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Impact of climate change training intervention in savings groups

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Abstract

This paper investigates the impact of integrating climate change interventions in informal community-based institutions called savings groups. By integrating climate-related activities into these groups, the aim is to simultaneously strengthen the group's financial activities as well as improve knowledge and investment capacity in climate adaptation. We find that the introduction of the training increases meeting attendance rate and average loan sizes, suggesting that members can access larger sums for investment to implement the knowledge acquired during the training. We provide evidence that there are opportunities for economies of scope and for a larger positive impact on the livelihoods of the populations at the bottom of the pyramid by combining financial services offered in the savings groups and climate-related interventions.

KEYWORDS
'plus'-activities, climate change training, financial performance, savings group

JEL CLASSIFICATION
D14, G23, G51, L31, O12, O19, Q52

1 | INTRODUCTION

Poverty alleviation and mitigation of climate change are two of the greatest challenges of this century as highlighted in the 1st and 13th Sustainable Development Goals of the United Nations. Development actors are always searching for innovative interventions aiming at combining those two objectives for greater impact (Allen & Panetta, 2010; Gugerty et al., 2019). In this paper, we investigate one of these interventions that mix financial inclusion and training related to climate change awareness and adaptation. Namely, we are looking at the impact of introducing climate change training into informal saving and lending community-based institutions, called savings groups (SG).

Created by CARE International in the 1990s in Niger, SG programme is inspired by traditional rotating saving and credit associations (ROSCAs) that have existed for centuries (Ardener & Burman, 1995; Bouman, 1995). SG is a financial intermediation model between savers and borrowers specifically designed for rural and unbanked communities in low-income countries (Karlan et al., 2017). Financial inclusion, that is, access to savings, loans and insurance services, is a major lever for promoting inclusive and sustainable growth (Demirgüç-Kunt et al., 2021; Mlachila et al., 2016). In the last three decades, SG reached an estimated 15[1] to 100 million individuals worldwide that rely on the group to meet their financial needs (Burlando et al., 2021).

In addition to the basic savings and lending operations that take place in SGs, development interventions, often called 'plus'-activities, have been introduced by development agencies (Allen & Panetta, 2010; Mersland et al., 2019) to tackle the complexities of poverty. With the increasing urgency of the climate crisis, interventions in SG started to include more training related to climate change adaptation and mitigation.

So far, the literature studying the impact of those 'plus'-activities has solely focused on their effects on individual and household welfare (see, e.g. Gugerty et al., 2019 for a review of those findings). The question of whether those activities might have positive or negative externalities on the group's financial activities has been raised by various practitioners but not formally addressed by academic research (Orr et al., 2019). Indeed, 'plus'-activities may harm the performance of the groups by complicating the timeline for achieving financial operations or overloading groups with donor-driven activities that might not always best fit their actual needs (Adams & Vogel, 2016; Allen & Panetta, 2010; Gugerty et al., 2019; Odell & Rippey, 2011; Orr et al., 2019). Filling this gap, this paper questions how the group financial activities are impacted by training related to climate change. We document whether such training creates a disruption within the groups, as suggested by Nelson (2013) by diverting members focus and increasing management complexity, or, if on the contrary, whether it further supports the groups by fostering economic stability and preventing members' income shocks.

To this end, we analyse the Savings Groups Information Exchange (SAVIX) dataset, which provides standardized quarterly data of more than 200 000 SG in over 50 countries, representing more than 5 million people, from 2010 to 2017. To isolate the causal impact of the introduction of climate change training on the group's financial activities, we use propensity score matching where we compare groups with and without the climate-related training. As the allocation of the training is not random, the matching allows us to control for any observable confounders and reduce the risk of selection bias (Dehejia & Wahba, 2002).

We use six financial indicators to measure the financial performance of the group: savings per member, number of loans per member, average loan size, fund utilization rate, return on savings and group meeting attendance rate. We find that introducing climate change training in the groups has a positive impact on meeting attendance rate and fund utilization rate and increases average loan sizes. On the other hand, the training seems to reduce return on savings and has non-significant impact on savings per member. We interpret our findings by suggesting that climate change training might lead to loan scarcity in the long term by increasing the members borrowing needs without encouraging savings. Yet, the increased loan sizes suggest that following the training, members make use of the group's capital by borrowing to make larger investments.

By presenting novel evidence on the impact of development interventions in SG, we contribute to microfinance literature as well as to development literature. Firstly, this paper responds to Ashe (2002) questioning the future and potential of informal indigenous groups when development interventions are integrated. Studying 'plus'-activities

impact on groups' financial performance is important since group financial sustainability is a key factor for the long-term survival of the groups (Gonzales, 2020). Our paper sheds light on this by outlining the potential synergies between the financial inclusion promoted by the SG model and the economic and climate resilience pursued in climate change training. Indeed, in the face of multiple shocks and economic vulnerability, SGs are a tool to strengthen the income-generating activities of the poorest and means to manage their cash flows by encouraging savings and credit behaviours.

Second, this paper contributes to the evidence in the microfinance sector on the effectiveness of savings-led schemes in meeting the overall needs of the poor and on integrating non-financial activities into microfinance groups (Flynn & Sumberg, 2018; Lensink et al., 2018). We study this in the context of SG and informal indigenous groups. As previous studies focused on impact studies at the individual level (see Gugerty et al., 2019; Orr et al., 2019), we provide new insights by studying financial activities at the group level and issues related to group performance and sustainability. Our rich dataset containing detailed group financial activities allows us to study this in the context of non-governmental organization (NGO)-driven climate interventions into informal SG. We aim to provide evidence of how SG react to those interventions that could address simultaneously the various shocks and poverty issues faced by group members.

The rest of this paper is structured as follows: In Section 2, we present the general context of SG. Section 3 describes the data and the methodological approach undertaken to answer the above research question. The results are presented in Section 4. Section 5 is dedicated to the discussion of the results, the conclusion, policy implications and limitations and suggestions for future research.

2 | GENERAL CONTEXT

One of the main financial challenges facing low-income households in the Global South is to cope with uncertainty and the risks associated with income volatility and uninsured shocks (Adams & Vogel, 2016). With the recent surges of additional risks associated with climate change, vulnerability and uncertainty are exacerbated by a dependence on natural resources and low resilience to shocks (Dorfleitner et al., 2020; IPCC, 2021) as well as a lack of means to cope with these changes (Rippey, 2011). To reduce these vulnerabilities, financial inclusion, that is, access to loans, savings and insurance services, is often advocated as a lever to help weather income shocks and increase household resilience (Suri et al., 2021). Aside from business investments, loans and savings are used to mitigate immediate shocks and risks faced by households and smooth their consumption (Adams & Vogel, 2016). Financial inclusion is thus an important lever to achieve inclusive and sustainable growth and improve the livelihoods of those living at the bottom of the pyramid (Demirgüç-Kunt et al., 2021; Mlachila et al., 2016).

In this mindset, the SG model was created in the 1990s, following the example of pre-existing informal saving and lending communities, such as burial societies, mutual aid groups and ROSCAs. SGs are self-governing groups made up of 15–30 individuals that accumulate the savings of their members and in return provide them with access to affordable loans. Members come together at weekly meetings during which their savings are pooled together into a common fund available for borrowing. Loans have a typical duration of 3 months and are repaid with interest ranging from 5% to 20% (Le Polain et al., 2018). Groups work in a cycle, usually lasting 1 year, at the end of which loans have to be repaid and a share-out takes place. The share-out consists of redistributing to members the group's total funds by sharing the accumulated savings, the repaid loans and the interests. The payment of interest on loans thus creates an effective profit that is shared amongst members, earning them a real positive return on their savings (Allen & Panetta, 2010; Mersland et al., 2019; Orr et al., 2019).

The simplicity and flexibility of the SG model is well adapted to reach the most vulnerable populations and achieve greater social impact (Adetunji & David-West, 2019; Beaman et al., 2014; Karlan et al., 2017). The provision of savings services and borrowing opportunities through those community-based organizations has been remarkable in demonstrating the power of savings for poor households and helping them meet their overall financial needs

(Adams & Vogel, 2016; Cassidy & Fafchamps, 2020; Gash, 2017; Rasmussen, 2012). Evidence shows that SG participation facilitates access to larger lump sums and consumption smoothing by easing the management of household cash flows (Besley et al., 1993). In addition, there is evidence that SG membership results in a positive effect on income stability (Brunie et al., 2014) and that there is a positive relationship between higher frequency of saving within the group and member's income (Adetunji & David-West, 2019).

As group members meet at a fixed location and at regular intervals for their financial operations, SGs also have become attractive delivery platforms for development actors aiming to offer training and interventions and reach the most under-served and disadvantaged populations. Introducing development services directly into the groups allows NGOs to directly target those populations that need it most (Dunford, 2001). Yet, similarly to the microfinance sector, a debate exists on the inclusion of non-financial activities in finance-based institutions (Flynn & Sumberg, 2018; Lensink et al., 2018). Some argue that a minimalist approach, that is, sole access to financial services, is sufficient to address poverty. There are concerns that a multidimensional approach combining financial and non-financial services may be harmful for the long-term sustainability of the microfinance provider as it may distract resources and focus from its financial operations (Lensink et al., 2018; Morduch, 2000). Others advocate for an inclusive perspective combining financial services with other welfare programmes (Adams & Vogel, 2016; Allen & Panetta, 2010; Gugerty et al., 2019; Morduch, 1999; Odell & Rippey, 2011).

Regarding SGs, the multidimensional approach is often advocated, for example, by Adams and Vogel (2016) that suggest that poverty is too complex to be eliminated solely through access to basic financial services. Along the same line, Orr et al. (2019) and Dulhunty (2022) promote a holistic approach to acknowledge the multifaceted factors that contribute to extreme poverty. According to Gugerty et al. (2019), informal community groups such as SGs are an ideal platform for the delivery of development programmes as those are often complementary to the group's financial activities, thus producing additional efficiencies. They find that implementing development interventions through community-based organizations such as SGs lowers the per-person costs of providing services through economies of scale and scope (Gugerty et al., 2019).

In addition, 'plus'-activities have the potential to support the group's financial operations (Rippey & Fowler, 2011). 'Plus'-activities help vulnerable people to mitigate and reduce the effect of risks and ongoing shocks that impact vulnerable people lives and activities (Gugerty et al., 2019). In other words, additional training aims at sustaining both the group and member to build resilience though capacity building. Studies have shown that combining the SG model with empowerment programmes (Slegh et al., 2013) or with community labour organizations (Brunie et al., 2014) brings positive impacts on income and household welfare. Introducing 'plus'-activities in SGs has thus the potential to improve the livelihoods of populations at the bottom of the pyramid in a cost-efficient manner by reaching a large number of rural and urban dwellers, delivering more welfare improvement than the SG programme alone (Le Polain et al., 2018; Mersland et al., 2019; Orr et al., 2019).

While recognizing the importance of SGs and 'plus'-activities, some researchers have also pointed out the challenges that could arise in relation to SG 'plus'-programmes. Allen and Panetta (2010) acknowledge that adding multiple interventions to the SGs agenda carries 'overloading' risks. Similarly, Nelson (2013) warns against the risk of loss of group's autonomy and independence, increased management complexity and the loss of focus of the group's core activities, namely, building up savings and accessing loans.

2.1 | SG methodology and climate change training as 'plus'-activities

NGOs generally follow the Village Savings and Loans Association (VSLA) approach developed by Moira Eknes in 1991 at CARE International.[2] Field officers in charge of creating, training and supervising groups use the field booklet provided by major development agencies in the field of SGs, namely, Plan International, CARE, the Aga Khan Foundation, Catholic Relief Services, Oxfam and World Vision (see VSL Association website).[3]

The field booklet describes step by step the process of creating an SG, the types of training to be given at each stage, the aim and materials to be used for training, etc. For example, over a period of 14 weeks, once the SGs have been formed, the training sessions cover modules on group management, regulations and elections of group committee, running saving and loans activities, record-keeping principles, organization of meetings, etc. 'Plus'-activities, the climate change training included, are provided in the maturity phase, that is, from the eighth month since the group has been created for a period of 18 weeks. It is considered that during this period, SGs should be fully capable of running on their own and that they will have the time and attention needed to acquire knowledge and skills on other subjects to reinforce savings and borrowings activities (Allen & Staehle, 2007).

Training on climate change, regardless of its content, aims to facilitate climate change adaptation and mitigation and help vulnerable populations as well as financial inclusion institutions build their fund management skills (Agrawala & Carraro, 2010). Climate change is a complex multidimensional phenomenon, interacting with local and global socio-economic and political dynamics (Forcella et al., 2016; IPCC, 2021). Risks related to climate change increase uncertainties in the lives of vulnerable populations involved in SGs. Unpredictable and aggravated weather events threaten their livelihoods, particularly in settings where agricultural activities are the first source of household revenues. The capacity for adopting mitigation and adaptation measures strategically depends on developing awareness of the concerned populations (Bastiaensen et al., 2015) and developing access to the financial means needed to implement those measures.

In this perspective, SGs could prove to be an ideal platform not only for promoting knowledge about climate-related challenges but also for developing the strategies needed to face those challenges. Indeed, the group setting encourages the sharing of experiences between members and discussing matters related to the training, further increasing its impact (Bali Swain & Varghese, 2014; Carmichael, 2018). The presence of peer pressure pushes members to regularly remind each other to practice what they have learnt; and the social link and the common social norms lead members to behave in the same way or to take example on each other (Ambuehl et al., 2018; Breza & Chandrasekhar, 2019).

SGs, because they are deeply rooted in their local communities, can also reinforce the training intervention effects through the social capital they promote. Groups rely on existing social connections (Cassidy & Fafchamps, 2020) and further strengthen social capital within local communities (Flynn & Sumberg, 2018). The social capital is a key element to encourage the behavioural changes promoted by climate-related interventions (Biosca et al., 2014). Furthermore, if the programme is delivered by an NGO well known by members, the NGO plays the role of a 'norm-setter' that members trust to provide desirable climate recommendations and further triggers adoption and spillovers in local communities (Beaman et al., 2014).

Finally, the groups provide the opportunity to directly implement climate adaptation strategies promoted during training through access to financial resources. SGs by pooling savings and offering access to loans give the possibility to their members to invest in various climate-related projects such as low-carbon technologies or reforestation. In our sample, the projects implemented following a climate change training cover a large range of topics such as the promotion of fuel-efficient stoves, reforestation and carbon sequestration, awareness campaigns on risk and mitigation and adaption techniques, adoption of low-carbon technologies and capacity building of community risk management and resilience.

At the group level, climate change training might also foster the group's financial performance, creating a synergy between the implementation of climate-friendly strategies and the economic resilience promoted by the SG model. The new knowledge and skills acquired during the training might help members strengthen their various productive activities by better preventing themselves against climate-related shocks. Likewise, awareness of future climate risks may incentivize group members to dedicate more efforts to their income-generating activities as well as their group engagements. The changes in norms and practices promoted by the training might increase household resilience to shocks and increase group members' income stability and productivity (Gugerty et al., 2019; Orr et al., 2019). This will in turn strengthen the group's financial activities by increasing savings and productive loans.

However, climate change training may negatively impact group performance by reducing members' savings capacity if the disposable income is subsequently redirected in priority towards investment in climate mitigation and low-carbon technologies instead of saved within the group. As mentioned previously, the procurement of those technologies is costly and requires cash investments, which might in turn foster the demand for loans within the group. The two effects combined, lower saving capacity and higher borrowing demands, might lead to loan scarcity within the group. A similar impact is found by Burlando and Canidio (2016) and Burlando and Canidio (2017) when investigating the impact of integrating ultra-vulnerable households with low saving capacity but potentially high loan needs into SGs.

We thus aim at investigating whether there is a trade-off or a potential synergy between the introduction of climate change training into SGs and the financial inclusion promoted by those groups. As pursuing both objectives is key for sustainable and inclusive growth, documenting their interactions and their potential complementarity can provide useful insights for future development interventions aiming to promote both economic resilience and sustainable behaviour.

3 | DATA AND METHODS

3.1 | Data

We use secondary data from the SAVIX database, an unbalanced panel dataset containing standardized data on 200 000 SG in 50 countries across 7 years (2010–2017). The dataset is financed by the Bill and Melinda Gates Foundation and is based on a partnership between different development organizations to collect data on SGs for monitoring and comparison purposes.[4] The dataset includes group financial operations (number of loan outstanding, savings per member, assets), composition (number of members, meeting attendance, gender repartition) and other various characteristics (location, link with NGO, additional services and training). These data represent a unique opportunity to understand SGs and study group-level outcomes, without being dependent on the impact evaluation of one specific programme or regional context.

For this paper, we restrict our sample to groups in countries where there is some variance regarding our variable of interest, whether groups receive climate change training or not. Countries with groups both with and without climate training are Ethiopia, Ghana, Kenya, Madagascar, Malawi, Niger, Uganda and Zimbabwe. This accounts for 25 762 groups in total, amongst which 633 (2.5%) receive training related to climate change. Although sample size is important in such analysis (Fan & Nowell, 2011; Staffa & Zurakowski, 2018; Zhang et al., 2019), the current asymmetry between treatment and control groups is not a concern per se, as we are still within the acceptable range of over 200 treated units (Howarter, 2015).

The fact that groups receiving climate change training are concentrated in sub-Saharan Africa is no coincidence. A body of literature argues that climate change effects currently impact much more sub-Saharan regions (Gugerty et al., 2019; IPCC, 2021; Rippey, 2011), where agriculture is the principal source of income. As environment protection also becomes a growing concern for development organizations, it is no surprise that those regions are targeted in priority for the delivery of climate change adaptation and mitigation programmes. From an econometric perspective, as groups will be matched within countries, it also makes sense to reduce our sample to only countries that include both types of groups. Table 1 presents the dispersion of groups with and without training amongst countries.

In Table 2, we present a preliminary analysis of potential differences in our outcome variables between SGs receiving climate training and SGs that do not. Table 2 presents the results of univariate means comparison test between the two types of groups.

As can be observed, the univariate mean comparison tests suggest significant differences between groups that receive climate change training and those that do not for all of our outcome variables. We find that, on average, treated groups have significantly higher savings per member and average loan size and number of loans per member

TABLE 1 Number of groups per country that do and do not receive climate change training.

Country	Without climate training	With climate training	Total
Ethiopia	2923	15	2938
Ghana	6428	18	6446
Kenya	4758	1	4759
Madagascar	179	2	181
Malawi	402	328	730
Niger	929	55	984
Uganda	7537	213	7750
Zambia	1973	1	1974
Total	25 129	633	25 762

TABLE 2 Mean comparison tests for our outcome variables.

Outcome variables	Combined	Control	Treatment	Difference	t-stat
Savings per member ($)	23.640	22.492	34.346	11.853***	−27.776
Average loan size ($)	34.921	34.467	39.111	4.644*	−10.090
Number of loans per member	0.587	0.574	0.711	0.137	−32.086
Fund utilization rate (FUR) (%)	0.873	0.881	0.799	−0.082***	15.660
Return on savings (ROS) (%)	0.316	0.322	0.265	−0.056***	11.506
Meeting attendance rate (%)	0.905	0.903	0.921	0.018***	−11.026

Notes: Mean comparison of outcomes variables between treated and control groups; treatment is SGs receiving climate change training, and control, SGs that do not. $, % in parenthesis are the unit of measure.
*$p < 0.1$, **$p < 0.05$, and ***$p < 0.01$.

as well as meeting attendance rate. In contrast, it seems that treated SGs have a lower fund utilization rate and a lower return on savings. Taken together, these preliminary results indicate that there are significant differences between groups receiving climate change training and groups that do not. However, we cannot conclude here that this difference is due to the 'plus'-activity, that is, climate training. We will investigate this causal relationship through a matching process where we control for observable confounders.

3.2 | Identification strategy and the matching process

In order to estimate the causal impact of climate training on the financial performance of SGs, we compare 'treatment' groups, SGs receiving a climate change training, and 'control' groups, SGs that do not. However, treatment is not randomly allocated, and thus, we need to understand the treatment decision process and control for differences between treatment and control groups. To do so, we use propensity score matching: This method computes the probability to receive treatment based on observable characteristics and then matches SGs from control and treatment groups with similar probabilities (Dehejia & Wahba, 2002). This method is used to control for selection bias and endogeneity: Without matching, it is possible that SGs in treatment and control groups are systematically different even in the absence of treatment. Those systematic differences might influence their financial performances and thus need to be controlled to isolate the impact of treatment (Caliendo & Kopeinig, 2008).

Regarding the treatment decision process, that is, which groups receive climate change training or not, it is important to note that the training is offered for free to the groups. Moreover, based on practitioners' testimony, it

seems that the decision to provide additional services to groups, such as climate change training, is mainly taken by NGOs, based on their social mission and priorities of action, rather than resulting from the group demands or needs (Allen & Panetta, 2010; Nelson, 2013; Orr et al., 2019). This is unfortunate since there is likely to be a substantial overlap between groups' needs and development actors' priorities (Allen & Panetta, 2010). This supply-driven approach to development interventions in SGs strengthens our matching approach as receiving treatment is likely to depend on practical considerations rather than on unobservable group characteristics, such as inner motivation, that could threaten the validity of propensity score matching (Dehejia & Wahba, 2002).

We thus estimate the impact of climate change training on group's financial activities in two steps. First, we use a logit regression to compute the propensity score of each SG of receiving the training. To estimate this score, we use group characteristics measured pre-treatment (Caliendo & Kopeinig, 2008). In our case, we select the following matching variables to compute the propensity score: the number of members at group formation, the percentage of women members, the age of the group (measured in months), the group status (whether it is still supervised by an NGO), whether the group keeps a separate funds for insurance purposes and the purchasing value of physical assets that the group owns at the beginning of the first cycle. In addition, we control for country effects.

Once we have an estimated propensity score for each SG, we match treated and control SGs with similar scores. There are different potential matching algorithms available and no consensus on which one performs better. The choice of matching algorithms depends on a trade-off between efficiency and consistency: whether one treated unit is matched to one or multiple control units, a choice between reducing the variance of the estimate by relying on more matches for the estimation but at the risk of using lesser quality matches (Caliendo & Kopeinig, 2008). We implement three different matching algorithms: kernel, calliper and nearest-neighbour matching. All three algorithms provide similar estimations of the average effect of treatment. We present the results obtained through kernel matching in the next section, and the results of the other matching algorithms are available in the Appendix.

One of the main pre-conditions for propensity score matching is that there is an overlap between the density functions of the propensity scores of the control and treatment groups. This means that even if SGs in the control group and SGs in the treatment group do not have strictly equal propensities to be treated, there is at least some overlap where both types of SGs have propensity scores that are sufficiently similar (Caliendo & Kopeinig, 2008). We present evidence of sufficient overlap as well as balance between covariates in our Appendix (Table A1).

To measure the financial performance of the group, we identify six outcome variables: saving amount in dollars per member, fund utilization rate (FUR), return on savings (ROS), average loan size, number of loans per member and group meeting attendance. According to Burlando and Canidio (2017) and Greaney et al. (2016), these variables capture the group's 'business model' and determine the group's financial sustainability. Indeed, savings are the main foundation of the group: SGs promote a safe and reliable saving instrument, along with a commitment incentive from group peer pressure to foster individual savings (Burlando & Canidio, 2016). Without regular savings, the common fund is empty, and there is no capital for loans.

We also include average loan size and number of loans per member in our analysis as we hypothesize that receiving climate training will influence borrowing within the group. We thus aim at uncovering the different mechanisms in which group lending activities are affected. In this case, there is no clear guidance on whether larger or more loans are beneficial for the groups. Indeed, as suggested by Le Polain et al. (2018), there is a tension in encouraging loan demand in the group between the risk of members' over-indebtedness and the importance of interest-bearing loans in profit generation. The impacts of climate training on these two variables are thus not to be interpreted in terms of positive or negative but rather as hint of how members adjust their financial behaviour to the addition of non-financial activities within the group.

The fund utilization rate is the percentage of savings that are actively transformed into interest-bearing loans. It is an important determinant of the profit-generating capacity of the group as if savings are left unused in the cashbox, no interest is paid and there is no profit to be distributed at the end of the cycle. The fund utilization rate is computed as the ratio between the total value of outstanding loans and the net value of savings. It can be interpreted to some extent as a proxy for the equilibrium between loan supply (the accumulated pooled savings available

for borrowing) and loan demand (the actual loans being taken out) within the group. Indeed, keeping savings and thus fund availability constant, a lower FUR suggests that members are not taking out as many or as large loans as they could, given the available loanable funds. In contrast, a higher FUR could indicate higher loan demand and borrowing needs.

The return on savings (ROS) is the percentage of return per dollar saved. It approximates the profit generated by the group (Bossuyt et al., 2024) and its capacity to reward members for their saving contributions. The ROS depends largely on loans frequency and amounts, the interest rate and the total amount of savings. It is distributed at the end of the cycle during the share-out, usually to match a moment of the year when all members have a synchronized need for cash, for example, during the lean season or when education fees are due (Beaman et al., 2014).

Finally, the rate of group meeting attendance gives us a proxy of member active participation in the group and an indication of whether they are satisfied with group activities or not. Introducing additional training to the group financial activities could cause members to drop out if they are not interested in those activities or, on the contrary, foster participation. Those six outcome variables are key to the good functioning of the group and thus are appropriate to study the group's financial performance. If climate training negatively impacts any of those variables, it might threaten the group financial sustainability and its long-term survival (Gonzales, 2020).

4 | RESULTS: THE IMPACT OF CLIMATE TRAINING ON SG FINANCIAL ACTIVITIES

4.1 | Computation of the propensity score

We first compute the estimated propensity score of each group to receive treatment, that is, to receive climate-related training in the group. We use group characteristics pre-treatment (measured at the group creation) to compute this score.

Table 3 presents the results of the logit regression used to compute group propensity scores used for the matching. We find that decisive variables for treatment assignment are the location of the group and whether it was independently created or trained by an NGO regarding the group methodology and accounting rules. Unsurprisingly, being a non-rural group (as opposed to a rural one) significantly decreases the probability of receiving climate change training. Non-rural groups refer to SGs located in urban and semi-urban areas, while rural groups are those created in rural areas (Mersland et al., 2019). A higher percentage of women members seem to also be positively linked with the probability of being treated.

4.2 | The effect of climate training on group performance

We present our estimated average treatment effect on the treated (ATT) based on our propensity score matching in Table 4. The ATT is computed as the difference in mean outcomes between the treatment and the control groups, weighted by the distribution of propensity scores over the common support area (Dehejia & Wahba, 2002). The coefficients presented here are obtained by matching treated and control groups with the kernel matching algorithm, and results obtained by testing other matching algorithms are available in the Appendix (Table A2). SGs in the control group are assigned weights depending on their difference in propensity score to the treated unit considered, with a maximum difference defined by the bandwidth parameter. Kernel matching is considered to increase precision by drawing on more information (one treated unit is matched to multiple control ones), but without significantly reducing its accuracy since control unites are weighted based on their matching quality (Caliendo & Kopeinig, 2008).

We find no significant impact of introducing climate-related training in SGs on the amount saved per member within the group. In contrast, climate training seems to have a strong impact on borrowing within the group. We find

TABLE 3 Logit regression to compute the propensity scores related to receiving climate training.

	Coefficient	Std. err.	Z	$p > z$
Members at formation	−0.004	0.009	−0.410	0.685
Women members rate (%)	0.850***	0.299	2.840	0.005
Group age (months)	−0.003	0.003	−0.850	0.397
Cash in other funds	−0.004***	0.001	−2.930	0.003
Group property at formation	−0.008**	0.004	−2.070	0.038
Non-rural	−6.767***	0.716	−9.450	0.000
Group status				
NGO-trained	−0.388**	0.167	−2.320	0.020
Self-managed	1.285***	0.433	2.970	0.003
Country				
Ghana	1.706***	0.351	4.870	0.000
Madagascar	0.000	(empty)		
Malawi	4.671***	0.175	26.720	0.000
Niger	0.337	0.523	0.640	0.520
Rwanda	0.000	(empty)		
Uganda	4.030***	0.184	21.910	0.000
Tanzania	1.937***	0.235	8.250	0.000
Zambia	0.000	(empty)		
Zimbabwe	0.788	1.031	0.770	0.444
Constant	−4.807	0.375	−12.810	0.000

Notes: Number of observations = 14 938; LR Chi^2 (14) = 2260.78; Prob > Chi^2 = 0.0000; pseudo R^2 = 0.4708. Non-rural groups refer to SGs located in urban and semi-urban areas. Group status: whether it is still supervised by an NGO. % in parenthesis is the unit of measure.
*p < 0.1, **p < 0.05, and ***p < 0.01.

TABLE 4 Estimated ATT of the impact of introducing climate change training (kernel matching).

Outcome variable	ATT	Std. err.	t-stat
Savings per member ($)	−0.33371	0.968	0.34
Average loan size ($)	13.15763***	1.7595	7.48
Number of loans per member	−0.08572***	0.014016	6.12
Fund utilization rate (FUR) (%)	0.067071***	0.01584	4.23
Return on Savings (ROS) (%)	−0.05663***	0.016657	3.4
Meeting attendance rate (%)	0.021997***	0.005878	3.74

Note: $ % in parenthesis are the unit of measure.
*p < 0.1, **p < 0.05, and ***p < 0.01.

that average loan sizes increase substantially following the training. Indeed, the average loan size per member in treated groups is 13$ higher than in control groups. As the average borrowed loan in our full dataset is 35$, the impact we find corresponds to loans 37% larger in groups receiving climate training.

Yet, if we find larger loan sizes in treated groups, it seems that it does not translate into more loans being taken out per member. We estimate that the number of loans per member decreases in SGs after the introduction of the

climate training. The reduction is small but significant and suggests that fewer but larger loans are being borrowed in treated groups. Our results support thus the hypothesis that climate training fosters group borrowing in order to invest in climate change mitigation strategies and low-carbon technologies. Yet, this borrowing is concentrated in a few large loans rather than increasing the number of loans taken by each member.

Regarding the fund utilization rate, it increases by 6 percentage points after the introduction of the training. This is not surprising as the fund utilization rate is the ratio between the total value of outstanding loans and the net value of savings. As savings stay constant and loan sizes increase, it is thus only logical that the fund utilization rises.

Taken together, constant savings and increased loans sizes and fund utilization rate could potentially become problematic if the trends persist in the long term. Indeed, loans in the group are available only if there are sufficient available funds in the group, that is, if there are enough savings contributions by the member. An increased borrowing demand in the group could thus lead to loan scarcity if it is not followed by an increase in loan supply created by higher savings. As the supply of money available for loans in SGs depends entirely on the amount saved by members, these combined effects of training might lead to important loan scarcity within the groups and threaten the group's long-term survival (Allen & Panetta, 2010; Gonzales, 2020). Without regular savings, there is no capital for loans, so it is impossible for the group to generate profits and for members to meet their borrowing needs.

The reduction in the number of loans per member could also threaten the group's coherence as SGs ideally promote equal and active participation of all members. Evidence of fewer and larger loans could reflect elite-capture where a few privileged members monopolize the group's resources and available funds, reducing the capacity of other members to borrow small amounts. Yet, if those larger loans are taken in order to invest in larger environmentally friendly projects, it could also have a positive impact for the whole community. The training would then be effective in promoting sustainable adaptation. This would be in line with Nelson (2013), who states that the introduction of development activities in SGs causes the group members to redirect their loans and savings towards the new services. Unfortunately, we do not have data on the utilization of loans distributed by the groups.

Regarding the return on savings, our analysis indicates a significant reduction of 5 percentage points attributable to climate change intervention. This is economically important as the average return on savings in our dataset is around 30% for both types of groups combined. This return plays a key role in the group since it 'rewards' members savings contributions. In comparison to the formal banking system that struggles to offer a real positive interest rate on savings accounts, SGs are thus an advantageous way to save (Allen, 2006). In addition, this return is shared at the end of a group cycle but typically is synchronized to a period when members can particularly make use of this additional revenue, for example, in the lean season when income is low (Allen & Panetta, 2010). A reduction in the return savings could thus disrupt members' financial planning.

Yet, Le Polain et al. (2018) suggest that often group members do not consider the return on savings to be a primordial factor in group participation. Rather, members join principally for access to a safe savings instrument that includes a commitment feature where they are reminded to save at each meeting by their peers. If this is the case, the reduction in the return on savings might then not deter members from participating in this perspective.

Finally, we find that treated groups have significantly higher group meeting participation rate by 2% points. The SG programme relies on the voluntary participation and involvement of the community, meaning that any training that discourages members from joining the meeting will negatively impact the groups' long-term sustainability. A higher meeting attendance suggests that members are satisfied with the activities related to climate change and that engaging in this additional training incentivizes them further to be active group members.

5 | DISCUSSION AND CONCLUSION

In this paper, we study climate change training delivered in informal financial communities offering saving and borrowing services to their members. Considered a tool for achieving broader financial inclusion, SGs are also promising platforms to address other development objectives and participate in the achievement of the UN Sustainable

Development Goals. Particularly, given the urgency of developing strategies to slow down climate change, SGs could be ideal beneficiaries of training related to climate change mitigation and adaptation. By integrating climate-related activities into these informal community-based groups, the aim is to simultaneously strengthen the group financial activities as well as improve development outcomes for some of the world's poorest populations.

Indeed, those groups are specifically designed to promote financial inclusion and economic resilience for populations in rural areas, still under-served by the traditional banking system (Burlando & Canidio, 2017). As those communities are also the ones most vulnerable to the consequences of climate change (Rippey, 2011), we evaluate the effectiveness of introducing a climate change-related training in SGs, building on the advantages of the group setting for greater impact. SGs are potentially ideal platforms to develop knowledge of climate issues but also to give financial means to their members to act upon this knowledge by investing in low-carbon technologies and other environmental strategies. There is thus scope for complementarity efficiency gains between the access to financial services offered by the group and the promotion of sustainable behaviours (Gugerty et al., 2019; Nelson, 2013).

By using propensity score matching on a rich dataset, SAVIX, containing data on group financial activities, we estimate the impact of introducing climate-related training in SGs. We show that the introduction of climate change training into SGs has a positive impact on group participation. Meeting attendance rate increases following the training, hinting that members find the training useful and are encouraged to further get involved in the group. This is of particular importance as groups are entirely member-based and require active participation.

Yet, this higher participation does not seem to translate into higher savings per member during those attended meetings. Similarly, we find that the training reduces the return on savings, a measure of profit creation within the group. On the other hand, climate training increases the average loan sizes within the group and the fund utilization rate (the percentage of savings converted into loans).

It seems that following the training, group members take advantage of the group's capital by borrowing larger loans, potentially to invest in climate adaptation strategies and apply the knowledge acquired during the training. Increased meeting attendance also indicates that the training reinforces group active participation and that members find some benefits in the training. However, as savings do not increase in parallel to borrowed sums within the group, there could be concerns of loan scarcity related to the training in the long term as the capital available for borrowing depends entirely on the members' savings contributions.

We thus provide evidence of existing synergies between climate change training and the financial inclusion promoted by SGs. Specifically, the synergy seems to originate from the fact that SGs are able to offer the capital necessary for investments through group loans and active meeting participation. Opportunity for economies of scope by combining financial services offered in the SGs and climate-related interventions can be achieved by promoting interventions and climate-related training in SGs whose members are largely populations at the bottom-of-the-pyramid that are in the most need of both financial tools adapted to their needs and strategies to reduce their vulnerability to climate shocks.

Yet, the delivery of these training can be improved by including a component highlighting the importance of savings within the groups to incentivize members' contributions and avoid loan scarcity. Precautionary savings are an important tool to insure households against all types of shocks, including climate-related ones (Somville & Vandewalle, 2019), and this should be highlighted by the NGOs providing training to SGs. Equally important, it is acknowledged that the cost of acquiring climate-friendly technologies is high for poor households (Microenergy International, 2015), which would imply high investment costs that reduce members' savings contributions. Therefore, training should not only build knowledge but also facilitate access to affordable and safe climate-friendly technologies.

Although our propensity score matching technique allows us to mitigate estimation bias resulting from observable differences between treated and non-treated groups, which is a considerable improvement over traditional regression-based techniques, we are aware that our method also has its limitations. For example, this method does not account for unobservable characteristics. In addition, though we have tried to solidify our identification strategy,

we have encountered data limitations. The current data do not provide sufficient information on the specificities of the training. For example, we do not have sufficient information on what is included in the climate change training provided by each organization or how it is organized. Such information could have helped to deepen the analysis by addressing the heterogeneity of climate change training in more detail. Nevertheless, we believe that this is an avenue for future research that could explore the impact of each type of training on climate change.

Our findings could also be nicely complemented by experimental evidence using randomized controlled trials. It is key to understand the different aspects of the training in different contexts and, for example, to know to what extent adding an incentive to save in the training could change the impact on the group financial sustainability. Obtaining additional information on the usage of the loans is also an important step to further understand the interaction between financial inclusion and climate interventions. Indeed, we hypothesize here that the larger borrowed sums can be used to invest in climate adaptation strategies. Yet, collecting detailed data on how members invest their loans could help us prove this statement and further understand how the SGs effectively develop the financial capacities of their members to face the climate crisis. Additionally, it could provide information on what type of technologies are available to group members and at what cost.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] According to 2020 figures from the SEEP Network, https://seepnetwork.org/files/galleries/SEEP_Savings-Groups-and-COVID19_20200329_FINAL.pdf.

[2] https://www.findevgateway.org/guide-toolkit/2006/06/village-savings-and-loan-associations-vslas-programme-guide-field-operations.

[3] https://www.vsla.net/ consulted on 6 November 2023.

[4] SAVIX website: https://thesavix.org/.

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APPENDIX A

TABLE A1 Balance on matching covariates between treated and control groups.

	Mean			*t*-test		
Variables	**Treated**	**Control**	**%bias**	**t**	***p*** **> t**	**V(T)/V(C)**
Members at formation	21.124	21.659	−9.1	−1.36	0.176	0.51*
Women members rate (%)	0.78376	0.75508	14.2	2.31	0.021	0.73*
Group age (months)	17.946	19.668	−10.2	−1.7	0.09	0.60*
Cash in other funds ($)	26.507	19.315	17.5	3.81	0	1.39*
Group's property at formation ($)	7.4415	5.9599	5.9	2.22	0.027	0.83*

Note: $ % in parenthesis are the unit of measure.

TABLE A2 Impact of climate training (ATT) estimated with different matching algorithms.

Outcome variables	**Kernel**	**Calliper[a] (0.05)**	**Nearest-neighbour (3)[b]**
Savings per member ($)	−0.334	−0.561	3.157
Std. err.	(0.968)	(0.965)	(1.297)
t-stat	*0.34*	*0.58*	*2.43*
Average loan size ($)	13.158***	13.272***	10.415***
Std. err.	(1.760)	(1.756)	(2.040)
t-stat	*7.480*	*7.56*	*5.11*
Number of loans per member	−0.086***	−0.085***	0.020***
Std. err.	(0.0149)	(0.014)	(0.017)
t-stat	*6.120*	*6.120*	*1.190*
Fund utilization rate (FUR) (%)	0.067***	0.066***	0.053***
Std. err.	(0.016)	(0.016)	(0.016)
t-stat	*4.230*	*4.170*	*3.290*
Return on savings (ROS) (%)	−0.057***	−0.057***	0.116***
Std. err.	(0.017)	(0.017)	(0.021)
t-stat	*3.400*	*3.450*	*5.600*
Meeting attendance rate (%)	0.022***	−0.030***	−0.054***
Std. err.	(0.006)	(0.005)	(0.004)
t-stat	*3.740*	*−6.400*	*−15.250*

Notes: Standard errors in parenthesis. $, % in parenthesis are the unit of measure.
Variable significant:
*$p < 0.1$, **$p < 0.05$, and ***$p < 0.01$.
[a]We impose 0.05 as a maximum tolerance level to ensure quality matches only (see Caliendo & Kopeinig, 2008).
[b]We match each treated unit to three control units with the closest propensity score.