Strengthening climate resilience through Farmer Field School practices in Oromia, Ethiopia*

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Abstract

In rural Ethiopia, small-scale farmers have suffered from recurrent extreme climate events, such as droughts, that have caused crop failures and the death of livestock. The Farmer Field School (FFS) approach is an agricultural extension approach considered to support climate-resilient farming and livelihoods. Focusing on an FFS project implemented by the Oromia Bureau of Agriculture and Natural Resource in collaboration with Japan International Cooperation Agency (JICA), this paper aims to observe the effectiveness of the FFS approach in strengthening the climate resilience of rural communities and to explore factors that further improve and enhance community resilience. The analysis shows that the FFS project in Oromia contributed to strengthening the climate resilience of rural households in two ways: (i) income source diversification, nutritional diversification, and reduction of soil erosion were achieved, and (ii) the personal attitudes and behaviors of farmers were transformed; this was particularly observed where farmers started new processes to solve farming problems, developed new enterprises for income generation, and supported neighboring farmers to develop skills after the project ended. Although the resilience of participating rural households against climate disturbances was strengthened, it is not clear whether their capacity to cope with and recover from prolonged climate disturbances was sufficiently improved. This can be addressed by integrating climate information and simulation practices into FFS curriculums. By contemplating the potential severity of climate disturbances, particularly recurring droughts, farmers and concerned stakeholders can develop and share images of what could happen and how they should prepare for it. Additionally, FFS should address the capacity of rural communities to expand networks with external stakeholders and initiate collective action to address common issues by themselves. Taking collective action is particularly important for ensuring that natural resources and ecosystems are cared for, which in turn, strengthens the climate resilience of socio-ecological systems at the community level.

Keywords: Rain-fed agriculture, Climate disturbances, System-level intervention, Active participation of farmers, Climate information and simulation practices

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1. Introduction

Climate change and variability have had a negative impact on the livelihoods of small-scale farmers in Sub-Saharan Africa (Belay et al. 2022). One of the key factors behind the negative impact is the greater reliance on rain-fed agriculture, which is vulnerable to climate variability (Antwi-Agyei and Stringer 2021; Mbuli et al. 2021; Cooper et al. 2008). In Ethiopia, small-scale farmers occupy most of the cultivated land and subsistent rain-fed farming is the dominant production practice (Matewos 2019). Millions of farmers have endured recurrent extreme climate events, such as droughts, that have caused crop failures and the death of livestock (Mersha and van Laerhoven 2018; Araya and Stroosnijder 2011; Seleshi and Zanke 2004).

Over the past decade, a range of attempts have been made to strengthen the resilience of rural communities against climate change and variability. The Government of Ethiopia launched the Climate-Resilient Green Economy Strategy in 2011 and the Climate Resilience Strategy - Agriculture and Forestry- in 2017 (FDRE 2017; FDRE 2011). Donors and international organizations have also taken action to support the government's strategies and action plans by designing and experimenting with resilience activities and indicators for resilience building (D'Errico and Smith 2020; IDB 2019; USAID 2019). One of these actions was the establishment of the Farmer Field School (FFS) approach, which had been utilized in various Sub-Saharan African countries including Ethiopia, as an agricultural extension. Although the FFS approach was not explicitly designed to address climate change and variability, what rain-fed farming households learn through FFS practices contributes to resilient farming and livelihood systems (Bryan et al. 2013).

In Ethiopia, the Ministry of Agriculture has experimented with the FFS approach in collaboration with the Food and Agriculture Organization of the United Nations (FAO), the

International Fund for Agricultural Development (IFAD), Japan International Cooperation Agency (JICA), and other organizations. In 2017, the Ministry of Agriculture and Natural Resources published the Agricultural Extension Strategy of Ethiopia which designates a group-based approach as one of the key agricultural extension strategies; the FFS is referred to as one of these approaches. The strategy articulates that a group-based approach has the advantage of enhancing social networks and learning among farmers in addition to efficiently reaching large numbers of farmers at a minimum cost. However, the advantage of a group-based approach is not described in the context of climate smart agriculture or resilience against climate change. (MoANR 2017).

This paper aims to examine the effectiveness of the FFS approach in strengthening the climate resilience of rural communities and to identify factors that further improve and enhance community resilience. The paper is organized as follows: following this introduction, the author examines the resilience concept and identifies what factors are critical and what types of external interventions are effective in strengthening the climate resilience of rural communities, which leads to the development of the analytical framework of this paper. Second, using secondary data recorded in project reports, the author describes and analyzes one FFS project implemented in Oromia, Ethiopia. Third, the author discusses how the FFS approach contributes to strengthening climate resilience in rural communities and how reference to the analytical framework can help improve the contribution the approach can make. Finally, concluding remarks advance a way forward.

2. Framing resilience for rural communities

2.1 The concept

The resilience concept has been widely used in various disciplines such as psychology, ecology, disaster risk reduction, and urban planning (Lorenz 2013). Although a universally agreed definition of the concept does not exist, scholars working on climate resilience in rural communities and the literature they refer to generally agrees that it is the capacity to cope with and recover from disturbances (Cradock-Henry 2021; Enfors-Kautsky et al. 2021; Walker and Salt 2012; Adger et al. 2005). While there is general agreement about the capacity aspect of dealing with disturbances, various differences in opinion should be pointed out. The first is who or what has capacity. Scholars who conduct a field-based case study tend to focus on the capacity of actual entities such as "communities", "communities and the surrounding natural environment", or "farms" (Cradock-Henry 2021; Payne et al. 2021). Scholars who focus on conceptual discussions, however, often refer to abstractive entities such as the capacity of a "system" (Adger et al. 2005; Walker and Salt 2012).

Second, what ends capacity refers to is unclear. Earlier literature focuses on the capacity of a system to maintain key structures and function by coping with and recovering from disturbances (Schwarz et al. 2011; Adger et al. 2005; Cumming et al. 2005; Holling 1973). More recent literature, on the other hand, discerns various dimensions of resilience such as the absorptive, adaptive, and transformative dimensions, and emphasizes the importance of capacity within a system so as to transform and re-organize the system itself in addition to the capacity to maintain key structures and functions (Choudhury et al. 2021; Enfors-kautsky et al. 2021; Li, Westlund, and Liu 2019; Manyena et al. 2019; Smith and Frankenberger 2018; Bene et al. 2014; Linkov et al. 2014; Walker and Salt 2012; Cutter et al. 2008; Folke 2006). The importance of the

transformative dimension has been gaining attention as the only way to address complexity and prepare for the uncertainty of future disturbances (Enfors-Kautsky et al. 2021).

2.2 Lessons learned from the operationalization of the concept

Over the past decade, many international organizations have examined how to operationalize the concept of resilience in the development domain (IDB 2019; OECD 2014). They have developed resilience measurement methods, tested them on the ground, and carried out project interventions to strengthen the resilience capacity of target systems such as rural communities (D'Errico and Smith 2020; USAID 2019; Boka 2017; Maru et al. 2017; Hoffman and Hancock 2017; Laganda 2015; Constas et al. 2014; UNU-IAS et al. 2014). Table 1 gives examples of the resilience indicators presented by international organizations for different target areas and contexts. In the USAID case, for example, a pastoralist area in Ethiopia was the target area and context for the development of indicators. These indicators correspond to the specific activities undertaken to improve the aspects represented by the indicators.

Table 1: Examples of resilience indicators proposed by international organizations

Organization / Area / Context	Examples of Indicators		
	Human and social relations category	Agriculture and natural resources category	Infrastructure category
USAID Ethiopia Pastoralist area	-Human & social capital -Livelihood diversity -Asset & cash savings -Access to safety nets	-Access to livestock services -Access to communal natural resources	-Access to basic services, markets, finance, & insurance -Disaster preparedness -Conflict mitigation support
AfDB Ethiopia Climate change	-Wealth, gender, age, marital condition, literacy level -Knowledge of Disaster Risk Reduction -Relatives in the community -Engagement in local institutions	-Tree coverage, plots diversity -Land & livestock ownership -Years of farming experience -Access to irrigation, & improved technologies (seeds fertilizer)	-Early warning systems -Climate information -Formal extension services -Access to credit, markets

IFAD General Agricultural climate	-Food & energy access, health, nutrition, waste & hygiene practices, housing, & clothing -Employment, & human capacity -Fixed assets and remittances	-Land tenure & quality -Crop, livestock, & aquaculture inputs -Water for agriculture	-Access to quality education, health care, water, energy, & finance -Climate-resilient infrastructure
FSIN* East Africa Food security	-Education, health & wellness -Food & financial security -Livelihood diversity -Business -Social capital	-Agriculture -Soil & water resources -Cropping & grazing practices -Natural resource management	-Access to markets, & medical care -Supply chain efficiency -Water & sanitation -Institutional effectiveness -Risk strategy, & social protection

* The Food Security Information Network (FSIN) is a project coordinated by FAO, International Food Policy Research Institute and World Food Programme.

Source: Extracted from USAID (2019), Boka (2017), Laganda (2015), Constas et al. (2014)

Although the examples shown in Table 1 are limited to four cases, two characteristics for operationalizing resilience can be drawn from them.

First, there is no difference between the individual activities and indicators proposed for strengthening or measuring resilience and the existing activities and indicators for the respective sectors. This leads to a question on the significance of operationalizing the resilience concept, as the activities and indicators for resilience do not provide any added value to the existing sectoral framework. This question can be answered in relation to two aspects which would add value to the application of the resilience concept.

The first aspect is that resilience interventions often utilize activities and indicators from different categories. For example, all four cases in Table 1 employ activities and indicators that fall within the human and social relations category, as well as the agriculture and natural resources category, and infrastructure. An intervention aimed at strengthening resilience is essentially a multiple sector approach, although the respective sectoral activities and indicators do not differ

from existing ones (Smith and Frankenberger 2022; Smith and Frankenberger 2018; Adger et al. 2011). Resilience is further strengthened by combining interventions with a set of actions across multiple sectors, rather than implementing them separately (USAID 2019). There are synergies and trade-offs between activities in multiple sectors, and synergies can be realized by selecting interventions that take these relationships into account. A critical challenge is to identify added values when combined actions over multiple sectors and their synergies are observed.

The second aspect is that individual activities and indicators take the premise of disturbances when they are developed under the resilience concept, while sectoral activities and indicators do not (Boka 2017). This has serious implications in that some of the same activities and indicators are difficult to implement and achieve at times when disturbances occur. For example, while the conditions of "access to water" and "access to markets" can be improved in ordinary times, uncertainty remains high unless a sufficient level of improvement is ensured in times of disturbances. Simply strengthening activities and indicators without considering the level of impact caused by disturbances is not sufficient to improve climate resilience in a meaningful way. It is therefore essential to assume disturbance as a premise.

Second, the proposed activities and indicators differ in each case as each has different target areas and contexts; activities and indicators were proposed by responding to such contexts. This demonstrates that resilience activities and indicators are context-dependent and no single framework that represents a resilience concept could be identified as globally applicable (IDB 2019). The units of analysis for the four cases presented in Table 1 target particular agro-ecological or climate zones. Communities within these target areas are treated as having the same characteristics and, therefore, the same activities and indicators can be proposed. It is reasonable to assume that within one climatic zone the characteristics in relation to climate resilience are the same. However, context-dependence means that every level such as a climate-related zone,

community, household, or individual has its own context. There are diverse contexts on a smaller level (e.g. at the community, household or individual level) within the same larger context (e.g. within an agro-ecological or climate zone). It is vital to work out ways to accommodate such diversity.

2.3 Framing climate resilience

Based on the above understanding, this paper proposes an analytical framework for exploring the concept of climate resilience in relation to the FFS case in Oromia. The question of who or what has capacity is specified in this paper as the capacity of a socio-ecological system consisting of rural communities and their surrounding natural environment, which should be strengthened in order to cope with and recover from climate change disturbances, particularly recurrent drought. According to evidence from a quantitative analysis on resilience-strengthening interventions made in pastoralist areas in Ethiopia by Smith and Frankenberger (2022), focusing on the system is critical. The interventions showed that households can achieve greater resilience to shocks if a project is designed to intervene at the systems-level and then pro-actively plans for the direct participation of households.

In terms of questioning what the capacity is for, the livelihood of local people in a rural community is critically important. This paper emphasizes that the main livelihood activities in Oromia involve a mixed crop-livestock farming system, which is dependent on the availability of the surrounding natural resources in order to function. Thus, this paper defines the type of capacity as what is needed to maintain, transform, and re-organize the key structures and functions of a mixed crop-livestock farming system to support the livelihoods of rural communities against climate disturbances.

This paper also incorporates the perspective of how capacity for coping with and recovering from climate change disturbances is strengthened. It is imperative that learning processes accommodate the reflection, improvement, and transformation of a mixed crop-livestock farming system so as to enhance the capacity of transforming and re-organizing a system. This can be done with support from professional stakeholders who create learning environments in a community through which rural households learn to initiate a learning process in their daily livelihood activities.

3. Farmer Field School (FFS) in Oromia, Ethiopia

3.1 FFS principles

A Farmer Field School (FFS) is an agricultural extension approach developed upon adult learning principles (Davis et al. 2012). While previous extension approaches have followed a top-down process in which experts act as teachers to transfer technical knowledge and skills to farmers in villages, the FFS approach is a participatory, experiential, and reflective learning process aimed at improving the problem-solving capacity of groups of farmers (Larsen and Lilleør 2014). Learning takes place under the guidance of highly trained facilitators, who help promote active participation, group dialogue, and reflection (Friis-Hansen and Duveskog 2012). Under the FFS model, a group of farmers meet regularly, often weekly, in the field, and their study materials are plants and animals at the learning site. The facilitator encourages the farmers to engage in critical reflection by carrying out comparative experiments and discovery-based activities, which stimulate the farmers to further question their preconceived beliefs and norms about farming (Duveskog et al. 2011). While extension officers often take on the facilitation role, a move towards having the local farmers who live in the target communities act as facilitators is preferable

as they know the community and its members and are seen by them as colleagues (Braun and Duveskog 2011).

3.2 FFS project in Oromia

3.2.1 Overview: Target area and project implementation

"The Project for Sustainable Natural Resource Management through Farmer Field School (FFS) in the Rift Valley Area of Oromia Region" was implemented by the Oromia Bureau of Agriculture and Natural Resource, Federal Republic of Ethiopia in collaboration with JICA between 2013 and 2018. The purpose of the project was to strengthen the capacity of project stakeholders in order to promote sustainable natural resource management through FFS (AI-CD 2022). One FFS course ran over one year or 52 weeks during which time members conducted weekly learning-by-doing practices in the field. From 2013 to 2016, four rounds of FFS courses were implemented in three districts of East Sho'a Zone, namely, the Liben-Chukala, Bora, and Adama districts. According to the 2007 national census, the rural population of the three districts was estimated to be 250,179 (Population Census Commission 2008). As the average family size in Oromia is estimated at 4.88 people (Lazzari et al. 2021), the number of households is calculated to be 51,266 across all three districts. The total number of FFS participants for the four rounds was 872 people; in total 437 people or about 50% of the participants, graduated from the course (see Table 2). Many of the participants quit before graduation partly due to a lack of understanding about the design of the FFS process at the time they first joined the courses. This figure suggests that around 0.85% (=437/51,266) of rural households in three districts are FFS graduates. The graduation rates improved as the project gained experience and made efforts to enable prospective participants to fully understand the type of work they would do in the FFS courses.

The average altitude of the three districts is more than 1500 meters. Annual precipitation in the Liben-Chukala district ranged from 613 mm (2009) to 919 mm (2010) during the 2007-2012 period (IC Net Limited 2014b). The light rainy season occurs from March to May and the heavy rainy season from June to September. There is almost no rainfall between October and March each year. The main livelihoods in the rural part of the three districts are characterized as part of a rain-fed and mixed crop-livestock farming system (Negesse Senbeta et al. 2020; Bati et al. 2019; IC Net Limited 2014a). Farmers grow cereals such as teff, maize, wheat, and peas as their main crops, and keep cattle, sheep, goats, and poultry as livestock (CSA 2021; Negesse Senbeta et al. 2020). The results of the survey in Liben-Chukala district show that 77% of farmland is used for annual crop cultivation, meaning the surface of the soil is exposed and subject to erosion in times of heavy rain (IC Net Limited 2014a). Both physical and biological watershed conservation measures, such as soil bunds, terracing, check-dams, and planting multi-purpose trees and grasses, have been promoted by the government and international organizations to prevent soil runoff (Negesse Senbeta et al. 2020). In addition to farm-based livelihoods, households are also engaged in off-farm income-generating activities such as farm labor, petty trade, guard duty, and driving carts.

Table 2: Numbers of organized FFS groups and their participants

	1st round	2nd round	3rd round	4th round	Total
	Jun. 2013 – Dec. 2014	May 2014 – Dec. 2015	Dec. 2014 – Jun. 2016	Dec. 2015 – Dec. 2016	
FFS groups	11	29	11	20	71
Total participants	144	374	160	194	872
Male	47%	64%	59%	91%	66%
Female	53%	36%	41%	9%	34%
Graduation rate	41%	49%	52%	76%	50%

Source: JICA and IC-Net (2018).

3.2.2 Project impact

In January 2017, a survey was conducted to assess the impact of the FFS implementation. Out of 437 graduates, 92 people in the Liben-Chukala district were randomly identified as interviewees for the impact assessment. Approximately half of the interviewees were women. A questionnaire was prepared and structured survey interviews were conducted. Next, 20 out of the 92 interviewees were randomly identified and participated in a verification survey with open-ended interviews.

Table 3 and Table 4 show the enterprises and best practices that graduates continued to use after the FFS courses were completed. In most cases, around 80% of the graduates adopted what they had learned. Some of best practices utilized had been newly introduced through the FFS while others were traditional practices that were applied in a more appropriate way. According to a separate survey report, graduates from the first round of the FFS course increased their annual income from vegetable production by approximately 3,000 to 5,000 birr (US$135-225), compared with non-participants (JICA and IC-Net 2018). While the adoption of FFS mechanisms was high in vegetable production, this did not crossover into fodder and fruit. The reason for the low adoption rate for fodder and fruit enterprises was the frequent water shortages in the Liben-Chukala district. Both fodder and fruit require good soil moisture during the dry season. However, there are few perennial rivers in the district and water supply comes primarily from wells. Due to the prioritization of water use for domestic purposes, it was not feasible for graduates to supply water to fruits and fodder, and they were obliged to discontinue their enterprises.

Table 3: Adoption of enterprises by FFS graduates

Enterprise	Adoption rate (%)	Increase in area (times)
Vegetables	78.0	5.5
Cereal + Agroforestry	83.5	1.0
Fodder	51.0	5.3
Fruit	48.0	30.3
Tree seedling	82.0	2.7
Woodlot	81.8	1.6

Source: NRM-FFS project (2017)

Table 4: Adoption of selected best practices by FFS graduates

Practice	Adoption rate (%)
Chemical fertilizer	94.9
Fencing for seedlings	93.7
Chemical pesticide	90.1
Manure use	87.6
Regular monitoring	87.4
Line/row sowing	84.2
Compost	84.2
Transplanting	82.9
Intercropping	73.4

Source: Modified from NRM-FFS project (2017)

Table 5 lists changes that were observed among graduates in the impact survey. Broadly, there were two types of observable changes: economic and environmental changes, and changes in the attitudes and behavior of graduates. The latter can be further classified into two types: first, a continuation of practices they learned, such as farm record keeping, cost-benefit analysis, work discipline, and saving methods, and the second relates to the application and further development of what they learned. For example, graduates undertook six different enterprises during the FFS through which they learned how to solve problems and acquire skills and techniques. They then applied this learning process in a way that addressed emerging problems and allowed them to

acquire new skills and techniques after the courses ended. Several graduates started new enterprises such as animal fattening, small-scale irrigation, or trading as a way of learning how to manage a process of enterprise development. Thirty-five (35%) of the graduates developed what they learned by creating or joining new group enterprises, and 90% of them became an extension agent to help others to learn new skills and techniques (JICA and IC-Net 2018).

Table 5: List of livelihood and life changes observed among FFS graduates

Observed livelihood and live changes		Rate (%)
Economic and environmental	Income diversification and increases thanks to enterprises	91.3
	Nutritional diversification thanks to fruit production	83.7
	New land practices leading to productive and sustainable farms	55.4
Attitude and behavior	Farm record keeping	81.2
	Cost-benefit analysis of farm enterprises	78.2
	Cultivation of a culture of saving	65.2
	Creation of the mind set of experimenting to solve own/farm problems	76.1
	Women developed their own enterprises that earn them an income	62.8
	Transfer of farmers' knowledge and skills to their neighbors	90.2

Source: NRM-FFS project (2017)

4. Discussion

4.1 FFS and its contribution to strengthening climate resilience

4.1.1 Improving the capacity of a socio-ecological system

In the rural part of the three districts that formed the project target area, the major livelihood system was mixed crop-livestock farming. Through the FFS, six new enterprises were introduced; of these six enterprises, approximately 80% graduates adopted those related to vegetables and agroforestry, which enabled them to diversify their income sources. Meanwhile, around half of the graduates adopted fruit cultivation enterprises, which brought about nutritional diversification.

Looking at farm and land management, more than 80% of graduates began to produce tree seedlings and engaged in woodlot development, which contributed to the reduction of soil erosion. Observation of such impacts of the FFS, demonstrates that several new elements were added to the previous farming and livelihood systems; as a result, the capacity of the socio-ecological system in the target farmland areas was improved. On the one hand, improving the capacity of the socio-ecological system has likely led to greater climate resilience. As the multi-sectoral intervention was carried out at the system level by way of a formal FFS program and since graduates were active participants in the interventions, income source diversification, nutritional diversification, and reduction of soil erosion were observed. On the other hand, it is not clear to what extent this diversification and improvement can contribute to maintaining key structures and functions of the farming, natural resource, and livelihood systems when severe climate disturbances such as prolonged droughts continue to occur. Without knowing or contemplating the severity of climate disturbances, it is difficult to assess them. In addition, the impact of the improvement and diversification is limited to the farmland areas and livelihoods of FFS graduates. Since FFS graduates are estimated to make up only 0.85% of households in the target districts and given the scattered nature of their farmland, it is unlikely that the project was effective in strengthening the climate resilience of the target socio-ecological system at the community level. In order to make a meaningful impact at the community level, it is necessary to continue FFS courses until the number of graduates reaches a certain threshold such as 10-15% of the village households.

4.1.2 Developing the capacity to reflect, transform, and re-organize

Various studies have reported on the transformation of personal attitudes and behavior as a result of the FFS (van den Berg et al. 2020; Tomlinson and Rhiney 2018). Based on findings from a

large and well-functioning FFS program that was running over eight years in western Kenya, Duveskog et al. (2011) argue that individual transformation was reflected in an increase in confidence, critical thinking, and greater individual agency by graduates. Two prominent changes should be emphasized. One is the perceptual shift of FFS graduates from haphazard unplanned subsistence farming to market-oriented planned agriculture, whereby they obtained and enhanced their managerial and planning capacity (Duveskog et al. 2011). The other is perceptual transformation related to traditional gender roles. In one example, a father went so far as to provide land inheritance rights to his daughters by changing the traditional male inheritance system with regards to his land (Najjar et al. 2013).

Given that ideas of participatory, experiential, and reflective learning are embedded as principles within FFS, it is not surprising that attitude and behavioral changes among FFS graduates were reported as outcomes of the project intervention (See for example, Friis-Hansen and Duveskog 2012). As discussed in 3.2.2 above, graduates continued to apply and develop what they learned through the FFS courses, both during and after the project ended. Although the application and further development carried out by graduates was on a personal level, rather than group actions, there seemed to be a partial transformation of their livelihood style.

The transformation of personal attitudes and behavior observed in FFS projects as described above would have enhanced the capacity of graduates to initiate a learning process to reflect, improve and transform both farming systems and their relationships with the surrounding natural resources. This was demonstrated in the FFS project in Oromia where several farmers adopted new processes for solving farm problems, developed new enterprises for income generation, and supported neighboring farmers in developing skills after the project ended. Theoretically, farmers can cope with and recover from disturbances if they have sufficient capacity to make choices toward desired outcomes. It is unclear, however, to what extent

graduates are capable of making choices to deal with climate disturbances. This is also dependent on the scale of climate disturbances as the larger the scale, the more difficulties they will face. As discussed above, knowing or contemplating the potential severity of disturbances is therefore essential.

It is also important to look at capacities at the community-level when initiating a learning process for transformation. Although individual farmers gained trust and respect from their fellow farmers and demonstrated leadership skills during and after the FFS courses, this does not necessarily equate to community capacity (Duveskog et al. 2011). A critical mass of farmers who can lead the coping and recovering process in a collaborative manner is required for system-level transformation to take place at the community level.

4.2 Issues and challenges for unlocking the full potential of the FFS

The discussion above demonstrates that, to a certain degree, FFS practices are already beneficial for strengthening the climate resilience of rural communities and their surrounding natural environment despite their effectiveness still being limited under current conditions. Discussions also point out that the FFS approach can further unlock this potential. This paper presents three perspectives that would enhance the effectiveness of the FFS approach: contemplating the potential severity of climate disturbances, emphasizing the capacity of group initiatives, and incorporating the idea of caring for the surrounding natural resources and ecosystem.

4.2.1 Contemplating the potential severity of climate disturbances

The FFS approach was not designed to directly address disturbances caused by climate change and variability. Therefore, it is unclear whether the multi-sectoral intervention at the system level with active participation from graduates, which was realized in the target farmland areas, would

be sufficient to cope with and recover from recurrent climate disturbances. This ambiguity could be partly addressed by adding a new curriculum on climate disturbances to the FFS courses. With additional information about the scale of disturbances and their potential impact on a rain-fed and mixed crop-livestock farming system, households and communities are in a better position to contemplate the extent to which they need to strengthen their capacity to support the livelihoods of rural communities.

The scale of climate-related disturbances can be roughly identified using past data. For example, the scale of drought can be inferred by referring to past precipitation data, under the assumption that similar droughts would occur in the future. An additional aspect that should be considered, is the impact of climate change. As the scale of disturbances has become larger as a result of human-induced climate change, we may need to assume that future climate disturbances will increase in severity; for example, the level of the precipitation could decrease by a further 10-20% compared to past droughts. Such predictions can be made by researchers and professionals who can interpret the data analysis to be applied to agriculture. The results of the analysis can then be used in FFS courses. If the analysis and interpretation of results was incorporated into the FFS course design, graduates would be able to find more innovative ways to cope with possible future disturbances, imagining the possible impact they might have and coming up with actions to counter them. Although the uncertainty of predicting future climate disturbances and their impact on a rain-fed and mixed crop-livestock farming system is high, contemplating the potential severity of disturbances, coming up with coping methods, and then examining them in the field would enhance the resilience capacity of graduates to deal with climate disturbances.

Similar experimentation has in fact been carried out in East Africa. There are research programs conducted by international organizations such as Consultative Group on International

Agricultural Research that integrate climate resilience into the FFS curriculum to develop a climate-resilient agribusiness FFS approach (Osumba et al. 2021). Such programs promote the inclusion of climate information into FFS learning agendas through participatory scenario planning workshops held at the start of each season to discuss seasonal weather forecasts (WMO 2023). In Ethiopia, the National Adaptation Plan published in 2019 provides projections of annual temperatures and rainfall up to 2100 through the application of climate models. Climate model researchers, therefore, could contribute to FFS courses to ensure the latest scientific findings are reflected in the curriculum. One good example is the simulation of water availability and crop yields under different climate scenarios as a way to support the examination of the effectiveness of an irrigation project in Kenya (Narita et al. 2020). By referring to such simulated data, farmers, facilitators, and all concerned stakeholders can share the potential severity of climate disturbances in a tangible manner and contemplate how project interventions could mitigate their impact.

4.2.2 Capacity of group initiatives

This paper specifies the capacity of rural communities and their surrounding natural environment, or socio-ecological systems, and how it can be strengthened to cope with and recover from climate change disturbances. In this case, it is not enough to target the capacity of FFS graduates as individuals. It is vital to address the capacity of collective actions at the community level aimed at caring for the surrounding natural resources, as local natural resources and ecosystems are often common property, rather than individual assets.

Although the observed impacts of the FFS project in Oromia did not explicitly extend to collective actions to address common problems, research findings suggest that the FFS approach can also promote collective processes after the completion of the courses (van den Berg et al. 2020). For example, Wageningen Economic Research (2016) reported that FFS was implemented

for smallholder tea growers in Kenya from 2006 to 2016. A total of 3,436 FFS courses were implemented, and 72,816 farmers graduated, 53% of whom were women. The impact survey showed that around half of the graduates continued group activities after the courses ended and most of these groups met weekly or monthly. Many groups simply continued what they had learned, while some went beyond what they learned and developed their own emerging activities including the production of new crops and livestock, saving activities, tree growing, and environmental activities (Wageningen Economic Research 2016). If such collective learning processes become the norm when the courses end, the FFS approach could become widely recognized as an effective way to strengthen climate resilience at the community level.

The key to success is to train a large number of farmer facilitators and have them form a network to continue their activities, which has already been attempted in some projects (van den Berg et al. 2021). It is important to design FFS courses in which participants learn and possibly experience ways to organize and galvanize group learning processes. Rather than relying on external organizations such as local governments to support collective processes at the community level, it is important for communities to take the initiative themselves thereby strengthening the capacity of community resilience.

4.2.3 Incorporating the subject of caring for surrounding natural resources and ecosystems

Since FFS is by its nature an agricultural extension approach, it is understandable that FFS curriculums do not necessarily accommodate the subject of caring for natural resources and ecosystems. However, as has been shown by the evolution of FFS curriculums to include climate resilience, there is also the possibility of accommodating the subject of natural resources and ecosystems as field-based experimentation.

The FFS project in Oromia included the production of tree seedlings and woodlot development, which contributed to a reduction in soil erosion. The next step is to explore and experiment with ways the rural communities can take action to create natural resources and ecosystems that can withstand climate disturbances, especially recurring droughts. This is not only to conserve existing natural ecosystems but also to examine pro-active methods for a drought-tolerant environment such as agro-forestry, the growing of deep-rooted plant species, or drip irrigation systems. By doing so at the community level, advances can be made towards strengthening the climate resilience of the socio-ecological system.

5. Conclusion

FFS is widely acknowledged as an approach to empower smallholder farmers. The impact survey of the FFS project implemented in Oromia, corroborated this reputation in that it showed the project enhanced farmers' capacity for improving their own farm and livelihood systems. The FFS approach positively contributes to strengthening the resilience of rural households against climate disturbances although it is still unclear whether the strengthened capacity is sufficient for coping with and recovering from prolonged climate disturbances. This lack of clarity can be partly overcome by integrating climate information and simulation practices into FFS curriculums. By contemplating the potential severity of climate disturbances, especially recurring droughts, farmers and concerned stakeholders can expand their ability to imagine of what could happen and how they can prepare for it.

In addition to strengthening the capacity of rural households to improve their own farm and livelihood systems, FFS projects may contribute to their capacity for expanding networks and initiating collective actions by themselves. Having an extensive network helps them to mobilize

external support. Additionally, the capacity to take collective action is particularly important in caring for the surrounding natural resources and ecosystems that support the farm and livelihood systems of rural communities. The climate resilience of the socio-ecological system is strengthened by community initiatives for collective action to improve the surrounding natural resources and ecosystems so that it becomes more drought tolerant. FFS programs will then further advance the effectiveness of such initiatives for a resilient future.

Finally, the importance of the roles played by experts and government officials needs to be emphasized. Basic information on the potential severity of climate disturbances on a farming system should be provided by researchers and professionals, and government officials should facilitate extensive networks between rural households and beyond. The effectiveness of FFS programs will be enhanced by such commitments from these external stakeholders.

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