interest Groups (GIEE) have grown fast since they were introduced in 2014 to enhance collective action of farmers and to promote agroecological practices and systems (Westerink et al., 2017).

Building on the strength of the early bottom-up approach of FCs in England, the H2020 project FRAMEwork[1] extends the FC concept by providing a new level of technological and scientific support to deliver eleven FCs across Europe covering a range of farming systems and social-ecological contexts. The overarching aim of FRAMEwork is to support the FCs, which operate as real-world living-labs (Fischer et al., 2021), to develop into a self-sustaining and growing network of FCs across Europe with potential to improve biodiversity and ecosystem services via tailor-made landscape scale changes in agri-environmental management.

This paper is, to our knowledge, the first account of a comparative case study analysis of collaborative farmer-based initiatives, established as part of an international research project, to enable a transition to biodiversity sensitive farming in Europe. Our contribution to research and practice is threefold. First, we extend previous studies that considered FCs or the CSFF in England (Prager, 2022) by investigating the deliberate implementation and development of FCs in a wider European context. Second, we contribute more broadly to the literature on interlinked conditions and processes affecting the functioning of collaboratives for improved and landscape-scale agri-environmental management (e.g., Prager, 2022; Westerink et al., 2017; Velten et al., 2021). Third, we offer the maturity assessment matrix as a tool for FCs (and landscape-scale collaboratives) to reflect on their progress and capacity in achieving their goals, guiding future efforts for effective FC (landscape-scale collaborative) management.

[1] The FRAMEwork (Farmer Clusters for Realising Agrobiodiversity Management across Ecosystems) project started in October 2020 and ends in September 2025 (https://www.framework-biodiversity.eu/).

2. Underlying concepts

The following key concepts underpin and frame the transdisciplinary research in the eleven FCs.

2.1 Landscape-scale collaboration in Farmer Cluster living labs

We refer to 'landscape-scale collaboration' as a process aimed at solving complex spatially explicit agri-environmental problems in a landscape or agricultural region, for which single farms or plots are too small to achieve effective management. We conceptualise the eleven FCs as living labs, where groups of farmers, motivated by a lead farmer (typically the group chairman) and supported by a facilitator (group coordinator and advisor) work together to set their own landscape-scale objectives, including problem definition and solution, make collective decisions about adjustment to their agri-environmental management, and translate these decisions into tangible collective actions and outcomes (Mills et al., 2011; McHugh 2023a, 2023b). Further, in line with the living labs approach (e.g., Potters et al. 2022; Cascone et al. 2024), FCs collaborate with multiple actors, such as government agencies, conservation or citizen groups in action-based research and learning processes focusing on interventions that aim to contribute to transitioning to biodiversity sensitive farming across Europe (Lang et al. 2012; Schäpke et al. 2018; Fischer et al. 2021). The perspectives of those involved mutually inform one another, facilitating the co-production of knowledge. New knowledge and new networks can lead to co-innovation in agri-environmental practices and can support peer-to-peer learning (Berthet and Hickey, 2018; Mills et al., 2011). Monitoring by experts, farmers and citizens in the FCs can be complementary and achieve multiple goals, including providing the evidence base needed for mainstreaming biodiversity sensitive farming across Europe (Tscharntke et al. 2021) and raising awareness about the importance of agrobiodiversity delivered by farmers as a public good (Primdahl and Kristensen, 2011).

2.2 Conceptualising outcomes and 'success' of landscape-scale collaboration

Velten et al. (2021) describe five criteria to conceptualise outcomes and 'success' of landscape-scale collaboration, which we linked to the FC approach. The first three criteria consider 'achievements of the *social, environmental and economic goals*' of a collaborative

(ibid. p. 14622), which is an assessment of the extent to which a collaborative is able to realise the objectives it set out to achieve. The fourth criterion is '*durability'*, defined as an assessment of the actual or likely endurance of a collaborative and its achievements despite changing conditions (e.g., the end of funding or project support). Finally, the fifth criterion is '*acceptance'* of a collaborative. It is defined as the degree to which a collaborative is supported or opposed by the involved and other affected actors.

3. Methods

We used an explorative multiple case study approach (Yin, 2014) to reveal and synthesise the diverse ways in which the eleven FCs were established across nine European countries (from 2020 onwards) and to demonstrate how they have evolved over the past four years. A multiple case study approach is ideal when complex issues need to be explored from a holistic social-ecological systems perspective and in situations where the context in which the case studies are embedded is important (ibid.).

3.1 Farmer Cluster case studies

Inspired by the growing number of FCs in England, eleven FCs were established across Europe as part of the FRAMEwork project, with the aim of investigating the potential of FCs to promote biodiversity friendly farming across Europe. The overall process to establish the FCs was initially based on the best practice from the English FC approach (GWCT, 2019), although it was altered in several instances to adapt to local conditions and constraints. The English approach proposes the following steps: (1) the identification of a lead farmer to act as a steering member of the FC; (2) the lead farmer reaching out to potential FC members utilising friendships, business networks and other relationships; (3) members selecting a facilitator who is responsible for administrative tasks, including the identification of funding opportunities, the organisation of training events, the coordination of surveys, and the creation of habitat management plans; (4) mapping of the extent of the FC area, habitats and information on species present in the area; and (5) the facilitator organising meetings to establish the group's biodiversity targets and priorities, and the changes in farming practice to address these. The FRAMEwork FCs cover several biogeographical regions, farming systems, and socio-political contexts (Figure 1). This diversity was intentional to maximise

variation, gain a deeper understanding of the commonalities and differences between the FCs, and to be able to inform policy and best practice. A brief overview of the FCs and some of their characteristics are provided in Table 1.

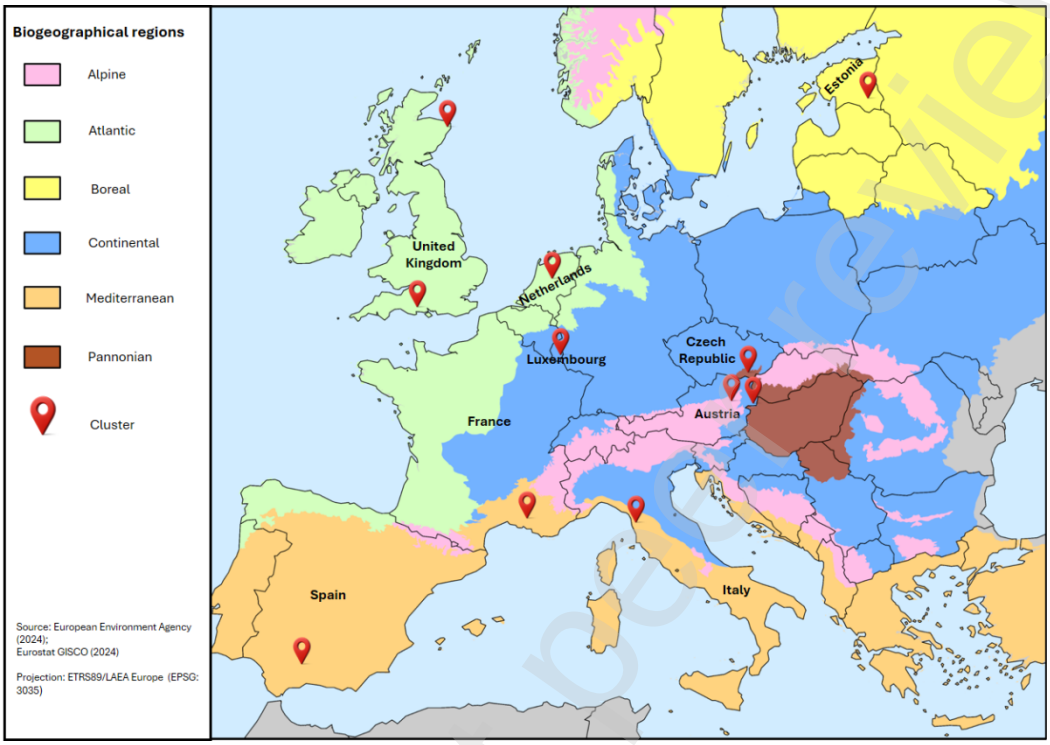


Figure 1: Biogeographical location of the eleven FCs across Europe.

Table 1: Location and characteristics of the eleven FCs established across Europe as part of the FRAMEwork project (adapted from Nichols et al. in review; Recodo 2025).

3.2. Data sources

The primary data source for the cross-case study analysis was a Common Enquiry Framework (CEF), consisting of survey questions to be answered by all FCs. The CEF was based on (i) relevant guidelines for how to create and manage a FC (GWCT, 2019, McHugh 2023a, 2023b), (ii) a literature review of factors influencing the success of collaborative resource management, including characteristics of the managing group, the resource system, or supporting institutional arrangements (e.g., Agrawal, 2003; Plummer et al., 2012; Reed, 2008), and (iii) emergent observations from activities in the FCs as part of the action-

based research. The CEF can be found in the supplementary materials (S1). Co-authors working with the FCs, mainly FC facilitators and FC lead partners including researchers from universities, research providers, and environmental NGOs, answered the questions for their respective FC, drawing on first-hand experiences and reflections from practice. Furthermore, we used meeting and planning notes and conversation insights from project implementation as a data source to provide additional contextual and real-world information and to close potential information gaps in the CEF survey results.

3.3 Inductive analysis and identification of formative dimensions

As a first step, we inductively explored outcome-related aspects of the CEF using Velten et al.'s (2021) indicators of 'success' as outlined in Section 2. This initial step proved to serve a dual purpose. On one hand, it allowed a first validation of perceptions and interpretation of each of the FCs' success trajectories, following a case-oriented approach (i.e., exploring each FC as a whole entity) (Ragin, 1987). But it also helped us reframe the analysis and move from a pure focus on outcomes and 'success' to a broader framing of FC development in terms of formative aspects, i.e., what affects the functioning and development of FCs. The reframing also allowed a more dynamic and overarching perspective on the development of farmer collaboration in FCs, following a variable-oriented approach (i.e., investigating themes that cut across cases) (Miles et al., 2019). This was also necessary, as the large number of factors attributed to collaborative resource management outcomes in the literature challenges a pre-selection of relevant factors for a detailed analysis (e.g., Agrawal, 2001; Emerson et al., 2012, Velten et al., 2021). From our inductive analysis, five formative dimensions – (1) governance, (2) leadership, (3) facilitation, (4) group characteristics and (5) context – emerged to be critical for FCs to develop, function and ultimately achieve 'success' (Velten et al., 2021).

3.4 Maturity assessment

We then introduced levels of maturity to capture each FC's situation at a specific point in time on their dynamic trajectories in the evolution of the FCs, with each level entailing a specific development potential as well as inherent challenges. For this purpose, we contextualise FC maturity broadly as a state of development and readiness, aligned with

existing group and community maturity models (Boughzala, 2014; Pretty and Ward, 2001; Westermann et al., 2005). In the FC context, it includes, amongst others, the degree to which structures, processes, and coordination mechanisms are developed and implemented and the capacity for sustained performance. Using an assessment matrix, we considered each FC's individual situation regarding each formative dimension, including potential interlinkages of the dimensions and the dynamic nature of the FCs overall. Maturity levels describe the degree to which a FC can realise each dimension for the benefit of the FC and to support the FC's collaborative work. The five maturity levels are based on a 5-point Likert scale ranging from 1 - a low level of maturity where major challenges persist and the learning and development potential for the FC is highest, to 5 - a high level of maturity where the FC appears to live up to its full potential yet faces the challenge of having to maintain such a high level of maturity. A description of the assessment matrix, including descriptions of the five formative dimensions and the maturity levels, can be found in the supplementary materials (S2). Each FC was assessed individually. Then, assessments were aligned across FCs. This step was done individually by the first four co-authors. Results were then compared, discussed and aligned by consensus in the same core group. These consolidated maturity assessments were then shared and discussed with the wider group of co-authors (the FC facilitators and FC lead partners), who had initially answered the CEF survey and are largely responsible for managing and facilitating the FCs, aiming at a reflexive approach to involve all relevant team members in knowledge creation and consolidation (Mauthner and Doucet, 2008). A final assessment for each FC was agreed, although, after joint exploration and discussion, no changes or adaptations were made during this final round.

3.5 Statistical analysis

Furthermore, hierarchical cluster analysis was used to identify distinct groups of FCs based on the similarity of their formative dimension rankings. The cluster analysis was run with the "between groups linkage" and "squared Euclidian distance" options. Afterwards, rankings of each formative dimension were compared between the two largest groups of FCs using independent-samples Mann-Whitney U Tests to determine significant differences in

formative dimension rankings between the two groups. Analyses were carried out using the statistical software package SPSS (version 26).

4. Results

In this section, we first provide a synthesis of the five formative dimensions which emerged from the inductive analysis as playing a pivotal role in enabling or inhibiting the development and functioning of a FC, including its capacity to reach goals and achieve success. The outline of the five formative dimensions is followed by the results of mapping each FC's level of maturity against each of the five dimensions to capture where the different FCs stand on a potential development trajectory after four years of inception.

4.1 Five formative dimensions

The five dimensions identified are (1) governance, (2) leadership, (3) facilitation, (4) group characteristics, and (5) context.

4.1.1 Governance

In the context of this study, we understand governance as the decision-making structures and processes set up to support and shape group activities and action towards desirable outcomes in the FCs. These may include means and processes of farmer involvement in defining FC activities, the establishment of a joint communication channel for decision-making or processes to deliberate joint biodiversity targets. We identified three broad governance approaches across the eleven FCs: explicitly agreed, implicitly agreed based on lived experience, and no agreed governance structures and processes (neither explicit nor implicit). For example, some FCs have an explicit, formal mode of operation and a shared commitment of taking decisions together. The Cranborne Chase FC in England elected a chairman and steering group of seven members to guide FC activities, as well as a voting procedure for situations where no consent can be reached. These formalised means of FC governance aid collective decision-making in this largest FC in the cross-case comparison, having 22 members (Table 1). Some tasks are delegated to smaller sub-groups (i.e., the steering group), and a majority vote can substitute the search for unanimous consent when member preferences diverge. The Zeeasterweg FC in the Netherlands utilises formalised

processes for collective action linked to the collective Dutch AECS administration. The FC has two dedicated meetings annually to collectively decide which agri-environmental measures to implement over the next year under AECS contracts and to assess whether last year's measures and contracts have gone according to plan. Collective decision-making in the Dutch FC is thus, at least regarding the implementation of measures under AECS funding, institutionalised by the collective nature of AECS administration (Boonstra et al., 2021). The Mostviertel FC in Austria, on the other hand, is largely based on implicit agreements. Here, actions are discussed, and decisions are made together via lived, collaborative culture rather than being the result of an agreed procedure. Each member can propose group activities, which are then discussed and decided upon in the group. There is no assignment of decision roles, and the FC partly relies on the farmers to step up in areas where they are interested and/or knowledgeable. In some other FCs, no governance structures and processes are agreed upon or part of the common culture and thus, they largely depend on ad-hoc deliberations and decision-making.

4.1.2 Leadership

Related to this study, we consider leadership as the presence of a person or an organisation in the FC who provides clear direction and momentum in advancing FC activities. In this regard, the Cranborne Chase FC in England aligns closest with the relevant guidelines for establishing and managing FCs (GWCT 2019; McHugh 2023a, 2023b). One farmer took the initiative by inviting neighbouring farmers and a neighbouring FC to come together to share experiences about the benefits of establishing a FC. Under the lead of the farmer, the farmer group then decided to start their own FC, and they jointly selected a facilitator to support them. Today, the leadership of the FC is shared and formalised as part of the FC's governance structure. The lead farmer, who initiated the FC is still acting as its chairperson. The facilitator provides leadership support by organising FC meetings and leading specific efforts such as identification of potential funding. The FRAMEwork lead partner organisation (GWCT) of the Cranborne Chase FC pro-actively contributes expert advice and leadership on domain-specific topics such as farmland birds, and the steering group of seven FC members are responsible for overall direction setting for the group.

Other FCs across Europe were established by FRAMEwork partner organisations (mainly universities), tasked to establish a FC in their respective country. These FCs are characterised by a range of leadership types. Besides the approach of shared leadership as part of a formalised governance structure, three additional manifestations of leadership were identified in the FCs: First, local actors can take on important roles of leadership. For example, in the Born FC in Luxembourg, business partner Ramborn Cider Co, a fruit processer, not only buys fruit from local farmers who are part of the FC and supports them in the maintenance of the heritage fruit orchards, but the company also supports FC direction setting, co-organises FC activities, and provides meeting facilities for the FC. In the Cazadores de Aguilar FC in Spain, the local hunters' society has taken on a topical leadership role by championing and promoting the recovery of permanent vegetation cover in the olive groves, motivated by habitat needs of small game populations. Second, in the absence of a shared leadership structure supported by a lead farmer, FC leadership can fall towards FC facilitators. Whether or not facilitators can fully support a leadership role depends on farmers' acceptance of the facilitator as a leader and setter of direction and availability of required resources (particularly time) to support this additional role. For example, the Zeeasterweg FC relies on an intermediary organisation and facilitator (BoerenNatuur) to lead farmers in setting and reaching their common goals or participating in any facultative activities. Third, FC leadership is provided by one individual lead farmer or farming business, supported by the facilitator. For example, the Velke Hosteradky FC in the Czech Republic largely depends on the lead farmer and his farming business that connects several farms via sharing of knowledge and experience. Likewise, in the Val Graziosa FC in Italy, one farmer is considered the lead farmer, because he holds a substantial share of land in the FC and has been very active in the local community for years, including yearlong collaborations with local researchers. However, towards the end of the FRAMEwork project, another FC landowner decided to invest in the area and has been buying or renting land from others allowing for a huge impulse in the FC area in terms of recovery of abandoned olive groves. In summary, leadership manifests in multiple ways: being shared and formalised, falling upon actors outside the immediate members of the FC, such as facilitators and other interested parties, or relying solely on individual actors in the FC.

4.1.3 Facilitation

For the purposes of this study, facilitation is framed as the functioning and role of the FC facilitator in enabling, supporting and shaping group activities and outcomes. Effective facilitation can help FCs to co-develop ideas and solutions, maintain momentum as a group, manage conflict, access funding or expert knowledge, and lower the administrative burden for farmers for engaging in collective efforts (e.g., by organising group meetings, or organising resources related to land management, including speciality seeds, hedge plantings, bird feeders, etc.). Similar to the variation in leadership constellations, two types of facilitation were identified in the FCs. On the one hand, facilitation is largely managed by one person, the facilitator, and on the other hand, by a facilitating team, comprised of people from one or several organisations, providing different support functions and expertise. Team facilitation can be beneficial to realise the diverse skills and traits required for supporting and shaping group activities and outcomes. This includes access to a wide network of experts from whom the FC can draw knowledge, as well as facilitation skills such as supporting the implementation of on-ground environmental measures and organising group meetings. As all those traits and skills are seldom present in one single facilitator, it can be beneficial to have the facilitation tasks provided by a team. For example, the Austrian Burgenland FC is facilitated by a team, where one person has close pre-existing relations with the farmers and is well suited to coordinate their collective efforts, whereas another person provides more technical support in specific activities such as biodiversity monitoring. A potential risk of team facilitation is diluting facilitator responsibilities if no single person feels responsible (or capable) of facilitating the FC. This can result in facilitators being perceived as, for example, scientific experts supporting biodiversity monitoring in the FC, such as the case in the Scottish Buchan and the Estonian Kanepi kihlkund FC, rather than supporting group activities. Supportive conditions to enable effective facilitation include sufficient time and funding for facilitation, the spatial proximity of the facilitator's residence and the FC area, and a well-suited professional background of the facilitator, at best, providing the skills or expertise needed to support the FC to reach its objectives, such as in the French Basse Durance FC. In addition to the two types of facilitation, two different modes of facilitation could also be observed: an ad-hoc and opportunistic mode, and a deliberate mode with planned and recurring activities. The structured mode with recurring meetings or activities supports notions of working as a formalised group and 'functioning as

a FC', whereas the ad-hoc mode results in discrete and occasional events supporting a much looser notion of working together with less emphasis on group coherence.

4.1.4 Group characteristics

We define group characteristics as the in-group characteristics of the FCs that may support or challenge collaboration. For example, farmers located in close proximity, sharing similar (farming) views and values and being motivated to work together as a group are considered beneficial and enabling in-group conditions for a FC. On the contrary, conflicting views, values, and power asymmetries among farmers may lead to conflict and/or farmer disengagement. Considering the group characteristics across the FRAMEwork FCs, three observations stand out. First, certain group characteristics may turn out to be conflicting, creating trade-off situations. For example, in the Val Graziosa FC in Italy, the expectation of having adjoining land parcels in the FC to support landscape-scale management led to the development of a locally proximate, but heterogeneous FC group that includes both hobby and commercial olive farmers, which tend to hold contradictory views regarding the management of olive groves. Consequently, the FC struggled to find common grounds to implement joint measures. The Mostviertel FC in Austria, on the other hand, focused on a specific region but did not enforce spatial requirements for new FC members. Importance was placed on farmers' intrinsic motivation to collaborate on biodiversity enhancing measures. This led to the formation of a FC which is spatially dispersed across 130 kilometres (Table 1) and cannot jointly implement landscape-scale connected measures, but it is composed of like-minded farmers who individually implement similar measures. Second, some group characteristics appear to be crucial to enable farmer collaboration, whereas others can be considered supporting conditions. Among the crucial characteristics are (i) a general motivation and willingness to engage in collaborative efforts and (ii) the perception of being part of a group. FCs in which a large share of farmers are not motivated to engage or do not consider themselves being part of a group tend to lack active participation. FC members remain passive and participate in group activities only upon deliberate request. Hence, the prioritisation of a minimum level of intrinsic farmer motivation is required when establishing a new FC. Group characteristics such as spatial proximity, pre-existing social links, and homogeneity in farming systems and views are

supporting conditions shown to ease active collaboration and collective decision-making. However, lack thereof may be overcome or compensated by high motivation levels as well as time and resources available to invest, for example, in social-capital building. Third, farmer motivations are not fixed and can vary greatly within and across FCs, working in favour of the FC if aligned with FC objectives. Motivations also change over time and as a result of engaging in FC activities. For example, most farmers were purely economically motivated and initially joined the Zeeasterweg FC for accessing AECS under the Dutch system. Additional activities about voluntary biodiversity monitoring or social-capital building in the group did not receive much attention. However, due to investments in such activities over time, farmer's awareness about the interlinkages between economic and environmental benefits increased also affecting their motivation to participate.

4.1.5 Context

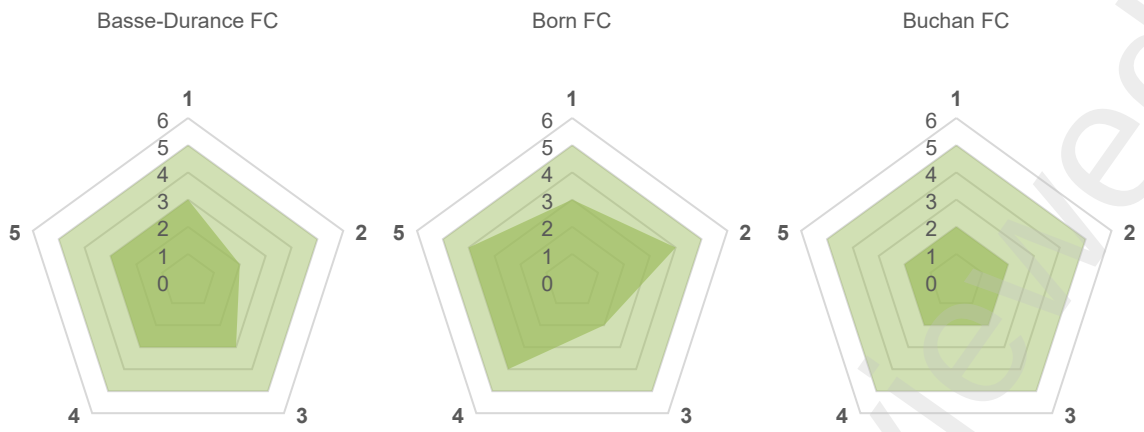
All FCs were initiated and operate in a European context. Nevertheless, they evolved in multi-layered national and regional settings with diverse historical, political, legal, cultural, social, environmental and other influences, such as national policy frameworks, funding schemes and support networks of (local) actors. These multi-layered contexts can ease collaborative agri-environmental management but also present a barrier to it. Hence, understanding context is critical to understanding FC development trajectories and their potential to fully achieve effective collaboration. It is also important to consider the additional effort required if contexts are inhibiting, rather than enabling farmer collaboration. An example of a favourable context is England, where FCs can receive funding for a facilitator via the CSFF, and some AECS are open for group applications. Furthermore, given that collaborative farmer groups have been established and exist across England, an extensive knowledge base and support network can be accessed. This is in vast contrast to Scottland, where no funds are available for group facilitation and no support network exists. Other contexts prove to be also challenging for farmer collaboration and for finding common ground in a FC. For example, entrenched agri-cultural norms, e.g., of what is considered 'good farming', may slow down the implementation of biodiversity sensitive farming measures. Establishing and leaving groundcover vegetation in olive groves is debated controversially in the Cazadores de Aguilar FC in Spain, and it is potentially dividing

farmer groups, despite being an accepted measure to reduce soil erosion and run-off, increasing water retention and soil moisture, and potentially delivering economic benefit, helping to alleviate some of the farmers' greatest agricultural challenges. Likewise, in some post-socialist countries (Estonia, Czech Republic), the idea of collaborative work may raise reluctance rooted in their 20th century histories. Additional resources and time may be required to build new social capital and to re-establish trust in collaborative efforts before group activities can be progressed and environmental measures can be jointly implemented.

4.2 Farmer Cluster maturity

The maturity levels of the FCs on each of the formative dimensions is shown in Figure 2, visually depicting the diverse setup and conditions of the FCs four years after their inception. The realisation of the five dimensions across the FCs varies greatly, and it emphasises the diversity of possible trajectories FCs can take in their development, based on different initial conditions and formative dimensions, some of which can be influenced more directly (e.g., facilitation and governance) than others (e.g., context).

FCs' maturity levels reached on the governance, leadership and facilitation dimensions range between 2 to 5. The levels on group characteristics and context spread between 1 and 5, from lowest to highest levels of maturity across the eleven FCs. Set up and managed as part of the FRAMEwork project across nine European countries, FCs were, on average, able to reach medium maturity on all five dimensions, reaching 3.1 on governance, 3.3 on leadership, 3.5 on facilitation, 3 on group characteristics and 2.9 on context.



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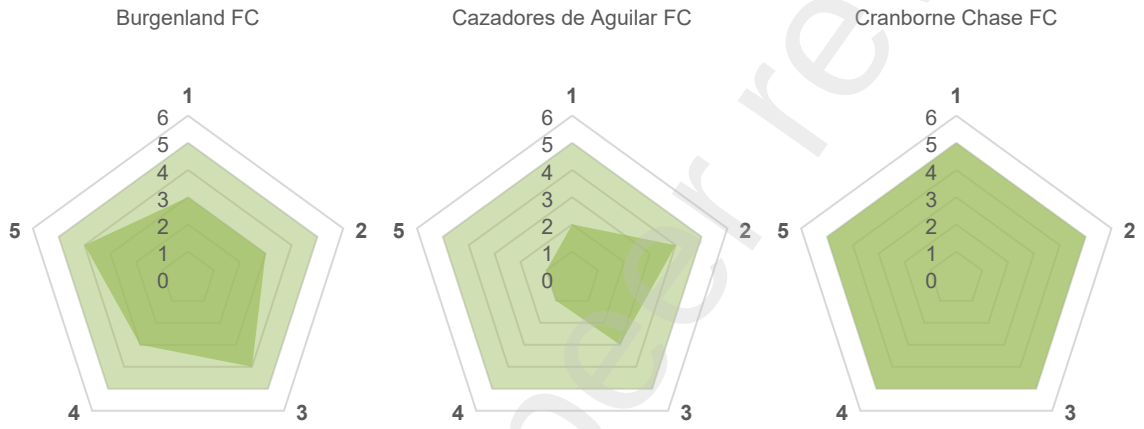

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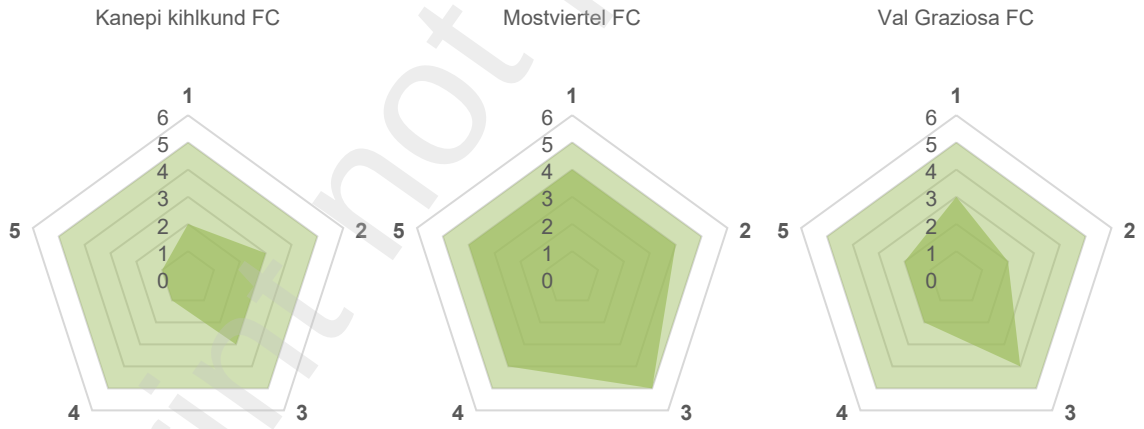

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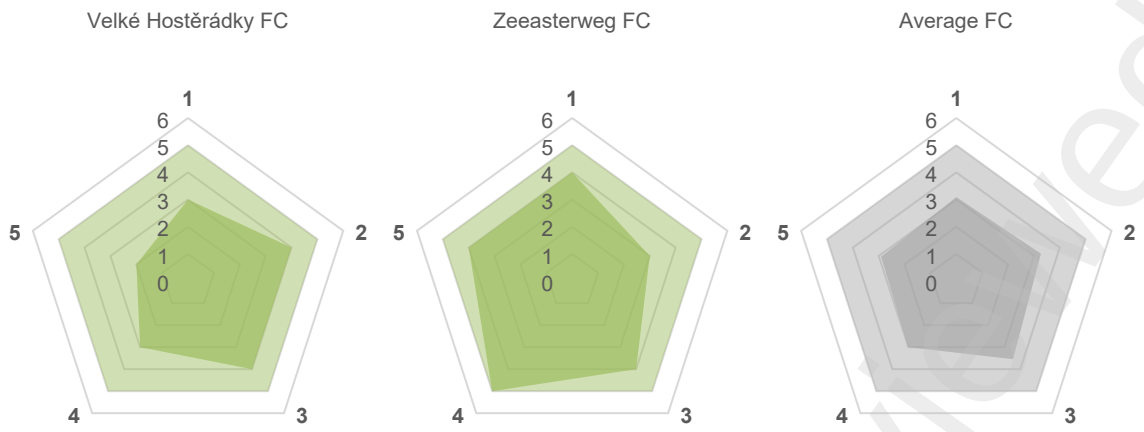

Figure 2: Kite diagram showing the levels of maturity of all eleven FRAMEwork FCs in alphabetical order after four years of inception (dark green), and development potential of each FC (light green) in terms of the five formative dimensions (bold numbers outside the kite diagrams), (1) governance, (2) leadership, (3) facilitation, (4) group characteristics, and (5) context. Levels of maturity (horizontal) range from 1: low level of maturity to 5: full maturity. The final diagram (grey, bottom right corner) shows the average maturity reached across the eleven FCs.

4.3 Interdependence of formative dimensions

Using two contrasting examples, we illustrate results on the interdependence of formative dimensions on the development and functioning of the FC as a collaborative endeavour to manage agrobiodiversity on a landscape-scale. In the Italian Val Graziosa FC, certain group characteristics and contextual aspects challenge the FC to implement supportive governance structures or leadership despite regular and attentive facilitation and despite successful implementation of activities, such as joint pest monitoring of the olive fruit fly and community engagement via an annual citizen science “BioBlitz” in the FC area. Olive groves are extensively and organically managed by both hobby and commercial olive growers. Discrepancies in size of land owned and associated dominance in the FC are considerable, and views and values diverge in relation to olive tree management and pest control, reportedly hindering the FC to jointly define biodiversity targets and activities, or to rally behind a common leadership figure. Additionally, hobby farmers are not economically dependent on the quality and amount of oil they produce, whereas existing agri-environmental schemes are only accessible to commercial farmers. Furthermore, the

economic and policy context does not provide incentives for hobby farmers to implement pest management strategies. Hence, the low maturity on the group characteristics dimension (i.e., heterogeneity), the context dimension (i.e., policy frameworks and lack of incentives for hobby farmers) and the leadership dimension hinders the FC from implementing suitable governance structures and from formulating and realising shared group objectives (Figure 3).

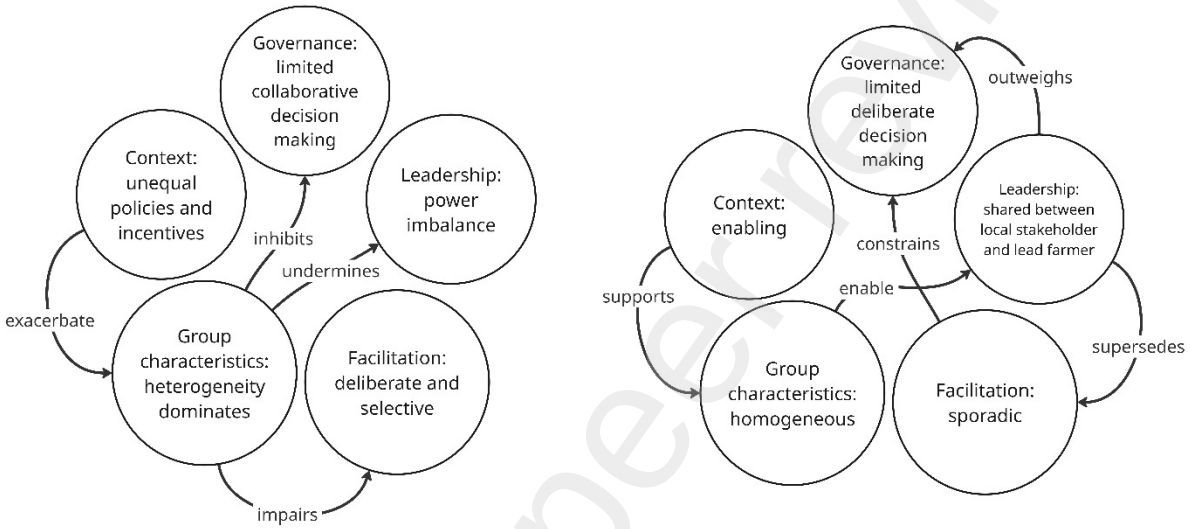

Figure 3: Two illustrative examples of interdependence of formative dimensions in the Val Graziosa FC in Italy (left) and in the Born FC in Luxembourg (right).

In contrast, in the Born FC in Luxembourg, leadership is provided by local actor and business partner Ramborn Cider Co, together with a lead farmer, who supports the FC in setting directions, co-organising FC activities and providing facilities for FC meetings.
This strong leadership is coupled with a high level of maturity in terms of group characteristics. The FC is homogeneous regarding the farming system (fruit orchards with grazing livestock), the proximity of farms as well as the level of farmer motivation (Figure 43). Furthermore, contextual aspects related to cultural norms of collaboration and local networks of actors can be considered beneficial. In sum, this leads to certain positive outcomes, such as the joint maintenance of the traditional orchards by the farmers and the interplay of these dimensions can compensate partly for lower levels of maturity around governance and facilitation. As there are no deliberate governance structures agreed upon and the facilitator is considered an expert in monitoring biodiversity rather than support for

regular group activities, the FC would benefit from more regular joint activities and better defined shared goals which are championed by the lead farmer together with the farmers and that go beyond pruning, replacing trees, harvest and participation in the City Nature Challenge.

4.4 Differences in formative dimension rankings between Farmer Cluster groups

Upon sorting the FCs according to similarity regarding their formative dimension rankings, two groups (A and B) were found.[2] A dendrogram visualising these results is included in the supplementary materials (S3). The average formative dimension rankings of group A and group B were 2.66 and 4.40, respectively. Independent-samples Mann-Whitney U Tests revealed that the leadership and the facilitation ranks did not differ significantly between the groups A and B (P=0.177 in both cases). In contrast, governance, group characteristic and context rankings differed between the FC groups A and B at P=0.030, P=0.009 and P=0.004, respectively. These findings suggest that the primary differences between FCs in our sample lie in governance, group characteristics, and contextual factors. This may reflect the fact that such factors, particularly group-level and contextual variables, often fall outside the direct or immediate control of the FCs, thereby limiting their capacity to influence or adapt them in support of more favourable cluster dynamics.

5. Discussion

The explorative multiple case study approach (Yin, 2014), including the different methodological and analysis steps, enabled a detailed and in-depth assessment of the eleven FCs. Overall, the five formative dimensions derived from the inductive analysis align well with the success *factors*, external and internal to collaboratives, identified by Velten et al. (2021)(Table 2).[3] As we only considered Velten et al.'s success *criteria* in the initial analysis of the CEF results, and derived the formative dimensions inductively in a

[2] Group A comprises the FCs Cazadores de Aguilar, Kanepi kihlund, Basse-Durance, Val Graziosa, Buchan and Velke Hosteradky, whereas group B includes the FCs Mostviertel, Zeeasterweg, Burgenland, Born and Craneborne Chase.

[3] Success *factors* in Velten et al.'s (2021) study denote aspects that determine a collaborative's success, whereas success *criteria* are used to operationalise how success materialises. In other words, success *factors* describe inputs or drivers, whereas *criteria* conceptualise the outcomes.

subsequent step, the alignment and overlap of the five dimensions with Velten et al.'s (2021) success factors can be considered a form of converging evidence and triangulation of findings (Creswell and Miller, 2000), underpinning the importance of these dimensions in determining the functioning of collaboratives, such as FCs. However, with this paper, we provide additional and more nuanced insights on the interlinkages of the formative dimensions and their implications for the maturity of collaborations. Hence, while Velten et al.'s (2021) model focuses on success factors and related outcomes (success criteria) in a rather linear fashion, we propose a complementary framing (cf. Emerson et al., 2012; Ulibarri et al., 2020) which focuses on dependencies of dimensions as well as understanding FCs or collaboratives as evolving living and learning groups, which are constantly changing on a development and maturity trajectory (cf. Westerink et al., 2017).

Table 2: Alignment between the five formative dimensions and Velten et al.'s (2021) 'success factors' external/internal to collaboratives. The facilitation dimension maps against external and internal factors, and the context dimension encompasses four external factors. The governance, leadership and group characteristics dimensions align with internal factors.

Five formative dimensions	**Velten et al.'s (2021) success factors external/internal to collaborative**
Governance	Internal: Organisation and management
Leadership	Internal: Organisation and management/Actor related
Facilitation	External: Conditions and support Internal: Organisation and management/Actor related
Group characteristics	Internal: Actor related
Context	External: Conditions and support/Market-related/Policies/Issue addressed

Regarding the governance dimension, the results show that deliberate and encompassing governance structures and processes can be beneficial for FCs because they ensure meaningful farmer involvement and support effective collective action, especially if the FC is large (cf. Dik et al. 2023). They also promote social capital building and mutual learning through farmer-to-farmer exchange (e.g., via frequent FC meetings or a joint communication channel), and they enable joint decision-making based on a shared evidence base, such as biodiversity monitoring data and external knowledge (cf. Alblas and van

Zeben, 2023a, b). The Zeeasterweg FC in the Netherlands, for example, is primarily motivated economically and joint decision-making revolves largely around acquiring and monitoring AECS funding, which can only be applied for collectively. The groups' governance approach focuses on AECS and is effective in co-delivering environmental and economic objectives, but it is less likely to promote social outcomes and enabling the durability of the FC, especially if AECS funding was terminated. Paradoxically, such collectives are nonetheless required to professionalise and self-govern to meet the demands of the Dutch government and EU legislation (Westerink et al., 2020), growing from Local Environmental Cooperatives to Agri-Environmental Collectives that are bigger in size (from local-regional to regional) and responsible for more advanced tasks (from organising local exchange and learning to spatial coordination, contracting, control and payment). FCs with a lack of dedicated structures and processes to self-govern frequently appear to be challenged to progress group activities and to build group coherence. The Mostviertel FC, on the other hand, builds on an implicit, fairly unstructured governance approach, which is still effective and can be linked to favourable group characteristics. The FC is comprised of a rather homogenous group of farmers who hold similar views on farm management and environmental conservation. All farmers proactively volunteered to enter the group and are generally motivated to collaborate. With only twelve member farmers, the group size does not necessitate more formal means of joint decision-making, which suggests that implicit governance can be effective if the group can harness other capacities (e.g., strong social capital, high intrinsic motivation) to motivate and facilitate collective action. Hence, while deliberate governance structures clearly support the functioning of a FC, and should be promoted, they are, under certain conditions not a pre-requisite for enabling FCs to reach their goals.

In terms of the leadership dimension, the presence of a lead farmer or lead organisation who is well accepted as a leader within the group is beneficial, if they manage to speak on behalf of the collective, and bring other farmers, local businesses, community or conservation groups, and citizens together in support of FC activities. However, while it may be advantageous for FCs to be guided by a strong lead figure and draw on the resources provided by leading business partners or interest groups there is an inherent risk based on power imbalance, potentially undermining the group's purpose and shared goals, especially

if farmers are dependent on such partners or interest groups. Dominant leadership can also limit other farmer's involvement, e.g., by imposing goals and group activities or by enabling 'wait and see' positions if the leader advances and the rest of the group become passive observers. Therefore, dedicated leadership figures can support FC functioning and champion activities towards successful outcomes, if unnecessary and unfavourable power imbalances can be kept in check.

Regarding the facilitation dimension, the level of involvement of a facilitator is crucial for the ongoing operation and development of a FC (cf. Jones et al., 2023). For example, if a facilitator has regular interactions with the FC and its farmers, the FC is perceived to function well and members value being part of a group. In some FCs, dedicated one-on-one conversations are needed between farmers and facilitators, before farmers are willing to join group activities, to build trust and respect, and to keep farmers engaged to ultimately build social capital (cf. Berthet and Hickey, 2018; Pretty and Ward, 2001). In most FCs, the level of involvement of the facilitator or facilitation team is subject to financial resource availability. If funding is limited, fruitful facilitation is difficult to realise. Furthermore, experiences with farmer groups in England suggest that changes in the facilitator position can cause disturbances in group cohesion (Nye et al., 2018). Several facilitator changes occurred in our FC case studies, and here, the change impacted the FCs positively. In the Basse-Durance FC in France, the new facilitator was employed by an association of fruit producers to advise farmers about agrobiodiversity. The new facilitator had existing links to the Basse-Durance FC, providing technical support for farmers members of the GIEE monitoring fruit pests. The new facilitator's expertise was seen as a valuable asset for the group. This change of facilitator reportedly increased the cohesion of the group as well as participation rates to group events (cf. Westerink et al., 2017). A change in the facilitator position can thus be beneficial if it unlocks valuable expertise or can build upon pre-existing social capital.

The group characteristics dimension also helps understand a FC's performance and development towards maturity (cf. Barghusen et al., 2021). FCs with greater homogeneity perform better than heterogeneous groups, where the performance largely depends on the goals of the collaboration. To maximise social outcomes and the durability of a FC, it is

advantageous to aim for higher social cohesion and similarities in terms of attitudes, world views and farming approaches. For certain environmental and landscape-scale targets, on the other hand, spatially coordinated conservation efforts are required but only work well, if the environmental goals provide a strong bond between the members of the collaborative. Focussing on the spatial proximity of member farms, e.g., by only allowing neighbouring farms to join a FC, may enable farm system and climatic homogeneity and high local environmental impact, but it may also create socially heterogeneous FCs that are challenged to collaborate effectively (cf. Prager, 2022; Riley et al., 2018). Ideally, FCs are comprised of like-minded farmers whose farms share borders (cf. Nichols et al., in review), but ultimately, more benefits may be gained from socially homogeneous FCs with spatially distant farms (mutual learning, individual implementation of measures and lighthouse character of individual farms), than from a socially heterogeneous FC with adjacent farms (low engagement, disagreement of goals, no joint measures).

The context dimension is influenced the least by individual FC actors directly, including cultural norms around farmer collaboration, available funding to support collaboration as well as policies to support transition to biodiversity sensitive agricultural practices. The contextual dimension does not pre-determine FC functioning and progress necessarily, but it is the fundamental backdrop, which can either enable or inhibit the development of FCs from the start (cf. Nichols et al., in review). Hence, considering and understanding the contextual embedding and potential contextual barriers is essential when setting up and running FCs as collaboratives (ibid.).

Two more lessons surfaced from the cross-case analysis of the five formative dimensions. First, FCs are shaped by dynamic, evolving processes influenced by both internal characteristics and external conditions. Each FC operates within a unique farming system, cultural and political context, and landscape setting, yet all function as real-world living labs to establish landscape-scale collaboration for environmental, social and economic benefit. The diversity of starting points—ranging from environmental conditions to existing coordination needs—demonstrates that enabling conditions or barriers influence how each FC develops (Figure 3). A starting point may refer to the territory where the FC was established, including the environmental state of the landscape, the need for joint

landscape-scale management, and other types of farmer motivation for joining a FC. Thus, when scrutinising the functioning of FCs within their individual contexts, the dynamic nature of collaboration and potential path-dependencies induced by initial conditions need to be considered. Second, to understand the outcomes of any FC, it is not sufficient to look at the five dimensions in isolation. As they interact, complement or constrain each other, their interplay determines a FCs' performance. Likewise, the interplay of dimensions makes it difficult to pinpoint a single decisive influence on performance but highlights the importance of case-by-case understanding. Furthermore, interlinkages and time lags between action and outcomes as well as the differentiation of intermediary and final results underline that collaborative processes are dynamic and do not unfold in a linear sequence (Emerson et al., 2012). Collaboration in FCs shifts over time in response to internal and external changes, such as changes in leadership or group composition, as well as new regulations, incentive schemes, or environmental shocks, emphasizing the importance of adaptive learning, flexible governance and active collaboration of all involved actors (Ulibarri et al., 2020).

Shifting from focusing on success and outcomes to the notion of maturity and FCs as dynamically developing and changing collaboratives based on the formative dimensions also enables painting a realistic picture of what can be achieved under certain circumstances. At the same time, it is important to stress that a FC does neither require high maturity levels in all dimensions to function well as a FC nor to deliver certain outcomes. We use the maturity framework to highlight that FCs, including facilitators and local involved actors, are constantly navigating a joint learning journey. In this regard, lower levels of maturity describe potential challenges and barriers for development, regarding one or more interlinked formative dimensions, as well as spaces for opportunity and development. Different levels of maturity reflect different achievements but also different types of challenges. FCs with lower levels of maturity are challenged to address and find solutions to specific barriers, including disagreements based on FC members' different world views, dominant leaders and power imbalances, or lack of farmer motivation and involvement (Figure 4). FCs with high maturity, on the other hand, are challenged to maintain their level of activities, coherence and performance as a group, such as retaining farmer interest and

motivation over time, securing long-term funding for FC support, as well as achieving common goals and defining new ones.

The study presented in this paper has two main limitations. First, the explorative inductive multiple case study approach, which involved FC facilitators and lead partners as "inside researchers" (Rabe, 2003) provides a rich picture about how the FCs developed but may be subject to research biases, including insider research bias, self-selection bias and the challenge of managing reflexivity (Wilkinson and Kitzinger, 2013). For example, there may have been potential biases in filling in the CEF by FC facilitators and lead partners, many of whom have several roles in the project and in the FCs. To address these challenges, we incorporated triangulation in our study approach (Carter et al., 2014; Jonsen and Jehn, 2009), including method and data source triangulation using different data sources and data collection methods as well as investigator triangulation by including several researchers in the core team who were able to provide case observations from different perspectives, in addition to co-researchers who were more directly engaged in FCs' activities. Furthermore, the different perspectives of the researchers and the co-researcher group were regularly consolidated, and joint reflections were structurally embedded in the overall process. Second, the results present a snapshot in time in the dynamic evolution of FCs that have been established across Europe. They lack, for example, insights on the different FC trajectories over time and are, due to delays inherent in the research process, likely, not reflective of the current state of the studied FCs. Nonetheless, this snapshot offers insights relevant to other collaboratives and, together with the maturity assessment matrix, can be used as a guide on how to reflect on FC trajectories, enabling joint action to further advance collaboration.

6. Conclusions

In this paper, we identified and analysed five formative dimensions which are important for FCs to develop, achieve their objectives, and which ultimately influence the outcome and progress of such initiatives. These are: (1) governance, (2) leadership, (3) facilitation, (4) group characteristics and (5) context. Further, we present an assessment of the levels of maturity of each FC measured against these formative dimensions. The assessment of the

maturity levels of the FCs helped illustrate the dynamic trajectories and diversity of levels in maturity reached by the FCs after four years of operation. The outcomes and maturity levels of established FCs across Europe differ greatly depending on pre-conditions (e.g. policy context, trust, norms, pre-existing networks) interplaying with governance processes, facilitation, leadership and group characteristics. Establishing effective collaboration in challenging contexts and where farmer groups are very heterogeneous requires substantial facilitation resources and time and, unless contextual and group-related aspects change considerably, have difficulty reaching full maturity. While FCs do not necessarily need high levels of maturity on all dimensions to be able to function and achieve their goals, deliberate considerations and reflections about initial conditions and the five formative dimensions are key to understanding a FC's overall potential for progress. In this regard, the maturity assessment matrix, including the five formative dimensions and maturity levels can serve not only as a research tool for comparative analysis and benchmarking but also as a facilitation and learning tool to support collaborative evaluation of FC progress and development. Overall, this comparative cross-case study provided a unique opportunity to examine a diverse set of FCs established in different farming contexts and to gather insights into the functioning and continuation potential of FCs across Europe, irrespective of project funding. The results and insights can inform the design and development of policies supporting adaptive collaborative governance, learning, monitoring and evaluation in farmer-led landscape scale initiatives for improved agri-environmental management across Europe.

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Table 1: Location and characteristics of the eleven FCs established across Europe as part of the FRAMEwork project (adapted from Nichols et al. in review; Recodo 2025).

Location / broad climate zone based on biogeographical region	Farming system / Main crops, livestock	No. of farms	Range of farm sizes (ha)	Total area of cluster (ha)	Cluster structure	Main biodiversity focus
Basse-Durance (Rhône Valley), France / mediterranean climate	Partly organic / Apple, pear orchards	9	25 - 175	1759	Adjoined	Pest natural enemies, birds (insectivores, raptors), bats, arthropod predators (spiders, butterflies, earwigs, hoverflies), and Hymenoptera parasitoids
Born, Luxembourg / continental climate	Partly organic / Apple, pear orchards	8	10 - 200	480	Partially dispersed	Farmland birds, wild pollinators, vegetation
Buchan, Scotland / atlantic climate	Conventional / Arable crops, cattle, sheep	5	80 - 364	2205	Partially dispersed	Soil health, pollinators, farmland birds
Burgenland, Austria / continental/pannonian climate	Mostly organic / Arable crops, cattle, poultry	11	15 - 500	2870	Dispersed	Farmland birds, pollinators, vegetation
Cazadores de Aguilar, Spain / mediterranean climate	Conventional / Olive groves	11	<1- 45	160	Partially dispersed	Establishment of ground vegetation cover for erosion control, birds, pollinators and red-legged partridge
Cranborne Chase, England / atlantic climate	Partly organic / Arable crops, cattle, sheep	22	92 - 1300	10,000	Adjoined	Farmland birds, aquatic invertebrates
Kanepi kihlkund, Estonia / boreal climate	Partly organic / Arable crops, permanent grassland and mixed farming with sheep and cattle	10	300 - 600	3170	Adjoined	Wild pollinators, natural enemies, native plants (*Trollius europaeus, Primula farinosa*)
Mostviertel, Austria / alpine climate	Organic / Permanent grassland, cattle, sheep, goats, some arable crops	12	16 - 60	300	Dispersed	Grassland plant diversity, farmland birds
Val Graziosa, Italy / mediterranean climate	Partly organic / Olive groves	15	<1 - 12	54	Adjoined	Bees, butterflies, birds, ground-dwelling natural enemies and parasitoids for olive fruit fly control, soil biological quality, and spontaneous vegetation.
Velké Hostèrádky, Czech Republic / continental/ pannonian climate	Organic / Arable crops, vineyards, vegetables, fruit	9	3-1271	2822	Partially dispersed	Birds (for pest control), pollinators (via wildflower strips and habitat creation), soil health (via cover crops and crop rotation)
Zeeasterweg, Netherlands / atlantic climate	Partly organic / Potato, Wheat, Onion, sugar beet, Carrot, Bulbs	10	30 - 90	600	Adjoined	Farmland birds, natural enemies (flying and ground dwelling), pollinators