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Adaptive Governance and Resilience Capacity of Farms: The Fit Between Farmers' Decisions and Agricultural Policies

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Greater resilience is needed for farms to deal with shocks and disturbances originating from economic, environmental, social and institutional challenges, with resilience achieved by adequate adaptive governance. This study focuses on the resilience capacity of farms in the context of multi-level adaptive governance. We define adaptive governance as adjustments in decision-making processes at farm level and policy level, through changes in management practices and policies in response to identified challenges and the delivery of desired functions (e.g. private and public goods) to be attained. The aim of the study is twofold. First, we investigate how adaptive governance processes at farm level and policy level influence the resilience capacity of farms in terms of robustness, adaptability and transformability. Second, we investigate the "fit" between the adaptive governance processes at farm level and policy level to enable resilience. We study primary egg and broiler production in Sweden taking into consideration economic, social and environmental challenges. We use semi-structured interviews with 17 farmers to explain the adaptive processes at farm level and an analysis of policy documents from the Common Agricultural Policy program 2014–2020, to explain the intervention actions taken by the Common Agricultural Policy. Results show that neither the farm level nor policy level adaptive processes on their own have the capacity to fully enable farms to be robust, adaptable and transformable. While farm level adaptive processes are mainly directed toward securing the robustness and adaptability of farms, policy level interventions are targeted at enabling adaptability. The farm- and the policy level adaptive processes do not "fit" for attaining robustness and transformability.

Keywords: CAP, Sweden, resilience capacity, farms, adaptive governance

INTRODUCTION

Farming systems in Europe face increasing uncertainty (e.g. delivering healthy food products, generating adequate incomes, providing good working conditions etc.) due to frequent shocks and disturbances originating from economic, environmental, social and institutional challenges. Resilience is needed for farming systems to deal with these multiple challenges. To be resilient, farming systems should be robust to absorb disturbances, but also to allow adaptations for necessary adjustments and transformations to enable the system to overcome the exposure to disturbances by developing into something new if business as usual is no longer possible (Walker et al., 2004; Darnhofer, 2014; Meuwissen et al., 2019). Recent findings show that the current resilience of European farming systems is mostly oriented toward keeping the status quo (robustness), but farming systems lack the necessary resilience capacities of adaptability and transformability to respond to current and future system challenges (Meuwissen et al., 2020).

There is an increasing recognition that better resilience can be attained through adequate adaptive governance (AG) (Huitema et al., 2009; Djalante et al., 2011; Rijke et al., 2012; Feindt et al., 2020; Mathijs and Wauters, 2020). AG is context dependent and, in practice, applies to problems of a specific system (Walker et al., 2004; Rijke et al., 2012; Chaffin et al., 2014). In this study we define the AG of farming systems as adjustments in the decision-making processes at farm level and policy level, through changes in farm management practices and policies in response to identified challenges (social, environmental, economic) and the delivery of desired functions (e.g. private and public goods) to be attained. AG is necessary when the current state of a system is undesirable, unattainable, or both (Chaffin et al., 2014). That is when the farming system cannot ensure provision of the desired functions such as, for example, securing healthy food products, while attaining high animal and environmental standards, generate adequate incomes, provide good working conditions for employees and ensuring the attractiveness of rural areas (Reisma et al., 2020). The more variability and uncertainty in the provision of system functions, the stronger the need for the decisions to be adaptive (Nyamekye et al., 2018). While delivering the desired functions, AG connects multiple level actors, e.g. primary producers, policy makers, industry and NGOs, in collective action (e.g. Ostrom and Janssen, 2004; Folke et al., 2005; Rijke et al., 2012) to cope with the present (i.e. show robustness), as well as responding to challenges (i.e. enabling adaptive and transformative changes) (Gregg et al., 2015; Mathijs and Wauters, 2020).

Hence, we consider the decisions as adaptive if actors involved in the AG cope with, and respond to challenges. For instance, when coping with a certain challenge e.g. unstable incomes, adaptive decisions will imply short term adjustments that will maintain the income (e.g. via diversifying production). Responsive actions to unstable income might imply mid- and/or long-term technological adaptations and transformations to decrease the dependence of the farm income on the current capacity of the system. In that regard, the resilience capacity depends on multi-level AG, both enabled and constrained by adaptive management processes (herewith AG processes) supporting the system of interest to overcome the challenges (e.g. Gregg et al., 2015). In terms of primary farm production, farmers and policy makers should "ideally" work toward "reaching a desired state" by AG processes at both 1) farm level, e.g. demographics, agricultural practices, financial/risk management (Smit and Skinner, 2002; Meuwissen et al., 2019), and 2) policy level, including interventions with policy programmes, such as the Common Agricultural Policy (Feindt et al., 2019; Mathijs and Wauters, 2020).

Several authors have studied AG of farming systems from the perspective of adaptation decisions and policy interventions (Hurlbert and Pittman, 2014; Morrison and FitzGibbon, 2014; Nyamekye et al., 2018), showing that AG enhances resilience in terms of adaptability. However, from an AG perspective, there remains a lack of clarity and empirical evidence in the scientific literature on how the AG process at farm- and policy level shape and interact to build the resilience capacity, and thus enable farms to be robust, adaptable and transformable. Scholars (e.g. Rijke et al., 2012) are also calling for empirical studies to analyze the "fit" between the AG processes at different levels (e.g. farm level, farming system level) and for different purposes, because AG emerges from the interaction between multiple stakeholders, with multiple functions. Hence, which processes are involved and how they "fit" will depend on the stakeholders considered. Furthermore, in line with the general tendency in the literature on socio-ecological systems (SES), the empirical applications are mainly for environmental and/or climate challenges (e.g. Anderies et al., 2013; Chaffin et al., 2014). However, according to Folke et al. (2005), giving priority to a specific group of challenges may lead to too narrow decisions, which will not guide the system toward sustainable outcomes.

In this study we focus on the resilience capacity of farms in the context of multi-level AG. This approach follows the literature (e.g. Anderies et al., 2013; Meuwissen et al., 2019), where AG is expected to contribute to enhance the resilience capability of a system along the three resilience capacity dimensions. The aim of this paper is two-fold. First, to analyze how AG processes at farm- and policy level influence the resilience capacity of farms in terms of robustness, adaptability and transformability. Second, we investigate the "fit" between the AG processes at farm- and the policy level, to enable resilience. We study the primary egg and broiler production in Sweden, taking into consideration economic, social and environmental challenges. We use semi-structured farmer interviews to explain the AG processes at farm level, and analyze policy documents from the Common Agricultural Policy (CAP) program 2014–2020, to explain the intervention actions taken by the CAP.

CONCEPTUAL FRAMEWORK: FARM LEVEL AND POLICY LEVEL ADAPTIVE PROCESSES SHAPING THE RESILIENCE OF THE FARMS

Much of the AG literature explains the governance of SES in terms of resilience. Building on recent work by Meuwissen et al. (2019),

we define resilience of the farming systems as its ability to ensure the provision of the system functions in the face of economic, social, environmental and institutional shocks and stresses, through capacities of robustness, adaptability, and transformability. Robustness is the capacity of the system to absorb disturbances; adaptability is the ability to proceed with necessary adjustments; and transformability refers to being able to overcome the exposure to disturbances by developing into something new (Walker et al., 2004; Darnhofer, 2014; Meuwissen et al., 2019). To be resilient, farms should be resistant to changes, i.e. robust, adaptable and allow transformations (e.g. Meuwissen et al., 2019).

Higher resilience can be achieved by adequate multi-level AG processes (Huitema et al., 2009; Djalante et al., 2011; Rijke et al., 2012; Feindt et al., 2020; Mathijs and Wauters, 2020), involving processes by a range of actors. In terms of AG of farming systems, specifically for the primary production both farmers and policy makers (Darnhofer, 2014; Nyamekye et al., 2018; Meuwissen et al., 2019) influence adaptive processes, and thus shape resilience. The system's resilience capacity is an outcome of these processes, which cannot be reduced to either side (Resilience Alliance, 2010). Hence, in this study we understand AG as adjustments in decision making in both farm- and policy level through changes in farm management practices and policies in response to identified challenges (social, environmental, economic and institutional) and the desired state to be achieved.

Analytical frameworks applying resilience thinking (Meuwissen et al., 2019) and AG (Nyamekye et al., 2018; Smit and Skinner, 2002) of farming systems distinguish between farm level and policy level decisions, where a variety of AG processes and mechanisms are crucial features for the resilience of the farms. For instance, farms bring labor, capital and knowledge to the production process (Darnhofer et al., 2010b; Noe and Alrøe, 2012), and shape the resilience of the farm through multiple AG processes on demographics, agricultural practices, financial/risk management (Meuwissen et al., 2019; Smit and Skinner, 2002). Demographics includes: 1) the dynamics of labor in the farming system, such as: hired labor force, generation renewal by succession; 2) the structure of the agricultural labor force, such as age, qualification, gender, origin; 3) socio-economic issues related to income level, long working hours, remote locations (Bijttebier et al., 2018). Agricultural practices refer to, for example, technological solutions (e.g. organic farming technology, robots), farming routines, and so forth. Risk management relates to strategies for dealing with risk, such as diversification activities, sharing resources, building human capital, openness to learn, applying new ideas and novel approaches, cooperation, etc. (Meuwissen et al., 2019; Spiegel et al., 2020). Themes of farm level adaptive process are summarized in Table A1, **Supplementary Appendix S1**. Current research indicates that at the farm level, robustness is mainly ensured through temporary reallocation of resources, primarily labor and capital, such as finances, equipment and machinery (e.g. Darnhofer et al., 2010b; Darnhofer, 2014). Adaptability implies adjustments to changing context or preferences of employees (predominantly family members), the use of new technologies or access to new markets, responses to climate change and environmental requirements, the acquisition of new knowledge and skills, and so forth. Transformation is triggered by crizes (excessive work load, debts, etc.), and takes place when farmers see their farms as dysfunctional units not able to deliver the desired output (Darnhofer, 2014).

Farm resilience can be facilitated or hindered by the CAP (Feindt et al., 2020; Mathijs and Wauters, 2020). CAP should assist farms to maintain the status quo (if/when the status quo is desirable), but also to help them adapt and transform when needed (Buitenhuis et al., 2020; Mathijs and Wauters, 2020). Given the CAP framework, the expectation is that policy measures will support farmers' income and viability, enable generational renewal, foster innovations, strengthen European rural areas and therefore increase the resilience of the farming systems (European Commission, 2017, 2020). Except for recent studies by Feindt et al. (2019), and Mathijs and Wauters (2020) based on the analytical approach by Buitenhuis et al. (2020), the academic literature on resilience does not provide a systematic assessment capturing the effect of the CAP on resilience (robustness, adaptability and transformability). Hence, in this study we build upon the work by Buitenhuis et al. (2020).

Buitenhuis et al. (2020) introduced the Resilience Assessment Tool (ResAT) to provide a systematic set of key indicators and their respective characteristics for resilience-enabling policies. ResAT aims to explain to what extent current policies at the member state level, and in particular the CAP, enable or constrain the resilience of farming systems along the dimensions of robustness, adaptability and transformability. The key indicators, and anchor examples/characteristics for policy measures enhancing the resilience capacity in terms of robustness, adaptability and transformability are provided in Table A2, in **Supplementary Appendix S1**. Within the ResAT approach, based on an extensive literature review, the authors identify four key indicators for each type of resilience. Key indicators of robustness enabling policies are: 1) short-term focus for recovery and continuation of the status quo with marginal adjustments; 2) protecting the status quo by marginal adjustments; 3) buffer resources to enable the availability and accessibility of; and 4) preventing risk measures. Key indicators of adaptability enabling policies are: 1) middle-to long-term adaptations; 2) flexiblity, to allow actors to respond; 3) variety of system solutions (diversification, ecosystem services); and 4) social learning. Finally, key indicators of transformability enhancing policies are: 1) long-term focus, i.e. policies address a time span of over five years to decades; 2) dismantling incentives to prevent status quo/to support transformative practices, 3) in-depth learning; and 4) enriching and accelerating niche innovations and experimentation, see Table A2, in **Supplementary Appendix S1**. The resilience AG process at farm level and policy level influencing resilience capacity in terms of robustness, adaptability, and transformability are summarized in **Figure 1**.

AG processes at farm- and policy level should interact in order to "reach a desired state". The "desired state" should be identified by the actors involved in the system of interest (e.g. farming system), and may refer to the delivery of a variety of functions representing private and/or public goods

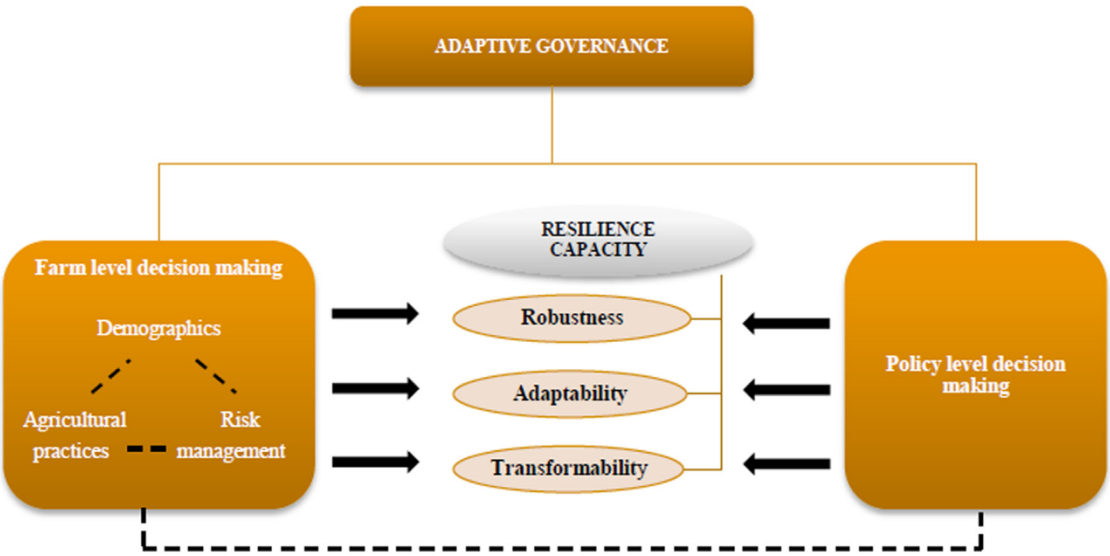

FIGURE 1 | Adaptive governance processes: farm level and policy level adaptive processes influencing the resilience capacity of farms.

(Meuwissen et al., 2020). In the literature, this is known as "fit/misfit" (e.g. Huitema et al., 2009; Chaffin et al., 2014) or "connects/disconnects" (Termeer et al., 2019) between the AG processes and the system of interest. Rijke et al. (2012) introduce the concept of "fit-for-purpose" governance to be used as an indication of the effectiveness of governance structures and processes to fulfill a certain objective at a certain point in time. It is expected that the AG processes provide a framework for solutions for the farm challenges, enabling farms to deliver the main functions, hence the resilience. The question about the "fit" can be posed for different purposes (Rijke et al., 2012). In our study we use the "fit" approach to evaluate the potential effectiveness of policy to support farm level AG processes to deal with the challenges and deliver the desired functions and thus stimulate the resilience of farms.

"Misfits" can arise as a result of gaps in the AG processes at farm level and/or policy level, disenabling the farms to manage their resources or activities or deliver the essential functions (Ekstrom and Young, 2009). Identifying "misfit" is a critical step of identification of underlying gaps in AG processes (Ekstrom and Young, 2009; Rijke et al., 2012). In our study, the results on the "fit" will bring attention to insights for potentially inappropriate AG processes for robustness, adaptability and transformability.

To sum up, this paper studies the multi-level character of AG to shape the resilience of farms. The study differentiates between farm level ("demographics", "agricultural practices" and "risk management") and policy level AG processes. We incorporate the resilience concept as put forward by Meuwissen et al. (2019), considering: 1) existence of three resilience capacities: robustness, adaptability, and transformability, and 2) multiple challenges: economic, social, environmental and institutional.

METHODOLOGY

Case Study: Functions and Challenges

AG is context dependent, where different practices of farm level and policy level decision making are case study specific (Rijke et al., 2012; Chaffin et al., 2014). To assess how AG shapes the resilience of a system, one must specify which functions are of interest and to which challenges they might be vulnerable (Carpenter et al., 2001; Meuwissen et al., 2019), so that action can be taken (Cabell and Oelofse, 2012).

The Swedish commercial egg and broiler production are among the most prosperous agricultural productions in Sweden, where family farms constitute about 95% of all farms (Jordbruksverket, 2015). Both egg and broiler production is growing fast, and since 2010 has increased in volume by 34% in the egg sector and by 36% for the broiler sector (Jordbruksverket, 2020a; Jordbruksverket, 2020b). Both egg and broiler producers are strongly oriented toward production for domestic markets, where production of safe food, viable incomes, low nutrient loss, animal health and welfare, and farm employment are among the desired functions. However, despite the prospering market, egg and broiler production are under constant pressure from institutional, societal and environmental requirements for ecologically and animal-friendly production, and farms face steadily increasing production costs. Challenges and the desired functions identified for Swedish egg and broiler production are summarized in **Figure 2**.

Since 2000, the Swedish egg and broiler sector has been constrained by various challenges, in particular meeting new requirements for food safety, animal health and animal welfare (Regeringskansliet, 2015). These issues are debated by a wide range of actors at different levels, e.g. producers, processors,

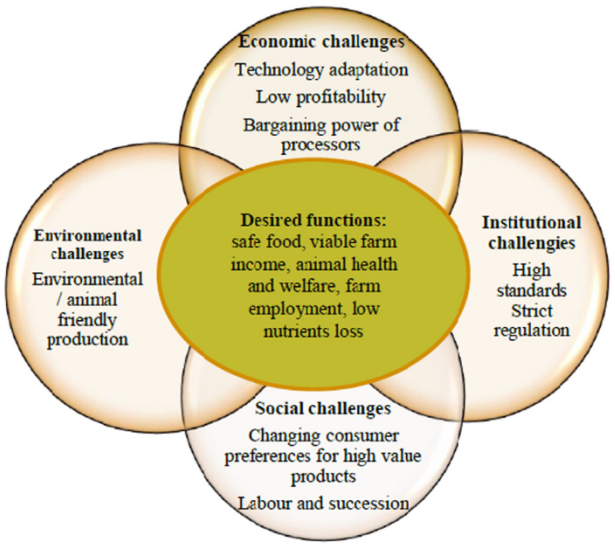

FIGURE 2 | Toward desired functions: main challenges identified for Swedish egg and broiler primary production.

consumers, NGOs and governmental bodies. In Sweden, animal welfare is considered a public good (Petitt and Bull, 2018). According to governmental documents (Regeringskansliet, 2015), Swedish standards for animal welfare and disease protection are higher than most of the EU directives and regulations. The main challenges imply that this makes production costs higher, and thereby the Swedish broiler and egg producers are uncompetitive on price (Jordbruksverket, 2018b). The increased costs are expected to be offset, due to consumers' higher willingness to pay for the relatively higher levels of animal health and welfare standards.

Following market liberalization after joining the EU and its internal market in 1995, the relatively high costs (compared to other EU member states) for inputs such as labor, energy and especially feed prices put pressure on Swedish farmers to continue with structural investments in order to remain competitive through increased productivity (Regeringskansliet, 2015). Dependence on processors (slaughter houses and egg packaging companies) leads to low value added at farm level and thus low margins for the two types of production (Bijttebier et al., 2018). Generational change, gender balance and lack of skilled workers are among the commonly identified social challenges.

Data Collection and Analysis

A qualitative approach was adopted to analyze both farm- and policy level AG. This approach was appropriate as the aim was to generate deep insights and context-dependent narratives at the farm level, as well as a deep understanding of the extent to which policy constrains or enables resilience. Firstly, 17 semi-structured interviews were conducted with farmers/farm employees during 2018 in order to understand the farm management practices that they employ in order to remain resilient (Coopmans et al., 2019). Secondly, a content analysis of policy documents on CAP for the period 2014–2020 was conducted to determine to what extent policies enable or constrain the resilience capacities of robustness, adaptability and transformability. By analyzing both farm- and policy level dimensions, we are seeking to better understand the interplay and "fit" toward assuring robustness, adaptability and transformability of the farms.

Semi-Structured Interviews with Farmers and On-Farm Employees

Semi-structured interviews (Wengraf, 2001; Silverman, 2017) were conducted during the summer of 2018 and included respondents from six farms (4 conventional and two organic) in the southern part of Sweden, where most of the egg and broiler farms are located. We employed purposive, non-random sampling, not aiming to reach statistical representativeness, but to cover as much diversity as possible with as few respondents as possible. Within each farm, several interviews were conducted, involving different respondents with different roles and experience (e.g. young active farmer, old active farmer, the spouse, successor/future successor and employee). The rationale behind involving respondents with different roles was to gather all opinions of importance for the farm. Respondents were not randomly chosen, but specifically selected according to the occupational status and the characteristics of the farm (Coopmans et al., 2019; Denzin and Lincoln, 2000). The main characteristics of the farms and the respondents participating in the semi-structured interviews are resented in **Table 1**.

Farms and their associated respondents were not randomly chosen, but specifically selected in order to reach a diverse sample in terms of respondent type and farm situations. As a case study, the results are not intended to be representative of the egg and broiler farming system as a whole, but provide a good illustration of the likely resilience capacities across the sector (Denzin and Lincoln, 2000).

An interview guide was used to ensure consistency in the questions asked across the interviews. Reflecting the conceptual framework that defines farm level adaptive processes along the dimensions of farm demographics, agricultural practices and risk management, respondents were invited to talk about the historical trajectory of the farm, particularly in terms of what challenges had been faced over time, and what coping strategies the farmer had employed in order to deal with them. Questions also focused on how various factors, such as farm demographic change, family relations, objectives for the farm, uptake of new technologies were perceived as influencing the farm's resilience. Themes and guiding questions used for the farm interview are provided in Table A3, in **Supplementary Appendix S1**. All interviews were conducted by two researchers, and lasted between one and 1.5 h. Interviews were audio recorded (with the consent of participants) and transcribed verbatim.

Qualitative thematic analysis was undertaken on the transcripts (Creswell, 2013), using NVivo 12 Pro software (QSR, 2018). Coding involved aggregating the text into categories or themes by coding text fragments to various thematic codes (Auerbach and Silverstein, 2003). A short set of provisional codes was first identified from the research questions in the study, but these were expanded inductively as

TABLE 1 | Characteristics of farms and respondents participating in the semi-structured interviews.

Farm and respondents characteristics		Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	No
Production specialization	Broilers	1			1	1		3
	Eggs		1	1			1	3
Production orientation	Conventional	1	1	1	1			4
	Organic					1	1	2
Respondent	Farm owner/manager	1	1	2	1	1	1	7
	Successor		1		2	1	1	5
	Other person taking over the farm	1						1
	Employee		1	1			2	4
Gender	Male	2	2	2	1	2	3	12
	Female		1	1	1		1	5

Note: In the table, the numbers represent the total number of farms and respondents in the respective production specialisation/orientation, and in the respondent/gender category.

coding proceeded, with additional codes added, or existing codes revised (Creswell, 2013). The codes included the three resilience capacity dimensions (robustness, adaptability and transformability) and strategies adopted by respondents across the farm level adaptive processes of demographics, agricultural practices and risk management (see Table A1 in **Supplementary Appendix S1** for the final set of codes). Although participants did not necessarily use the specific terms robustness, adaptability or transformability, attributes that reflect these capacities were identified and thus coded into the relevant thematic code.

In order to minimize researcher bias, three researchers were involved in coding and interpretation of the data. Each transcript was coded and interpreted independently by two researchers, who then compared their coding to check for consistency or differences in coding. Differences in interpretations were registered and further discussion was undertaken by the three researchers in order to determine the final analysis.

Policy Document Analysis

Firstly, relevant policy documents were identified by the researchers. These included 1) national CAP documents, such as basic payment schemes and the rural development program (RDP), over the 2014–2020 period, and implementation plans for 2017 and 2018; 2) EU documents on the CAP for the policy program 2014–2020. In total, eleven documents were identified, providing an overview of the existing policy instruments (see **Supplementary Appendix S2** for a list of the selected policy documents).

A content analysis was undertaken on the documents to investigate the extent to which the current CAP in Sweden enables or constrains the resilience of the egg and broiler sector in terms of robustness, adaptability and transformability (e.g. Buitenhuis et al., 2020). Firstly, the identified documents were imported into Nvivo 12 Pro software (QSR, 2018) and analysis proceeded by coding sections of the documents to a coding framework developed from Termeer et al.'s (2018) ResAT tool. Thus, codes included type of resilience, key indicators of resilience and examples of how the indicators are enabled by policy instruments (Termeer et al., 2018) (see **Supplementary Appendix S2**). Validation of the results from the policy document analysis was undertaken by face-to-face interviews with two stakeholders (one policy analysist and one specialist in poultry production) and a focus group with eleven stakeholders, all working with agricultural policy evaluations.

Finally, the results from the farm level and policy level analysis were compared to identify the "interplay" and "fit" between these two operational levels of AG in response to the identified challenges and desired functions.

RESULTS AND DISCUSSION

This section presents and discusses the main findings on: 1) the key farm level and policy level AG processes that shape the robustness, adaptability and transformability of the farms, and 2) the "fit" between these two operational levels of AG in response to the identified challenges and desired functions.

Adaptive Processes Enabling Robustness

Farm Level Processes Enabling Robustness

At farm level, "farm demographics" and "risk management" are the main categories of AG processes shaping the robustness of the farms in the case study. These processes are generally responsible for securing resources, such as labor, financial capital and social networks.

Through our interviews, farming was seen "as a lifestyle" involving long and irregular working hours, seasonal shifts, and informal and unpaid labor. One of the *respondents described the farmers' lifestyle as a 24-h job:* "You are on-call 24 h per day". *Under such circumstances,* the family, especially the wife's involvement was explained as crucial for the robustness of the farm. Women were also often declared responsible for '*soft values*', close to the chickens, as several informants believed that women have an '*eye for animals'* that men do not. Administration was also among the tasks mostly carried out by women, especially with the increase in bureaucratic work load. Generational shift was seen as a "natural process" but required early involvement of offspring in "farm life". To decrease the risk of high reliance on family members and individuals who know the particular farm operation, farmers try to improve human capital, as illustrated by this respondent: "*not rely on only one person - farming activities need to be maintained when anyone in the family get sick*". They do this by providing training for family members or hired staff, and thus securing farm labor to be able to perform tasks

independently or to take over for a period of time when the responsible farmer is absent. Family members taking off-farm jobs were seen by the respondents as a "risk management" strategy to buffer farm economics, but also to adapt farm labor in periods when the need for labor changes. The 'risk management' strategy to build good relations and cooperation with neighbors was important. It increases interactions and social wellbeing, but also the willingness to support each other with labor and machinery, or to share opinions and provide help with unforeseen events on the farm, and thus contribute to its robustness.

Results from our study show that farm level decisions have a great influence over the use of resources (as in: Resilience Alliance, 2010), and adaptations on farm labor involvement building human capital and networks are among the most common (e.g.,Smit and Skinner, 2002; Darnhofer, 2010). Smit and Skinner (2002) showed that diversifying income through off-farm employment provides robustness for farms facing crizes. Moreover, the authors showed that combining different types of information and sharing this in various networks is important for identifying partners for joint ventures when attractive opportunities arise. Cooperation has also been explained as important to avoid the isolation of working on one's farm and to maintain social life in the rural community (Smit and Skinner, 2002; Ashkenazy et al., 2018). 'Risk management' strategies secure social capital through knowledge building and financial capital through diversified on-farm and off-farm incomes (Darnhofer, 2010; Bertolozzi-Caredio et al., 2021), but also facilitate positive farm demographic trends for increased interest of the younger family members to continue the farm business (Darnhofer, 2010). From a social point of view, possibilities for diversification allow each family member to find activities that correspond to their personal preferences and interests, in that sense improving the job satisfaction as a key component to quality of life, and thus to ensure farm succession. However, Darnhofer (2010) does not relate farm strategies with resilience capacity dimensions.

Policy Level Processes Enabling Robustness

The CAP in Sweden is not oriented toward securing the robustness of farms' "short-term objectives", but rather toward "mid- and long-term" objectives (Regeringskansliet, 2014) which are targeted toward enabling adaptability and transformability (Termeer et al., 2018; Buitenhuis et al., 2020): "In Sweden, the agricultural policy is intended to be designed in as long term as possible (Regeringskansliet, 2014, *p*. 9), with liberalized, market-oriented and competitive agricultural sector driven by the consumers demand and taking into account climate, environment, animal welfare and development (Regeringskansliet, 2014, *p*.112)".

Within the CAP, robustness is partially maintained via direct farm payments which 'protect the status quo', however these payments are not coupled to egg and broiler production:"Direct payment is provided per ha land and is aimed at "supporting farm income" as it adds to farm income in a direct way (Regeringskansliet, 2014, *p*. 111; European Commission, 2016, *p*. 23). Hence, the influence of this measure is indirect through on-farm fodder production, as it is provided per hectare utilized. Income stability risk measures are not provided. The policy expectation is that 'soft' robustness-oriented policies will increase the risk aversion of farmers and initiate adoption of "risk preventive measures", enabling the farms to secure their incomes by investments and knowledge (e.g. to prevent spreading of pathogens and diseases, work related injuries, etc.). Risk "preventive" measures such as support for modernization of stables, improved work environment, knowledge acquisition, etc., are incorporated in the rural development program. In terms of securing on-farm labor, young farmer payments are provided to facilitate generational shift, but the instrument is more oriented toward mid-term planning, thereby adaptability. Short-term labor variations (day-to-day, seasonal, etc.), are not considered.

Research findings have shown that policy measures for income stabilization have a potential to alter the funds available to farmers to reduce the risk of income loss as a result of increased incidence, severity and duration of disaster-related events (Smit and Skinner, 2002; Feindt et al., 2019; Meuwissen et al., 2019; Bertolozzi-Caredio et al., 2021). However, such measures can discourage changes in land use and production practices. For instance, insurance measures have been associated with lower levels of off-farm income, less diversification, e.g. products and inputs, spatial diversification, resistant crops, etc. (Smit and Skinner, 2002).

Adaptive Processes Enabling Adaptability

Farm Level Processes Enabling Adaptability

"Risk management", including diversification, building human capital and networks, changes in "agricultural practices", e.g. applying new technologies, are the main farm level processes enabling the adaptability of the Swedish egg and broiler production, identified in our study. On-farm diversification, e.g. forest, horses, pigs, fodder production, tourism, was represented as a "risk management" strategy used to secure the farm from being dependent on sole income.

From the "risk management" strategies, building good relationships with farmers and surrounding networks (advisory services, industry, authorities) for sharing knowledge, was seen as important for the adaptability to changing circumstances in terms of farm enterprise development and demographic change, as demonstrated by one farmer: "And later in the evening, when my brother was at the local store doing some shopping, he ran in to an old friend who said: "Do you know anyone who is hiring? I have a boy at home dwelling around". 'Well, send him over', he had answered. And now he is here."

Participants considered "risk management" decisions to change the "agricultural practices" by adopting advanced technical solutions central to the development of the farms, as it allows for adaptation in terms of labor (as less manual labor and fewer working hours are needed), but also for dealing with challenges related to meeting regulatory environmental/animal welfare, and consumer requirements: *"Rregulations are complex and require a lot of work, but one simply has to adjust to adjust the production to them"* and "*I don't want to see regulatory changes in Sweden, I want to see them in the EU*".

New machines and robots, particularly within egg production have helped to eliminate heavy physical work, which previously limited the opportunities for older farmers and farm workers to continue working: "We stacked six trays on top of each other. They each weighed 12 kilos." [. . .] "Well, for someone who's young it's no issue, but we have people over 60 working here, and that wouldn't have worked very well."

Applying organic farming technologies is in accordance with new market trends and consumer and societal preferences for safe/organic food: *"Well it is possible to adjust, so that you can follow the market"* [. . .] *"In the meanwhile we have become more and more ecological because chicken manure is eco-approved"* [. . .] *"There is a financial incentive when we see that we can make more money if we invest."*

Findings are in line with the resilience literature, where diversification is a well-established "risk management" strategy for enhancing adaptive capacity in general (e.g. Darnhofer et al., 2010a; Darnhofer, 2014; Ashkenazy et al., 2018). Diversification helps in the reorganization of resources, which as a consequence increases farmers' room to maneuver (Darnhofer et al., 2010a), and secures different sources of income for the farm household (Knickel et al., 2018). From a case study analysis including 14 EU countries, Ashkenazy et al. (2018) identified three main clusters of diversification toward adaptability: finding new products, creating new ways to structure supply chains and initiating new activities; all requiring farmers to devote resources and to develop new skills, and to undertake new operations. Through a literature review analyzing farm adaptive management approaches, Darnhofer et al. (2010a) and Darnhofer (2010) showed that in addition to diversity, learning, sharing information, building networks and flexibility are key strategies of farm level actions recognized as appropriate for adaptability. Learning, experimentation, and flexibility have also been emphasized as ways to achieve adaptability for institutional (formal governance) adaptive processes of SES (Huitema et al., 2009).

Policy Level Processes Enabling Adaptability

At the level of the policy process, adaptability is expected to be achieved mostly via support that facilitates a "mid-term solution for adaptations", "variety of system solutions", and social learning, mainly focusing on environmental and climate objectives. The support for environmental and the climate objectives takes a large share of the Swedish CAP, with 63% of the total budget allocated to restoring, preserving and enhancing ecosystems related to agriculture and forestry (European Commission, 2016, *p*. 324).

In regard to "mid-term solutions for adaptations", "variety of system solutions" support is provided to enable restructuring and modernizations of buildings providing good animal welfare, replacement and use of energy effective technology and innovative methods (Regeringskansliet, 2015, *p*. 208–209), thus helping farms to adapt to environmental and climate requirements (Regeringskansliet, 2015, *p*. 225). Support for cooperation and pilot projects is expected to help for enhancing skills, the ability to manage and lead companies and spreading good examples of business models (Jordbruksverket, 2017, *p*. 51–52). Furthermore, the support for ecological production is expected to have positive effects on the environment, climate, animal health and rural development (Regeringskansliet, 2015, *p*. 450), foster creation markets and products with high value added. In budgetary terms (total public funding), support for organic farming (nearly 12% of the total budget) is among the four biggest RDP measures contributing to both the economic and environmental targets (European Commission, 2015). Within CAP, special emphasis (both within Pillar one and Pillar 2) is given to the need for young farmers to enter the farm, and thus ensure the domestic food production and, consequently, the production of collective goods (Regeringskansliet, 2014, *p*.112,; Regeringskansliet, 2015, *p*. 79 and 91,; Jordbruksverket, 2018a, *p*. 7). Last but not least, *knowledge/competence development, knowledge transfer measures* are in place to facilitate the environmental/climate adaption. Such measures are expected to help farmers to receive practical/individually adjusted advice and in that way to develop, to be market oriented and to adjust to the environmental requirements and climate change. (Jordbruksverket, 2017, *p*. 18 and 26,; Jordbruksverket, 2018a, *p*. 17, *p*. 17).

"Social learning" is enabled by policies designed to promote social activities/inclusion and local development in rural areas, and can be expected to be fostered by instruments for building infrastructure necessary for social learning development such as: a quality broadband network in rural areas (Regeringskansliet, 2015, *p* 270), developing products, methods, processes and techniques to share knowledge (Jordbruksverket, 2017, *p*. 64), investment for rural services and leisure to keep the local service in the rural areas, and provide possibilities for sport, leisure and meeting rooms (Regeringskansliet, 2015, *p*. 287). In Sweden 22% of the total RDP budget is allocated to the development of rural areas (European Commission, 2016, *p*. 324). Knickel et al. (2018) have identified knowledge and learning among the most important instruments for initiating changes, playing an important role in EU rural development policy.

Adaptive Processes Enabling Transformability

Farm Level Processes Enabling Transformability

At farm level, shifts in "agricultural practices" was identified as a main AG process shaping transformability. From the interviews it was clear that triggers leading to transformability were "*unforeseen coincidences*" or the farmer seeking a chance to increase profit. This could have been an opportunity to buy a farm that was suited for a certain kind of production, or the main processing company asking the farmer to join the production. *Interviews provided* several examples where farmers' decisions to transform their businesses were a response to a request or push from the industry. For instance one farmer indicated that he/she was instructed by the industry (a processing company) to convert from turkey to chicken production. Smit and Skinner (2002) also explain the transformations of the "private sector" as "spontaneous", or a combination of "consciously planned and spontaneous" strategies. *In the existing l*iterature, transformation

is linked to shifts initiated by both new opportunities and new patterns. A crisis can also be considered a "window of opportunity", enabling transformative change (Darnhofer, 2014). However, the literature has also shown that opportunities that influence the decision-making processes do not always result in decisions taken (Prager and Freese, 2009).

Policy Level Processes Enabling Transformability

At the policy level, transformability is mainly related to "long term" environmental and climate objectives, i.e. the generation of public goods and innovative production. For that purpose, multiple instruments such as support for non-productive investments, support for vocational training and advisory services, organic farming support and support for agri-environment-climate commitments, support for cooperation, building innovation groups and innovation projects with a focus on long-term social, environmental and climate objectives is provided.

Transformability is also supported by "initiatives for niche innovations", enabled by knowledge transfer and information measures (e.g. Regeringskansliet, 2015, *p*. 164), and support for pilot projects and cooperation between the innovation groups (e.g. Jordbruksverket, 2017, *p*. 47). Sweden has allocated 3% of the total RDP budget to knowledge transfer and innovation actions (European Commission, 2016, *p*. 326). However, together with cooperation actions this expenditure increases to 8% and in total 135,000 places on training courses will be provided (European Commission, 2015, *p*. 2). As described in the RDP, vocational training and advisory services are expected to convey new results from research and disseminate innovations (Regeringskansliet, 2015, *p*. 90); support for demonstration is likely to encourage the use of new methods and knowledge (Regeringskansliet, 2015, *p*. 166–167); and courses and information sharing are considered an effective way for spreading innovation (Regeringskansliet, 2015, *p*. 165, 167). Within the EIP special emphasis is put on environmental production where organically produced broilers for fattening are among the prioritized production types, whereas organic egg producers are not (Jordbruksverket, 2017, *p*. 55). In general, the effect of knowledge transfer and information measures on the enhancement and acceleration of niche innovations is indirect, e.g. it increases the awareness/interest to invest/apply innovative production. On the other hand, pilot projects allow different solutions to be tested before they are fully implemented.

According to Knickel et al. (2018), knowledge and learning are key instruments for initiating/inhibiting transformation. Our results show that transformations are highly related with social networks, both at farm level (e.g. industry, other farmers) and policy level (knowledge transfer platforms, cooperation and innovation groups).

What Is the Interplay and the "Fit" Between the Farm Level and Policy Level Adaptive Processes While Building Resilience?

In this study we show that different farm level and policy level AG processes are responsible for shaping the different resilience capacities of the farms. "Demographics" adaptive decisions are mainly related to robustness. "Risk management" strategies enable robustness and adaptability. Changes in "agricultural practices" enable adaptability and transformability of the farm. Policies were found to be mainly oriented toward adaptability, and to some extent for transformability and robustness. A summary of farm level and policy level attributes enhancing the resilience capacities of robustness, adaptability and transformability is provided in **Table 2**.

Smit and Skinner (2002) explain that AG processes are not mutually exclusive and are often interdependent; public policy to "fit" the farm level processes needs to be developed with respect to farmers' adaptive decisions undertaken to deal with the challenges and to deliver the desired functions. Our findings show that among the farm level AG processes, "risk management" and "demographics" interplay for securing robustness. The main common practices are managing labor availability and competence to secure farm activity and thus the social and the economic wellbeing of the farm. Important challenges are the low interest in farming in general, and the involvement of family members and the younger generation. In our study we did not find evidence of policy instruments developed for securing the labor availability/competence for day-to-day/seasonal planning, enabling robustness of the farms. Young farmer payments (to facilitate generation shift) and knowledge-related payments are provided, but the objectives of these instruments are more oriented toward mid-term adjustments, and thus adaptability of the farms. Fischer and Burton (2014) have shown the importance for farm succession of children forming a farming identity at an early age. To "fit" the farm-level adaptive decision making, future policies should also consider: 1) making farming attractive as an occupation, so farmers can have better access to labor; 2) attract farmers to enter farming/become managers at an earlier stage.

Private and public adaptation processes often have interrelated roles in the case of adaptability (Smit and Skinner, 2002). From our results, we see that both farm level adaptive processes, including "risk management" and "agricultural practices", and policy level adaptive processes exist to work mutually for market adaptations, farm modernization and knowledge management enabling adaptability. The AG processes at farm and policy level "fit" to enable compliance with food and environmental standards, changing consumer needs, and securing the viability of farms.

At farm level, transformability is operationalized with "agricultural practices" through spontaneous decisions initiated from the social networks, mainly contact with industry, considered by the farmers as trustful, despite its high bargaining power. The changes applied on the farms were seen as continuous adaptations to requirements for technology change, initiated by regulations and changes in consumer preferences. According to Lebel et al. (2006), proper communication is important for building trust and understanding the need to mobilize resources, in order to foster self-organization. Policy measures for transformation exist in the CAP documents (innovations, experimentation, niche production, etc.) but we did not find evidence for on-

TABLE 2 | Summary of farm level and policy level attributes enhancing the resilience capacity: robustness, adaptability, and transformability.

Farm level processes	Robustness	Adaptability	Transformability
Demographics	• secure labor: generation change, other labor • social networks		
Agricultural practices		• applying new technologies: less labor intensive, agro-environmentally and animal welfare friendly	• applying new technologies, new opportunities or seeking profit
Risk management	• off farm jobs • adapt labor to seasonal needs • good relationship and cooperation	• diversification of farm and off farm income • building human capital • openness to learn, and share knowledge • cooperation: advisory services, industry, authorities	
Policy level processes	• policies to protect the status quo (very limited)	• policies for "mid-term solutions for adaptations to improve the environment, animal welfare, and replacement of old energy inefficient technology • policies for variety of system solutions • policies for social learining	• policies for long term planning and strategies related with agro-environmental and climate strategies • policies for accelerating niche innovations

farm transformations enabled by/related to policies supporting transformation. Knickel et al. (2018) have also found that inadequate linkages between knowledge, innovation and rural development are insufficiently supportive of longer-term adaptive management frameworks. In that regard, for the desired "fit", building proper channels for transferring the knowledge to the farms is needed. That would enable knowledge creation, which can influence transformative decisions on farms (e.g. Nyamekye et al., 2018). In regard to the result obtained for the "misfit" of the policy to enable transformation, it is worth mentioning that in fact, transformative processes take a long time, and the final outcome might be through step-wize adaptation (e.g. Darnhofer, 2014). Smit and Skinner (2002) distinguish between actions for transformations that are undertaken as a regular part of ongoing management activities, from those that are deliberately planned to fulfill specific objectives. In this study, the phenomenon of transformative changes initiated by the CAP that led to adaptations was not observed.

Discussion on the Limitation of the Study

This study focuses on farm level and policy level AG processes, omitting the remaining decision-making levels within the value chain. All actors of the multi-level governance value chain (e.g. industry, consumers, retailers, legislation) contribute to various AG process levels by involving their capacity to enable building resilience of the system (e.g. Ostrom and Janssen, 2004). Our results show clear evidence for the importance of industry involvement in transformative processes on the farm level, such as choosing to be a broiler farmer, or transformation to organic farming. Furthermore, from the results it was clear that adaptations are influenced by consumers' preferences for high value products. However, the interlinkages and the cross-level interactions between the various AG processes at these decision levels were not studied in details. Furthermore, in our study, policy level AG processes are observed only from a top-down approach, showing the potential for the policy to meet the need for the identified challenges. However, this does not automatically imply that the farming system uses the capacity provided by the policy (Buitenhuis et al., 2020). How policies are implemented remains to be investigated.

Analysis using a full set of AG processes at various decision levels can create a system-wide perspective on how the farming system is governed (Ekstrom and Young, 2009). The need for such analysis is confirmed in the research, but as the qualitaive research provides in-depth evaluations which are time intesive, qualitative research examining fit typically focuses on a selected set of AG levels (e.g. Nyamekye et al., 2018).

CONCLUSION

The research presented in this article focuses on the resilience capacity of the Swedish egg and broiler farms in the context of multi-level AG. In particular, the study analyses: 1) which AG processes at farm level and policy level shape the robustness, adaptability and the transformability of the farms and how? and 2) what is the fit between these two levels of AG in response to the identified challenges and desired functions? This is a first attempt to analyze farm resilience in the context of AG while considering the three resilience capacities, i.e. robustness, adaptability and transformability, and multiple challenges identified for the farming system.

Results show that both farm level and policy level AG processes shape the resilience of farms. However, neither farm level nor policy level AG processes on their own have the capacity to entirely enable the farms to be robust, adaptable and transformable. The AG processes have different strengths and weaknesses and are, therefore, to a varying degree, appropriate for the desired functions (as in, for example, Rijke et al., 2012).

The farm level adaptive processes are mainly directed toward securing the robustness and adaptability of the farms. Farmers try to keep and/or adjust production within the existing regime, continuing with eggs and broiler production. In the resilience literature, this is explained as a "conservative notion" used to "stabilize the system and return to normal" (Pike et al., 2010; Darnhofer, 2014). "Demographics" in terms of labor availability

and labor division of gender are mainly related to robustness. "Risk management" strategies enable both robustness and adaptability to safeguard financial capital and social capital. Securing social capital, i.e. building knowledge, is crucial for both labor availability for different farm operations, and for adopting new "agricultural practices". Changes in "agricultural practices" enable the farms' adaptability for complying with high standards and regulations and changing consumer preferences. Transformability of the farms is also related to changing "agricultural practices", operationalized by spontaneous decisions when "new opportunities and crizes" appear (as in Smit and Skinner, 2002). The "risk management" and the "demographics" interplay to enable the robustness and the adaptability of the farms. Moreover, "risk management", "agricultural practices", and "policy" interplay for adaptability.

The fit between the AG processes at farm level and policy level is evident for reaching adaptability. Common desired functions are delivering safe food, meeting societal and consumer needs for safe food, animal health and welfare, and securing farm employment. In our study, the largest "misfit' is that between the farm level and the policy level adaptive processes for attaining robustness and transformability. In particular, while robustness at farm level is mainly related with securing labor availability, we did not find evidence of policy instruments developed to help enhance competence for day-to-day and seasonal planning. From a policy perspective, farm robustness is only partially enabled via direct payments as a buffer capacity for capital, but these payments are not coupled to the egg and broiler production. Moreover, while policy attempts are partially present to build infrastructure for future transformations (mostly environmental benefits), applications of transformability-related adaptive practices at farm level were not found. Instead, transformations identified at farm level result from initiatives undertaken by the industry and consumer preferences for high value products. One possible reason for not identifying transformability actions initiated by the policy could be that transformation takes a long time and such responses might be considered as a regular part of ongoing management activities, through step-wize adaptation (e.g. Darnhofer, 2014).

This research contributes to the literature on AG of farming systems. In line with the existing knowledge, findings show that the AG of farming systems is tailored toward adaptability. This raises concerns for future AG operationalisations, where robustness and transformability need to be considered along with adaptability actions. We acknowledge that AG of farms is complex (Smit and Skinner, 2002; Rijke et al., 2012; Ashkenazy et al., 2018) and interpreting and generalization of results on the concept of resilience depends on the system to which it is applied (Knickel et al., 2018). However, our study provides a conceptual framework on AG of farming systems and explains empirically how farm level and policy level AG processes shape the resilience of farms, i.e. the robustness, adaptability and transformability. The study covers economic, environmental, social and institutional challenges, filling the gap in the AG literature, which prioritizes environmental challenges. Results on the fit between the farm level and the policy level AG processes are a valuable input for the policy makers. Recognizing potential misfits between farm level and policy level AG processes may contribute toward building future strategies and actions for improvements in the respective farm resilience capacity, and therefore the resilience of rural areas.

Resilience is a relational issue that can be addressed at different level of governance. Extending the relational perspective from farm level and policy level to the broader farming system environment is crucial for future studies. Future research could consider including other levels of governance, including, for example, industry, retailers, suppliers, consumers, policy makers and a mixed top-down and bottom-up approach (e.g. Rijke et al., 2012; Ashkenazy et al., 2018), with details on how the various multi-level AG processes are planned, operationalized and interplay in the practice.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Legal Affairs Unit of the Swedish University of Agricultural Sciences. The participants provided written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CRediT author statement: 1. M-TG: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Supervision, Visualization; Writing – original draft; Writing – review and editing. 2. PA: Conceptualization; Data curation; Formal analysis; Investigation; Software; Writing – original draft; Writing – review and editing. 3. LS: Conceptualization; Data curation; Formal analysis; Investigation; Software; Writing – original draft; 4. BI: Conceptualization; Methodology; Writing – original draft; Writing – review and editing. 5. MM: Conceptualization; Funding acquisition; Methodology; Writing – original draft; Writing – review and editing. 6. FP: Conceptualization; Funding acquisition; Methodology; Formal analysis, Writing – original draft; Writing – review & editing; 7. UJ: Methodology; Writing – review & editing.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fenvs.2021.668836/full#supplementary-material

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