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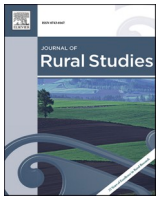

# Family farm succession and agroecology? A life-history approach to young farmers' sustainability strategies

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ABSTRACT

The generational renewal in family farms represents a pressing challenge for the sustainability of family farming, and agriculture more broadly. However, very few studies have investigated whether and how farm succession stimulates more sustainable farming. We apply an agroecology lens to farm sustainability and combine life-history research with other qualitative methods to describe three family farm succession pathways and investigate how these shape the farming strategies of young farmers in Castilla y León, Spain. We show how young farmers in blueprint succession pathways are inclined to continue with – and intensify – their parents' conventional farming strategies, assisted by farmer unions, public training, and policy subsidies. Agroecology appears instead after long disruptions in family succession as a cost-effective strategy to reinvigorate small and obsolete farms. Nonetheless, the agroecology transition is challenging, and disruptive successors have limited support from family, neighbors, farmer unions and subsidies. These findings problematize the idea that farm succession leads unequivocally to more sustainable farming, and suggest that generational renewal policies should broaden their compass to support disruptive succession processes and provide specific support for agroecological transitions.

## 1. Introduction

Family farming remains the main form of farm organization worldwide (Graeub et al., 2016) and a central pillar of European agriculture. However, this model is experiencing profound structural changes in farm demographics, farming methods and scale of production. A sharp decline in generational renewal signals an uncertain future (Calus and Huylenbroeck, 2010; Zagata and Sutherland, 2015). Moreover, family farms face the challenge of adopting productive strategies that are environmentally, socially, and economically sustainable (Suess-Reyes and Fuetsch, 2016).

The so called "young farmer problem" has stimulated burgeoning research on farm succession processes and motivated the implementation of specific policy instruments in the European Common Agricultural Policy (CAP hereafter) but these efforts seem disjointed from sustainability agendas. For example, while the literature associates farm succession with major changes in farm management strategies and attributes young farmers a higher environmental sensitivity, very few studies engage in analyzing succession-related farm changes from a sustainability lens (Suess-Reyes and Fuetsch, 2016; Zagata and Sutherland, 2015). As regards policies, none of the CAP reforms after the introduction of generational renewal instruments in 2013 has linked these to the adoption of sustainable farming practices (European Commission, 2013; Chartier et al., 2023).

Moreover, farm succession studies have predominantly focused on the traditional family succession, a long-term process starting during successors' childhood, and involving a progressive transfer of skills, knowledge, and farm responsibilities (Bertolozzi-Caredio et al., 2020; Coopmans et al., 2021; Fischer and Burton, 2014), which we refer to as "the blueprint succession pathway". Fewer studies have analyzed the specific social-ecological dynamics that result when blueprint succession becomes disrupted, but a young person eventually takes the family farm over (Carolan, 2018; Góngora Pérez et al., 2020; Joosse and Grubbström, 2017).

In this research, we tackle these gaps and investigate how family farm succession shapes the adoption of sustainable farm development

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strategies – two key phenomena traditionally studied separately -. We use an agroecological framework to analyze farmers' strategies, as it offers a holistic and transformative approach to agricultural sustainability (Altieri, 1989; Barrios et al., 2020; Gliessman, 2018; IPES-Food et al., 2016). Drawing on qualitative interviews with farmers in Castilla y León, a central-western region in Spain notable for its vulnerability to depopulation and global agricultural markets (Gaitan-Cremaschi, under review), we provide novel insights into (1) three family succession pathways through which young farmers access agriculture, (2) how these pathways shape the development strategies they adopt, and (3) the barriers and opportunities for agroecology adoption. In doing so, we highlight the diversity of generational renewal pathways, problematize the assumption that such pathways inherently promote agricultural sustainability, and call for further research on the identified synergies, trade-offs, and policy implications.

The remainder of this introduction outlines the theoretical framework and section two describes our methodological approach. Section three introduces the results, divided into (3.1) a description of the farm development strategies identified amongst successors, and (3.2) a description of three types of farm succession pathways, and how these influence successors and their farm development strategies. Section four discusses the main results and Section five outlines the conclusions.

### 1.1. Agroecology as a departure from conventional farming

Industrial agriculture emerged in the late nineteenth century as industrial technologies (e.g., high-yielding seeds, tractors, and chemical fertilizers) gradually replaced traditional practices like artisanal farming and ecology-based soil fertility, transforming the material and social relations of agricultural production (Goodman et al., 1987; Van Der Ploeg, 2021). From the 1950s onwards, these technologies spread widely in Europe and the United States and expanded globally through the so-called 'Green Revolution' (Eliazer Nelson et al., 2019; Pingali, 2012). Over time, industrial agriculture became worldwide dominant, earning the label of "conventional farming". However, its implementation varies significantly across regions, differing in crop mix, farming methods, input use, mechanization and digitalization (IPES Food et al., 2016; Pingali, 2012).

We understand conventional agriculture (or conventional farming, terms used interchangeably) as farming strategies that prioritize increased productivity through specialization in a few crops or livestock intensification practices. These strategies rely on mechanization and use of industrially produced inputs (e.g., seeds, fodder, agrochemicals, and fossil fuels) to supply large amounts of homogenous produce to long national and international value chains (IPES Food et al., 2016). These strategies often treat ecological functions and farmers' livelihoods and knowledge as secondary concerns (Van Der Ploeg, 2021).

In Western Europe, a large proportion of family farms have incorporated these logics into their production strategy (Calus and Huylenbroeck, 2010), despite conventional agriculture is associated with environmental degradation, the erosion and loss of traditional knowledge, practices, and landraces, and the impoverishment of farming communities (Altieri and Toledo, 2011; Díaz et al., 2019; Foley et al., 2005). Since the 1980s, alternative approaches to farming have emerged in response to these disservices, such as climate-smart agriculture, precision farming (Pingali, 2012), organic and regenerative agriculture (Gordon et al., 2022; Morgan and Murdoch, 2000), permaculture, and agroecology (Altieri, 1989). These approaches diverge in their sustainability framings, and the extent to which they depart from conventional farming (Gliessman, 2018).

Climate-smart agriculture and precision farming represent a "2.0 green revolution", promoting industry innovations and digital technology, sponsored by public-private partnerships. The goal is to push the "yield frontier" while improving resource efficiency, reducing pollution, and sparing land from agricultural uses (G. Conway, 2000; Pingali, 2012). However, this approach rests on narrow sustainability framings, ignoring its dependence on dwindling fossil fuels (Weis, 2010), and further potential disservices to biodiversity and farmers' livelihoods, especially the rural poor (Díaz et al., 2019; IPES Food et al., 2016). Organic farming replaces chemicals with organic inputs to reduce pollution but does not transcend per se industrial farming logics (Migliorini and Wezel, 2017). This is evident in recent EU calls for "sustainable intensification", which encourage technology-driven monocultures of organic crops to boost productivity, specialization and market competitiveness (Daheim et al., 2016).

Agroecology, in contrast, advocates a radical departure from industrial farming logics, aiming to transform the entire food system and achieve food sovereignty (Anderson et al., 2019a; Gliessman, 2018). Agroecology has been advanced by social movements, farmers' organizations, interdisciplinary scholars, and practitioners worldwide, encompassing diverse visions of how transitions should unfold. Some proponents prioritize de development of farming practices that leverage ecological functions and cycles to boost productivity while minimizing external input use (Rosati et al., 2021). Others prioritize redesigning food networks from production to consumption for transforming the global food regime, with varying emphasis set on community self-organization and political struggles for food sovereignty (Altieri and Toledo, 2011; Gliessman, 2018; Rosset et al., 2019). Recent integrative agroecology frameworks acknowledge multiple non-linear transformation pathways, emerging and evolving through diverse biophysical, social, and power-laden contexts. As such, agroecology should be understood through guiding principles rather than prescriptive rules or rigid frameworks (Anderson et al., 2019a; Barrios et al., 2020; Tittonell, 2020).

We define agroecology (at farm level) as a long-term reconfiguration process and progressive adoption of practices, not the attainment of a fixed agroecological state. Thus, in this research, a farm is engaged in agroecology when committed to redesigning farm organization and activities to eliminate agrochemicals, enhance soil health and biodiversity, diversify crops, and integrate sustainable animal husbandry where possible, increasing circularity and multifunctionality. These efforts should align with commercial strategies that boost farm revenues through localized food distribution and foster social networks for sharing technology, infrastructure, and local ecological knowledge (Barrios et al., 2020; Gliessman, 2018; Tittonell, 2020).

### 1.2. Family farm succession and farm change

European family farms would have to undergo profound changes to transition away from conventional farming (Prost et al., 2023). Family succession could play a pivotal role in this process, as farmers often reconfigure farm development strategies during succession – particularly in the years leading up to the farm transfer, and the early years under new leadership (Coopmans et al., 2021; Corsi et al., 2021; Joosse and Grubbström, 2017).

The archetypal or blueprint family farm succession is a long-term process where a farmers' heir – often a son –, identified during childhood as the potential successor, gradually engages in farm activities, assumes responsibilities, and eventually inherits physical and intangible farm assets when the incumbent retires (Fischer and Burton, 2014). Throughout succession, the farm development strategy evolves through reciprocal interactions with two other processes: (1) the social construction of the successor's identity as the future farm manager, and (2) successor's incremental acquisition of farm management control, metaphorically termed the "farm ladder" (Chiswell, 2018; Hutson, 1987). These three intertwined processes influence each other in sequential, endogenous cycles, shaped by exogenous factors, and vary in importance over time (Bertolozzi-Caredio et al., 2020; Chiswell and Lobley, 2018; Fischer and Burton, 2014).

In the initial stages of blueprint succession, constructing successor's identity as the future farm manager is critical, with family dynamics playing a vital role. Through involvement in farm activities, the

potential successor develops an initial willingness to farm, gains knowledge and skills from the family and attachment to the farm legacy. Involvement during childhood increases the likelihood of forming this successor identity (Bertolozzi-Caredio et al., 2020; Chiswell and Lobley, 2018; Fischer and Burton, 2014). During this period, incumbent farmers may begin adapting the farm development strategy to facilitate the successor's future incorporation – a phenomenon known as the "succession effect" (Bertolozzi-Caredio, 2024).

As successors move from childhood to early adulthood, they progressively commit to the farm, taking on increasing responsibilities. External influences gain importance in shaping their identity during this period (Bertolozzi-Caredio et al., 2020; Coopmans et al., 2021). Climbing the farm ladder – the management hierarchy – they increasingly share and negotiate decisions with their predecessors, introducing practices and strategies informed by skills and knowledge acquired outside the family, a phenomenon termed the "successor effect" (Chiswell, 2018). Through these negotiations, successors internalize "good farming" norms from their families, shaping future farm development (Fischer and Burton, 2014). At this stage, the farm's ability to provide labor and income for both incumbent farmers and successors becomes crucial, driving progressive investments, structural adjustments, and intensifying succession and successor effects (Bertolozzi-Caredio et al., 2020; Chiswell, 2018; Coopmans et al., 2021; Fischer and Burton, 2014).

In the final succession stage, young farmers have fully embraced the identity of "the future farm manager" and assume responsibilities for most management decisions. As succession solidifies, larger adjustments in farm organization, and investments in machinery, infrastructure, or land align the successor's development plans (Bertolozzi-Caredio et al., 2020; Chiswell, 2018; Fischer and Burton, 2014). At this stage, contextual factors – such as access to land, subsidies and agricultural markets – become as influential as personal attributes (e.g., skills, and knowledge) and family dynamics (e.g., respect, support, retirement timing) in shaping succession outcomes (Coopmans et al., 2021; Góngora Pérez et al., 2020; Joosse and Grubbström, 2017; Leonard et al., 2017).

Any disruption in this lengthy process can distort successor's identity formation, the progression of the farm ladder, the succession and successor effects, and the farm's development trajectory (Fischer and Burton, 2014). For instance, delays in identifying a potential successor, extended periods away from the farm, or non-patrilineal farm transfers often explain greater diversity in successors' life histories, knowledge, skills, and worldviews (Carolan, 2018; Góngora Pérez et al., 2020; Monllor Rico, 2013), as well as varied power dynamics in farm ladder negotiations (Chiswell, 2018; Joosse and Grubbström, 2017), that could influence different farm development choices.

## 2. Methodology

We have applied a combination of qualitative methods to investigate young farmers' succession pathways, and how these shape different farm development strategies. Below, we describe the study region to contextualize our findings, then we describe our data collection methods, and finally we explain our analysis.

### 2.1. Farming in Castilla y León

Castilla y León is Spain's largest region and the EU's fifth largest NUTS-2 area[1]. It dedicates 72 % of its land to agriculture, with the central plains dominated by rain-fed cereal monocultures, rotated with oil seeds, legumes, and fodder, making it the EU's fourth-largest cereal producer in 2021. Free-range cattle graze mountainous pastures, pigs populate the southern "*Dehesas*", and sheep farming has shifted from dominating the central plains to occupying peripheral areas. Organic farming, though marginal at 1.5 % of agricultural land—well below Spain's 17 % average—has seen growth, with organic hectares doubling between 2015 and 2020, primarily in permanent pastures (Consejería de Agricultura, Ganadería y Desarrollo Rural, 2023a; INE, 2022).

With a population density of 25.6 inhabitants/km$^2$, Castilla y León is Spain's least densely populated region, and 90 % of its municipalities have less than 500 residents. Agriculture represented 5.6 % of the region's gross added value in 2020—above Spain's 3.4 % and the EU's 1.8 %—and accounted for 6.2 % of regional employment (Analistas Económicos de Andalucía, 2021). Family farms dominate, but their numbers are declining, and managers are aging. In 2020, 39 % of farms were run by farmers over 65, compared to just 8 % under 40 (INE, 2022). Youth typically enter farming through family succession, as land access via purchase or rent is limited (Alario Trigueros et al., 2018). While farm numbers decrease, the remaining farmers—especially younger ones—are professionalizing, intensifying and scaling up production (Arnalte et al., 2008; INE, 2022). Also, the regional Rural Development Plan notes raising demand for "young farmer subsidies" since 2014 and calls for expanded support. This includes a CAP-backed "start-up" subsidy for under-40s launching their first farm business. Applicants must manage a farm equivalent to at least half an Annual Working Unit (AWU) and stick to a five-year modernization plan with investments in machinery, infrastructure, land, or livestock (Consejería de Agricultura, Ganadería y Desarrollo Rural, 2023b).

### 2.2. Research design and data collection

Fig. 1 shows our main research steps. First, we defined the two phenomena of interest: family farm succession (blue) and the adoption of agroecology versus other farm development strategies (yellow). "Family farm succession" was broadly defined as any process by which a person under 40 years old receives farm assets (land, livestock, machinery, housing) from family and consequently becomes the farm manager. We defined the "farm development strategy" as a somewhat structured management plan that combines practices, investments, and organizational adjustments for mobilizing farm resources to achieve specific goals. This definition draws on the "farm development trajectory" concept – the idea that current practices and farm structures reflect an ongoing process of adaptation to changing family dynamics and context (Bertolozzi-Caredio et al., 2020; Joosse and Grubbström, 2017; Milone and Ventura, 2019). Through literature review, we defined four categories of farm development strategies: agroecology, conventional, industrial, and sustainable intensification (see Fig. 2A in results section).

Next, we recruited research participants who had become farmers through family succession within the last decade, selecting similar numbers of agroecological (50 %) and more conventional (50 %) farming strategies. Initial contact was made through regional associations, cooperatives, organic markets, and snowballing, via email or word of mouth. We followed up by phone to ensure the respondents' profiles matched the study's criteria and to schedule an interview. The final selection included 20 participants (18 men, 2 women), aged 23 to 46 at the time of the interviews.

The first author conducted semi-structured, face-to-face interviews on the participants' farms or their preferred locations in August 2021. Each interview lasted 1,5 to 2,5 h. Participants were informed about the research objective and gave oral consent for being recorded. The interview had three parts and dealt with participants' succession experiences in chronological order. The first part encouraged participants to introduce themselves and explain how they became farmers. The first author then sought clarifications and introduced research-relevant topics. This method allows retrieving information from interviewees self-reported biographies ("what is told"), and narrative structures ("how is told") (Hollstein, 2019). The second, more structured part started with the

[1] According to EU Nomenclature of territorial units for statistics (NUTS) classification (EUROSTAT, 2021 retrieved from: https://ec.europa.eu/eurostat/web/nuts/background).

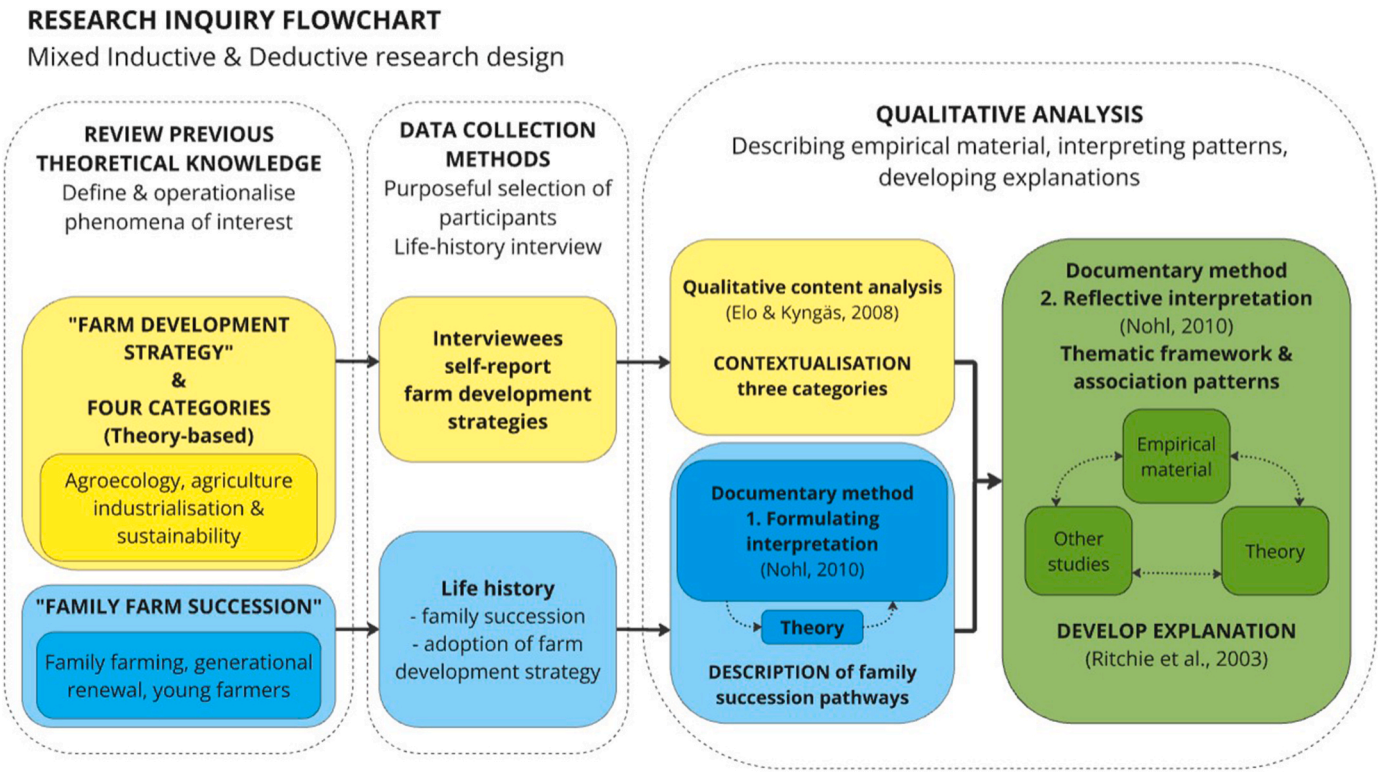


**Fig. 1. Research inquiry flowchart.** Two distinct knowledge bodies inform this research on the intersection (green box) between *family farm succession* (blue box), and *the adoption of agroecology and other farm development strategies* (yellow box). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

interviewer reading four statements representing the predefined farm development strategies: agroecology, conventional, industrial, and sustainable intensification (see Fig. 2A in results). Participants then (1) chose the strategy best representing their approach, (2) explained their practices, investments, and development goals aligning with such choice, and (3) elaborated on when and how these strategies had been inspired and implemented, considering their life history, succession experiences, farm characteristics, and socioeconomic factors like resource availability or subsidies. This method enriched participants' autobiographical narratives by revealing interconnected elements in their storylines (Reimer and Matthes, 2007). The third part included non-autobiographical questions exploring interviewee's views on agricultural sustainability and the barriers and incentives for adopting agroecology.

### 2.3. Data analysis

After data collection, we replaced participants' identities with pseudonyms. The qualitative analysis design included two sequential analytical stages (see Fig. 1). In the initial, descriptive stage, we separately analyzed participants' farm development strategies through deductive content analysis (Kyngäs and Kaakinen, 2020), and their life histories using Nohl's documentary method (Nohl, 2010). In the second, interpretive-explanatory stage, we deepened the documentary analysis of life histories, integrating farm development strategies as phenomena ingrained in succession.

Deductive content analysis served to contextualize our theory-based farm development strategies by identifying throughout interview data all attributes linked to each theory-based strategy (Kyngäs and Kaakinen, 2020). The coding framework included (i) farm characteristics and agricultural practices, (ii) commercial and associative practices, (iii) past, recent and planned investments, (iv) development goals, and (v) views on agricultural sustainability. The code drew from the authors' conceptualization of the "farm development strategy" and familiarization with the dataset (Elo and Kyngäs, 2008). We identified clusters of attributes associated with each strategy, highlighting distinctive features and overlaps. This led to reorganizing the four theoretical farm development strategies into three contextualized ones (see Fig. 2B and Fig. 2C in results).

Nohl's documentary method (Nohl, 2010) was used to analyze participants' life histories in three stages. First, the lead author listened to each interview and organized the identified topics chronologically in a table. This allowed us to identify relevant events, themes, and preliminary comparisons between life histories (Nohl, 2010). Subsequently, transcripts were organized into a matrix: we listed the topics in the first column and aligned each interviewee's transcripts following the same topical structure. We annotated chronological discrepancies, and linked passages to several topics when required. For example, Isaac's passage explaining how he proposed a new crop to his family after training, was placed under both "training" and "participation in farm strategic decisions". This matrix organization created a thematic framework (Ritchie and Lewis, 2003), enabling analysis of individual life histories (columns), and a constant comparison of topics across participants (rows) (Nohl, 2010).

Subsequently, the lead author summarized each participant's life history in her own words (Nohl, 2010). These summaries were contrasted with family succession histories from the literature to identify patterns and potential associations. At this stage, provisional hypotheses about how different life history sequences influence the adoption of specific farm development strategies were developed and discussed. Finally, the lead author proceeded to reflect on and scrutinize the narrative structures of the interviewees' autobiographical accounts, to uncover their pre-reflexive, action-guiding knowledge, or *modus operandi* (Hollstein, 2019; Nohl, 2010). For example, when Isaac recounted proposing a new crop after his training, he noted that his predecessors "helped [him] see it was not a good idea". This way of narrating that his

proposal was rejected suggests that Isaac values his predecessors' knowledge above his technical training or prioritizes respecting elders' wishes over innovation.

After such three-stage analysis of participants' life histories, we were able to identify three types of family succession pathways, and to interpret the adoption of specific farm development strategies in relation to previous empirical findings and existing theories.

## 3. Results

Life histories varied significantly amongst interviewees. However, all shared similar motivations for entering farming: a desire for a rural lifestyle, working closely with nature, and being their own boss. Those who took over their parents' farm also cited family responsibility as a key driver. Farming was the primary income source for all but one interviewee, being farm profitability a necessary pre-condition to become farmers. This involved two key assessments: 1) having sufficient initial assets, and 2) developing a mid-to-long-term strategy to ensure those assets were productive.

Below, we first describe the farm development strategies adopted by participants. Then we examine three family farm succession pathways, highlighting their influence on the adoption of agroecology or other development strategies.

### 3.1. Contextualizing farm development strategies

Fig. 2A displays the four theory-based farm development strategies presented to participants during interviews, and how they identified with them. Regardless of their choices, all participants expressed sustainability concerns and linked their strategies to these. Thus, those choosing the "industrial" category also identified with "sustainable intensification", viewing the two as inseparable. Consequently, during data analysis we merged the four categories into three: (1) agroecology, (2) conventional without intensification, and (3) conventional with intensification (see Fig. 2C).

Fig. 2B shows the key attributes of participants' farm development strategies and how commonly these were reported as part of a specific category (an extended version of Fig. 2B can be found in Supplementary material 1). Some practices, like crop rotations, are universal. Others, such as diversifying crops/livestock, are common in one category but rare elsewhere. Certain attributes, like organic certification or precision technologies are category-specific. We observed significant diversity of practices within each category and some overlap between them. Thus, Fig. 2C represents the categories as three partially overlapping circles, forming a gradient where participants' strategies are positioned based on their unique traits.

#### 3.1.1. Agroecology

Ten participants operate small to medium-sized farms with agroecology-aligned strategies (Fig. 2C). All have implemented agroecology by simultaneously (1) replacing chemical inputs with mechanical and ecology-based methods for managing fertility and pests, and (2) shifting to local, differentiated markets (see Fig. 2B). Crop diversification enables ecology-based productivity and year-round production to supply local consumers. Many have introduced premium crops, livestock, or traditional landraces (e.g., organic seed potatoes, regional specialties, rustic breeds, bread-making wheat, brewing barley). Most blend farming with marketing, while others partner with an organic-focused regional cooperative. Three participants have expanded into artisanal food production (e.g., cheese, honey, flour, pasta), and one has joined a cooperative slaughterhouse.

These strategies aim to recoup yields over time, minimize production costs tied to external inputs, and increase benefits by avoiding intermediaries and/or selling value-added goods. By doing so, they aim to decouple farm prosperity from expanding farm size or production scale. This approach requires more labor per unit area but, according to interviewees, delivers greater long-term benefits, including economic gains.

We identify six overlapping challenges to the viability of agroecological farms during the initial transition years: low productivity, underdeveloped markets, prohibitive costs for local processing, bureaucratic burdens, adverse land markets, and inadequate subsidies.

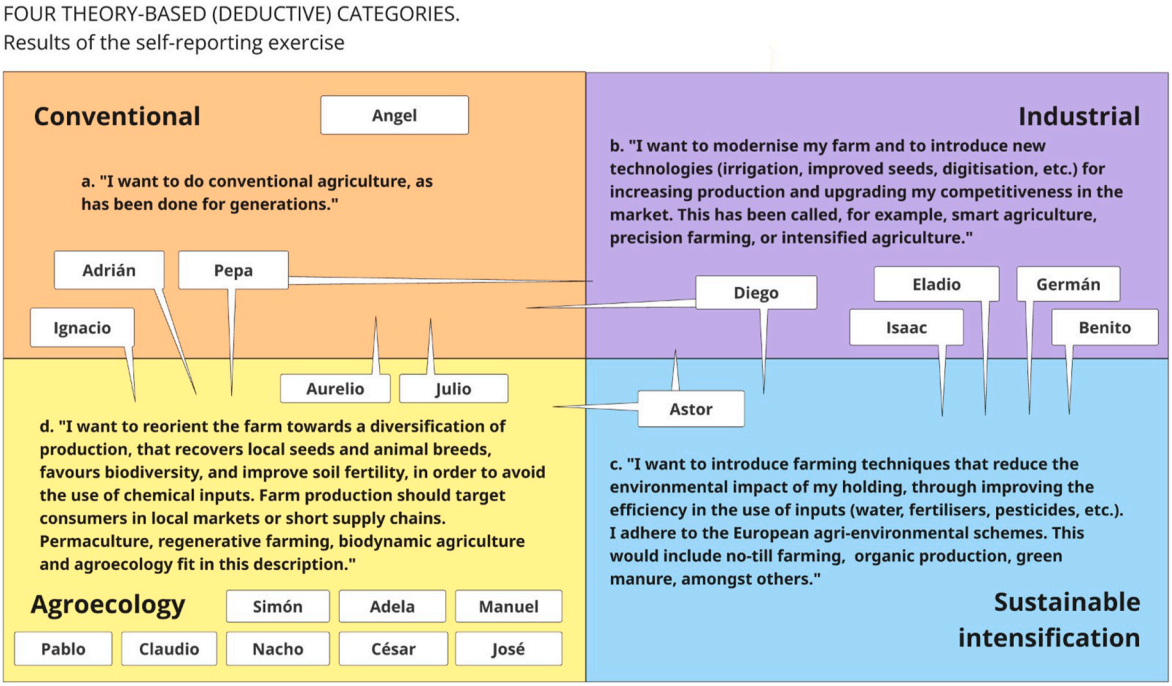


**Fig. 2A. Farm development strategies – theory-based categories.** Each colored box represents a category, and the corresponding statement provided to interviewees. Participants' pseudonyms are placed in the category they found most representative of their farm development strategy, with tails indicating other categories they partially identified with.


**Fig. 2B. Farm development strategies – Attributes.** Each attribute is associated with one, two or three symbols, and represent how many interviewees (symbol size) of those grouped on each farm development strategy (symbol color), reported that attribute as part of their strategy. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

For example, while crop rotations with fodders restores soil fertility, a regional decline in livestock farms is pushing interviewees to sell fodder to intermediaries at lower prices. Similarly, small-scale food manufacturing boosts revenues and offsets initial yield declines but requires investments in private facilities (e.g., mills, silos, workrooms, and slaughterhouses), as existing infrastructure does not support small operations. These investments, along with organic certification, increase bureaucratic workloads and costs, and typically take three to eight years to result in higher net margins. While regional organic subsidies aim to mitigate such economic risk, they must be repaid if land access is lost. With rising land rental prices and limited support for non-renewed leases, interviewees found subsidies insufficient for effective risk reduction.

### 3.1.2. *Conventional without intensification*

These four interviewees (Fig. 2C) run average-sized farms – three with extensive or semi-extensive livestock and one with rainfed cereals – and either chose "conventional" as their most representative strategy or are drawn to alternatives (see Fig. 2A) but lack the means to implement them. They invest in structural adjustments and rely on chemical inputs and conventional markets but lack the interest and ability to intensify production through expansion, rescaling, or technological upgrading. Instead, they view diversification as a strategy to produce value-added goods – e.g., cheese – or access new markets (Fig. 2B). Adrián, for instance, has integrated his farm with a self-managed artisanal canning business, using locally sourced feed and shared small-scale infrastructure, and selling premium canned goods directly to gourmet markets.

Angel and Ignacio expressed interest in 'going organic,' and Pepa in adopting a 'farm-to-fork strategy'. They believe that minor adjustments would secure organic certification and boost revenues but feel pressured to increase and standardize production (intensification strategy) for cost-effectiveness. They cite two main challenges to long-term viability: shrinking profit margins due to rising production costs and price fluctuations, and a limited capacity to innovate and diversify, partly due to bureaucratic hurdles and sanitary norms, lack of small-scale shared infrastructure, limited training, financial constraints, and insufficient institutional support and advice.

### 3.1.3. *Conventional with intensification*

Six interviewees operate larger-than-average farms dedicated to cereals, rotated with fodder legumes (e.g., alfalfa, vetches), potatoes, oilseeds, protein crops, and/or sugar beet. They specialize in two to five arable crops, adapting to market demand and CAP subsidies, but consider further diversification risky due to limited time, labor, and resources. All rely on large cooperatives and intermediaries for inputs, machinery, and market access. They pursue prosperity through farm expansion, boosting yields, leveraging CAP surface-based subsidies, and enabling investments in machinery and infrastructure. Three of them have introduced no-till farming, four precision agriculture, and four sprinkler and drip irrigation (Fig. 2B). These technologies have reduced fertilizer, pesticide, and water use to "the minimum required levels", lowering costs and environmental impact – always according to interviewees. These structural adjustments enhance efficiency and competitiveness and minimize labor and logistic costs, fostering a cycle of expansion and specialization. However, these six farmers face three key challenges: shrinking profit margins due to rising land and input costs against low product prices, bureaucratic burdens, and intense land market competition, which complicates acquiring and consolidating

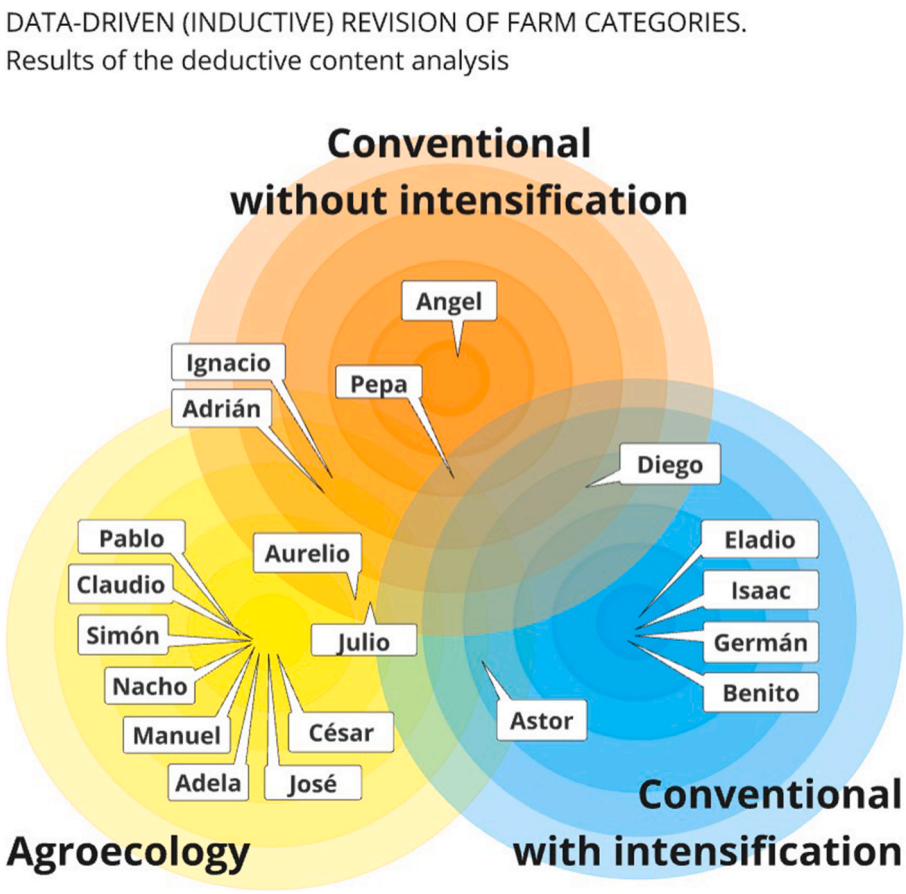


**Fig. 2C. Contextualized farm development strategies.** Colored concentric circles represent each category, and overlap creating gradients. Participants' strategies (tags & tails) are placed along the gradients according to their particularities.

land for optimal machinery use.

### 3.2. Succession pathways and farm development strategies

Through farmers' life histories, we identified three types of succession pathways: 1) the blueprint (reflected in the literature), 2) disruptive succession with a short and delayed farm ladder, and 3) disruptive succession without farm ladder (abrupt management transfer). See Fig. 3 for a comparative schema.

These pathways differ in (i) the sequence of succession events, (ii) the type and extent of disruptions, (iii) the importance of the farm ladder in skill acquisition amidst other learning experiences, and (iv) the farm development trajectory before succession. These differences influence the adoption of different farm development strategies in several ways. See Supplementary material 2. For more detailed information on participants' succession histories.

#### 3.2.1. Blueprint succession

Seven interviewees had a blueprint succession (Table 1). They grew up on the family farm, participating in farm activities from childhood and recalling positive memories. As teenagers they were assigned tasks and involved in management decisions, marking early socialization as future farm managers. Their desire to become farmers became explicit at various stages – after school, higher education, or initial work experiences elsewhere. Some were encouraged by parents to study or work outside farming, while others pursued university willingly, but all remained committed to farm activities and decisions. Succession required having sufficient farm assets (primarily land) for successors to farm full-time, with transfers planned and agreed upon by the family, including investments to accelerate the process. Some interviewees worked as part-time wage laborers for their parents' while waiting for the retirement of another family member (parents, uncles, or grandparents). Incumbents often stayed involved in decisions after retirement. The two women interviewed followed a blueprint pathway, joining the family farm alongside siblings through the creation of a family cooperative.

Although these blueprint pathways are not disruptive, they are neither linear. We identify events and circumstances that could have caused disruption but were resolved swiftly (*D* in Fig. 3), including: 1) parents' reticence to let successors join the farm immediately after school, 2) successors' voluntary exploration of non-farming careers, and 3) insufficient assets to incorporate the willing successor (see Supplementary material 2).

Blueprint successors experienced a long farm ladder from adolescence to adulthood (Fig. 3), gaining most farming skills through participating in farm activities and decisions. They complement this knowledge with external training and advice, though any innovations require incumbents' approval. They highly value their family legacy and reverence their predecessors' experiential knowledge, rarely questioning their parents' strategies or reporting disagreements. Only Astor and Pablo express slight misalignment with their predecessors (Table 1). During the farm ladder, blueprint successors were introduced to cooperatives, farmers' unions, and input providers trusted by their families. They express pride in maintaining these relationships as part of their family legacy, meaning most external advice and support is shared with (and approved by) their parents.

As Table 1 shows, incumbent farmers made regular investments in land, machinery, infrastructure, and strategic diversification before full management transfer, partly driven by a sense of "succession security". As Adela noted: *'Our parents worked on the premise that we were staying.*

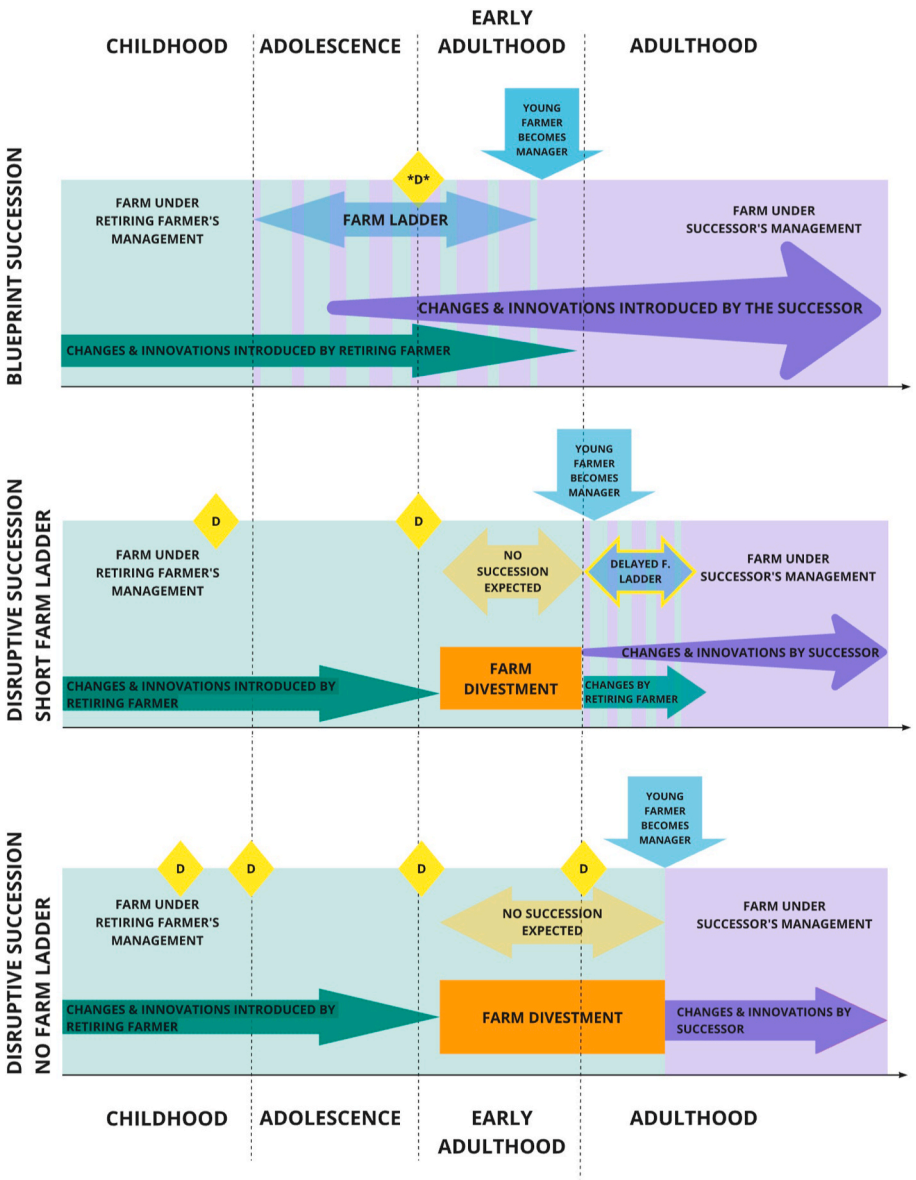


**Fig. 3. Three family farm succession pathways compared**. Succession pathways chronologically organized (left to right) by successors' life stages. Blueprint succession sequence shown in green-blue-violet. Disruptions (D) and discrepancies from this blueprint sequence appear highlighted in yellow-orange (*D* in blueprint succession denotes quasi-disruptive events). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

*Otherwise, they might not have done so much.'* Successors actively participated in these decisions, ensuring the farm strategy aligned with their preferences as future managers. All rate the inherited farm assets between optimal and adequate for their operations, and large enough to justify the minimum Annual Work Unit (AWU), thus qualifying for the CAP start-up subsidy (Table 1).

Pablo and Adela's parents had transitioned from conventional management to agroecology before succession (see Table 1). The shift was gradual, with the whole family contributing extra labor and financial investments. While they faced the initial challenges of agroecology transitions (described in section 3.1.1), these had been resolved before incumbents' retirement. As one noted: *'We've been involved since kids. I was sixteen when we discussed going organic. Yes, there were difficulties, but when I took over, the farm was running smoothly.'* Pablo and Adela learned "good farming" references from their parents, later expanding their knowledge through agroecology movements, farmer unions, and cooperatives. Both received CAP start-up subsidies and used them to update machinery, diversify activities, enhance circularity, and/or establish a family cooperative. Overall, their incorporation as full-time agroecological farmers has been smooth and unchallenging, however, they felt pressured to oversize their farms to meet the CAP start-up subsidy requirements.

Pepa believes her parents' vision for their free-range livestock farm aligns with agroecology. However, the family-run butcher shop closed during succession, and new sanitary norms forced them to sell livestock to intermediaries, who pay lower prices and demand larger operations to cut logistics costs. To adapt, Pepa and her siblings have incorporated an intensive feedlot and conventional agriculture for grain and fodder. These changes, planned by the family and funded by the CAP start-up subsidy and a bank loan, have shifted the farm's strategy. While Pepa wishes to return to a 'farm-to-fork model,' she feels socio-economic pressures are steering them in a different direction.

Isaac, Germán, Astor and Eladio see farm enlargement and modernization as part of their family legacy, and their duty as successors. As Isaac explained:

**Table 1**
Blueprint succession & farm development histories.

Agroecology, Conventional without intensification, Conventional with intensification
Size: (>>) very large, (>) large, (=) standard, (<) small, (<<) very small

| Successor | Predecessor /alignment | Farm type legacy | Investments by predecessors (before succession) | Size (relative to AWU) | Farm assets received | CAP start-up subsidy | Investments by successors (after succession) |
|---|---|---|---|---|---|---|---|
| Adela | Parents /Total | Arable agriculture, extensive livestock, cheese | Organic certificate, farm enlargement, creamery opening, local direct sales | = | Optimal | Yes | New machinery, rooftop solar panels on creamery |
| Pablo | Parents /Partial | Arable rainfed cereals, legumes, horticulture | Crop diversification, organic certificate, machinery updates, local direct sales | < | Adequate | Yes | Crop diversification, machinery updates, market diversification (local) |
| Pepa | Parents /Total | Extensive diverse livestock | Regular updates | = | Adequate | Yes (unhappy) | New machinery. New Feedlot & rainfed agriculture of fodders. Market diversification (international) |
| Isaac | Parents /Total | Arable cereals, fodders, oilseeds | Irrigation, farm enlargement, precision technology | >> | Optimal | Yes | Farm enlargement, machinery |
| Germán | Parents /Total | Arable cereals, fodders, oilseeds | Irrigation, farm enlargement, no-till technology | > | Optimal | Yes | Farm enlargement, machinery re-scaling |
| Astor | Parents /partial | Arable cereals, no rotation | Farm enlargement, machinery updates | >> | Adequate | Yes | Crop diversification, rotations, irrigation, precision technology, eco-schemes. Market diversification (National) |
| Eladio | Parents /Total | Arable cereals, fodders, potatoes | Regular updates | > | Optimal | Yes | Farm enlargement, machinery re-scaling |

*'My father started with my grandpa I've seen them improve, enlarge, and modernize. I'm not here to dismantle what they built but to improve it further.'*

However, these four farmers face a conflict between such imperative to enlarge farms and the rising land market related pressures, exacerbated by surface-based CAP incentives in a negative feedback loop. As Eladio explains, '*you either come from a wealthy family, or you can't start without the CAP start-up subsidy, which requires 100 ha*'. This minimum surface requirement forces young successors to expand their farms, while special CAP incentives enable them to pay higher land rents. Since their strategy hinges on achieving economies of scale and securing surface-based CAP incentives, these young farmers accept inflated rent prices—sometimes exceeding the revenues from those lands. They feel both victimized by and complicit of growing competition in local land markets. As Germán explains:

*'When CAP offered young farmers extra funds, everyone rented lands at higher prices, because you needed the 100 ha for the AWU, and you could afford it. Six years later, the extra funds are gone, but the tenant won't lower the rent, because new young farmers with CAP bonuses are willing to pay. You cannot lose your AWU, so you're trapped paying soaring prices!*'

These four blueprint-intensifying successors also place foremost importance on being seen as "good farmers" by their families and communities, particularly during the farm ladder. This means '*keeping up with sector updates*' (Isaac) and regularly attending training sessions on innovations aligned with their predecessors' intensification strategies. They believe agroecology would challenge their identity legacy, and thus never attended training on agroecological practices. They associate organic farming with low productivity, carelessness, unprofessionalism, and backwardness. For example, Eladio stressed that '*if you don't spray, you don't harvest … [the farm] gets overrun with shit (weeds)*'. Astor, despite his commitment to sustainability, argued that '*by going organic, he would ruin the soil on his family's land*'. Isaac dismissed organic farmers as '*weekend farmers … who earn their salary elsewhere and if the experiment takes five years to give results, they can wait.*' Isaac, Eladio and Germán equated organic farming with '*going back to ploughing with mules*'.

### 3.2.2. Disruptive succession with short farm ladder

Four interviewees experienced this succession pathway (see Table 2). Ignacio took over his father's farm, while Julio, Diego and Angel took over farms from relatives with no descendants. All four participated in farm activities as children but were never treated as potential successors or given responsibilities during adolescence. This lack of early recognition as successors was the earliest and only common disruption across all non-blueprint succession histories, always paired with at least one later disruption (see Supplementary material 2). Before becoming farmers, these participants experienced career changes, migrated nationally and internationally, and occasionally considered joining the farm. Their involvement in farm activities was sporadic at best, until they became farm successors. Disenchanted with their careers and seeking a lifestyle change, they seized their opportunity when their retiring relatives made a final call for a successor. Succession occurred with little planning and no prior farm ladder. Instead, they experienced a short ladder (1–3 years) after taking full economic responsibility for the farm (Fig. 3).

The early disruptions in these life histories are: 1) the absence of a direct succession line, and 2) the failure to identify a potential successor during adolescence. These may be followed by 3) parents' reluctance to let a willing successor pursue farming, 4) insufficient farm assets and capital to incorporate a willing successor, and/or 5) tensions in negotiating farm strategic decisions.

During the short, delayed farm ladder, successors learnt basic farming skills from predecessors and short union training. They felt unprepared for independent management and incumbents made the

**Table 2**
Disruptive succession with short farm ladder & farm development histories.

Agroecology, Conventional without intensification, Conventional with intensification
Size: (>>) very large, (>) large, (=) standard, (<) small, (<<) very small

| Successor | Incumbent /alignment | Farm type legacy | Investments by predecessors (before succession) | Size (relative to AWU) | Farm assets received | CAP start-up subsidy | Investments by successors (after succession) |
|---|---|---|---|---|---|---|---|
| Julio | Uncle/limited | Rainfed & irrigated cereals and other arable | Austere updates | = | Outdated machinery & infrastructure. Depleted soils. Inadequate marketing strategy | Yes | Crop diversification, organic practices, soil restoration. Irrigation. Market diversification (local) |
| Angel | Uncle/Partial | Rainfed cereals | Divestment | < | Outdated machinery, infrastructure & marketing strategy | Yes | Machinery substitution |
| Ignacio | Parents/ Partial | Extensive livestock | Austere updates | = | Adequate | Yes (unhappy) | Herd enlargement, machinery renewal |
| Diego | Uncle/Partial | Rainfed & irrigated cereals and other arable | Austere updates | > | Sufficient | Yes | Machinery updating, irrigation infrastructure, no-till technology, farm enlargement. |

most strategic decisions. Successors respect their predecessors' experiential knowledge and value their support but critique some sustainability aspects of their approaches, informed by environmentalist movements (Julio and Ignacio) or *'general awareness'* (Angel and Diego). Consequently, these four successors relied on the advice of the neighbors, cooperatives, unions, and input providers recommended by their relatives, but complemented those with sources better aligned with their sustainability concerns.

As Table 2 shows, farm management had become conservative, due to unexpected succession, with minimal investments in land, machinery, and infrastructure, and no innovations in cropping patterns. Successors received functional but outdated equipment and enough land to qualify for the CAP start-up subsidy—on condition they made overdue investments, funded through bank loans and family funds. While successors bore the economic risk, retired relatives often retained management decisions, occasionally causing conflict.

Julio believed his uncle's farm was too small for profitable conventional management, and the surrounding land was inaccessible. Inspired by experiences on agroecological farms, he transitioned to agroecology after one year doing conventional farming with his uncle. As he recalled:

> *'I was scared my uncle wouldn't like the idea … but he accepted. I think he would have gone organic himself, but this is a small village, you know?'*

Transitioning to agroecology was challenging (Section 3.1.1) and worsened by his limited knowledge and constraints to apply an adaptive learning approach under rigid CAP start-up subsidy requirements (e.g., the prescriptive business plan). Economic uncertainty and stress made Julio's early farming years difficult.

Angel, Ignacio, and Diego, in turn, continued their predecessors' conventional strategies with varying levels of intensification. Motivated by environmental concerns, all three considered adopting organic management—either combined with agroecological practices (Ignacio, Angel) or blended with intensification and specialization (Diego). However, they cited three challenges: conflicting views with predecessors, the obligation to follow the 5-year CAP subsidy management plan, and a lack of training and advice for transitioning to organic production.

### 3.2.3. *Disruptive succession without farm ladder*

Nine interviewees experienced this type of succession, which involves the widest diversity of kinship relations between retired farmers and successors (see Table 3). While these interviewees participated in farm activities as children, they were never socialized as potential successors. Nacho reported unpleasant memories of farm activities as an early disruption. Claudio and José expressed interest in farming after high school, but José's parents pushed him toward '*any career but farming*', and Claudio lacked the capital to join his grandparents' farm or start his own. These nine interviewees' early adulthood included career changes, national and international migrations, and periods of unemployment, with minimal involvement in the family farm (se Supplementary material 2).

They became farmers when three circumstances converged: (1) disenchantment with their professional careers and a desire for change, (2) access to land, farm assets and/or housing from a retired relative or communal land through family mediation, and (3) sufficient capital and experience to start their own farms. These pathways resemble those described in section 3.2.2. but have resulted from more and longer succession disruptions (see Fig. 3). As a result, farm management is transferred abruptly (without a farm ladder). Sometimes there is even a gap between retirement and succession, during which the family farm ceases to function as a stand-alone production unit, becoming abandoned, rented, or partially sold.

The early disruptions identified include: 1) no direct succession line, 2) no identified successor during adolescence, and/or 3) negative childhood farm experiences. These combine with later disruptions like 4) parents' reluctance to let successors join the farm, 5) insufficient farm assets or capital, 6) a gap between retirement and succession, and/or 7) tensions between predecessors' legacy and successors' plans.

Without a succession ladder, these interviewees gained agricultural skills through formal training or previous work in other farms. While they respect their predecessors' knowledge, they dismiss it as a reference for best practices, due to critical views about conventional farming's sustainability that stem from formal education and engagement with environmentalist and agroecology movements. As farm managers, they rely on cooperatives, unions, and other farmers for advice, selecting –

**Table 3**
Disruptive succession without farm ladder & farm development histories.

Agroecology, Conventional without intensification, Conventional with intensification
Size: (>>) very large, (>) large, (=) standard, (<) small, (<<) very small
Sufficient* only with agroecology

| Successor | Predecessor /alignment | Farm type legacy | Investments by predecessors (before succession) | Size (relative to AWU) | Farm assets received | CAP start-up subsidy | Investments by successors (after succession) |
|---|---|---|---|---|---|---|---|
| Aurelio | Father-in-law/Limited | Rainfed arable crops | Austere updates | = | Sufficient. Insecure tenure Depleted soils | Yes (conventional) | Machinery renewal. Crop diversification, soil restoration, change to organic |
| Nacho | Parents/ Misaligned, conflicting | Rainfed cereals | Divestment | << | Sufficient* Depleted soils | No | Soil restoration, crop diversification, permaculture, biofertilizers. Set-up mill. Market diversification (consumer groups) |
| Simón | Aunts/ Limited | Rainfed cereals | GAP. Lands rented to neighbors | << | Sufficient* | No | Soil restoration. Livestock & barn. Set-up cooperative slaughterhouse. Market diversification (local) |
| Manuel | Parents/ Limited | Rainfed & irrigated cereals | Divestment No rotation Downsizing | < | Inadequate. Insecure tenure. Depleted soils | Yes (discontent) | Soil restoration, crop mix change & diversification, change to organic. Market diversification (local) |
| José | Parents/ Partial, conflicting | Arable rainfed crops | Austere updates | = | Sufficient* | ** Not yet farmer | **Not yet farmer |
| Claudio | Grandparents/ Partial | Abandoned municipal pastures | GAP | << | Sufficient* | No | Small herd purchase. Regenerative pasture rotations. 3 years breeding & enlarging herd. Then, direct sales |
| César | Grandparents & mother's friends | Abandoned horticultural plots | GAP | < | Sufficient* | No | Plots rehabilitation. Permaculture, biofertilizer and biopesticides production. Market diversification (consumer groups) |
| Adrián | Grandparents/ Partial | Hobby farm. Semi extensive livestock | Divestment Downsizing | < | Outdated. Adequate | Yes | Livestock. Barn rehabilitation. Set-up cooperative slaughterhouse. Build workshop. Market diversification (national) |
| Benito | Parents/Total | Rainfed & irrigated cereals & fodders | Austere updates | < | Sufficient | Yes | Farm enlargement. Machinery renewal. Precision technology. Irrigation |

when possible – knowledge holders based on specific needs rather than family connections. Overall, they lament lacking place-based knowledge for informed decisions, attributing this to limited experience, restricted access to relatives' and neighbors' advice, and/or inadequate guidance from their advisors.

As Table 3 shows, unexpected succession is strongly associated with slowed farm structural adjustments or even downsizing. This can render farms too small and outdated to qualify for CAP start-up subsidies during succession. Aurelio is an exception, as his farm matched the region's average size for profitable rainfed cereal farms. For him, becoming a farmer and adopting agroecology were inseparable, but complying with the CAP start-up subsidy requirements was easier with conventional management, and thus he farmed conventionally during these five years, gradually phasing out agrochemicals.

Nacho, Claudio, Simón, Manuel, and César started farming in circumstances where a conventional strategy would have required unaffordable investments in land, machinery, and inputs, making agroecology their only viable option (Table 3). Unlike Aurelio, they could not transition gradually and had to restore soil fertility, upgrade machinery, and diversify crops and markets all at once. With limited local knowledge, they relied on trial and error, worsening their challenges. They financed their projects through savings, small loans, and family support, with two taking secondary jobs at the local cooperative. Only Manuel qualified for the CAP start-up subsidy, but its restrictions on crop experimentation slowed recovery. Unlike Pablo and Adela, they had little family help and even faced ridicule for their organic practices, leading to financial struggles, stress, and demotivation. As Manuel explained:

> '*The last years my father even stopped rotating crops. The monoculture of cereals had left very poor soils, full of weedkiller (…) I had to buy a subsoiler and a new "escardadora" for mechanic weeding. (…) It has taken me six years to make those lands productive again. (…) From 2013 till 2017 I had only economic losses*'.

As for the rest of farmers in disruptive successions without farm ladder, José is committed to farming, working seasonally on agroecological farms across Europe while awaiting his father's retirement. Meanwhile, he is excluded from family farm decisions and discouraged from succession due to his father's distrust of agroecology. Adrián, by contrast, received housing and enough farm assets to start a small, specialized farm business with artisanal production of gourmet foodstuffs, supported by the CAP start-up subsidy and his family's backing, making his early years in farming relatively easy. Benito inherited a smaller-than-average farm eligible for the CAP subsidy but required significant additional investments. Following advice from his predecessor's trusted union, he took a large loan to expand the farm by 40 % through rentals, increasing CAP revenues and securing modernization subsidies. While this restored the farm's viability, it left him heavily indebted for at least five years. Despite recognizing the environmental harm of conventional practices, he refuses to adopt organic methods due to his predecessor's legacy, the advice of his peers, and his current financial burdens.

## 4. Discussion

The results above have helped us to disentangle the complex relationship between family farm succession and the adoption of different farm development strategies, in the specific context of Castilla y León, Spain. Drawing on the "development trajectory" concept, our contextualization of farm development strategies situates current farm practices and structures in an ongoing process of agrarian change. In this regard, our results capture the struggle between the green revolution legacies embedded in the development trajectories of European family farms, and young farmers' pursuit of sustainability through different strategies (Arnalte et al., 2008; Calus and Huylenbroeck, 2010; Milone and Ventura, 2019). However, our findings do not attempt to represent agroecology adoption rates, for they are based on a purposefully selected group of participants. Likewise, the three succession pathways described are not intended as a universal categorization. Instead, they serve as a framework to organize complex life history data, highlighting the patterns linking succession dynamics to participants' farm development strategies, including agroecology.

We have understood family farm succession as a potentially non-linear and haphazard process, where disruptions can be cumulative, trigger sequential effects, and impact succession in multifaceted ways, creating an intricated web of causalities. The results align with theory and empirics that consider farm succession as an assemblage of long-term parallel processes that shape each other sequentially (Chiswell, 2018; Coopmans et al., 2021; Fischer and Burton, 2014). The farm ladder, central to blueprint succession, links the formation of successors' personal traits (e.g., identity and knowledge) with the farm's development trajectory through the successor and succession effects (Coopmans et al., 2021; Fischer and Burton, 2014). In our findings, the ladder acts as a central switch, regulating interactions between these intra-familiar succession elements and exogenous factors, explaining key differences among the three succession pathways and their intersection with different farm development strategies.

In our findings, blueprint succession pathways appear strongly linked to farm development strategies that pursue efficiency-based sustainability through farm specialization, modernization and economies of scale in land and production (Arnalte et al., 2008; Pérez and Miranda, 2008). These strategies are to be realized and maintained through continuous investments under "the succession effect" (Calus and Huylenbroeck, 2008) and rooted in legacy-driven "good farmer" identities. These "good farmer" identities tie farmers' skill and commitment to visible productivity—such as large machinery and homogeneous fields— establishing normative frameworks and expected behaviors (Burton, 2004). Blueprint successors learn and endorse these throughout the farm ladder, gaining respect and support from their family and community (Bertolozzi-Caredio et al., 2020; Joosse and Grubbström, 2017). Acquired during adolescence, these "good farmer" norms shape blueprint successors' strategic choices and sometimes lead to repudiation of organic farming (Kovách et al., 2022; Monllor Rico, 2013). Farmer unions, mainstream training, and CAP incentives further reinforce conventional norms (Baraja Rodríguez et al., 2021; Pérez and Miranda, 2008).

In contrast, we find that disruptive succession pathways are more associated with agroecology adoption in at least two ways. First, disruptive succession reduces the family imprint on successors' "good farmer" norms, evidenced by participants' criticism of their predecessors' strategies. This stems from minimal farm ladder negotiations during successors' adolescence, delaying the establishment of "good farmer" norms until adulthood, when contextual factors outweigh family influence (Coopmans et al., 2021). As a result, successors become more receptive to competing norms of good/bad farming (e.g., agroecology) beyond their immediate family environment (Góngora Pérez et al., 2020; Monllor Rico, 2013). Second, disruptions in family succession induce farm divestment and downsizing, representing the opposite to the "succession effect" – incumbent farmers' tendency to invest in farm structural adjustment when succession is secure (Bertolozzi-Caredio, 2024; Calus and Huylenbroeck, 2008). Young farmers in disruptive pathways, receiving divested, small and outdated farms turn to agroecology to restore viability, especially where conventional development is not cost-effective. Similar strategies have been observed among farmers with limited access to land and credit, and owners of small traditional farms in other regions of Spain and Europe (Góngora Pérez et al., 2020; Milone and Ventura, 2019).

While these insights above paradoxically suggest that disruptive succession facilitates agroecology adoption – and vice versa – we found these succession histories particularly challenging in several ways. On the one hand, the long-term and intensive labor requirements of agroecology transitions clash with the abrupt and lonely nature of disruptive succession. In advanced economies, agroecology adoption departs from intensively managed farms, requiring deep and lengthy ecosystem restoration (Tittonell, 2020), and a systematic change in the entire farming system (Prost et al., 2023). Experienced farmers forge ahead with this transition gradually, testing and optimizing practices on a small-scale before scaling up (Catalogna et al., 2022). In our analysis, disruptive succession leads instead to the abrupt, farm wide adoption of untested and non-optimized agroecological practices, resulting in sharp productivity declines and high risks. These challenges are coupled with strong demands on labor related to market creation and development for agroecological produce (Argüelles et al., 2018; Cuéllar-Padilla and Calle-Collado, 2011), and disruptive successors have limited family help to absorb these extra tasks.

The young farmers we interviewed have limited farming experience, scant place-based knowledge, and restricted access to the knowledge legacies of neighbors and relatives, as observed among new entrants in other studies (Alario Trigueros et al., 2018; Carolan, 2018; Góngora Pérez et al., 2020; Joosse and Grubbström, 2017; Monllor Rico, 2013). This belies the notion that agroecology relies primarily on the traditional and local knowledge of smallholder farmers (Altieri, 1989; Barrios et al., 2020). In Europe, industrialization has displaced traditional agroecological knowledge, confining it to "pockets" of social-ecological memory or embedding it within conventional family farming (Barthel et al., 2013; Gómez-Baggethun et al., 2013; Reyes-García et al., 2014). The barriers to accessing this knowledge, highlighted in our findings, suggest a bottleneck in integrating traditional knowledge into agroecological practice and reveal gaps in understanding the knowledge systems driving European agroecology transitions (Anderson et al., 2019b).

These are questions which of course become less relevant when agroecology is introduced gradually with adequate financial support (Aurelio) or within blueprint succession pathways (Pablo and Adela). The latter could provide a favorable setting for scaling out agroecology transitions, by offering secure land access, family support, greater investment capacity, and access to diverse knowledges. However, this would require transforming the conventional "good farmer" norms tied to these legacies. Hybrid forums – training programs that integrate agroecological and conventional networks fostering knowledge exchange and cooperation – are promising tools (López-García et al., 2019). Yet, their transformative effects may also depend on family negotiations, as described in this and other research (Chiswell, 2018; Joosse and Grubbström, 2017).

Finaly, our results hint at some limitations and potentially contradictory effects of CAP subsidies for generational renewal, which warrants further interrogation. For example, while the CAP start-up subsidy has effectively supported blueprint succession in established family farms with conventional development strategies and up-to-date investments, it has been far from adequate for young farmers in disruptive succession who adopt agroecology to revitalize small, divested farms. These limitations stem from (1) minimum surface requirements misaligned with the realities of disruptive succession, and (2) the obligation to follow a pre-stablished business plan for five years, which conflicts with the adaptive learning and experimentation required throughout agroecology transitions (López-i-Gelats et al., 2009; Milone and

Ventura, 2019). The current subsidy undermines family farming sustainability by overlooking young successors in precarious situations, especially those supporting the Farm to Fork Strategy (European Commission, 2020), as seen also in Italy (Milone and Ventura, 2019). It seems also an important driver of land concentration and rising rental prices (Corsi et al., 2021), which are increasing tenure insecurity, reducing family farms, and potentially hindering sustainability transitions. While the 2023–2027 CAP reform aims to redistribute support to smaller farms, the start-up subsidy still funds land acquisition without caps of progressive limits (Chartier et al., 2023).

## 5. Conclusions

We have investigated how family succession shapes the farm development strategies of young farmers in Castilla y León, Spain, through life history interviews. We have described three family farm succession pathways and explored the synergies and frictions between these pathways and the adoption of agroecology and other agriculture sustainability approaches – a knowledge gap in family farming studies (Suess-Reyes and Fuetsch, 2016). In blueprint succession, the farm ladder and "succession effect" encourage successors to align their farming strategy with their predecessors' approach, which, in the study region is mostly linked to farm enlargement, modernization of conventional farming, and conservative sustainability framings. In contrast, disruptive succession pathways distort the farm ladder and "succession effect" allowing successors to misalign their farm development strategy from their predecessors' approach. However, this can also involve farm downsizing, limited access to credit, subsidies, family help and knowledge. In such context, agroecology adoption is challenging but could represent a cost-effective strategy to reinvigorate small and obsolete farms.

Our findings challenge two generalizations in European family farming literature and related policies. First, blueprint succession is said to guarantee family farm sustainability (Chartier et al., 2023; Suess-Reyes and Fuetsch, 2016). While we recognize the importance of blueprint succession and its potential role in sustainability transitions, we also show how conservative "good farmer" norms may shape blueprint successors' strategies, antagonizing agroecology adoption and sometimes encouraging unsustainable development. Second, succession studies often portray small farms as unprofitable and unattractive for young farmers, with some arguing that such farms should close and transfer their land to neighbors (S.F. Conway et al., 2020; Corsi et al., 2021). With similar rationales, the CAP start-up subsidy funds enlargement and modernization in farms that meet "business-as-usual" size requirements but neglects young successors with smaller farms (Chartier et al., 2023; Zagata and Sutherland, 2015). While we have shown that unprofitability deters young farmers, we have also made evident that small farms are not inherently unprofitable. Instead, some of our interviewees' lives suggest that small and divested farms can be viable with the right development strategy and support, even after prolonged succession disruptions.

Overall, these findings deepen our understanding of a sticky paradox in contemporary rural development, i.e., that those family farms most capable of undertaking transformative sustainability strategies are the least likely to do so, while those with limited access to farmland and resources seem more prone to do it (Góngora Pérez et al., 2020; Suess-Reyes and Fuetsch, 2016). We thus suggest that sustainability transitions in family farming may not necessarily result endogenously and could be encouraged with two complementary lines of research and support. On the one hand, understanding the knowledge politics underpinning young farmers' sustainability strategies could help identifying mechanisms of cross-fertilization between traditional "good farmer" norms and transformative sustainability framings, fostering transitions within blueprint succession. Second, current generational renewal efforts could increase their effectiveness by including disruptive succession pathways in their scope. Disruptions to the succession ladder may increase as traditional rigidity weakens, farms' socioeconomic context evolves, and contemporary youth navigate complex structural challenges like individualization, hypermobility, and labor precariousness (Chiswell and Lobley, 2018; White, 2021). Supporting succession in these disruptive family farms may be crucial to prevent further rural exodus and land concentration by investors and large companies, fostering livable, vibrant and sustainable rural areas.

## CRediT authorship contribution statement

**Ana Villán:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Sergio Villamayor-Tomás:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Esteve Corbera:** Writing – review & editing, Validation, Supervision, Project administration, Funding acquisition, Formal analysis, Conceptualization.

## Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used DeepSeek AI in order to improve the readability of the text. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrurstud.2025.103815.

## Data availability

The authors do not have permission to share data.

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