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Bridging Silos: Unlocking SDG Synergies Through an Integrated Development Approach to Landscape Restoration

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Abstract

Achieving Sustainable Development Goals (SDGs) requires integrated interventions that leverage synergies and minimize trade-offs across sectors and institutions. However, siloed institutional structures often prevent such alignment. Using panel data from 361 households and a difference-in-differences approach, this study examines how an integrated landscape restoration intervention, combining homestead gardening, soil and water conservation (SWC), and credit provision, affects SDG outcomes in rural Ethiopia. The study evaluated impacts on SDG-1 (no poverty), SDG-2 (zero-hunger), SDG-13 (climate-action), and SDG-15 (life-on-land) outcomes. Results indicate no statistically significant outcomes from single-intervention participation. Among dual interventions, SWC + credit improved all SDG indicators except SDG-1, while homestead gardening + SWC showed limited impacts. These results suggest that credit provision plays a critical catalyst in widening the impact of biophysical interventions across multiple SDGs. Participation in the full tripartite intervention induced significant, synergistic improvements across all SDG outcomes. These findings provide empirical evidence that bundling biophysical restoration with socio-economic interventions maximizes synergies. The results also underscore the need to inform integrated development approaches using ex-ante analysis of potential synergies and trade-offs among interventions to optimize efficacy and avoid unintended consequences. The findings offer critical guidance for evidence-based multi-objective policy formulation to advance the 2030 Agenda.

Keywords: integrated development; homestead gardening; alignment; Ethiopia; trade-offs

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1. Introduction

The adoption of the 2030 Agenda has highlighted the challenges of aligning initiatives aimed at achieving Sustainable Development Goals (SDGs). As the 17 goals are inherently interlinked to each other [1–3], achieving them depends on their interactions, as the progress in one goal can reinforce or hinder progress in others [1–3]. Aligning the efforts and resources of diverse actors, such as government agencies, civil society, and the private sector, toward achieving the SDGs is a major challenge. This is particularly true in developing countries where institutional capacity is weak and sectoral priorities frequently change. Crises such as economic recessions, armed conflicts, and pandemics have also diverted the attention and resources of actors away from SDG-related initiatives, further weakening sectoral alignments [4,5]. In conflict-affected settings, weak institutional capacity to coordinate cross-sectoral actions complicates alignment efforts. These challenges are exacerbated by the lack of widely accepted operational frameworks for SDG implementation [3,6]. An integrated development approach, which focuses on designing context-specific multi-dimensional solutions to local development challenges, could offer a promising pathway for addressing multiple SDGs at the same time [7–9]. Recent empirical studies show that synergies across SDGs are most effectively realized when interventions are deliberately designed to bridge sectoral silos and align cross-sector priorities [10,11]. Emphasizing integrated project design and implementation, the approach aligns efforts and resources, and thereby facilitates progress toward both SDGs and localized development targets.

An Integrated Development Approach (IDA) is a holistic framework of linking the design, delivery, and evaluation of interventions across multiple sectors to produce amplified collective impacts [7–9,12]. Unlike the top-down model for designing multisectoral interventions, which typically involves the integration of interventions at higher levels (e.g., national, regional, or ministerial), the IDA employs a bottom-up framework. The approach requires a single unit or organization to assume the responsibilities of coordinating the multisector interventions and tailoring them to the specific needs of communities [7–9,12]. This allows the responsible organization to design, implement, and evaluate a multisectoral intervention with a multi-sectoral perspective. A central principle of IDA is that a multisector-focused intervention within an implementing organization is easier to align its objectives, intervention instruments, and implementation modalities [7–9,12]. However, this requires the organization to reassess its internal structures to eliminate silos among departments and establish stronger collaboration with other organizations across different sectors [13,14]. This poses challenges, particularly in terms of organizational capacity. Yet, it also offers the advantages of higher responsiveness to local needs and provision of context-specific integrated solutions, leading to achievements of multiple development goals in targeted communities.

Multisectoral interventions are traditionally understood as mechanisms or tools designed to create alignment across various initiatives at higher levels, such as national, regional, or sectoral scales. Such interventions are often informed by a comprehensive understanding of the country-specific interconnectedness of the SDGs and the need for coordinated efforts across sectors [15–17]. The primary objectives of such interventions are to facilitate the achievement of multiple SDGs at the country level by introducing systemic changes that ensure sustained alignments among multiple actors across different sectors and levels [15,16,18,19]. This requires the adoption of a top-down approach to introduce the required systemic changes. Such an approach implicitly assumed that the alignment mechanisms established at the top administration level would be effectively cascaded down to the lower administration levels. However, this assumption can be far from reality, particularly in contexts where governments have weak hierarchical structures, limited capacity, or lack the political will to enforce. One of the potential solutions to such limitations is to incorporate bottom-up insights into the design and implementation of SDG-related initiatives, using an IDA targeting a local community.

IDA-tuned interventions can be more deliberate in reflecting the locally specific interconnected nature of multi-dimensional development challenges faced by local communities. Designing and implementing IDA-tuned interventions, however, would be a challenge for the current international development architecture, where many of the actors are purely focused on single issues with highly specialized areas, focusing on either agriculture, industry, health, or the environment [7,9,20]. Its approach is also ill-suited in the context of the existing development financing modality, which makes IDA not widely adopted both in policy and practice. Recent studies show that integrated development approaches are being applied in diverse contexts. For instance, Basuki, Nugroho [21] demonstrated how integrated watershed management can simultaneously improve ecological, social, and economic outcomes. Consequently, despite its potential for achieving broader and more sustainable results, IDA is still underexplored in the literature and has not received sufficient attention from policymakers, researchers, and practitioners [7,9,20].

Understanding interactions of SDGs at the local level is crucial for fostering integration of actions and resources. Recent studies [6,10,11,22] have highlighted how an in-depth understanding of SDG interactions at the local level informs the design of localized alignment mechanisms, which is key in enhancing SDG coherence and integration. More than the national-level institutional settings, localized institutional mechanisms play a very critical role in creating SDG coherence and integration [11,22]. For such localized institutional mechanisms to emerge, however, national coordination frameworks and the localization of the SDGs must first be established. National coordination frameworks and local SDG mainstreaming tools—such as integrated budget tagging, multi-level planning, and voluntary local reviews—enhance the effectiveness of SDG localization [6]. Building on these insights, this article empirically examines how IDA contributes to synergetic effects across multiple SDGs within an integrated landscape restoration initiative.

This article empirically examines how IDA contributes to achieving multiple SDGs by addressing the multi-dimensional and interrelated development challenges at the local community level. By explicitly exploring how IDA unlocks synergies and minimizes trade-offs, the article contributes to the literature on integrated development. Specifically, it addresses the gap identified by Masset [20] regarding the limited exploration of IDA in rural contexts. In doing so, the article deepens the understanding of how localized IDA strategies complement broader, top-down governance frameworks in improving the impact of development interventions on SDG targets. We did this using the Integrated Landscape Management and WASH (ILMWA) project implemented in the Amhara regional state, Ethiopia, as a case. The project integrates four major interventions: landscape restoration, livelihood enhancements, WASH service enhancements, and institutional and infrastructural capacity building. The initiative aims to contribute to several SDGs, particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 13 (Climate Action). It also serves as a practical case for testing the validity of the IDA framework.

The focus of this article is on the project's household-level interventions. Using difference-in-difference analysis, the article addresses the following research questions: (1) how effective is the project in improving the poverty status (SDG 1), food security status (SDG 2) of its beneficiary households, regenerating degraded lands (SDG 15), and building resilient livelihood (SDG 13); (2) which combination of the interventions were most effective in achieving the expected outcomes on multiple SDGs; and (3) what are the synergies and trade-offs between SDGs.

The article is organized as follows: Section 2 provides an overview of the research context and the methods. Its first sub-section describes the Kunzila Integrated Landscape Management and WASH (ILMWA), followed by a discussion of the potential synergies between its integrated intervention and its contributions to multiple SDGs. The data sources and analytical methods used in the study are outlined in the subsequent subsections. Sections 3 and 4 present the results of the statistical and econometric analyses, highlighting the impacts of the interventions on various SDG indicators and their broader theoretical and practical implications. Finally, Section 5 concludes by summarizing the main findings in relation to existing literature and policy implications.

2. Research Methods

2.1. The Case Study: Kunzila Integrated Landscape Management and WASH (ILMWA) Project

The Kunzila Integrated Landscape Management and WASH (ILMWA) project was launched in 2020 in Kunzila town, Amhara Regional State, Ethiopia, and funded by the Royal Netherlands Embassy. The project consists of two primary components: integrated watershed management and WASH interventions. The project targets smallholder farming households, cooperatives, and public institutions, addressing critical development challenges such as land degradation, poverty and food insecurity, inadequate WASH services, and limited access to infrastructure and weak institutions. The project aims to promote a healthier and more prosperous population in the Kunzila Watersheds by combining interventions that address community-level and household-level development challenges. The community-level interventions largely focus on building infrastructural and institutional capacities, such as community ponds, water supplies, financial and product markets, extension services, WASH services to schools, and health centers, and the restoration of degraded communal lands; however, these community-level interventions are not the primary focus of this study (Figure 1).

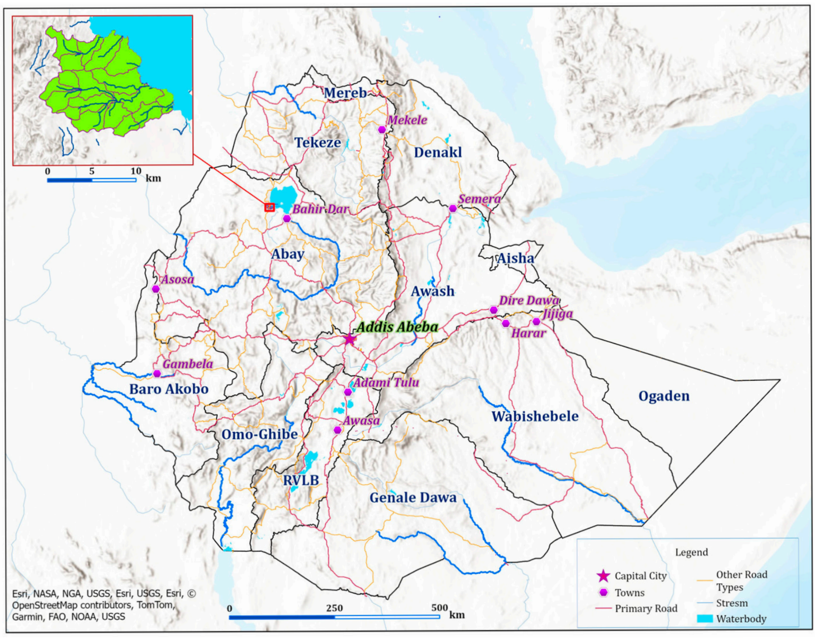

Figure 1. Research area, Kunzila landscape.

The household-level interventions comprise three distinct packages aiming to address livelihoods and agricultural productivity challenges of the participating individual households. The first package focuses on homestead development. This package integrates several interventions, including horticulture production, agroforestry, forage production, fattening, dairy, apiculture, home management, fuel-saving stove, etc. The package aims to improve nutrition and increase incomes by diversifying livelihoods and by intensively utilizing the homestead. Among these multiple homestead development interventions, this study specifically focused on homestead gardening interventions, which include agroforestry development, fruit and vegetable production, and forage development. The second package aims to support farmers in implementing landscape restoration works on the farmlands. Given the high vulnerability of the project area to land degradation, this intervention focuses on rehabilitating and conserving different land uses through physical, agroforestry, and biological SWC measures, aiming to restore soil fertility, enhance agricultural productivity, and increase resilience to climate-related shocks. Though the project implements

SWC works on farmland, degraded lands, grazing lands, wetlands, and gullies, the study focused only on household-level restorations on farmland. The third package involves the strengthening of financial services for households. By strengthening the financial and managerial capacities of the rural Saving and Credit Cooperatives (SACCOs), the project fosters savings and improves access to credit so that households can finance the adoption of new technologies, diversification, and intensification of their livelihoods. The credit also promotes savings, financial literacy, and entrepreneurial skills among participating households. The project aims to improve overall household well-being and long-term resilience through the combined intervention of landscape restorations (SWC), homestead gardening, and credit.

Through the integration of these three interventions, the project targets the enhancement of multiple SDGs, particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 13 (Climate Action). The project's objectives are strategically aligned with Ethiopia's national Climate Resilient Green Economy (CRGE) strategy and its 10-Year Development Plan. This alignment demonstrates the project's direct contribution to national sustainable development priorities. According to the International Resource Panel [23], landscape management initiatives can impact multiple SDGs through two impact pathways: the processes used in restoration and the outcomes of the intervention.

SDG 1: No Poverty—The ILMWA project addresses poverty through direct and indirect mechanisms aligned with the two pathways. The process of implementing SWC activities creates immediate short-term employment and income-generating opportunities for participating households. Studies widely show that community-based large-scale landscape restoration programs create employment opportunities through tree planting, agroforestry, and sustainable land management activities [24–26]. Furthermore, the project implements the SWC in combination with livelihood enhancement activities, including the production of fruits, apiculture, and the sale of trees. Similarly, the project's diversification and intensification of livelihood interventions through homestead gardening serve to directly address poverty. Consequently, the combined outcome of the SWC measures and homestead gardening activities helps to restore the productive capacity of the ecosystems, leading to increases in agricultural yields and income [27–29]. These interventions also improve the ecosystem services, such as improving water availability and soil fertility [30,31]. The credit component amplifies these effects by enabling investments and the adoption of new technologies in SWC and homestead gardening. In many developing countries, such integrated interventions help to lift individuals out of poverty in rural areas. Additionally, sustainable land management practices, such as physical SWC practices and homestead gardening, help to build resilience capacity to climate-related shocks, which help communities better adapt to extreme weather events and foster long-term socio-economic stability [32,33].

SDG 2: Zero Hunger—The project's contribution to zero hunger is achieved by directly increasing agricultural productivity and enabling diversified production, leading to increases in the quality and quantity of food production [23,29,33]. Land restoration and homestead gardening promote sustainable farming systems. The practices positively impact agricultural productivity by improving soil fertility and ecosystem services such as pollination, pest control, and nutrient cycling [29,34–36]. This, in turn, enables communities to produce more food and more nutritious crops, which directly addresses hunger and malnutrition. The homestead gardening package specifically promotes dietary diversity by increasing the availability of nutritious fruits and vegetables. By strengthening the resilience of farming systems to climate extremes, the project aims to safeguard food production against shocks and thus enhances food security and agricultural sustainability [24–26]. The credit package also facilitates the intensity of adoption of the technologies, as well as allowing households to increase their capacity to access nutritious foods from markets. The employment opportunities created in the restoration process also help to indirectly reduce hunger and malnutrition.

SDG 13: Climate Action—The ILMWA project embodies climate action by transforming agricultural landscapes into carbon sinks and supporting local adaptive capacity. The primary outcome of the restoration and homestead gardening activities is to increase biomass and soil organic carbon, helping carbon sequestration and ecosystem resilience [23]. Land restoration via reforestation increases the carbon sink, which is critical to combat climate change [37]. As a result, restored lands support biodiversity and soil fertility and favor the resilience of ecosystems in the face of climate-related hazards [37–39]. Agroforestry as a multipurpose restoration approach offers climate change adaptation solutions by diversifying ecosystem services and income sources for local communities [40].

2.2. Data

The study is based on two rounds of household survey data: baseline and second-round surveys. The baseline data was collected in June 2020 during the project's inception, while the second round was collected after about three years in April 2023 from the same households in both rounds. A total of 361 households were surveyed in both rounds. Before the baseline assessment, a reconnaissance survey was first used to assess potential heterogeneity of the study area. Based on the insights, a sample of 420 households, representing 15% of the total households, was proportionally allocated across the villages. The sample households were selected through a systematic random sampling method using households' rosters of the *kebeles*. Interviews were primarily conducted with the household heads, sometimes accompanied by other household members. The second-round survey used the baseline sample list, but not all households were available. Of the 420 households surveyed initially, only 361 participated in the second round. This was largely due to the timing, coinciding with the Eastern Fasting season of Ethiopian Orthodox Christians, when many household heads were engaged in religious activities. Additionally, some villages from the baseline survey were later found to be outside the watershed and were excluded from the project, further reducing the number of participants.

The three major treatments of the project—homestead gardening, soil and water conservation (SWC), and credit—involving both treated and control households. Credit was not provided independently but accompanied either home gardening or SWC to support technology adoption. Depending on the level of participation in the treatments, households were categorized into six treatment groups: those receiving only home gardening or SWC, those in two-treatment combinations (home gardening plus credit, SWC plus credit, or home gardening plus SWC), and those receiving all three treatments. The control group comprised households that did not participate in any treatment. Table 1 presents the distribution of sample households across the treatment and control groups.

Table 1. The distribution of sampled households across the control and treatment groups.

Treatment Status	Treatment Level	Treatment Description	N	%
Not treated	t = 0	Control	40	11.1
	t = 1	Homestead gardening only	38	10.5
	t = 2	SWC only	89	24.6
	t = 3	Credit provision + Homestead gardening	33	9.1
Treated	t = 4	Credit provision + SWC	43	11.9
	t = 5	Homestead gardening + SWC	74	20.5
	t = 6	Credit provision + Homestead gardening + SWC	44	12.2
Total			361	100

2.3. Output Indicators

To assess the project's impact on various SDGs, relevant indicators were selected based on the project's goals and household-level interventions. The project aims to enhance prosperity and health by addressing low agricultural productivity, land degradation, and limited off-farm activities. Accordingly, four key SDGs were identified: poverty alleviation (SDG1), ending hunger (SDG2), resilience and adaptive capacity (SDG13), and life on land (SDG15). Appropriate outcome indicators were chosen to measure these impacts, as shown in Table 2.

Table 2. Selected SDGs, targets, and indicators.

SDGs	SDG Targets	SDG Indicators
SDG1	T1.1: Eradicate extreme poverty	Number of different assets owned
	T1.2: Half of the people living in poverty	Income earned from off-farm activities
	T1.4: Ensure access to economic resources and basic services	The total size of the iron sheet house
SDG2	T2.1: End hunger and access to nutritious food	Household Dietary Diversity Score
	T2.3: Double the agricultural	Productivity of major cereals per hectare: Teff, Maize, and Millet
	T2.4: Ensure sustainable food production systems	Farmlands covered with Physical SWC measure
SDG13	T13.1: Strengthen resilience and adaptive capacity	Households' Resilience Capacity Index
SDG15	T15.2: Promote the implementation of sustainable management of all types of forests	Farmlands covered with agroforestry practices
	T15.3: Land Degradation Neutrality	Farmlands covered with Physical SWC measures

For SDG 1, three key targets were selected—Target 1.1 (eradicating extreme poverty), Target 1.2 (reducing poverty by half), and Target 1.4 (ensuring access to basic services)—with indicators including the number of assets owned, income from off-farm activities, and house size measured by the number of iron sheets used in construction. These indicators holistically evaluate household poverty status. For SDG 2, Target 2.1 (ending hunger) was measured using the Household Dietary Diversity Score (HDDS), Target 2.3 (doubling agricultural productivity) was assessed through changes in crop yields of teff, maize, and millet, while Target 2.4 (ensuring sustainable food production) was measured by the extent of farmland under soil and water conservation (SWC) measures. SDG 13's Target 13.1, which focuses on strengthening resilience to climate change and disasters, was assessed using the TANGO approach of measuring Resilience Capacity Index, encompassing absorptive capacity (household ability to manage shocks), adaptive capacity (proactive resource management), and transformative capacity (governance, infrastructure, and safety nets). For SDG 15, Target 15.2 (promoting sustainable forest management) was evaluated based on changes in farmland hectares covered by agroforestry, while Target 15.3 (restoring degraded land and soil) was measured by the extent of farmland with SWC measures, reflecting efforts in land restoration and sustainability (Table 3).

Table 3. Description of the indicators.

	Indicators	Type	Description
	SDG 1 indicators		
Target 1.1	Asset ownership	Integer	Total number of assets owned out of 18 wealth-indicating assets
Target 1.2	House (iron sheet)	Integer	Total number of iron sheets used to make the house, including for humans and animals

Table 3. *Cont.*

	Indicators	Type	Description
Target 1.4	Off-farm income	Continuous	The sum of off-farm incomes earned over the 12 months
	SDG 2: Indicators		
Target 2.1	Dietary Diversity Score	Continuous	The number of food items consumed by household members in the past 7 days
Target 2.3	Teff productivity (kg/ha)	Continuous	Teff production in kg/total hectare of land cultivated with Teff.
Target 2.3	Maize productivity (kg/ha)	Continuous	Maize production in kg/total hectare of land cultivated with Maize
Target 2.3	Millet productivity(kg/ha)	Continuous	Millet production in kg/total hectare of land cultivated with Millet
Target 2.4	Farm size with physical SWC (ha)	Continuous	Total farmland area covered with physical SWC measures
	SDG 13: Indicators		
Target 13.1	Resilience Capacity Index	Continuous	An average index value of the adaptive, absorptive, and transformative dimensions of resilience capacity
	SDG 15: Indicators		
Target 15.2	Farm size with Agroforestry (ha)	Continuous	Total farmland area covered with agroforestry SWC measures
Target 15.3	Farm size with physical SWC (ha)	Continuous	Total farmland area covered with SWC measures
	Other variables		
	Treatment	Categorical	1 if the household is part of the treatment or 0 otherwise
	Gender	Categorical	Sex of the household head, 1 = Male and 2 = Female
	Age	Integer	Age of the household head
	Household size	Integer	Total number of individuals living in the same household
	Farm size (ha)	Continuous	Total area of farmland owned by the household
	Remittance	Continuous	Total amount of money received by the household as transfers in the past 12 months

2.4. Data Analysis

The difference-in-differences (DiD) method was used to evaluate the impact of the project on the selected SDG indicators. The method is widely used in the evaluation of policy interventions where random assignment to treatment groups is not feasible [41,42]. This methodology allows for controlling for both time-specific and individual-specific effects [41,42]. The DiD model used in this study can be expressed as

$$Y_i = \propto + \gamma T_i + \delta P_i + \beta\, T_i * P_i + \theta X_i + \varepsilon_i \quad (1)$$

where Y_i represents the outcome variable for the i-individual, corresponding to one of the SDG indicators discussed previously (see Table 2); α is the intercept or constant term. T_i is a binary variable which equals 1 if individual i is part of the treatment group or 0 otherwise, and its coefficient γ accounts for the time-fixed effects, factors that affect all individuals at a specific time, such as macroeconomic events or policy changes. P_i is also a binary variable—1 for the post-intervention period and 0 for the baseline period—and its coefficient δ controls for individual fixed effects due to time-invariant characteristics unique to each individual, such as baseline wealth and farm size. The coefficient β on the interaction term represents the DiD estimate of the causal impact of a treatment, capturing the difference in the outcome variable between the treatment and control group, after controlling for time trends and individual–specific factors. A statistically significant estimate for β provides evidence of a causal impact of the treatment intervention. In addition to the main treatment variable, the model also includes a vector of covariates (X_i) to control for household heterogeneity, including the gender of household head, age, household size, total farmland size, and remittance income. This specification improves precision and reduces omitted variable bias, enhancing the validity of the causal interpretation. θ is the coefficient vector for variates. ε_i is an error term, accounting for any unobserved factors affecting the outcome.

The non-random implementation of interventions like SWC measures makes the DiD approach a particularly suitable evaluation tool [41,43]. DiD isolates the causal effects of the treatment by comparing the pre-and post-treatment outcome differences for the treated and control groups. This approach allows for controlling time-varying confounding variables that might affect both the treated and control groups as well as the outcome over time, thereby providing more reliable effect estimates [41,42]. The DID approach has been used to analyze the effects of SWC measures and other environmental interventions on various SDG-related indicators [44,45].

To address the potential selection bias, we conducted a balance test comparing treatment and control groups across a wide range of observable baseline characteristics. The results show no statistically significant differences in key socio-economic variables, suggesting that the groups were comparable before the intervention. While unobserved heterogeneity can never be fully ruled out in non-randomized settings, the balance test strengthens the credibility of our DiD estimates by demonstrating that observable selection bias is unlikely to drive the results. Moreover, the project identified target villages based on their level of food insecurity. This process was performed in close consultation with Development Assistants (Das) in each village, ensuring that treatment and control households were similar in their socioeconomic conditions before the project inception.

The validity of the DiD approach also depends on the parallel-trend assumption, which requires that treatment and control groups would have followed similar trajectories in the absence of the intervention [41,43,45]. Given that only two survey rounds (baseline and midterm) were available, a formal statistical test of this assumption was not feasible. Nevertheless, comparison of baseline means across key SDG-related indicators revealed no significant differences between the two groups, supporting the parallel-trends assumption. Furthermore, to ensure the robustness of the estimates, our analysis incorporated several robustness checks. This includes testing different model specifications by adding household-level covariates, including gender, age, farmland size, and remittance. The robustness checks also include subgroup analysis by gender, consistently confirming the stability and reliability of the estimated treatment effects.

3. Results

Table 4 presents the descriptive statistics of control and treated groups, the aggregate mean of the first and second surveys, and their correlation. The control group members exhibited a lower mean value of iron-sheet house size (56.9), which reflects lower wealth status; lower productivity (e.g., maize yield of 2930 kg/ha), limited off-farm income (1189), and a lower dietary diversity score (4.8). During the second round survey, treated groups receiving interventions showed significant improvements in productivity, income, and resilience. The "credit plus SWC" group had the highest maize productivity (3572 kg/ha) and a resilience capacity index of 0.53, compared to 0.41 in the control group. The "credit plus home gardening plus SWC" group had the highest off-farm income (3634) and dietary diversity (7.3). These results highlight the synergistic benefits of integrated interventions in enhancing multiple SDGs for households.

Table 4. Descriptive statistics.

		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	House (iron sheet)	1.00									
2	Asset ownership	0.48 ***	1.00								
3	Off-farm income	0.01	0.18 ***	1.00							
4	Dietary Diversity Score	0.19 ***	0.40 ***	0.21 ***	1.00						
5	Teff productivity (kg/ha)	0.12 *	0.23 ***	0.16 **	0.32 ***	1.00					
6	Maize productivity (kg/ha)	0.09 **	0.14 ***	−0.01	0.16 ***	0.03	1.00				
7	Millet productivity(kg/ha)	0.07 *	0.13 ***	0.12 ***	0.25 ***	0.18 **	0.32 ***	1.00			
8	Farm size with physical SWC (ha)	0.21 ***	0.24 ***	0.08 **	0.00	0.19 ***	0.08 **	0.04	1.00		
9	Resilience Capacity Index	0.27 ***	0.43 ***	0.21 ***	0.23 ***	0.25 ***	0.11 ***	0.09 **	0.31 ***	1.00	
10	Farm size with Agroforestry (ha)	0.17 ***	0.18 ***	0.10 ***	0.02	0.16 **	0.01	0.04	0.30 ***	0.20 ***	1.00
Mean (SD)	Control Group	56.9 (23)	1.8 (1.5)	1189 (1638)	4.8 (1.7)	742 (185)	2930 (1280)	1417 (41)	0.07 (0.13)	0.41 (0.12)	0.04 (0.07)
	Experimental Groups										
	Homestead gardening	68.7 (33)	2.2 (1.6)	564 (975)	4.7 (1.7)	695 (118)	3260 (1317)	1465 (527)	0.07 (14)	0.42 (0.10)	0.13 (0.27)
	SWC	79.2 (32)	2.7 (1.8)	750 (1877)	5.0 (2.0)	711 (132)	3334 (1360)	1503 (535)	0.71 (1.1)	0.46 (0.12)	0.29 (0.51)
	Credit + Homestead gardening	65.8 (26)	2.1 (1.6)	3094 (1035)	6.3 (1.8)	782 (213)	3561 (1381)	1563 (596)	0.08 (0.17)	0.45 (0.15)	0.10 (0.07)
	Credit + SWC	81.6 (40)	3.2 (1.9)	3125 (1883)	6.5 (1.9)	1005 (301)	3572 (1201)	1768 (492)	0.63 (0.85)	0.53 (0.14)	0.23 (0.36)
	Homestead gardening + SWC	74.9 (33)	2.4 (1.6)	615 (1778)	5.1 (1.9)	774 (216)	3451 (1343)	1494 (591)	0.67 (1.1)	0.43 (0.12)	0.28 (0.60)
	Credit + Homestead gardening + SWC	83.7 (31)	3.8 (2.2)	3634 (1052)	7.3 (2.3)	935 (359)	3477 (1045)	1623 (583)	0.65 (0.94)	0.51 (0.15)	0.23 (0.47)

Statistical significance: * $p < 0.01$, ** $p < 0.05$, *** $p < 0.001$.

The table also presents the correlation matrix among SDG indicator variables. Asset ownership showed a strong positive correlation with house size, dietary diversity, resilience capacity, and farmland under soil and water conservation (SWC), suggesting that wealthier households have better housing, dietary habits, and resilience. Contrary to our expectations, off-farm income had weaker correlations with other indicators, except with asset ownership and resilience capacity, implying its limited direct impact on agricultural productivity. The agricultural productivity variables, such as maize and millet productivity, demonstrate moderate correlations with asset ownership and dietary diversity. This underscores their contributions to more robust economic profiles and better dietary outcomes.

3.1. The Impacts of Silo Treatments on SDG1, SDG2, SDG13, and SDG15

Table 5 presents the impacts of two silo treatments, homestead gardening only and soil and water conservation (SWC) only, on the selected SDG indicators using a difference-in-difference (DiD) analysis. The findings reveal variations in impacts across indicators. As shown in Table 5, households participating in homestead gardening alone exhibited limited or insignificant improvements in most SDG indicators, except for Target 15.3. The homestead gardening-only intervention showed no statistically significant effects on ownership of assets in the treated group, indicating its limited impact on wealth-related assets in isolation. While maize and millet productivity showed modest increases in the treated group, these improvements were not statistically significant, indicating that the home gardening development-only strategy did not lead to substantial agricultural yield gains. Household dietary diversity (HDDS) declined slightly in both groups, with a greater decrease in the treated group. The DiD estimate confirmed no statistically significant improvement in HDDS to the treated group. Additionally, off-farm income and resilience capacity index showed no significant differences between groups, suggesting that this intervention did not effectively enhance economic diversification or resilience in the short term. However, the intervention showed statistically significant effects in improving the farmland covered with agroforestry SWC measures in the treated group. The intervention resulted in an average increase of 0.16 hectares in the farmland area covered by the agroforestry SWC measures. Moreover, the effect sizes differ by the gender of the household head—the standardized Cohen's d effect size is 0.36 units higher for female-headed households than for male-headed ones, suggesting that the intervention may also contribute to the enhancement of gender equity. Overall, the homestead gardening development-only strategy showed no co-benefits for other SDG targets and may even have trade-offs, as treated households experienced slight declines in several indicators.

Table 5. The impact of the homestead gardening-only and soil and water conservation-only strategies on the SDG indicators.

	Homestead Gardening Only				SWC Only			
Indicators	**$Diff_1$ [1]**	**$Diff_2$ [2]**	**Diff-in-Diff**	**t-Value**	**$Diff_1$**	**$Diff_2$**	**Diff-in-Diff**	**t-Value**
SDG 1.1: Asset ownership	0.37	0.22	−0.16	0.31	0.67 **	1.06 ***	0.41	0.88
SDG 1.2: Off-farm income (per hh members)	−579.6 *	−645.2 **	−47.7	0.11	541.5	−330.8	210.6	0.43
SDG 1.4: House (iron sheet)	13.45	10.09	−3.35	0.36	23.0 ***	21.6 ***	−1.41	0.17
SDG 2.1: Household Dietary Diversity Score	−0.12	−0.24	−0.12	0.22	0.47	−0.24	−0.71	1.45
SDG 2.3: Increase in cereal production:								
Teff (kg/ha)	−83.2	−41.5	41.7	0.27	−119.6	32.0	151.6	1.80
Maize (kg/ha)	229.6	434.2	204.6	0.47	228.9	584.2	355.3	0.95
Millet (kg/ha)	−15.6	110.1	125.7	0.70	−12.0	187.4	199.4	1.24
SDG 13.1: Resilience capacity index	0.04 *	−0.01	−0.05	1.52	0.05	0.06 ***	0.01	0.39
SDG 15.2: Farm size covered with agroforestry (ha)	0.07 *	0.24 ***	0.16 ***	2.65	0.07	0.44 ***	0.36 ***	3.31
SDG 2.4 and SDG 15.3: Farm size with physical SWC measures (ha)	−0.01	0.01	0.02	0.53	−0.02	1.29 ***	1.31 ***	6.60

Statistical significance: * $p < 0.01$, ** $p < 0.05$, *** $p < 0.001$. [1] The subscription indicates the difference in mean value between the control group and the treatment group during the baseline. [2] The subscription indicates difference in mean value between the control group and the treatment group during the second-round survey.

Similarly, Table 5 presents the impact of the soil and water conservation (SWC)-only treatment on outcome variables. The treated group showed significant improvements in agroforestry practices and physical SWC measures, indicating the intervention's impacts on SDG 15 targets—sustainable forest management and land degradation. The intervention resulted in an average increase of 0.36 and 1.31 hectares in farmland area covered with agroforestry and physical SWC measures, respectively. In terms of gender, its effect size is higher among male-headed households, which is quite logical as the intervention is relatively labor-intensive and may therefore favor households with greater access to male labor resources. Yet, the SWC-only treatment had no significant effect on off-farm income, and the Household Resilience Capacity Index showed only a small increase (see Table 5). The DiD estimate for the HDDS was negative, indicating a decline in dietary diversity among treated households. This result suggests the limitation of purely SDG 15-focused interventions in addressing broader socio-economic challenges. Overall, both silo treatments, home gardening only and SWC only, showed improvements in SDG 15-related targets but had limited effects on income, dietary diversity, and resilience. These findings highlight that without complementary socio-economic support mechanisms, these isolated interventions are insufficient for achieving comprehensive and balanced SDG outcomes.

3.2. The Impacts of Two Treatment Combinations on SDG1, SDG2, SDG13, and SDG15

Table 6 presents the impact of home gardening plus credit treatment on SDG indicators, showing significant improvements across multiple areas compared to silo treatments. The treated group exhibited notable progress in SDG 2 indicators, with a statistically significant increase in the HDDS, maize productivity, and millet productivity. Under SDG 1, off-farm income increased significantly, reflecting the intervention's impact on enhancing income diversification to the treated group. Additionally, the intervention showed significant improvement in resilience capacity—increasing by 0.06 points in the treatment group—and in farmland covered with agroforestry SWC measures, which is increased by 0.09 hectares more than in the control group. These findings indicate that combining home gardening with credit effectively boosts income, food security, and environmental resilience, addressing multiple SDG targets more comprehensively than homestead gardening alone.

Table 6. The impact of homestead gardening plus credit and soil and water conservation plus credit strategies on the SDG indicators.

	Homestead Gardening + Credit				SWC + Credit			
Indicators	**$Diff_1$**	**$Diff_2$**	**Diff-in-Diff**	**t-Value**	**$Diff_1$**	**$Diff_2$**	**Diff-in-Diff**	**t-Value**
SDG 1.1: Asset ownership	0.13	0.33	0.20	0.40	0.93 **	1.67 ***	0.73	1.36
SDG 1.2: Off-farm income (per hh members)	54.2	3762.4 ***	3708.3 **	2.36	88.10	3795.7 ***	3712.6 *	1.88
SDG 1.4: House (iron sheet)	7.13	10.63 *	3.50	0.42	22.5 ***	26.8 ***	4.27	0.41
SDG 2.1: Household Dietary Diversity Score	0.47	2.56 ***	2.08 ***	3.73	0.72 *	2.47 ***	1.75 ***	3.11
SDG 2.3: Increase in cereal production:								
Teff (kg/ha)	12.9	48.6	36.7	0.25	9.6	434.4 ***	424.8 ***	2.82
Maize (kg/ha)	228.7	1046.4 ***	817.7 *	1.80	292.6	988.1 ***	695.4 *	1.77
Millet (kg/ha)	−115.2	501.3 ***	616.5 ***	2.86	167.1	546.9 ***	379.8 **	2.29
SDG 13.1: Resilience capacity index	0.02	0.08 ***	0.06 *	1.49	0.09 **	0.14 ***	0.05	1.41
SDG 15.2: Farm size covered with agroforestry (ha)	0.01	0.11 ***	0.09 ***	3.85	0.10 *	0.27 ***	0.17 **	2.08
SDG 2.4 and SDG 15.3: Farm size with physical SWC measures (ha)	−0.02		0.06	1.10	0.04	1.06 ***	1.01 ***	6.37

Statistical significance: * $p < 0.01$, ** $p < 0.05$, *** $p < 0.001$.

Table 7 presents the impacts of the physical SWC measures plus credit treatment. Similar to the homestead gardening plus credit treatment, the treated groups showed modest improvements across various SDG indicators. These include improvement in off-farm income and all SDG 2 indicators: HDDS, and the crop productivity gains, including productivity gain of teff, maize, and millet. The treatment increased the number of food items consumed by 1.76 units and the kg of teff, maize, and millet production for the treatment group. The treatment has also led to positive outcomes of SDG 15 indicators: farmland covered with agroforestry and farmlands protected with physical SWC. However, unlike the prior treatment, the SWC plus credit intervention did not yield any significant improvements in the resilience capacity of the treated households. These findings imply that the intervention enhances food security and environmental indicators; however, it attenuates the effects on the overarching socioeconomic outcomes, such as poverty reduction and resilience capacity.

Table 7. The impact of homestead gardening plus SWC and homestead gardening + SWC + credit strategies on the SDG indicators.

	Homestead Gardening + SWC				**Homestead Gardening + SWC + Credit**			
Indicators	**$Diff_1$**	**$Diff_2$**	**Diff-in-Diff**	**t-Value**	**$Diff_1$**	**$Diff_2$**	**Diff-in-Diff**	**t-Value**
SDG 1.1: Asset ownership	0.45	0.73 **	0.27	0.62	0.88 **	3.12 ***	2.15 ***	4.38
SDG 1.2: Off-farm income (per hh members)	−582.8	−558.3	−24.3	0.05	−569.6	5466 ***	6036 ***	2.64
SDG 1.4: House (iron sheet)	18.1 ***	17.9 ***	−0.14	0.02	17.2 ***	36.2 ***	18.9 **	2.30
SDG 2.1: Household Dietary Diversity Score	0.38	0.04	−0.34	0.69	0.48	4.43 ***	3.95 ***	7.60
SDG 2.3: Increase in cereal production:								
Teff (kg/ha)	9.7	44.0	−34.2	0.27	−130.8	389.6 ***	520.4 ***	2.96
Maize (kg/ha)	387.1	658.3 **	271.1	0.71	267.1	834.3 ***	567.2 *	1.55
Millet (kg/ha)	5.1	151.3	146.3	0.82	−131.4	525.7 ***	657.1 ***	3.76
SDG 13.1: Resilience capacity index	0.01	0.03	0.02	0.66	0.06 ***	0.15 ***	0.09 **	2.43
SDG 15.2: Farm size covered with agroforestry (ha)	0.04	0.43 ***	0.39 ***	3.01	0.04	0.33 ***	0.28 ***	2.72
SDG 2.4 and SDG 15.3: Farm size with physical SWC measures (ha)	−0.03	1.22 ***	1.26 ***	6.87	0.01	1.15 ***	1.14 ***	6.54

Statistical significance: * $p < 0.01$, ** $p < 0.05$, *** $p < 0.001$.

The final two-treatment combination evaluated integrates homestead gardening with SWC treatment. As presented in Table 7, participants in this treatment exhibited significant positive impacts on SDG 15 indicators, specifically on the farmland area covered with agroforestry and physical SWC measures. However, the analysis also revealed that the intervention results in no significant improvements in SDG 1, SDG 2, and SDG 13 indicators. These results suggest that combining home gardening with SWC measures effectively addresses environmental outcomes but does not positively affect broader socioeconomic dimensions such as poverty, food security, and climate resilience. The absence of credit in this treatment appears to weaken the impacts observed in the previous two treatments.

The comparative analysis of two-way treatment combinations reveals that the integration of home gardening with credit and SWC with credit yielded significant improvements across multiple SDG indicators, including SDG 2 (food security), SDG 13 (climate action), and SDG 15 (life on land). This finding suggests that accompanying the interments with credit is a key factor for realizing synergistic effects of the treatments across multiple SDG indicators.

3.3. The Impacts of the Three Treatment Combinations on SDG1, SDG2, SDG13, and SDG15

Table 8 presents the impacts of a combined intervention including homestead gardening development, SWC measures, and credit treatment. The results show that the treated group showed significant improvement across all SDG indicators compared to the control group. Unlike other treatments, households in this treatment exhibited significant improvement in all SDG1 indicators, including the house's iron sheet size, asset ownership, and off-farm income. The treated groups also exhibited statistically significant improvement in the other SDG indicators, including SDG 2 indicators: HDDS, and the productivity of the three major crops—teff, maize, and millet; SDG 13—resilience capacity index; and SDG 15 indicators–farmland covered with agroforestry and the implementation of physical SWC measures. In terms of gender, except for SDG 2 indicators, where male-headed households exhibited relatively higher effect sizes, the treatment showed no significant differences in the effect sizes of other indicators by the gender of the household head.

Table 8. Summary of the treatment impacts on the SDG indicators.

SDGs	Indicators	One Treatment Group		Two Treatment Groups			Three Treatment Groups
		Homestead Gardening	SWC	Homestead Gardening + Credit	SWC + Credit	Homestead Gardening + SWC	Homestead Gardening + SWC + Credit
SDG 1	House (iron sheet)	−3.35	−1.41	3.50	4.27	−0.14	18.9 **
	Asset ownership	−0.16	0.41	0.20	0.73	0.27	2.15 ***
	Off-farm income (per hh members)	−47.7	210.6	3708.3 **	3712.6 *	−24.3	6036.4 ***
SDG 2	Household Dietary Diversity Score	−0.12	−0.71	2.08 ***	1.75 ***	−0.34	3.95 ***
	Cereal production:						
	Teff (kg/ha)	41.7	151.6	36.7	424.8 ***	−34.2	520.4 ***
	Maize (kg/ha)	204.6	355.3	817.7 *	695.4 *	271.1	567.2 *
	Millet (kg/ha)	125.7	199.4	616.5 ***	379.8 **	146.3	657.1 ***
SDG 13	Resilience capacity index	−0.05	0.01	0.06 *	0.05	0.02	0.09 **
SDG 15	Farm size covered with agroforestry (ha)	0.16 ***	0.36 ***	0.09 ***	0.17 **	0.39 ***	0.28 ***
	Farm size with physical SWC measures (ha)	0.02	1.31 ***	0.06	1.01 ***	1.26 ***	1.14 ***

Statistical significance: * $p < 0.01$, ** $p < 0.05$, *** $p < 0.001$.

The results suggest that the combination of all three treatments has stronger and more extensive impacts on multiple SDGs. Supporting the IDA, combining these three treatments creates synergies, producing more pronounced and widespread impacts than implementing each intervention separately or in two-way combinations. This integrated approach addresses both socioeconomic and environmental challenges, thereby helping to enhance progress on food security, income diversification, climate resilience, and land degradation neutrality. However, careful consideration is necessary to maximize the potential co-benefits and reduce their complexity as the implementation may present challenges. Table 8 summarizes the differential impacts of single, two-treatment, and three-treatment interventions on various SDG indicators.

To enhance the interpretation of treatment impacts, we also computed Cohen's *d* standardized effect sizes. Cohen's *d* expresses the magnitude of a treatment effect in terms of standard deviation units, thereby allowing meaningful comparison across indicators with different scales of measurement. Figure 2 summarizes the standardized effect sizes for each treatment group. Overall, the pattern of results aligns closely with the significance tests of the estimated coefficients, providing additional evidence on the relative strength and consistency of treatment effects.

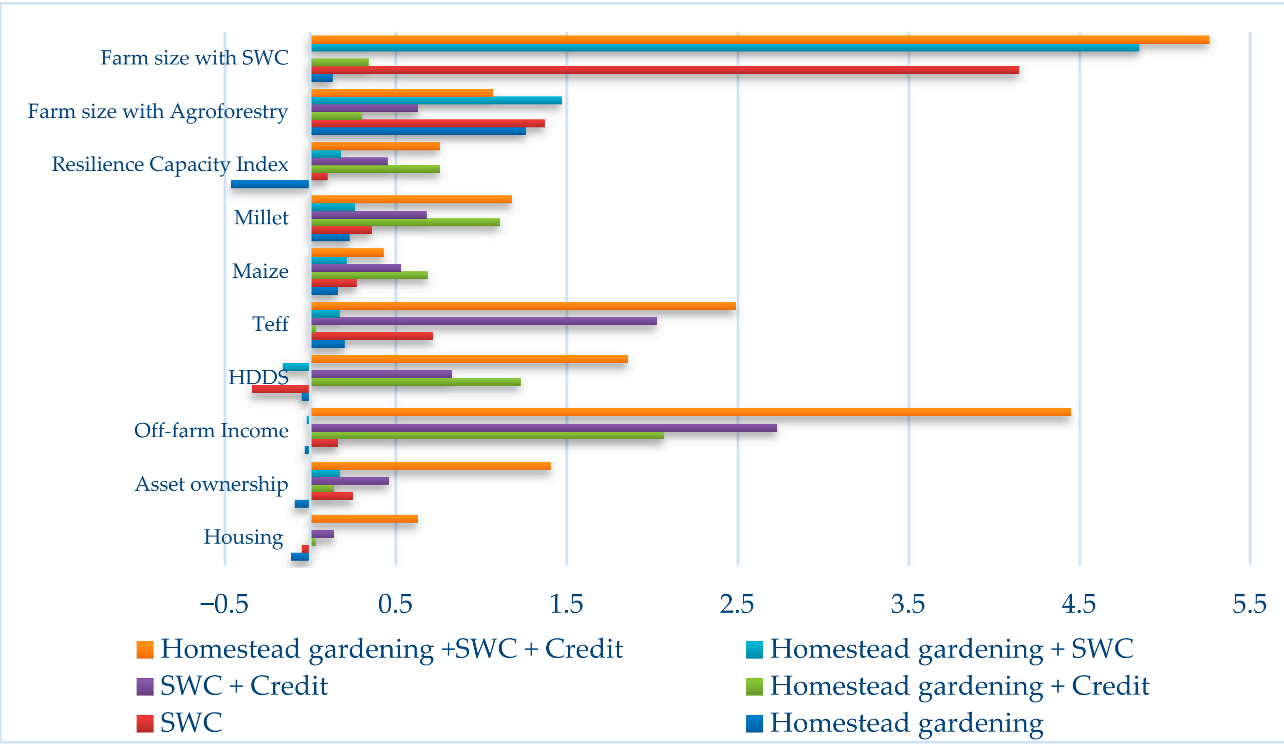

Figure 2. Summary of the Cohen's d standardized effect sizes.

Consistent with the significance tests, the Cohen's *d* effect size results indicate that siloed interventions produced relatively smaller impacts, while the integrated package generated the largest impacts. Homestead gardening alone yielded limited gains in crop yields and land use, with negative effects on dietary diversity and resilience. In contrast, SWC-only produced modest effect sizes in assets, income, and yields, alongside large impacts on SDG 15 indicators. Combining interventions increased effect sizes: homestead gardening with credit boosted its impacts on dietary diversity and income, and SWC with credit delivered very strong livelihood and environmental benefits. And combining homestead gardening with SWC enhanced agroforestry and land coverage. The tripartite intervention generated the highest effect sizes, reflecting its broader and transformative impacts on livelihoods, food security, and environmental outcomes across multiple SDGs.

4. Discussion

The study examines how combining landscape restoration efforts with complementary interventions enhances progress across multiple SDGs. The findings show that integrated interventions yield greater potential for synergistic outcomes than isolated efforts. However, success depends on how interventions are combined and implemented. This aligns with the critiques of Nilsson and Weitz [3] regarding the ineffectiveness of siloed interventions in addressing SDGs [17,29]. As poorly aligned interventions can also result in trade-offs [2,13], interventions should be strategically designed to ensure that interventions reinforce—rather than offset—one another.

The study offers a novel perspective by conceptualizing IDA as a continuum of integration rather than a simple binary between "integrated" and "non-integrated" interventions. By examining and comparing the impacts of siloed, dual, and triple-interventions, the study shows that higher levels of integration yield stronger and broader SDG impacts than lower-level integrations. These findings reinforce evidence that fragmented implementation constrains SDG progress [3,17,46,47]. Thus, the study positions IDA as one alternative pathway for achieving coherence across sectors and governance levels, which is one of the central challenges in sustainable development practice [2,3]. However, the study also cautions that excessive integration may reduce effectiveness. This suggests that development actors should strike a balance between achieving synergetic integrations and avoiding the complexity of overly integrated interventions. But the integration should remain tailored to local community-specific sustainable development challenges.

The findings highlight credit provision as a critical catalyst that propagates the impact of landscape restoration interventions across multiple SDGs. When effectively designed and contextually aligned, credit fosters synergies between SDG 15 with SDG 1, SDG 2, and SDG 13. Combining credit with biophysical landscape restoration activities allows for simultaneously addressing economic, environmental, and social challenges of a community. The implication is that integrated landscape restoration initiatives can effectively contribute to poverty reduction, food security, sustainable production, and resilience outcomes. However, their success depends on careful design, proper sequencing, and coordinated tailoring to local contexts.

By situating project-level SDG interaction assessments within a governance framework, the study extends prior work on Integrated Watershed Management (IWM). While IWM studies often emphasized biophysica-oriented integrations [48,49], this study highlights the role of institutional and governance mechanisms in enabling synergies. Conceptually, it links SDG governance with IWM by empirically demonstrating how coordination mechanisms and sectoral coherence deter or foster multi-goal outcomes. Achieving broader impacts requires IWM interventions to address the economic, social, and environmental dimensions of local community development challenges. Specifically, the provision of credit could help to promote the adoption of IWM-related technologies. These results provide a novel lens for designing effective IWM interventions and explain why such efforts succeed in some contexts but fail in others.

Our findings support the global arguments that localized implementation must acknowledge interdependencies among goals to avoid fragmented outcomes [50,51]. Bottom-up integration of interventions is aligned with SDG localization literature. It emphasizes context-specific solutions, community-based institutions for coordination, and co-production of solutions as a key enabler for synergetic integration [50,51]. Moreover, the findings show that national policy coherence is insufficient without vertically aligned resources and incentives [52]. In a nutshell, these results underscore that sustainable progress depends on locally grounded coordination mechanisms that enable alignment across sectors and levels.

This study contributes conceptually and methodologically by clarifying how governance dynamics shape the effectiveness of IDA. It shows how real-world projects operate within socio-ecological systems, where synergies emerge or fail depending on institutional coordination and governance quality. The study highlights the need for ex-ante analysis of potential synergies and trade-offs to prevent unintended outcomes. Beyond treating IDA as a continuum, methodologically, the study advances existing research by integrating governance issues with project-level SDG interaction analysis. By doing so, it offers a more comprehensive framework for assessing IDA. As such, the assessments should move beyond descriptive assessment of integration to explain whether complementarity guides the designing and sequencing of interventions [9,20].

In fragile and conflict-affected settings, our findings show that IDA offers a pathway for localized SDG progress. In such settings, advancing the systemic national-level transformation is often unrealistic [6]. As the number of conflict-affected countries continues to increase [4,5], our findings are critical to advance SDGs at the local level using IDA. Although such efforts often yield incremental gains compared to broader systemic transformations, they play vital roles in achieving SDG targets at the local community level [12]. The implication is that SDG localization should be complemented with integrated and community-driven approaches.

In terms of policy implications, the findings offer four major policy implications for strengthening SDG localization and landscape restoration governance in Ethiopia and beyond. First, observed synergies between SDG 1, SDG 2, SDG 13, and SDG 15 highlight the need to institutionalize integrated project design within national and regional planning frameworks to enhance SDG policy coherence [11,47]. Second, given the temporal or spatial variations in socio-economic and biophysical benefits, our findings suggest that landscape restoration interventions' appraisal should balance both synergies and trade-offs, especially in contexts where land restoration efforts may temporarily restrict land access or shift labor demands for vulnerable households. Third, our results highlight the need to strengthen local data systems for tracking synergies and trade-offs, which is key to enhancing coherence among actors. Finally, it also suggests that policymakers should prioritize and encourage multi-dimensional interventions. As such, interventions simultaneously addressing livelihoods, social, and environmental outcomes should be prioritized in advancing multiple SDGs. These steps would enable countries to effectively translate global sustainability commitments into localized, context-responsive development planning.

Despite its contributions, the study has limitations that provide insights for future research. First, the data were collected over a relatively short period (three years), which may be insufficient to capture long-term livelihood and economic outcomes, as such changes occur gradually. Longitudinal designs with multiple data rounds would generate new insights into the long-term impacts of the interventions as well as their interactions over the long run. Second, reliance on proxy indicators from self-reported household surveys may obscure intra-household inequalities and seasonal variations. Future studies should therefore complement proxy indicators with biophysical data, qualitative assessments, and participatory monitoring approaches to capture the full picture of restoration outcomes. Third, because participation in restoration programs was not randomized, households receiving interventions may possess pre-existing advantages, such as better access to extension services, stronger social networks, or more secure land rights, that also influence improvements in livelihoods and land conditions. These unobserved differences may bias our estimates. Thus, future studies can address this concern by applying the qualitative causal tracing method or mixed-method approaches. Addressing these limitations will enhance the understanding of how development interventions influence SDG indicators over time.

5. Conclusions

This study provides empirical evidence that integrated landscape interventions contribute to progress across multiple SDGs. It enforces the IRP [23] recommendation that identifying and leveraging cross-cutting opportunities inherent in landscape restoration interventions enables broader impacts. It underscores the importance of conducting a holistic and systematic analysis of SDG synergies and trade-offs prior to landscape restoration interventions. It also highlights the critical role of community-tailored approaches in maximizing SDG outcomes.

Beyond landscape restoration, the study illustrates how integrated development interventions can better advance multiple SDGs compared to isolated ones if they are carefully designed, sequenced, and aligned with local contexts. Synergies emerged from simultaneously addressing economic, social, and environmental dimensions, underscoring the need to draw insights from local-specific data over national uniform data. Lacking context-specific data could lead to poorly aligned interventions, creating trade-offs that undermine impacts.

The findings also highlight broader lessons for scaling integrated landscape management approaches for achieving SDGs in diverse socio-ecological contexts. The evidence demonstrates that combining land restorations with socio-economic interventions enhances synergies. However, achieving similar outcomes elsewhere may depend on multiple factors, such as institutional flexibility and sustained multi-actor commitment to co-govern multiple SDGs.

Overall, this study contributes to the growing literature on SDG interactions by demonstrating the conditions under which IDA generates synergistic outcomes. We concluded that achieving synergistic outcomes across SDGs depends strongly on coordinated implementation at the local level. Therefore, we recommend integrating these efforts into regional and national development plans to enhance coherence. We also suggest adopting local-level reporting systems to systematically track both synergies and trade-offs over longer time horizons.

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