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From Training to Self-Employment: Evidence from Youth Agricultural Programmes in Cameroon and Madagascar

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Abstract

Youth employment remains a critical issue in Sub-Saharan Africa. This study examines the impact of two large-scale governmental programmes in Cameroon and Madagascar that aim to promote self-employment in agriculture. Youth participated in vocational training and received technical support, inputs and mentoring to engage in crop, livestock or non-farming agricultural activities. We employ a quasi-experimental design to estimate the impact on the income of youth-led activities, and we address the limitations associated with such designs by carefully constructing a counterfactual. Our findings indicate that these integrated training and livelihoods programmes significantly enhance income from the targeted activities. We highlight the importance of providing regular support for participants during and after programme implementation.

JEL classification

D04, J43, O12, O55, Q12

Keywords

integrated training and livelihood programmes, youth employment, agriculture, impact evaluation, Sub-Saharan Africa

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1. Introduction

Sub-Saharan Africa (SSA) has the world's largest proportion of youth population (aged 15-24), accounting for 20% of SSA's total population (UNDESA, 2024). While the youth population is stabilising or declining globally, it is projected to grow significantly in SSA (Arslan, Tschirley, & Egger, 2021). Thus, SSA countries face a pressing challenge in integrating this growing cohort into the labour market (Ahmed, Cruz, Go, Maliszewska, & Osorio-Rodarte, 2016; Baah-Boateng, 2016).

National and international policymakers have promoted youth vocational training programmes as a response to the youth employment challenge (Bandiera, Elsayed, Smurra, & Zipfel, 2022; ILO, 2022). Traditionally, these programmes have focused on addressing the shortage of specific technical skills through short-term initiatives. Existing evidence suggests that vocational training programmes have no more than a modest impact on employment and earnings (Betcherman et al., 2007; Kluve et al., 2019; McKenzie, 2017), increasing scepticism about their effectiveness (Carranza & McKenzie, 2024). However, most of the studies have assessed traditional short-term vocational training programmes, whereas emerging evidence indicates that multi-component programmes including job search assistance, mentorship, and apprenticeship, yield more promising results (Alfonsi et al., 2020; Chakravarty, Lundberg, Nikolov, & Zenker, 2019; Das 2021; Hardy, Mbiti, Mccasland, & Salcher, 2019). Supporting this view, a recent systematic review by Agarwal and Mani (2024) offers a more optimistic perspective.

Additionally, the vocational training programmes examined in the literature predominantly target wage employment, despite the limited availability of such opportunities in SSA—particularly in rural areas—where young people are often driven toward farm and non-farm self-employment (Abay, Asnake, Ayalew, Chamberlin, & Sumberg, 2021; Bandiera

et al., 2022; Dolislager et al., 2021; Fox, Senbet, & Simbanegavi, 2016; Fox & Thomas, 2016; Yeboah & Jayne, 2018). This misalignment between vocational education and labour markets has been widely documented and is frequently cited as a key constraint to programme effectiveness (Biavaschi et al., 2012).[1]

Therefore, training programmes have recently started to support farm and non-farm self-employment activities. They also often take an integrated approach by combining skills training with entrepreneurship education, mentorship, and financial assistance, fostering a new generation of youth entrepreneurs (Carranza & McKenzie, 2024).

These initiatives also intersect with business development programmes,[2] for which the literature finds modest impacts on business revenues and income (Cho & Honorati, 2014; McKenzie & Woodruff, 2014). Yet, a recent meta-analysis finds profits and sales increases by only 5-10% on average (McKenzie, 2021).[3]

Overall, a notable gap remains in assessing the effectiveness of such integrated training programmes in SSA, particularly in fostering youth self-employment. Additionally, understanding the channels through which these programmes generate impact, as well as identifying key design and implementation factors, is crucial for improving their effectiveness (Agarwal and Mani, 2024; Kluve et al., 2019).

[1] Furthermore, evidence of their effectiveness in SSA remains particularly scarce. Most studies come from OECD and Latin American contexts (Card, Kluve, & Weber, 2010; Card, Kluve, & Weber, 2018). A systematic review of studies in low- and middle-income countries by McKenzie (2017) includes only 2 out of 8 studies from SSA. Similarly, among systematic reviews by Betcherman, Godfrey, Puerto, Rother, & Stavreska (2007) and Kluve et al. (2019), only 10% and 14% of the studies, respectively, are from SSA. Furthermore, existing SSA evidence is limited to a few countries. The SSA countries examined in McKenzie (2017) are Kenya and Malawi, while those in Kluve et al. (2019) are Malawi, Liberia (two studies), Uganda (four studies), Kenya (two studies), Ethiopia, South Africa.

[2] These programmes combine financial assistance with technical skills to improve business capacities.

[3] Early studies suffer from small sample sizes, attrition, and measurement issues (McKenzie, 2021).

To fill this gap in the literature, we measure the impact of two large-scale governmental programmes in Cameroon and Madagascar on income generated by youth-led income-generating activities. These two programmes, namely the Youth Agro-pastoral Entrepreneurship Promotion Programme (AEP-Youth – *Programme de Promotion de l'Entreprenariat Agro-pastoral des Jeunes*) in Cameroon, and the Vocational Training and Agricultural Productivity Improvement Programme (FORMAPROD – *Programme de Formation Professionnelle et d'Amélioration de la Productivité Agricole*) in Madagascar, combined vocational training, mentoring, and access to productive resources to support youth engagement in agricultural self-employment and enterprise activities. AEP-Youth reached 31,145 young people for a total cost of $73 million, whereas FORMAPROD reached 105,603 young people for a total cost of $84 million.[4] In this study, we measure the impact of the full-package intervention—comprising training, technical assistance, inputs, and regular follow-up—after 8 years of intervention in Cameroon (2015-2023) and 10 years in Madagascar (2013-2023). This study contributes to the broader debate on integrated training and livelihood programmes, by exploring how the design and implementation strategies of such programmes influence their effectiveness.

We estimate the Average Treatment Effect on Treated (ATET) on the gross income of youth-led activities and businesses using the Inverse Probability Weighted Regression Adjustment (IPWRA). The ATET is estimated using an ex-post counterfactual constructed through multiple rounds of matching, applied at both the sample design and data analysis stages.

The robustness of this approach is widely supported by prior studies (e.g. Bravo-Ureta, Higgins, & Arslan, 2020; Higgins, Arslan, & Winters, 2021; Hossain, Songsermsawas, &

[4] More detailed information about AEP-Youth and FORMAPROD is available at IFAD website (www.ifad.org).

Toguem, 2024; Kafle, Songsermsawas, & Winters, 2022; Neubauer, Songsermsawas, Kámiche-Zegarra, & Bravo-Ureta, 2022; Sibhatu, Arslan, & Zucchini, 2022; Songsermsawas, Kafle, & Winters, 2023; Songsermsawas, Mabiso, Arslan, Chiarella, & Savastano, 2023). Despite criticisms, ex-post quasi-experimental designs remain the most feasible method for evaluating large-scale public programmes. Randomised control trials are frequently impractical for large-scale public programmes, as these programmes prioritise specific targeting criteria, making random selection challenging. Moreover, the long duration of such initiatives limits ex-ante evaluation designs due to potential contamination between the programme's start and end. Finally, prior research has demonstrated that matching-based frameworks can produce results comparable to experimental designs when the programme selection process is well-known, and pre-programme data is available (Diaz & Handa 2006).

Our findings indicate that integrated training and livelihoods programmes can generate positive impacts for youth-led agricultural activities. However, consistent with McKenzie (2021) and Kluve et al. (2019), regular assistance and support for participants appear to be critical for their success. Additionally, we observe significant heterogeneity across income-generating activities and participant characteristics, suggesting that programmes should be tailored to target populations and local economic conditions, as highlighted by Bivaschi et al. (2012).

In the remainder of this study, we describe the two governmental programmes in Section 2, followed by the methodology in Section 3. In Section 4, we present the results and discuss the key drivers of programme effectiveness. In Section 5, we conclude the study and highlight its policy implications.

2. Context: integrated training and livelihoods programmes for youth

2.1 Cameroon: Youth Agro-Pastoral Entrepreneurship Promotion Programme (AEP-Youth)

Cameroon is a low-middle income country, with 23% of the population living below the international poverty line (World Bank, 2024). Of the 28 million inhabitants, 42% were under the age of 15 in 2023 (World Bank, 2024), highlighting a considerable number of young people expected to enter the labour market in the coming years. The agricultural sector employs 42% of the workforce (World Bank, 2024) but remains characterized by low productivity, making it less attractive to young people, who often migrate to cities for low-paying informal jobs (Fregene & Kahasha, 2023). Improving youth employment requires addressing multiple challenges, including high unemployment and underemployment, limited access to higher education, and a lack of opportunities for skills development (Housseini & Boudarbat, 2023).

Cameroon has actively sought to address these challenges, through national youth policies[5] that prioritize job creation, youth entrepreneurship, and vocational training programmes to meet labour market needs. Vocational education has evolved within the broader context of the country's post-colonial development, influenced by the British and French colonial legacy. Since independence, it has been recognized as an important component of national development and has gradually gained prominence in policy strategies aimed at addressing unemployment and enhancing workforce productivity. Over the past decades, a series of reforms have started to align vocational education with economic and labour market needs (Ebot Ashu, 2020).

In this context, the Ministry of Agriculture and Rural Development implemented AEP-Youth in partnership with the International Fund for Agricultural Development (IFAD). AEP-

[5] The main reference document for national youth policies is the "Politique National de la Jeunesse" in 2006.

Youth was conducted between 2015 and 2023 across 4 regions—Central, Littoral, North-West, and South[6]—with the goal of improving the living conditions and income of young people by promoting agro-pastoral production. This initiative targeted 16 agricultural production zones (*bassins de production*), each focused on various crop and livestock activities (see Table A1 in Annex). The initiative concentrated on areas with the greatest potential for agro-pastoral production of specific commodities, leveraging optimal agroecological conditions and a supportive environment that fosters economic development. Eligible participants were male and female individuals aged 18 to 35, regardless of their educational background and whether they were already involved in agricultural activities.

AEP-Youth supported these young people in establishing and managing agro-pastoral businesses while also promoting an organisational and institutional framework to foster the growth of youth self-employment and entrepreneurship. The programme was publicised through extensive sensitization and outreach efforts throughout its lifecycle, reaching a broad audience across the targeted areas. By the end of the programme, 31,145 individuals took part in at least one activity, whereas approximately 4,500 of them completed the programme's comprehensive support package.

Each year, a cohort of young people joined the programme and received this full-package intervention involving a structured business incubation process, training and capacity building in technical and entrepreneurial skills, business management, and financial literacy. As part of this process, participants received continuous advice and mentoring to refine their business ideas, develop projects, and create business plans, both during and after the incubation period. Activities were implemented through dedicated incubation centres, which also received substantial support as part of the programme's strategy to strengthen the organisational and

[6] Intervention areas are shown in Figure A1 in the Annex.

institutional framework. Additionally, the programme facilitated business financing through partial grants and a dedicated credit access mechanism: a refinancing fund and guarantee facility established at the Société Générale de Cameroun, operating through eight rural financial institutions and eleven microfinance partners, through which approximately 44% of supported enterprises accessed productive credits.

A total of 15 incubation centres, both public and private, were involved. AEP-Youth's support included strengthening the skills of personnel, improving buildings and equipment, developing pedagogical tools, enhancing management practices, and fostering networks and partnerships. These activities have been crucial in ensuring that the incubation centres could effectively coach young people and sustain their operations beyond programme participation.

2.2 Madagascar: Vocational Training and Agricultural Productivity Improvement Programme (FORMAPROD)

Madagascar is a low-income country with 80.7% of its population living below the international poverty line, making it one of the poorest countries in the world. Madagascar has an extremely young population, with 39% of its 30 million people under the age of 15 (World Bank, 2024), suggesting a significant increase of young people entering the labour market in the coming years. While 70% of employed people are in agriculture (World Bank, 2024), agricultural productivity is stagnating and remains at a low level (Pauw, Randriamamonjy, Thurlow, Diao, & Ellis, 2023). Traditional farming practices dominate the sector, and many young people have limited access to education in agriculture due to limited training infrastructure.

For many years, agricultural training in Madagascar suffered from insufficient funding and an inadequate supply relative to demand (Camilleri, 2024). In the 1960s, agricultural vocational training focused on long-term, diploma-based education aimed at supporting the

state-led agricultural sector. Structural reforms in the 1980s led to the sector's privatization and an increased role for non-state actors in training and service delivery. However, their effectiveness was limited by dependence on external funding, limited geographic reach, and weak institutional foundations. During the early 2000s, the system remained constrained in both capacity and diversity, unable to adequately meet farmers' needs. By 2010, political commitment to agricultural training was renewed with the launch of the National Agricultural and Rural Training Strategy (SNFAR – *Système National de Formation Agricole et Rurale*).

The SNFAR aims to establish a comprehensive framework to enhance agricultural and rural training across the country. It focuses on developing the technical skills of agricultural technicians, promoting capacity building and vocational training tailored for farmers and rural populations, supporting both public and private agricultural training centres, and fostering collaboration among various stakeholders to achieve long-term agricultural modernization and food security.

Within this context, FORMAPROD has been developed as one of the first initiatives supporting the national strategy. FORMAPROD was implemented by the Ministry of Agriculture, Livestock and Fisheries in partnership with IFAD. This programme was conducted between 2013 and 2023 in 14 of the 23 regions of Madagascar (see Figure A2 in Annex), with the goal of increasing the income and agricultural productivity of rural youths through agricultural training. FORMAPROD used local management units to facilitate decentralized program administration and built upon existing training structures while introducing an innovative apprenticeship-based approach. This programme has contributed to the development of the legislative and strategic framework of the SNFAR, and it has operationalized the regional system of rural and agricultural training (FAR – *Formation*

Agricole et Rurale) by equipping 155 training centres and building or rehabilitating 64 of them. A total of 105,630 young people in 292 municipalities were trained through FORMAPROD.

FORMAPROD targeted young individuals aged 14-29 who were out of school and without formal employment. To effectively implement this initiative, FORMAPROD established the Regional Councils for Agricultural and Rural Training (CRFAR – *Conseils Régionaux pour la Formation Agricole et Rurale*), which operate at the regional and municipal levels. The CRFARs were responsible for informing young people in their municipalities about existing training opportunities, assessing their needs, and facilitating access to the programme. To raise awareness of the initiative, CRFARs organised general assemblies at both municipal and local levels, which were complemented by a comprehensive communication campaign. This campaign included posters and spots on rural radio stations to reach a wider audience in the community. Eligible youths approached the CRFARs, where counsellors conducted skill assessments to help everyone select the most appropriate training topic and format.

Training activities included various modalities, such as apprenticeship, short courses, delocalised training, and initial vocational training (a detailed description is provided in Table A2 in Annex). While participants may have received one or more training modalities, the selection criteria were the same, and the objective remained to provide young people with the skills to implement agricultural income-generating activities. Training was provided primarily in livestock (48% of trainees) and crop farming (42%), with smaller shares in fishing and aquaculture (4%) and other activities such as handicrafts and technical trades (6%). Within livestock, local chicken rearing and pig farming were the most common sub-sectors, while vegetable gardening, rice cultivation, and legume and nut production dominated the crop farming category. Training was complemented by the provision of toolkits and start-up kits of basic materials required to begin the trained activity, received by 63% and 41% of sampled

youth respectively. Upon completion of their training, participants received regular support and guidance from the programme's mentors for up to six months, and they were put in contact with local extension services. FORMAPROD also supported participants in developing and implementing self-defined business plans. This assistance included follow-up technical assistance, additional training on marketing, group organisation, and cross-cutting themes, as well as facilitating access to markets and finance. These comprehensive measures aimed to ensure that participants were well-prepared to establish and sustain successful agricultural income generation.

3. Methodological framework

3.1 Data and outcome variable

We use quantitative and qualitative data collected as part of the IFAD impact evaluation agenda. The quantitative surveys in Cameroon and Madagascar followed a similar questionnaire structure, adapted to the programme and local context. The quantitative survey includes both household and community questionnaires, administered through Computer-Assisted Personal Interviews. The household questionnaire collects data on household demographics, farming and non-farming activities (including production and sales), wage employment, asset ownership, dwelling characteristics, shock exposure, nutrition and food security, social capital, and access to finance. Surveys gathered both household-level and youth-specific information. Identified youths, along with the household head—when distinct, were the respondents. The community questionnaire covers a range of topics to capture the availability of infrastructure and services, and the main challenges experienced by communities. Additionally, we combine household survey data with earth-observation data using the geo-referenced location of each household. We use several indicators to describe

climate patterns, economic background, market access and agroecological production potential. A detailed description of variables is reported in Section B of the Annex.

The data collection in Cameroon was conducted between November and December 2023 in the four regions where AEP-Youth was implemented, while that in Madagascar took place in July and August 2023 across the 14 regions of FORMAPROD. In both surveys, the intended sample size was calculated using statistical power calculation accounting also for potential outliers and the cleaning process. The final sample size after data cleaning consists of 2,073 households (1,058 treated and 1,015 control households) in Cameroon, and 1,704 households (788 treated and 916 control households) in Madagascar.

Quantitative surveys are complemented by qualitative inquiries, consisting of Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). KIIs were conducted with key programme staff and stakeholders, whereas FGDs involved programme participants and control households. Qualitative data help to understand the local context and dynamics, as well as programme implementation aspects.

The outcome variable is the gross income (sales revenues and value of home consumption) from the youth-led income-generating activities and businesses. To ensure comparability between the two programmes, the local currency values are converted to 2023 real international dollars, and values are reported as hundreds of dollars. For each programme, only the targeted income sources are considered. In AEP-Youth, these are farming, including crop, livestock, and fisheries (such as aquaculture)[7], as well as non-farming activities linked with agricultural activities. In FORMAPROD, income-generating activities are exclusively derived from farming activities, specifically crop, livestock and fisheries (including

[7] Given the limited number of young people engaged in fish-related activities, primarily aquaculture, we have grouped this income source under livestock. Analysing it separately would be difficult due its small representation.

aquaculture)[8]. We also assess the probability of youth engaging in one of the targeted income-generating activities. This variable assumes the value of 1 if a youth engages in crop, livestock or non-farm activities, and 0 otherwise.

3.2 Sample design and counterfactual construction

We have employed a quasi-experimental ex-post design, which involves constructing an ex-post counterfactual group to represent what would have happened to the treated youths in the absence of the programme. We have established this counterfactual in two stages: first, during the sample design, and second, during data analysis. At sampling, we used secondary and project monitoring data to ensure that untreated survey respondents met the programme's selection criteria. This means that both treated and untreated youths live in similar economic and environmental contexts and would have been eligible for programme participation. Once the survey was conducted on this sample, we used the collected data to match treated and untreated youths during data analysis. In this process, we replicated the targeting strategy used by the programme implementers to identify comparable control youths. To improve comparability, we control for factors that might influence the likelihood of investing in farm and non-farm activities or performance. Additionally, since we can only control for observable characteristics, we have included proxy variables that capture unobservable traits. For instance, household wealth and agro-climatic conditions serve as proxies for the willingness to invest in an income-generating activity. Overall, we match treated and untreated youths based on individual youth characteristics, household socio-demographics and wealth, agro-climatic conditions, and remoteness. To ensure that these control factors are not influenced by treatment status or outcomes, we have only included variables that are either time-invariant or refer to the pre-programme period.

[8] For fish-related activities, we have adopted the same approach as in AEP-Youth for similar reasons.

With this counterfactual construction, we ensure that treated and control youths share the same socio-demographic and economic characteristics before the programme and operate within the same socio-economic and environmental settings. Consequently, non-participant youths would have had the same probability of being selected by the programme. The main argument is that non-participants are solely excluded due to bureaucratic discretion during the programmes' design and implementation phases which is unrelated to the outcome of interest and randomly affects who gets chosen and who does not, making the non-participants a robust counterfactual of the participants (Delius & Sterck, 2024). This is the case when for example the timing of the application plays a role in the selection, as not everyone can access the programme because of resource exhaustion (Gibson & McKenzie, 2014). Although two individuals may be equally qualified, one might be included in the programme while the other is excluded purely due to timing. Similarly, at the design stage, the targeted areas of such large-scale governmental programmes are defined based on national priorities, and someone gets excluded from the programme only because of administrative location. Yet, programme designers usually do not have full information,[9] which may lead to exclude some areas that are later found to be comparable using ex-post-secondary data, like earth-observation data.

The matching process employs Propensity Score Matching (PSM) (Rosenbaum & Rubin, 1983), using k-nearest neighbours (k-NN) matching with a caliper distance as the matching algorithm. Details on the procedure are provided in Section C of the Annex. In the following, we describe the counterfactual construction separately for the two programmes.

3.2.1 Cameroon – AEP-Youth

AEP-Youth was implemented in 16 production zones over 4 regions. Since these areas are unique in their agroecological and economic characteristics, only people living in these

[9] For instance, programmes are designed many years before they are implemented.

production zones were considered eligible for the counterfactual. Within these zones, the programme did not select treated and untreated areas (nor villages or communities), but all young people living in these zones were potentially eligible for the programme.

Identifying the youth population in the production zones was not possible due to the absence of a comprehensive census of individuals aged 18-35. Reconstructing such data would have been operationally impracticable, further complicated by the misalignment between administrative units and production zones. To address these limitations, we relied on the list of programme applicants, which includes both participants and non-participants for each cohort year. Although all applicants were eligible for the programme, not everyone participated due to the high demand and limited financial resources. Thus, non-participants were only excluded due to the timing of the application. All young people considered treated in this list participated in training, technical assistance, and regular follow-up. As mentioned earlier, we only consider as treated population those individuals who participated in the incubator process, meaning they have received the full-package intervention.

Using the youth individuals in the programme list, we performed bootstrap sampling, creating 100 different random samples. Each sample consists of 2,000 untreated and 1,300 treated youths. For each bootstrap sample, we ensured a proportional representation of the target population. We then performed PSM for each bootstrap sample to assess the preliminary balance between treated and untreated youths on key characteristics like age, gender, educational level, affiliation with the production zone and the target investment sector. The sample that most effectively minimised bias was finally selected. The household survey was administered to this selected youth sample by targeting the household to which the youth belonged.

To control for potential spillover effects—since untreated individuals could be related to treated youth within the same age group and may have applied to the programme—we removed untreated youths who were exposed[10] to treated youths before and during the programme.

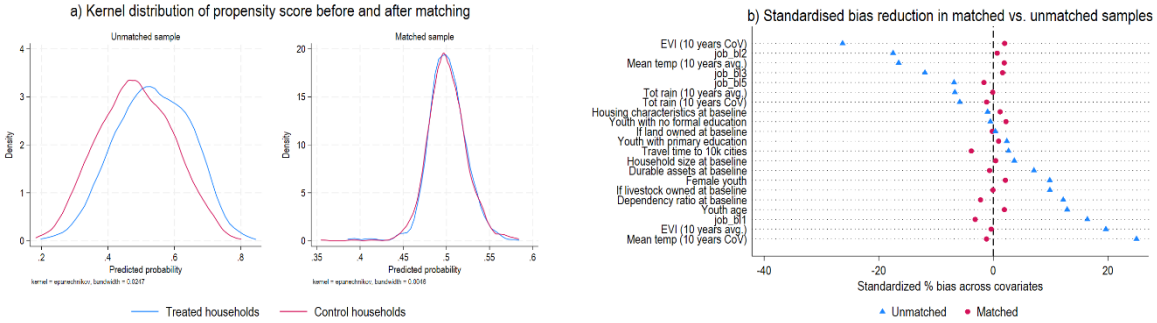
After conducting the household survey, we used PSM to match treated and untreated youths based on characteristics expected to have influenced selection into the programme, the likelihood to invest in income-generating or business activities and performance. The variables used in the matching process include youth characteristics (age, gender, educational level, and activity before programme participation) and household socio-demographic characteristics (household size and dependency ratio). We also included household wealth indicators like land and livestock ownership, ownership of durable assets, and housing characteristics. All these variables refer to the pre-programme period, for which information was collected in the household survey. Moreover, we incorporated earth-observation data, including long-term rainfall and temperature patterns, enhanced vegetation index and travel time to cities with a population of 5,000-10,000 inhabitants. The full description of these variables is reported in Section B of the Annex.

Figure 1 illustrates the matching results at the household level. The initial bias in the likelihood of participating in the programme between treated and control groups (left graph in panel a) is reduced after matching (right graph in panel a). In the matched sample, the propensity score distribution of treated and control groups exhibit considerable overlap, which is confirmed by the Kolmogorov-Smirnov test (Table C3 in Annex). The matching validity is further supported by the results of joint hypothesis testing (Table C1 in Annex). These results indicate that the treated and control groups had an equal probability of participating in the

[10] This refers to any type of personal relationship such as friendship, relatives, and professional connection.

programme. The standardised bias reduction graph (panel b) also shows a substantial reduction in bias across all variables, which is confirmed by t-tests (Table C5 and C7 in Annex). Therefore, any remaining differences between the two groups are not statistically significant. As a result of the matching process, 47 untreated and 3 treated households are removed.

Figure 1. Matching results at household level in the AEP-Youth counterfactual



Note. Panel a) shows the distribution of the propensity scores before and after matching. PSM is implemented using 5-nearest neighbours, which achieves the optimal balance between bias and variance, and a caliper set up 0.2 times the standard deviation of the logit-transformed propensity scores. Panel b) presents the standardised bias reduction for matching variables from the unmatched to matched sample.

3.2.2 Madagascar – FORMAPROD

The sample design for FORMAPROD follows a multi-stage sampling strategy using two rounds of PSM. Firstly, the sample was limited to the 14 regions where FORMAPROD was implemented, pairing each treated municipality with an untreated counterpart. Municipalities were matched based on programme and earth-observation data. The variables covered a range of aspects such as remoteness, climate, geography, population, economic and other benefits aiming at capturing FORMAPROD's selection criteria, and characteristics that may have affected the participation in farming activities. The full list of variables is described in Section B of the Annex. To maintain regional representation, an equal number of treated municipalities was selected per region, and villages were randomly selected within these municipalities. This first matching round ensured that treated and untreated youths selected for the survey lived in the same socio-economic context.

Within each control village, a full listing of households[11] was conducted to identify those with eligible youths according to FORMAPROD's eligibility criteria. A household was considered eligible for the survey if one of its members was between 17-38 years at the time of listing, had completed their highest level of education before 2019, had not held a stable job in the past 10 years, and had not lived in a treated municipality during the programme implementation. The final sample of untreated households was randomly drawn from this pool, ensuring an equal number from each village. Treated households were randomly selected from FORMAPROD participants trained before early 2020.[12]

A second round of matching was conducted at the household level after the data collection using household survey data and earth-observation data. This matching ensured that treated and control youths had the same characteristics in youth demographics (age, gender, education, marital status and activity before programme participation), household demographics (size and dependency ratio), household wealth (land size and dwelling), climate (rainfall and temperature), agroecology and village facilities (primary school and health centre). Education, marital status, activity, household demographics and wealth were derived from household survey data based on ten-year retrospective recall, as were village facilities, which were reported by community respondents over the same recall period. While wealth measures are more susceptible to differential recall error[13], results are robust to excluding these

[11] To limit survey costs and duration, the listing was restricted to one village district in villages with more than 200 households, randomly selected out of the districts of this village.

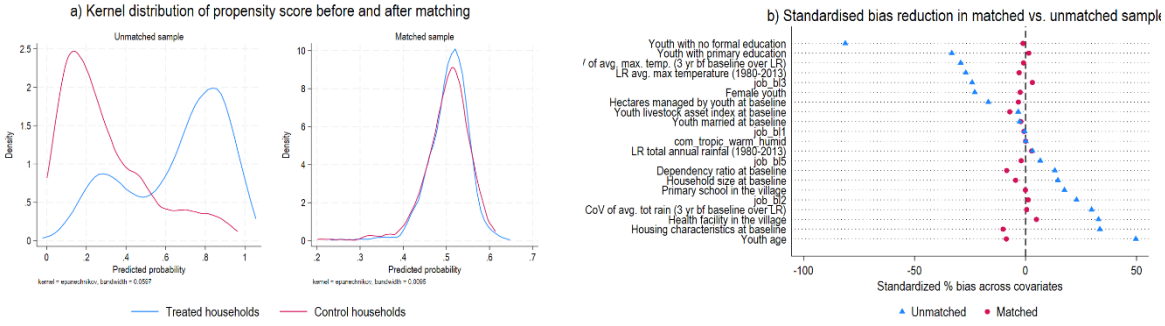
[12] Participants who joined the programme before 2020 were more likely to have fully realised the expected outcomes, and restricting the sample to these individuals helped mitigate the potential effects of COVID-19 on the programme's impact.

[13] Not all recall variables are equally problematic. Categorical variables such as educational attainment, marital status, and pre-programme activity relate to discrete life events that are unlikely to be forgotten even after ten years. Wealth measures such as livestock holdings, land area, and housing quality are more susceptible to recall error, as respondents may unconsciously anchor their recollections to current rather than past circumstances. This risk is greater if wealth trajectories differed between treatment and control groups over the programme period, which could introduce differential measurement error in the matching variables.

variables from the matching specification (similar magnitude and significance levels). The full description of these variables is reported in Section B of the Annex.

Figure 2 shows the matching results at the household level. The propensity score distribution between treated and control groups differs in the unmatched sample (left graph in panel a) but overlaps in the matched sample (right graph in panel a). This overlap is confirmed by the Kolmogorov-Smirnov test (Table C4 in Annex), while the joint hypothesis test further supports the robustness of the matching results (Table C2 in Annex), suggesting that the treated and control groups were equally likely to participate in the programme. The standardised bias reduction graph (panel b)) shows substantial improvements across all variables, and the bias reduction is corroborated by the results of t-tests (Table C6 and C8 in Annex). Consistent with the AEP-Youth counterfactual, these results confirm the balance achieved between the treated and control groups post-matching. As a result, 305 untreated and 38 treated households were removed.

Figure 2. Matching results at household level in the FORMAPROD counterfactual



Note. Panel a) presents the improvement in the propensity score distribution after matching. PSM is implemented using 5-nearest neighbours, which achieves the optimal balance between bias and variance, and a caliper set up 0.2 times the standard deviation of the logit-transformed propensity scores. Panel b) presents the standardised bias reduction for matching variables from the unmatched to matched sample.

3.3 Impact estimation

The potential outcome framework is the cornerstone of estimating the impact of a programme (Imbens & Wooldridge, 2009). The treatment effect T for an individual i can be written as:

$$T_i = Y_{i1} - Y_{i0} \quad (1)$$

Where Y_{i1} is the outcome for a treated individual and Y_{i0} if untreated. This framework compares the outcomes that would have occurred with and without the programme. We estimate the impact using the ATET[14], which is defined as:

$$ATET = E(Y_1 - Y_0|T = 1) \quad (2)$$

Where E is the expectation operator, Y_1 is the outcome of the treated individual, and Y_0 is the outcome if the treated individual had not been treated. To estimate the ATET, we use the IPWRA, a doubly robust estimator (Wooldridge, 2007). It is particularly valuable as it provides consistent estimates if either the model for the treatment assignment or the model for the outcome is correctly specified (Imbens and Wooldridge, 2009).

The IPWRA employs the inverse-probability weights (IPW) derived from the predicted probability of receiving treatment. This addresses the issue of missing data due to observing each household in only one potential outcome state (Hirano, Imbens, & Ridder, 2003). The predicted probability of treatment is estimated using the maximum likelihood of the probit model:

$$\hat{p}(X) \equiv \Pr(t = 1|X) = E(t|X) \quad (3)$$

Where $\hat{p}(X)$ is the estimated propensity score, t is the treatment indicator, X is a matrix of observable characteristics, which are not affected by the treatment, ensuring potential outcomes are independent of treatment assignment. Variables in matrix X are the same as used in the counterfactual construction at the household level. The IPW is computed as follows:

[14] We estimate the ATET because it measures the impact on those for whom the programme is intended, while the average treatment effect measures the difference of the expected outcomes between participants and non-participants, so it includes the effect on individuals for whom the programme was never intended.

$$\omega(t,x) = t + (1-t)\frac{\hat{p}(X)}{1-\hat{p}(X)} \quad (4)$$

These weights help balance the treatment and control groups, ensuring their comparability. Using the computed IPW, a weighted regression model is applied to estimate the predicted outcome for both the treatment and control groups. The regression model is specified as:

$$y_i = \alpha + \beta t_i + \gamma X_i + \delta(X_i - E[X_i|t_i = 1)t_i + \varepsilon_i \quad (5)$$

Where y_i is the outcome for household i, t_i is the treatment status for household i, X_i is the matrix of control variables, γ and δ are vectors of coefficients to be estimated, β is the coefficient of the treatment indicator, α is the constant and ε_i is the error term. The control variables in X_i include youth characteristics, household characteristics and geospatial variables. Details on these variables are presented in Section B of the Annex and summary statistics are presented in Tables D1 and D2 in the Annex. These variables were selected because they affect the outcome variable but are not influenced by the programme, helping to mitigate potential confounding. To avoid inconsistent standard errors that might arise from a two-step procedure–estimating selection and outcome equations separately–the IPWRA is implemented using the Generalised Method of Moments (GMM).[15]

Finally, to test the robustness of IPWRA results to the specification of selection and outcome equations, we also estimate the ATET using Regression Adjustment (RA) and Inverse Probability Weighting (IPW) models. Furthermore, we re-estimate the IPWRA model using only observations with positive outcome values to ensure results are not affected by cases with zero gross income. Results are reported in Table F1 and F2 in the Annex.

[15] When the selection and outcome equations are estimated in two separate steps, the estimate of the outcome equation in the second step ignores the estimation error in the first step of the selection equation.

4. Results and discussion

4.1 Descriptive statistics of the youth sample

Table 1 and Figure 3 present the key characteristics of the sample. In both programmes, youth participants are predominantly male, with an average age of 33 years in AEP-Youth and 26 years in FORMAPROD, which is consistent with the programme selection criteria. Most participants are household heads by the end of the programme, with a significant difference between treated and control groups in FORMAPROD.[16] This highlights that programme participation may have influenced young people in establishing their households.[17]

Educational levels also reflect programme selection criteria, particularly for FORMAPROD, which targeted out-of-school and unemployed young people. Only 1% of AEP-Youth participants lack formal education, compared to 32% in FORMAPROD. However, a considerable share of participants in both programmes have at least secondary education (84% in AEP-Youth and 61% in FORMAPROD), indicating the attractiveness of such initiatives among educated youths.

Regarding the employment status before participation, in AEP-Youth, 65% of participants were engaged in farm activities, followed by non-farm activities (14%) and schooling (13%). In FORMAPROD, 43% were in farm activities, 31% were students, and 21% were unemployed, consistent with the programme focus on unemployed youths. In FORMAPROD, a statistically significant difference exists between treated and control groups

[16] In the matching procedure, we excluded household headship as a matching variable because it may have been influenced by programme participation. Since the treated and control groups in FORMAPROD are statistically different in terms of household headship, we used marital status before participation in the FORMAPROD matching procedure. This ensures that any differences in household headship at the end of the programme are not due to pre-programme differences. Given that there is no statistical difference between treated and control groups in AEP-Youth, such variable is excluded.

[17] Among treated youth, 38% got married between pre- and post-FORMAPROD periods, compared to 27% of the control group. This difference is statistically significant, with the treated group being 31 percentage points more likely to get married between the two periods. For this reason, we included in the matching procedure if youths were married before the programme.

in participating in non-farm activities; however, this is negligible as it involves only 5 treated and 8 control youths.

Household composition reflects socio-demographic changes induced by the programmes. In AEP-Youth, the average household size of the treated group increased from 3.3 to 4.4 members, with the dependency ratio rising from 0.6 to 0.8. This change significantly differs from the control group, suggesting that programme participation contributed to an increase in household size, particularly the dependent members. In contrast, FORMAPROD participants experienced a decline in household size from 5.6 to 3.9 members and a decrease in the dependency ratio from 1.5 to 0.7. Consistent with the observed changes in headship, this trend suggests that many young people established new households.

Housing conditions follow a similar pattern. Treated youths in AEP-Youth lived in relatively well-off environments, with an average normalized index score of 0.6 (on a scale from 0 to 1), showing no notable change before and after the programme. In FORMAPROD, the housing conditions of treated youths were initially poorer but improved significantly after the programme, increasing from 0.18 to 0.36.

Youth self-employment is widespread in both treated and control groups, underscoring the economic dynamism of young people. In AEP-Youth, 88% of participants engage in one of the income-generating activities considered here (79% in the control group). Similarly, 94% of treated youths in FORMAPROD do so (92% in the control group). In terms of gross income, treated youths in AEP-Youth show an average of $8,848 more annually than their control group counterparts, while the difference is only $453 in FORMAPROD. Overall, youth-led income-generating activities significantly contribute to household income, accounting for 60% of total household income in AEP-Youth and 56% in FORMAPROD.

Gross income varies across income-generating activities. In AEP-Youth, livestock and non-farm activities generate the highest average gross incomes, contributing 43% and 39% of total gross income, respectively. Moreover, 54% of treated youths engage in livestock-related activities, while 49% conduct non-farm activities. In FORMAPROD, crop-related activities yield the highest average gross income but account for only 18% of total gross income, compared to 43% from livestock. Notably, 54% of treated youths in FORMAPROD operate livestock activities, while only 32% engage in crop-related activities.

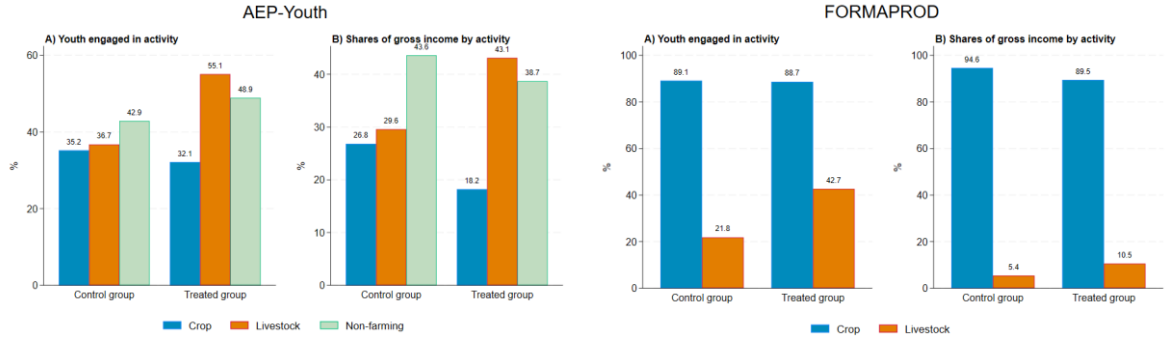
Table 1. Descriptive statistics of youth in the two programmes

	AEP-Youth			FORMAPROD		
	Treated (T)	Control (C)	T-C	Treated (T)	Control (C)	T-C
Youth characteristics						
If the youth is female (=1)	0.45	0.44	0.01	0.45	0.46	-0.01
Youth age	32.50	32.41	0.09	26.20	26.64	-0.44
If the youth is the household head (=1)	0.60	0.60	-0.01	0.53	0.39	0.13***
Youth educational level:[(a)]						
No formal education (=1)	0.01	0.01	0.00	0.32	0.33	-0.01
Primary education (=1)	0.15	0.15	0.00	0.06	0.06	0.00
Secondary and above education (=1)	0.84	0.84	-0.01	0.61	0.61	0.00
Youth activity before the programme						
Farm activities (=1)	0.65	0.66	-0.02	0.43	0.43	-0.00
Student (=1)	0.13	0.12	0.00	0.31	0.31	0.01
Unemployed (=1)	0.03	0.03	0.00	0.21	0.19	0.01
Non-farm activities (=1)	0.14	0.13	0.01	0.01	0.02	-0.01*
Wage employed (=1)	0.05	0.05	-0.00	0.05	0.05	-0.00
Youth household background						
Total number of household members at baseline	3.33	3.32	0.01	5.65	5.76	-0.11
Total number of household members at endline	4.43	4.27	0.16*	3.91	4.74	-0.83***
Dependency ratio at baseline	0.57	0.58	-0.02	1.48	1.57	-0.09
Dependency ratio at endline	0.78	0.70	0.08**	0.72	0.90	-0.19***
MCA index of housing characteristics at baseline (normalised 0 to 1)	0.65	0.65	0.00	0.18	0.20	-0.01
MCA index of housing characteristics at endline (normalised 0 to 1)	0.62	0.61	0.01	0.36	0.34	0.02**
Youth entrepreneurship						
Youth in income-generating activity (%)	0.88	0.79	0.09***	0.94	0.92	0.02
Youth gross income (in hundreds of international dollars, 2023 values)	211.83	123.35	88.48***	18.78	14.26	4.52***
From crop activities	21.79	14.87	6.92***	17.76	13.76	4.00***
From livestock activities	93.96	36.92	57.04***	1.01	0.49	0.52***
From non-farming activities	96.08	71.56	24.52**			

Note. Values are based on the matched sample and are sample means weighted using the analytical weights generated by PSM. Asterisks indicate the level of statistical significance of the t-test/chi-squared test of difference in means: *** < 0.01; ** < 0.05; * < 0.10. Number of observations is 2,023 for AEP-Youth (1,055 treated and 968 control group) and 1,361 for FORMAPROD (750 treated and 611 control group). The notation (a) indicates that education

levels for AEP-Youth refer to the current situation while referring to the baseline situation for FORMAPROD.

Figure 3. Youth-led income generation by type of activity



Note. Values are sample means weighted using the analytical weights generated by PSM.

4.2 Impact estimates

Table 2 shows the ATET of the two programmes. The full regression results as well as robustness checks are presented in the Annex (Table E1/E2/F1/F2, respectively).[18] Both programmes had a positive impact on the gross income of youth-led income-generating activities and the probability of engaging in such activities, with AEP-Youth demonstrating a larger effect compared to FORMAPROD. AEP-Youth participants have experienced an increase in annual gross income of $8,438 compared to a potential outcome mean (POM) of $12,745. FORMAPROD participants have seen an annual income increase of $530 compared to a POM of $1,347. In percentage terms, these impacts correspond to a 66% increase for AEP-Youth participants and a 39% increase for FORMAPROD participants. Furthermore, AEP-Youth participants have had an increase of 8 percentage points to engage in a farming or non-farming activity, while FORMAPROD has had no such impact. However, in both programmes, the POM is already high (80% and 91% in AEP-Youth and FORMAPROD, respectively), which may explain why the impact is overall limited.

Table 2. Average Treatment Effect on Treated (ATET) of the two programmes

[18] Robustness checks confirm that IPWRA estimates are not affected by the specification of selection and outcome equations, as well as by observations with zero gross income.

	Gross income of youth-led activities, in hundreds of international dollars (2023 values)		Probability of youth engaging in income-generating activity	
	AEP-Youth	FORMAPROD	AEP-Youth	FORMAPROD
ATET	84.35***	5.33***	0.08***	0.03
	(13.79)	(1.85)	(0.02)	(0.02)
POM	127.47***	13.45***	0.80***	0.91***
	(13.31)	(1.40)	(0.02)	(0.02)

Note. ATET is estimated using IPWRA, including covariates in the selection and outcome equations. Columns 1 and 2 show the impact on the gross income (expressed in hundreds of international dollars, 2023 values) of the youth-led farming or non-farming activities. Columns 3 and 4 present the impact on the probability that a youth engages in one of these activities. POM indicates the potential outcome mean, which is the value of the treated population had they not participated in the programme. Number of observations is 2,023 for AEP-Youth (1,055 treated and 968 control group) and 1,361 for FORMAPROD (750 treated and 611 control group). Standard errors are clustered at the sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

The programmes drove meaningful change in both agricultural practices and livelihood strategies. In Madagascar, this materialized through four main pathways. First, the combination of vocational training and a starter kit of basic materials enabled beneficiaries to access livelihood activities they had not previously engaged in. Qualitative interviews indicate that youth showed particular interest in short-cycle activities such as market gardening and small-scale livestock rearing, which offered faster returns in contexts where land access and formal education remained significant constraints. Second, the programme led to measurable shifts in productive practices: quantitative results show increased adoption of improved seeds, organic inputs, ploughing, drought-resistant crop varieties, and irrigation, with qualitative evidence further documenting the uptake of row planting, composting, improved animal husbandry, and enhanced storage techniques. Third, the additional income generated was frequently channelled into complementary livelihood activities rather than reinvested in the trained sector alone (livestock revenues, for instance, were commonly redirected toward crop farming) and a broader pattern of diversification emerged, with many youths combining multiple agricultural

pursuits or moving into small commerce. Fourth, and relatedly, the programme appears to have reshaped labour arrangements: qualitative interviews report that some beneficiaries transitioned from employed to self-employed status, while others hired temporary workers as their productive activities expanded.

In Cameroon, the following impact pathways can be identified. The business incubation process, combining technical training, continuous mentoring, and facilitated access to finance, provided young people with the knowledge, business planning skills, and capital that had previously kept them out of more profitable agropastoral sectors. This enabled a substantial share of participants to start new activities, most notably livestock rearing, where programme participants increased their involvement by 17.8 percentage points between baseline and endline, compared to only 3.6 percentage points in the control group. Engagement in these new activities, supported by ongoing mentoring from incubation centres, in turn, drove shifts in productive and business practices: treated youths were significantly more likely to engage in the commercialization and transformation of agricultural products (52.8% vs. 39.8% in the control group) and in livestock product processing (70.3% vs. 55.9%), pointing to the progressive adoption of more advanced, value-adding approaches to production and marketing. The expansion of these activities then translated into asset accumulation, with participants showing 30.2% higher productive asset ownership than controls, reinforcing the productive capacity of their enterprises. Finally, as businesses grew in scale and complexity, they began generating employment beyond the direct beneficiaries: supported enterprises were significantly more likely to hire paid workers, and their wage expenditures were considerably higher than those of non-participants.

These findings are consistent with recent studies (e.g. Unnikrishnan et al., 2022) and highlight the promising impact of integrated training and livelihoods programmes on fostering

youth self-employment. The impact of training tends to be more pronounced in contexts where initial educational levels are low (Kluve et al., 2019). Furthermore, the high prevalence of economic informality may drive the impact on self-employment relative to wage employment, as formal wage opportunities are typically limited (Alzúa, Batbekh, Batchuluun, Dalkhjav, & Galdo 2021; Chakravarty et al. 2019; Kluve et al. 2019). Qualitative investigations with stakeholders and programme participants suggest that in both programmes, the regular assistance provided to participants after the training was the key driver of these positive impacts.[19] This finding aligns with Kluve et al. (2019) and McKenzie (2021), who both emphasize the importance of individualised follow-up systems and mentorship activities to enhance the effectiveness of training.

In Cameroon, AEP-Youth established incubator centres, which have ensured long-term assistance, also after the creation of income-generating activities and eventual businesses. In Madagascar, FORMAPROD was implemented in the broad national framework of SNFAR, which has ensured follow-up technical assistance to programme participants in addition to the initial support. Mentors can follow up after the training through in-person visits, reinforcing the knowledge gained and assisting youths in the practical application of their skills (Anderson & McKenzie, 2022; Brooks, Donovan, & Johnson, 2018; Iacovone, Maloney, & McKenzie, 2022). For this reason, continuous mentoring is crucial for the success of these programmes.

[19] While FORMAPROD also sought to support access to finance and markets, these components received comparatively lower emphasis in implementation. The available evidence suggests they played a more limited role: significant barriers to commercialisation persisted, with 65% of beneficiaries reporting constraints in market access, and resources allocated to finance support remained modest and largely directed toward beneficiaries outside the study sample. In contrast, AEP-Youth included a dedicated financial services component (Component B, USD 23.3 million, 37% of total programme budget) aimed at improving participants' access to productive credit. While this component was integral to the full-package intervention received by the treated group, its effective reach was partial: approximately 44% of supported enterprises accessed productive credit by programme completion, against a target of 56%. The survey data confirm this partial uptake, and a loan access indicator during programme implementation is included as a control variable in the outcome equation of the IPWRA (see explanations in Section B in the Annex). To the extent that credit access contributed to income gains, the estimated ATET reflects the combined effect of training, mentoring, and financial facilitation consistent with the integrated programme design being evaluated.

Nevertheless, the impact may decrease or even disappear in the medium- and long-term (Blattman, Dercon, & Franklin, 2022; Novella, Díaz, & Rosas-Shady, 2024). Therefore, it is also essential that regular assistance is integrated into a broader national framework, as in the case of the incubator centres in Cameroon or the SNFAR in Madagascar. As highlighted by Mueller and Thurlow (2019) and McGrath and Yamada (2023), agricultural training should be integrated into broader rural transformation strategies.

4.3 Disentangling impact

Since the ATET may hide considerable heterogeneities,[20] we extend the analysis to explore the factors driving the positive impact. First, we examine the impact across the different income-generating activities. Then, we estimate the impact for each individual[21] and analyse their association with key youth characteristics.

The positive impact observed on the total gross income is not equally reflected across all income-generating activities. In Table 3, we present the ATET by the type of activity.[22] For space considerations, the full regression results are presented in the Annex (Tables E3 and E4). In AEP-Youth, the highest impact is observed in livestock activities ($5,378), followed by non-farm activities ($2,537), while there is no impact for crop-related activities. In percentage terms, the gross income from livestock increased by 134% and that from non-farm activities by 36%. Treated youths are 18 percentage points more likely to conduct livestock activities. In FORMAPROD, the impact coming from crop activities is equivalent to $481 (equal to a 37%

[20] For example, Alzúa et al. (2021) found that the positive impact of the evaluated youth vocational programme is observed for relatively older, richer, and better-educated young people.
[21] The impact at individual level is estimated by calculating the difference of the predicted values from the IPWRA estimation for each treated youth, both under the treated and untreated scenarios.
[22] Since we cannot control for selection bias in developing an income-generating activity over another, the estimates include all youths, including those who did not engage in the income-generating activity. However, we also estimate the ATET on the likelihood of engaging in the specific income-generating activity.

increase) and $49 from livestock activities (equal to a 94% increase). FORMAPROD increased the probability of treated youths to conduct livestock-related activities by 20 percentage points.

In both programmes, the impact has mostly been driven by increasing participation in new income-generating activities, particularly livestock, rather than increasing performance in an existing activity. In activities where both treated and control groups were already involved, the impact is not significant (crop activities in AEP-Youth) or limited (crop activities in FORMAPROD and non-farm activities in AEP-Youth). In contrast, when the probability of engaging in the activity increases, for instance livestock, the impact is notable in both programmes.

Table 3. ATET of the two programmes disaggregated by type of income-generating activity

Type of activity:	Gross income of youth-led activity, in hundreds of international dollars (2023 values)				Probability of youth engaging in income-generating activity			
	AEP-Youth		FORMAPROD		AEP-Youth		FORMAPROD	
	ATET	POM	ATET	POM	ATET	POM	ATET	POM
Crop activities	5.22	16.57***	4.84***	12.92***	-0.04	0.36***	0.00	0.89***
	(3.38)	(2.58)	(1.86)	(1.40)	(0.03)	(0.03)	(0.02)	(0.02)
Livestock activities	53.75***	40.22***	0.49***	0.53***	0.18***	0.37***	0.20***	0.22***
	(8.05)	(6.91)	(0.18)	(0.14)	(0.02)	(0.03)	(0.04)	(0.02)
Non-farm activities	25.39***	70.69***			0.04*	0.45***		
	(9.78)	(10.32)			(0.02)	(0.03)		

Note. ATET is estimated using IPWRA, including covariates in the selection and outcome equations. Columns 1-4 show the impact on the gross income (expressed in hundreds of international dollars, 2023 values) of the youth-led farming or non-farming activities. Columns 5-8 present the impact on the probability that a youth engages in one of these activities. POM indicates the potential outcome mean, which is the value of the treated population had they not participated in the programme. Number of observations is 2,023 for AEP-Youth (1,055 treated and 968 control group) and 1,361 for FORMAPROD (750 treated and 611 control group). Standard errors are clustered at the sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

In the remainder of this Section, we estimate individual-level impacts for the treated group and analyse the associated youth characteristics. The results are presented in Table 4. Household headship and gender are positively correlated with the individual impacts among AEP-Youth participants, while a negative correlation is observed for FORMAPROD participants. Similarly, age is negatively associated with the individual impacts for AEP-Youth participants and shows no association with those in FORMAPROD. In contrast, the educational

level follows a common pattern across both programmes. Using no formal education as the reference category, primary education is negatively associated with impact, while secondary education and higher levels are positively associated. As found by Alzúa et al. (2021), higher educational levels are associated with greater positive impacts. Interestingly, having no formal education seems to be more beneficial than having only primary education. This finding suggests that the programmes have a higher impact on youth with no formal education compared to primary education,[23] and primary education is not sufficient to generate meaningful change whereas secondary education or higher does.

Looking at household characteristics, household size and dependency ratio follow a consistent pattern across both programmes. Larger households are positively associated with impact, while a higher dependency ratio is negatively associated. These results might indicate that a larger household can provide more workforce for income-generating activities, whereas a higher dependency ratio may, conversely, limit the ability to employ family members in these activities. In contrast, differences emerge when considering the index of housing characteristics. In AEP-Youth, housing characteristics are positively associated with impact, suggesting that youth from wealthier households have benefited more from the programme. Conversely, in FORMAPROD, housing characteristics are negatively associated, indicating that youth from poorer households have experienced greater benefits.

Finally, while factors such as average annual rainfall and distance from cities are statistically significant in predicting impacts, their magnitude remains negligible. These findings suggest that while external factors are not important, the association of certain individual and household characteristics with impact depends on the context (for example

[23] Due to the small number of observations, we cannot perform any inferential analysis comparing youth with no formal education to those with primary education. However, descriptive analyses indicate that, in both programmes, the average individual impact is higher for youth with no formal education than for those with primary education. See Table F3 in the Annex.

gender, age, household headship and household well-being), while other factors appear to show consistent associations across programmes (such as education and household composition).

Table 4. Predictors of individual impacts

	Individual impact levels, in hundreds of international dollars (2023 values)		Probability that the individual impact is above ATET	
	AEP-Youth	FORMAPROD	AEP-Youth	FORMAPROD
Youth characteristics				
Youth is household head (=1)	19.04***	-1.22*	0.28**	-0.15
	(3.90)	(0.70)	(0.14)	(0.12)
Youth is female (=1)	75.44***	-4.67***	1.55***	-0.61***
	(3.89)	(0.89)	(0.15)	(0.13)
Youth age	-2.38***	0.11	-0.06***	-0.01
	(0.34)	(0.09)	(0.01)	(0.01)
Youth with primary education (=1)	-31.86**	-1.92*	-0.43	-0.34*
	(14.57)	(1.11)	(0.51)	(0.20)
Youth with secondary education (=1)	49.91***	1.46*	1.04**	0.26**
	(13.21)	(0.85)	(0.43)	(0.13)
Youth with tertiary education and above (=1)	51.89***	3.23*	1.19***	0.36*
	(13.76)	(1.73)	(0.45)	(0.20)
Household characteristics				
Number of household members at baseline	7.40***	0.39**	0.13***	0.07**
	(1.21)	(0.20)	(0.03)	(0.03)
Dependency ratio at baseline	-7.02***	-4.31***	-0.21***	-0.66***
	(2.19)	(0.34)	(0.06)	(0.07)
Housing characteristics index (0-1)	274.10***	-12.59***	6.03***	-1.31***
	(12.66)	(2.95)	(0.34)	(0.37)
Context characteristics				
Total annual rainfall (avg. 2006-2015)	-0.01***	-0.00**	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Travel time to the next 5-10k city (in minutes)	0.00	0.01*	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-69.30***	15.26***	-2.96***	1.62***
	(23.14)	(3.13)	(0.59)	(0.51)

Note. Coefficients of individual impact levels are estimated using the ordinary least squares model, whereas coefficients of probability that the individual impact is above ATET are estimated using the probit model. Number of observations is 1,055 for AEP-Youth and 750 for FORMAPROD. Standard errors are reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

5. Conclusion

This study examined the impact of two large-scale programmes in Cameroon and Madagascar that combined agricultural training, mentoring, technical assistance and access to productive resources to support youth engagement in self-employment. Using a quasi-experimental design, the analysis indicates that both programmes increased income generated from youth-led agricultural activities. Although the magnitude of the impact differed across contexts, the results suggest that integrated training and livelihood interventions can contribute to income generation among rural youth engaged in agriculture.

The findings also reveal substantial heterogeneity in programme outcomes. Impacts varied across income-generating activities and participant characteristics. In both programmes, a large share of the observed gains is associated with increased participation in new activities, particularly livestock-related activities, rather than solely with improved performance in activities that participants were already undertaking. In addition, higher educational attainment was consistently associated with larger programme impacts, whereas the relationship between other participant characteristics and programme outcomes differed across contexts.

Qualitative evidence further suggests that mentoring, technical assistance and continued follow-up may have contributed to programme effectiveness by helping participants apply newly acquired skills and establish or expand their activities. However, because the programmes were evaluated as integrated intervention packages, the contribution of individual components cannot be identified separately. Consequently, the results should be interpreted as the combined effect of training, mentoring, technical support and access to productive resources.

From a policy perspective, the findings suggest that integrated programmes supporting agricultural self-employment can contribute to improving economic opportunities for rural

youth. At the same time, the observed heterogeneity highlights the importance of adapting programme design to local contexts and participant characteristics. Future research should investigate the relative contribution and cost-effectiveness of different programme components, including training, mentoring and financial support, to strengthen the evidence base for youth employment interventions in Sub-Saharan Africa. Further questions for additional research relate to the optimal type and duration of follow-up support as well as to the preferred type of implementer (public or private) for similar programmes in SSA.

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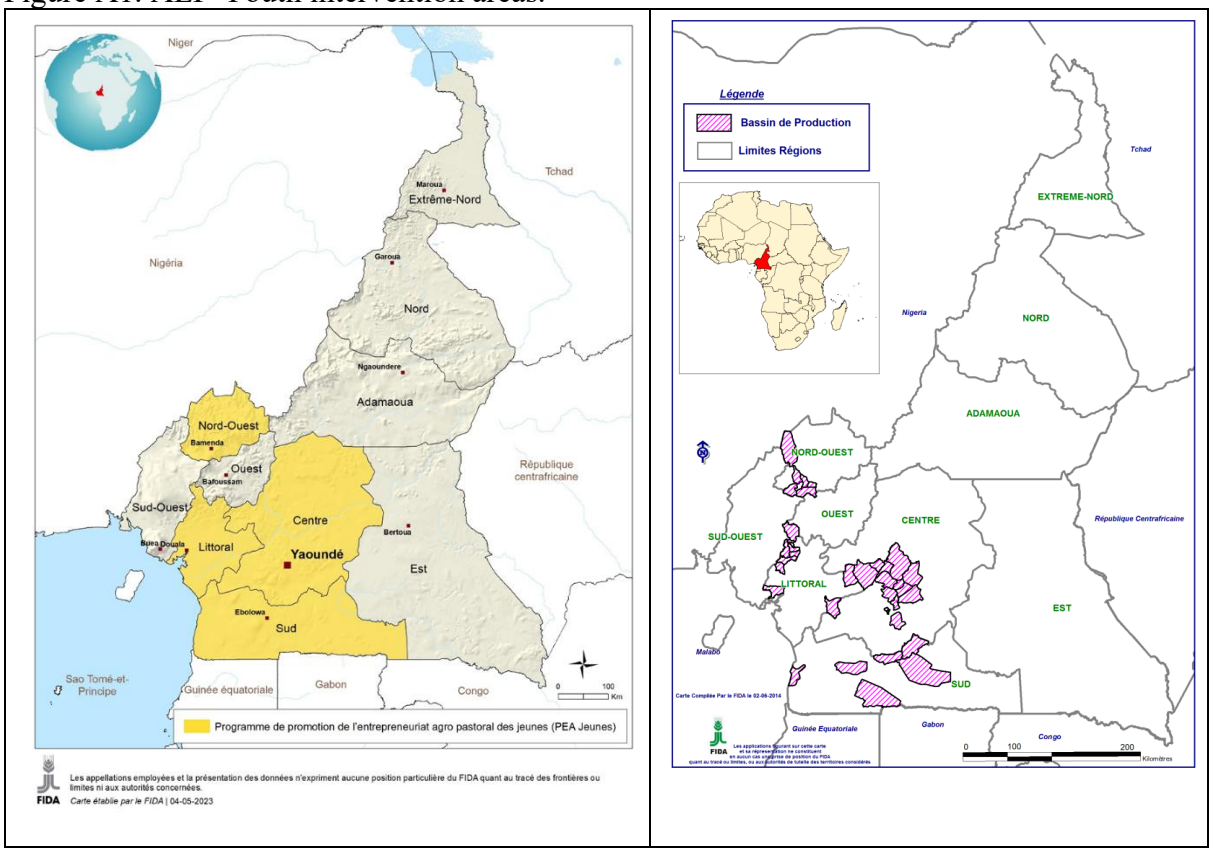
Annex

A – Background information

Figure A1. AEP-Youth intervention areas.



Source. AEP-Youth project completion report.

Figure A2. FORMAPROD intervention areas.

Source. FORMAPROD project completion report.

Table A1. List of production zones and respective commodities in the AEP-Youth.

Region	Departments	Production Zone	Potential Commodities
Centre	Lekié / Haute-Sanaga	Obala - Monatélé – Elig -Mfomobachenga - Mbandjock - Sa'a	Maize; Pigs; Sheep; Goats; Poultry; Other livestock; Aquaculture
Centre	Mbam-et-Inoubou	Ombessa – Bokito - Bafia	Ananas; Maize; Cassava; Pigs; Sheep; Goats; Poultry; Other livestock
Centre	Mbam-et-Kim	Ntui - Bangassina	Maize; Green bananas; Cassava; Pig; Sheep; Goats
Centre	Méfou-et-Afamba	Awae	Ananas
Centre	Méfou-et-Afamba	Mfou – Soa - Edzendouang	Ananas; Maize; Green bananas; Horticulture; Pigs; Poultry
Centre	Mfoundi	Youndé suburbs 6 & 7	Pigs; Poultry; Other livestock; Aquaculture
Littoral	Moungo	Njombe - Penja - Loum - Manjo - Nkongsamba - Melong	Ananas; Maize; Green bananas; Pepper; Cassava; Pigs; Poultry; Other livestock
Littoral	Sanaga-Maritime	Ndom	Green bananas
Littoral	Sanaga-Maritime	Pouma	Maize; Green bananas; Pigs; Poultry; Other livestock
Littoral	Wouri	Douala suburbs - Dibombari	Horticulture; Pigs; Poultry; Other livestock
Northwest	Menchum	Menchum Valley	Maize; Horticulture; Rice
Northwest	Mezam	Santa - Bamenda	Maize; Horticulture; Pigs; Poultry; Other livestock
Northwest	Momo	Batibo - Mbengwi	Maize; Horticulture; Pigs; Poultry; Aquaculture
South	Mvilla	Ngoulemakong - Mvangan - Ebolowa	Maize; Green bananas; Cassava; Pigs; Poultry; Aquaculture
South	Océan	Kribi	Maize; Horticulture; Cassava; Pigs; Poultry; Aquaculture
South	Vallée-du-Ntem	Ambam	Green bananas; Cassava; Pigs; Poultry; Aquaculture

Table A2. FORMAPROD training modalities.

Training modality	Description	Share of trainees
Apprenticeship	Based on mentorship at the mentor's farm. Selected tutors (local esteemed farmers) shared their experience by collaborating along with trainees between three and six months on the tutors' farm.	53% (55,642)
Short training	In-classroom instruction for up to six months, located in training centres of regional capital cities.	21% (22,569)

Training modality	Description	Share of trainees
Delocalised training	Combination of in-classroom instruction in youths' villages and practical experience on youths' farms, for up to six months.	24% (25,047)
Initial training	Two to three years of certified training to become a farmer (for youths with completed primary education) or an extension worker (for youths with completed secondary education).	2% (2,372)

B – Construction of variables

B1. AEP-YOUTH

Variables in the construction of the counterfactual household sample

The matching variables used to construct the household counterfactual and in the IPWRA selection equation include youth characteristics, household characteristics, climate factors and geographic accessibility.

- **Youth characteristics:** These include gender (a binary variable equal to one if female, and zero otherwise), age, educational level[24] and activity before programme participation. Educational level is captured by two binary variables: one indicating if the youth had no formal education (equal to one if true), and another indicating if they had only primary education (equal to one if true). Pre-programme activities are classified into five categories: farming, enrolled in education, unemployed, non-farm activities and wage employed, with non-farm activities serving as the reference category. These youth characteristics (with the exception of the educational level), were drawn from the programme's monitoring and administrative data, which served as the sampling frame to identify and select both treated and control respondents, and subsequently remeasured at the time of the household survey. In contrast, household wealth variables land and livestock ownership, housing characteristics, and durable assets were not available in programme records and were collected only through retrospective recall questions referring to 2015 as described below. The two sources are thus distinct and serve different roles in the matching procedure.

[24] This information is not available at baseline; however, since this variable is likely time-invariant, endline educational levels should not be affected by programme participation.

- **Household characteristics:** These encompass demographics and wealth indicators. Demographic variables include the number of household members at baseline and the dependency ratio at baseline, defined as the proportion of dependents (0-14 and 65+) to productive members (15-64). Wealth is measured through asset ownership, which includes land, livestock, housing characteristics, and durable assets. Land ownership is represented by a binary variable equal to one if the household owned land at baseline. Similarly, livestock ownership is represented by a binary variable equal to one if the household owned livestock at baseline. Housing characteristics and durable assets are summarised using normalised indices constructed through principal component analysis (PCA) and multiple component analysis (MCA), following the approach of Smits and Steendijk (2015). The housing index captures features such as building materials and facilities, while the durable assets index includes a set of key contextual assets. Information on land and livestock ownership, housing characteristics, and durable assets was gathered through retrospective questions referring to 2015, eight years before data collection. This reference year is consistent across all respondents, both treated and control regardless of cohort of enrolment, meaning that for participants enrolled in later cohorts, the 2015 reference year predates their programme entry and therefore captures a pre-exposure baseline for all. AEP-Youth enrolled participants across nine cohorts over the programme period (2015–2023), with the following distribution: cohort 1, 1.85%; cohort 2, 6.11%; cohort 3, 6.56%; cohort 4, 6.22%; cohort 5, 14.58%; cohort 6, 12.29%; cohort 7, 21.90%; cohort 8, 18.72%; cohort 9, 11.76%. We acknowledge that retrospective recall over an eight-year period introduces potential measurement error. While some studies suggest recall data can be informative for certain asset and activity variables, the literature also finds that recall error increases with the length of the recall period (De Nicola and Giné, 2014) and that

asset/consumption measures may be underestimated, particularly among poorer households (Beegle et al., 2012). To assess the sensitivity of our results to this limitation, we re-estimated all models excluding these wealth variables. Results were robust, with coefficients of similar magnitude and significance levels unchanged (available upon request).

- **Climate and geographic accessibility:** Climate variables include the average and coefficient of variation (CoV) of cumulative annual rainfall, mean temperature, and the Enhanced Vegetation Index (EVI) for the decade preceding programme implementation (2006-2015). Geographic accessibility is assessed as a proxy for market and service access, measured by travel time (in minutes) to the nearest city with a population of 5,000-10,000. These geospatial variables have been derived using the GPS coordinates of each household.

Variables in the Inverse Probability Weighted Regression Adjustment

The **variables in the selection equation** of the IPWRA are the same as those used in constructing the counterfactual.

In the **outcome equation** of the IPWRA, we control for youth characteristics, household characteristics and geographic accessibility. These control variables align with those used in both the counterfactual construction and the IPWRA selection equation. However, for wealth levels, we additionally include the number of hectares owned at baseline and the livestock owned at baseline, measured as Tropical Livestock Unit (TLU). Furthermore, we account for household shocks and financial access by including two additional variables: a binary indicator of whether the household experienced a shock in the previous 12 months (equal to one if true) and a binary indicator of whether the household accessed a loan during program implementation (equal to one if true).

Instead of the climate variables used in the matching process, we include a set of climate variables specifically linked to the agricultural season, to account for any farming-related effects. These climate variables include cumulative annual rainfall, the number of dry dekads during the rainy season, average mean temperature during the agricultural season, and the Enhanced Vegetation Index (EVI) for the same period.

B2. FORMAPROD

Variables in the construction of the municipality counterfactual

The matching variables used to construct the municipality counterfactual encompass several key dimensions: remoteness, climate, geography, population, and economy.

- **Remoteness variables** include the municipality's distance to primary and secondary roads, as well as to the nearest training centre, based on GIS data from the programme. Additionally, we account for the presence of major social and agricultural infrastructure, identified through consultations with regional programme offices.

- **Climate variables** cover the average total rainfall, maximum temperature, and fire occurrences, all derived from satellite imagery.

- **Geography variables** comprise average elevation from satellite data, proximity to the nearest water source (also computed from programme GIS data), land use data from the *Inventaire Écologique Forestier National*, and protected areas designated by the *Ministère de l'Environnement, de l'Écologie et des Forêts*.

- **Population variables** rely on population density estimates from WorldPop Global data.

- **Economy variables** include proximity to the nearest mine (sourced from the Bureau du Cadastre Minier) and the presence of dominant trades, as documented in municipal monographs.

- **National programmes** include whether an IFAD programme operated in the municipality between 2013 and 2023, as well as the presence of other public national interventions related to youth employment and agriculture. This variable was developed in consultation with regional programme offices.

Variables in the construction of the counterfactual household sample

The matching variables used in constructing the household counterfactual and in the IPWRA selection equation include youth characteristics, household characteristics, climate factors and remoteness.

- **Youth demographics:** These include gender (a binary variable equal to one if female, and zero otherwise), age, marital status (a binary variable to one if married, and zero otherwise), educational level at baseline and activity before programme participation. Educational level is captured by two binary variables: one indicating if the youth had no formal education at baseline (equal to one if true), and another indicating if they had only primary education at baseline (equal to one if true). Pre-programme activities are classified into five categories: farming, enrolled in education, unemployed, non-farm activities and wage employed, with non-farm activities serving as the reference category. All pre-programme information are based on 10-year recall data.

- **Household characteristics:** These encompass demographics and wealth indicators. Demographic variables include the number of household members at baseline and the dependency ratio at baseline based on 10-year recall data, defined as the proportion of

dependents (0-14 and 65+) to productive members (15-64). Wealth is measured through asset ownership, which includes land, livestock, and housing characteristics. Land ownership is represented by the number of hectares of land managed by youth at baseline. Livestock ownership is represented by a principal component analysis (PCA) index using the number of owned animals. Housing characteristics are summarised using normalised indices constructed through multiple component analysis (MCA), following the approach of Smits and Steendijk (2015). The housing index captures features such as building materials and facilities, while the durable assets index includes a set of key contextual assets. Information on land and livestock ownership, and housing characteristics was gathered through retrospective questions referring to the period before programme implementation. As for AEP-YOUTH, we re-estimated all models excluding these wealth variables. Results were robust, with coefficients of similar magnitude and significance levels unchanged (available upon request).

- **Climate and remoteness:** Climate variables include the average maximum temperature and cumulative annual rainfall in the long-run period of 1980-2013. We also include the ratio of the coefficient of variation (CoV) of average maximum and cumulative rainfall during the 3 years before the programme (2011-2013) to the long-run (1980-2013). Finally, we include a binary variable whether the household lives in a warm humid area (equal to 1 if true). Remoteness is assessed using two binary variables that indicate if a primary school and a health facility are present in the village.

Variables in the Inverse Probability Weighted Regression Adjustment

The **variables in the selection equation** of the IPWRA are the same as those used in constructing the counterfactual.

In the **outcome equation** of the IPWRA, we control for youth characteristics, household characteristics, and remoteness. These control variables align with those used in both the counterfactual construction and the IPWRA selection equation. Furthermore, we account for household shocks and financial access by including two additional variables: a binary indicator of whether the household experienced a shock in the previous 12 months (equal to one if true) and a binary indicator of whether the household accessed a loan during program implementation (equal to one if true).

Instead of the climate variables used in the matching process, we include a set of climate variables specifically linked to the agricultural season, to account for any farming-related effects. These climate variables include cumulative annual rainfall and average maximum temperature during the agricultural season. Additionally, we control if, in the area where the youth live, there has been a large-scale public programme focused on developing agricultural value chains.

C – Matching procedure

The choice of k balances the trade-off between bias in differences between treated and control groups and changes in variance due to matching, which can affect the precision of estimates (Caliendo & Kopeinig, 2008). A lower k, such as one-to-one matching, minimizes bias by ensuring closer matches, but variance increases due to the smaller effective sample size. Conversely, as k increases, variance decreases by including more observations, but bias grows because matches are less precise. To assess the bias, we examine the standardized mean difference (SMD) of covariates between the treated and control groups after matching (Stuart, 2010). An SMD below 0.1 is commonly regarded as a strong indicator of balance (Austin, 2009). To evaluate variance, we examine the within-group variance of covariates and the outcome variable, as well as the effective sample size[25] (Stuart, 2010). The caliper distance defines the maximum allowable distance between propensity scores for matching units, ensuring an adequate number of matches for each treated unit while guaranteeing that treated and control units are closely matched. The caliper is commonly set to 0.2 times the standard deviation of the logit-transformed propensity scores (Austin, 2011).

To enhance the common support area, treated units with propensity scores exceeding the maximum score of untreated units and untreated units with scores below the minimum score of treated units, are excluded before matching. This step ensures that treated and untreated units share overlapping propensity scores, thereby improving the common support area and reducing the risk of incomparable units in the analysis (Caliendo & Kopeinig, 2008). Following this, treated and untreated units are matched based on their propensity scores, and only the matched pairs are retained for subsequent analysis.

[25] The effective sample size quantifies the usable sample size when weights are applied.

The quality of matching is evaluated using various diagnostic tests, which include testing the joint significance of covariates in predicting the treatment status, testing covariate differences between treated and control groups, examining the reduction in SMD of covariates between groups, and testing the overlap in the propensity score distribution between groups (Caliendo & Kopeinig, 2008).

Table C1. Probability of participation in AEP-Youth (p-scores).

	Unmatched sample Treated=1	Matched sample Treated=1
Youth is female (=1)	0.14**	0.03
	(0.06)	(0.07)
Youth age	0.02***	0.00
	(0.01)	(0.01)
Youth with no formal education (=1)	-0.08	0.12
	(0.23)	(0.24)
Youth with primary education (=1)	-0.04	0.02
	(0.08)	(0.09)
Youth worked in farm activity at baseline (=1)	-0.07	-0.07
	(0.09)	(0.10)
Youth was a student at baseline (=1)	-0.29***	-0.05
	(0.11)	(0.12)
Youth was unemployed at baseline (=1)	-0.41***	-0.00
	(0.15)	(0.17)
Youth worked in wage employment at baseline (=1)	-0.26*	-0.12
	(0.14)	(0.16)
Number of household members at baseline	-0.03*	0.01
	(0.02)	(0.02)
Dependency ratio at baseline	0.08*	-0.03
	(0.05)	(0.05)
If household owned land at baseline (=1)	-0.08	0.00
	(0.06)	(0.07)
If household owned livestock at baseline (=1)	-0.03	0.02
	(0.07)	(0.08)
PCA index of durable assets at baseline (normalized 0-1)	0.80***	-0.09
	(0.28)	(0.31)
MCA index of housing characteristics at baseline (normalized 0-1)	0.26	0.07
	(0.19)	(0.22)
Avg. of cumulative annual rainfall 2006-2015	0.00	0.00
	(0.00)	(0.00)
CoV of cumulative annual rainfall 2006-2015	-1.80	-1.13
	(2.95)	(3.24)
Avg. of annual mean temperature 2006-2015	0.13***	0.02
	(0.04)	(0.04)
CoV of avg. annual mean temperature 2006-2015	147.44***	13.73
	(35.23)	(38.86)
Avg. of Enhanced Vegetation Index (EVI) 2006-2015	1.43***	0.18
	(0.52)	(0.58)
CoV of Enhanced Vegetation Index (EVI) 2006-2015	-2.37	0.77
	(2.06)	(2.28)
Travel time to the next 5-10k city (in minutes)	0.00	-0.00
	(0.00)	(0.00)
Constant	-5.39***	-0.84
	(1.27)	(1.40)

	Unmatched sample Treated=1	Matched sample Treated=1
No. of observations:	2,073	2,023
Treated	1,058	1,055
Control	1,015	968
Chi-squared:	109.8	3.260
Prob Wald:	0.000	1.000
Log-Likelihood:	-1382	-1460
Pseudo-R:	0.038	0.001

Note. Coefficients are estimated using the probit model. Standard errors are reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

Table C2. Probability of participation in FORMAPROD (p-scores).

	Unmatched sample Treated=1	Matched sample Treated=1
Youth is female (=1)	-0.32***	-0.03
	(0.07)	(0.10)
Youth age	0.06***	-0.01
	(0.01)	(0.01)
Youth with no formal education (=1)	-1.32***	-0.05
	(0.08)	(0.11)
Youth with primary education (=1)	-1.40***	0.01
	(0.12)	(0.15)
Youth married at baseline (=1)	-0.30***	0.02
	(0.09)	(0.12)
Youth worked in farm activity at baseline (=1)	0.65*	0.47
	(0.34)	(0.42)
Youth was a student at baseline (=1)	0.82**	0.48
	(0.35)	(0.42)
Youth was unemployed at baseline (=1)	0.49	0.51
	(0.35)	(0.42)
Youth worked in wage employment at baseline (=1)	0.57	0.39
	(0.38)	(0.47)
Number of household members at baseline	0.02	-0.01
	(0.02)	(0.02)
Dependency ratio at baseline	0.05	-0.04
	(0.04)	(0.05)
Hectares managed by youth at baseline	-0.16***	-0.04
	(0.05)	(0.07)
Livestock assets index at baseline	0.16	-0.19
	(0.20)	(0.27)
MCA index of housing characteristics at baseline (normalized 0-1)	-0.03	-0.40
	(0.27)	(0.35)
Avg. of max temperature (1980-2013)	-0.04***	-0.02
	(0.01)	(0.02)
Ratio of CoV of avg. max temp. during 3 years before programme to LR	-1.05***	-0.12
	(0.19)	(0.26)
Avg. of cumulative annual rainfall (1980-2013)	0.00	0.00
	(0.00)	(0.00)
Ratio of CoV of avg. rain during 3 years before programme to LR	0.31***	-0.05
	(0.10)	(0.15)
Tropical warm humid area (=1)	-0.68***	-0.02
	(0.09)	(0.13)
Primary school in the village (=1)	0.01	-0.01
	(0.09)	(0.11)
Health facility in the village (=1)	0.61***	0.15
	(0.11)	(0.14)
Constant	0.71	0.54

	Unmatched sample Treated=1	Matched sample Treated=1
	(0.70)	(0.98)
No. of observations:	1,704	1,361
Treated	788	916
Control	750	611
Chi-squared:	688	8.418
Prob Wald:	0.000	0.993
Log-Likelihood:	-832.3	-1,031
Pseudo-R:	0.292	0.008

Note. Coefficients are estimated using the probit model. Standard errors are reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

Table C3. Kolmogorov-Smirnov test for the distribution of treated and control p-scores in AEP-Youth.

	Unmatched sample		Matched sample	
	Difference	P-value	Difference	P-value
Control group	0.19	0.00	0.03	0.34
Treated group	0.00	1.00	-0.02	0.72
Combined K-S	0.19	0.00	0.03	0.65

Table C4. Kolmogorov-Smirnov test for the distribution of treated and control p-scores in FORMAPROD.

	Unmatched sample		Matched sample	
	Difference	P-value	Difference	P-value
Control group	0.55	0.00	0.05	0.17
Treated group	0.00	1.00	-0.04	0.41
Combined K-S	0.55	0.00	0.05	0.33

Table C5. Balance diagnostics: t-tests of standardised difference for AEP-Youth.

	Unmatched			Matched		
	Treated	Control	SD	Treated	Control	SD
Youth is female (=1)	0.45	0.40	0.10**	0.45	0.44	0.02
Youth age	32.52	31.92	0.13***	32.50	32.41	0.02
Youth with no formal education (=1)	0.01	0.01	-0.01	0.01	0.01	0.02
Youth with primary education (=1)	0.15	0.14	0.02	0.15	0.15	0.01
Youth worked in farm activity at baseline (=1)	0.65	0.57	0.16***	0.65	0.66	-0.03
Youth was a student at baseline (=1)	0.13	0.19	-0.17***	0.13	0.12	0.01
Youth was unemployed at baseline (=1)	0.03	0.06	-0.12***	0.03	0.03	0.02
Youth worked in wage employment at baseline (=1)	0.05	0.07	-0.07	0.05	0.05	-0.02
Number of household members at baseline	3.33	3.26	0.04	3.33	3.32	0.00
Dependency ratio at baseline	0.57	0.48	0.12***	0.57	0.58	-0.02
If household owned land at baseline (=1)	0.40	0.40	0.00	0.40	0.40	-0.00
If household owned livestock at baseline (=1)	0.26	0.22	0.10**	0.26	0.26	-0.00
PCA index of durable assets at baseline (normalized 0-1)	0.09	0.09	0.07	0.09	0.09	-0.01
MCA index of housing characteristics at baseline (normalized 0-1)	0.65	0.65	-0.01	0.65	0.65	0.01
Avg. of cumulative annual rainfall 2006-2015	6,374	6,493	-0.07	6,373	6,374	-0.00
CoV of cumulative annual rainfall 2006-2015	0.07	0.07	-0.06	0.07	0.07	-0.01
Avg. of annual mean temperature 2006-2015	23.24	23.58	-0.17***	23.25	23.21	0.02
CoV of avg. annual mean temperature 2006-2015	0.01	0.01	0.25***	0.01	0.01	-0.01
Avg. of Enhanced Vegetation Index (EVI) 2006-2015	0.31	0.30	0.20***	0.31	0.31	-0.00
CoV of Enhanced Vegetation Index (EVI) 2006-2015	0.05	0.06	-0.26***	0.05	0.05	0.02
Travel time to the next 5-10k city (in minutes)	84.91	76.56	0.03	85.03	97.05	-0.04
Observations	1,058	1,015	2,073	1,055	968	2,023

Note. Columns (2), (3), (5), and (6) report the mean of the respective group and sample. Columns (4) and (7) report the standardised difference (SD). The matched sample is weighted using sample weights generated by PSM. Asterisks indicate the level of statistical significance of the t-test/chi-squared test of difference in means: *** < 0.01; ** < 0.05; * < 0.10.

Table C6. Balance diagnostics: t-tests of standardised difference for FORMAPROD.

	Unmatched			Matched		
	Treated	Control	SD	Treated	Control	SD
Youth is female (=1)	0.44	0.55	-0.23***	0.45	0.46	-0.02
Youth age	26.35	23.82	0.50***	26.20	26.64	-0.09
Youth with no formal education (=1)	0.31	0.68	-0.81***	0.32	0.33	-0.01
Youth with primary education (=1)	0.06	0.16	-0.33***	0.06	0.06	0.02

	Unmatched			Matched		
	Treated	Control	SD	Treated	Control	SD
Youth married at baseline (=1)	0.25	0.26	-0.03	0.26	0.27	-0.02
Youth worked in farm activity at baseline (=1)	0.43	0.43	-0.00	0.43	0.43	-0.01
Youth was a student at baseline (=1)	0.32	0.22	0.23***	0.31	0.31	0.01
Youth was unemployed at baseline (=1)	0.20	0.31	-0.24***	0.21	0.19	0.03
Youth worked in wage employment at baseline (=1)	0.04	0.03	0.07	0.05	0.05	-0.02
Number of household members at baseline	5.68	5.32	0.15***	5.65	5.76	-0.05
Dependency ratio at baseline	1.48	1.34	0.13***	1.48	1.57	-0.08
Hectares managed by youth at baseline	0.29	0.45	-0.17***	0.29	0.33	-0.04
Livestock assets index at baseline	0.03	0.03	-0.03	0.03	0.04	-0.07
MCA index of housing characteristics at baseline (normalized 0-1)	0.19	0.14	0.33***	0.18	0.20	-0.10
Avg. of max temperature (1980-2013)	25.82	26.64	-0.27***	25.78	25.87	-0.03
Ratio of CoV of avg. max temp. during 3 years before programme to LR	0.91	0.98	-0.29***	0.92	0.92	-0.01
Avg. of cumulative annual rainfall (1980-2013)	1,628	1,611	0.03	1,654	1,639	0.03
Ratio of CoV of avg. rain during 3 years before programme to LR	1.06	0.92	0.30***	1.04	1.04	0.01
Tropical warm humid area (=1)	0.68	0.68	0.00	0.69	0.69	0.00
Primary school in the village (=1)	0.32	0.24	0.18***	0.31	0.31	-0.00
Health facility in the village (=1)	0.25	0.12	0.33***	0.22	0.20	0.05
Observations	788	916	1,704	750	611	1,361

Note. Columns (2), (3), (5), and (6) report the mean of the respective group and sample. Columns (4) and (7) report the standardised difference (SD). The matched sample is weighted using sample weights generated by PSM. Asterisks indicate the level of statistical significance of the t-test/chi-squared test of difference in means: *** < 0.01; ** < 0.05; * < 0.10.

Table C7. Balance diagnostics (t-tests) of household matching for AEP-Youth.

	Before matching				After matching			Reduction	
	Treated Mean/SE	Control Mean/SE	p-value	Bias	Treated Mean/SE	Control Mean/SE	p-value	Bias	in Bias (%)
Youth is female (=1)	0.45	0.40	0.025**	9.86	0.45	0.44	0.636	2.11	78.55
	0.02	0.02	.	.	0.02	0.02	.	.	.
Youth age	32.52	31.92	0.003***	12.89	32.50	32.41	0.662	1.94	84.93
	0.14	0.15	.	.	0.14	0.15	.	.	.
Youth with no formal education (=1)	0.01	0.01	0.909	-0.50	0.01	0.01	0.597	2.22	541.87
	0.00	0.00	.	.	0.00	0.00	.	.	.
Youth with primary education (=1)	0.15	0.14	0.591	2.36	0.15	0.15	0.836	0.93	60.75
	0.01	0.01	.	.	0.01	0.01	.	.	.
	0.65	0.57	0.000***	16.42	0.65	0.66	0.468	-3.15	119.20

	Before matching				After matching			Reduction	
	Treated Mean/SE	Control Mean/SE	p-value	Bias	Treated Mean/SE	Control Mean/SE	p-value	Bias	in Bias (%)
Youth worked in farm activity at baseline (=1)									
	0.01	0.02	.	.	0.01	0.02	.	.	.
Youth was a student at baseline (=1)	0.13	0.19	0.000***	-17.48	0.13	0.12	0.867	0.68	103.88
	0.01	0.01	.	.	0.01	0.01	.	.	.
Youth was unemployed at baseline (=1)	0.03	0.06	0.007***	-11.92	0.03	0.03	0.665	1.62	113.60
	0.01	0.01	.	.	0.01	0.01	.	.	.
Youth worked in wage employment at baseline (=1)	0.05	0.07	0.119	-6.84	0.05	0.05	0.699	-1.63	76.12
	0.01	0.01	.	.	0.01	0.01	.	.	.
Number of household members at baseline	3.33	3.26	0.403	3.67	3.33	3.32	0.924	0.42	88.56
	0.06	0.06	.	.	0.06	0.06	.	.	.
Dependency ratio at baseline	0.57	0.48	0.006***	12.21	0.57	0.58	0.633	-2.22	118.20
	0.02	0.02	.	.	0.02	0.03	.	.	.
If household owned land at baseline (=1)	0.40	0.40	0.934	0.36	0.40	0.40	0.970	-0.17	146.11
	0.02	0.02	.	.	0.02	0.02	.	.	.
If household owned livestock at baseline (=1)	0.26	0.22	0.025**	9.88	0.26	0.26	0.992	-0.04	100.45
	0.01	0.01	.	.	0.01	0.01	.	.	.
PCA index of durable assets at baseline (normalized 0-1)	0.09	0.09	0.106	7.10	0.09	0.09	0.887	-0.65	109.11
	0.00	0.00	.	.	0.00	0.00	.	.	.
MCA index of housing characteristics at baseline (normalized 0-1)	0.65	0.65	0.822	-0.99	0.65	0.65	0.786	1.20	221.05
	0.00	0.01	.	.	0.00	0.01	.	.	.
Avg. of cumulative annual rainfall 2006-2015	6 373.86	6 492.53	0.127	-6.71	6 372.67	6 374.24	0.983	-0.09	98.68
	51.15	58.67	.	.	51.29	51.56	.	.	.
CoV of cumulative annual rainfall 2006-2015	0.07	0.07	0.183	-5.85	0.07	0.07	0.784	-1.16	80.11
	0.00	0.00	.	.	0.00	0.00	.	.	.
Avg. of annual mean temperature 2006-2015	23.24	23.58	0.000***	-16.51	23.25	23.21	0.684	1.92	111.64
	0.07	0.06	.	.	0.07	0.07	.	.	.

	Before matching				After matching			Reduction	
	Treated Mean/SE	Control Mean/SE	p-value	Bias	Treated Mean/SE	Control Mean/SE	p-value	Bias	in Bias (%)
CoV of avg. annual mean temperature 2006-2015	0.01	0.01	0.000***	25.00	0.01	0.01	0.806	-1.18	104.73
	0.00	0.00	.	.	0.00	0.00	.	.	.
Avg. of Enhanced Vegetation Index (EVI) 2006-2015	0.31	0.30	0.000***	19.65	0.31	0.31	0.930	-0.37	101.87
	0.00	0.00	.	.	0.00	0.00	.	.	.
CoV of Enhanced Vegetation Index (EVI) 2006-2015	0.05	0.06	0.000***	-26.30	0.05	0.05	0.646	1.98	107.54
	0.00	0.00	.	.	0.00	0.00	.	.	.
Travel time to the next 5-10k city (in minutes)	84.91	76.56	0.545	2.66	85.03	97.05	0.462	-3.84	244.03
	10.14	9.29	.	.	10.17	12.87	.	.	.
No. of observations	1,058	1,015	.	.	1,055	968	.	.	.

Note. Point estimates are sample means with standard errors reported below. The matched sample is weighted using sample weights generated by PSM. Asterisks indicate the level of statistical significance of the t-test/chi-squared test of difference in means: *** < 0.01; ** < 0.05; * < 0.10.

Table C8. Balance diagnostics (t-tests) of household matching for FORMAPROD.

	Before matching				After matching			Reduction	
	Treated Mean/SE	Control Mean/SE	p-value	Bias	Treated Mean/SE	Control Mean/SE	p-value	Bias	in Bias (%)
Youth is female (=1)	0.44	0.55	0.000***	-22.87	0.45	0.46	0.657	-2.41	89.44
	0.02	0.02	.	.	0.02	0.02	.	.	.
Youth age	26.35	23.82	0.000***	49.67	26.20	26.64	0.111	-8.66	117.43
	0.15	0.19	.	.	0.15	0.24	.	.	.
Youth with no formal education (=1)	0.31	0.68	0.000***	-81.19	0.32	0.33	0.834	-1.15	98.58
	0.02	0.02	.	.	0.02	0.02	.	.	.
Youth with primary education (=1)	0.06	0.16	0.000***	-33.21	0.06	0.06	0.726	1.46	104.40
	0.01	0.01	.	.	0.01	0.01	.	.	.
Youth married at baseline (=1)	0.25	0.26	0.584	-2.66	0.26	0.27	0.696	-2.13	19.91
	0.02	0.01	.	.	0.02	0.02	.	.	.
Youth worked in farm activity at baseline (=1)	0.43	0.43	0.930	-0.43	0.43	0.43	0.897	-0.70	-64.19
	0.02	0.02	.	.	0.02	0.02	.	.	.
Youth was a student at baseline (=1)	0.32	0.22	0.000***	23.00	0.31	0.31	0.832	1.21	94.72
	0.02	0.01	.	.	0.02	0.02	.	.	.

	Before matching				After matching				Reduction
	Treated Mean/SE	Control Mean/SE	p-value	Bias	Treated Mean/SE	Control Mean/SE	p-value	Bias	in Bias (%)
Youth was unemployed at baseline (=1)	0.20	0.31	0.000***	-24.04	0.21	0.19	0.540	3.08	112.83
	0.01	0.02	.	.					
					0.01	0.02	.	.	.
Youth worked in wage employment at baseline (=1)	0.04	0.03	0.167	6.67	0.05	0.05	0.749	-1.95	129.27
	0.01	0.01	.	.					
					0.01	0.01	.	.	.
Number of household members at baseline	5.68	5.32	0.003***	14.60	5.65	5.76	0.424	-4.48	130.72
	0.08	0.09	.	.					
					0.08	0.11	.	.	.
Dependency ratio at baseline	1.48	1.34	0.006***	13.23	1.48	1.57	0.149	-8.50	164.25
	0.04	0.03	.	.	0.04	0.05	.	.	.
Hectares managed by youth at baseline	0.29	0.45	0.001***	-16.76	0.29	0.33	0.415	-3.23	80.74
	0.02	0.04	.	.	0.02	0.03	.	.	.
Livestock assets index at baseline	0.03	0.03	0.504	-3.26	0.03	0.04	0.221	-7.11	-118.10
	0.01	0.01	.	.	0.01	0.01	.	.	.
MCA index of housing characteristics at baseline (normalized 0-1)	0.19	0.14	0.000***	33.48					
					0.18	0.20	0.103	-10.11	130.21
	0.01	0.00	.	.	0.01	0.01	.	.	.
Avg. of max temperature (1980-2013)	25.82	26.64	0.000***	-26.89	25.78	25.87	0.599	-2.86	89.38
	0.10	0.11	.	.	0.10	0.13	.	.	.
Ratio of CoV of avg. max temp. during 3 years before programme to LR	0.91	0.98	0.000***	-29.22					
					0.92	0.92	0.859	-0.92	96.85
	0.01	0.01	.	.	0.01	0.01	.	.	.
Avg. of cumulative annual rainfall (1980-2013)	1 627.72	1 610.79	0.512	3.14					
					1 653.87	1 638.74	0.608	2.81	10.65
	22.15	14.52	.	.	22.57	18.57	.	.	.
Ratio of CoV of avg. rain during 3 years before programme to LR	1.06	0.92	0.000***	29.77					
					1.04	1.04	0.922	0.52	98.25
	0.01	0.02	.	.	0.01	0.02	.	.	.
Tropical warm humid area (=1)	0.68	0.68	0.979	0.13	0.69	0.69	0.992	0.06	55.85
	0.02	0.02	.	.	0.02	0.02	.	.	.
Primary school in the village (=1)	0.32	0.24	0.000***	17.54	0.31	0.31	0.992	-0.06	100.34
	0.02	0.01	.	.	0.02	0.02	.	.	.

	Before matching				After matching			Reduction	
	Treated Mean/SE	Control Mean/SE	p-value	Bias	Treated Mean/SE	Control Mean/SE	p-value	Bias	in Bias (%)
Health facility in the village (=1)	0.25	0.12	0.000***	32.88	0.22	0.20	0.390	4.91	85.07
	0.02	0.01	.	.	0.02	0.02	.	.	.
No. of observations	788	916	.	.	750	611	.	.	.

Note. Point estimates are sample means with standard errors reported below. The matched sample is weighted using sample weights generated by PSM. Asterisks indicate the level of statistical significance of the t-test/chi-squared test of difference in means: *** < 0.01; ** < 0.05; * < 0.10.

D – Summary statistics

Table D1. AEP-Youth descriptive statistics.

Variable	Average values		
	All sample	Treated	Control
Variables in the IPWRA outcome equation			
Youth is household head (=1)	0.60	0.60	0.60
Youth is female (=1)	0.45	0.45	0.44
Youth age	32.46	32.50	32.41
Youth with no formal education (=1)	0.01	0.01	0.01
Youth with primary education (=1)	0.15	0.15	0.15
Youth worked in farm activity at baseline (=1)	0.66	0.65	0.66
Youth was a student at baseline (=1)	0.12	0.13	0.12
Youth was unemployed at baseline (=1)	0.03	0.03	0.03
Youth worked in wage employment at baseline (=1)	0.05	0.05	0.05
Number of household members at baseline	3.33	3.33	3.32
Dependency ratio at baseline	0.58	0.57	0.58
If household owned land at baseline (=1)	0.40	0.40	0.40
Land owned at baseline (Ha.)	2.05	2.26	1.84
If household owned livestock at baseline (=1)	0.26	0.26	0.26
Livestock owned at baseline (TLU)	0.94	0.98	0.91
PCA index of durable assets at baseline (normalized 0-1)	0.09	0.09	0.09
MCA index of housing characteristics at baseline (normalized 0-1)	0.65	0.65	0.65
Household experienced a shock in previous 12 months (=1)	0.78	0.80	0.77
If household accessed to loan (=1)	0.34	0.43	0.25
Total seasonal rain 2023	4,485	4,473	4,496
No. of dry dekads during rainy season 2023	0.54	0.51	0.57
Avg. mean temperature during agricultural season 2023	23.03	23.05	23.01
Avg. EVI during agricultural season 2023	0.30	0.30	0.30
Travel time to the next 5-10k city (in minutes)	91.04	85.03	97.05
Variables associated with individual impacts			
Youth is household head (=1)		0.60	
Youth is female (=1)		0.45	
Youth age		32.50	
Youth with primary education (=1)		0.15	
Youth with secondary education (=1)		0.24	
Youth with tertiary education and above (=1)		0.59	
Number of household members at baseline		3.33	
Dependency ratio at baseline		0.57	
Housing characteristics index (0-1)		0.65	
Total annual rainfall (avg. 2006-2015)		6,373	
Travel time to the next 5-10k city (in minutes)		85.03	
Outcome variables			
Youth gross income (in hundreds of international dollars, 2023 values)	167.59	211.83	123.35
Probability of youth engaging in income-generation	0.83	0.88	0.79
Youth impact (in hundreds of international dollars, 2023 values)		84.35	

Variable	Average values		
	All sample	Treated	Control
If youth impact is above the average		0.49	
Youth gross income in crop activities (in hundreds of international dollars, 2023 values)	18.33	21.79	14.87
Probability of youth engaging in crop activities	0.34	0.32	0.35
Youth gross income in livestock activities (in hundreds of international dollars, 2023 values)	65.44	93.96	36.92
Probability of youth engaging in livestock activities	0.46	0.55	0.37
Youth gross income in non-farm activities (in hundreds of international dollars, 2023 values)	83.82	96.08	71.57
Probability of youth engaging in non-farm activities	0.46	0.49	0.43

Note. Values are sample means weighted using the analytical weights generated by PSM. The number of observations is 2,023 households (1,055 treated and 968 control groups), except for the youth impact that is computed only on the 1,055 treated households.

Table D2. FORMAPROD descriptive statistics.

Variable	Average values		
	All sample	Treated	Control
Variables in the IPWRA outcome equation			
Youth is female (=1)	0.45	0.45	0.46
Youth age	26.42	26.20	26.64
Youth with no formal education (=1)	0.33	0.32	0.33
Youth with primary education (=1)	0.06	0.06	0.06
Youth married at baseline (=1)	0.26	0.26	0.27
Youth worked in farm activity at baseline (=1)	0.43	0.43	0.43
Youth was a student at baseline (=1)	0.31	0.31	0.31
Youth was unemployed at baseline (=1)	0.20	0.21	0.19
Youth worked in wage employment at baseline (=1)	0.05	0.05	0.05
Number of household members at baseline	5.70	5.65	5.76
Dependency ratio at baseline	1.53	1.48	1.57
Hectares managed by youth at baseline	0.31	0.29	0.33
Livestock assets index at baseline	0.04	0.03	0.04
MCA index of housing characteristics at baseline (normalized 0-1)	0.19	0.18	0.20
Avg. max temperature during agricultural season	26.03	25.94	26.12
Total rainfall during the agricultural season	1,704	1,716	1,692
Tropical warm humid area (=1)	0.69	0.69	0.69
Primary school in the village (=1)	0.31	0.31	0.31
Health facility in the village (=1)	0.21	0.22	0.20
Household experienced a shock in previous 12 months (=1)	0.93	0.95	0.91
Area with a development programme of agricultural value chains (=1)	0.19	0.17	0.21
If household accessed to loan (=1)	0.05	0.07	0.04
Variables associated with individual impacts			
Youth is household head (=1)		0.53	
Youth is female (=1)		0.45	
Youth age		26.20	
Youth with primary education (=1)		0.06	
Youth with secondary education (=1)		0.48	

Variable	Average values		
	All sample	Treated	Control
Youth with tertiary education and above (=1)		0.13	
Number of household members at baseline		5.65	
Dependency ratio at baseline		1.48	
Housing characteristics index (0-1)		0.18	
Total annual rainfall (avg. 2006-2015)		1,654	
Travel time to the next 5-10k city (in minutes)		67.31	
Outcome variables			
Youth gross income (in hundreds of international dollars, 2023 values)	16.51	18.78	14.25
Probability of youth engaging in income generation	0.93	0.94	0.92
Youth impact (in hundreds of international dollars, 2023 values)		5.33	
If youth impact is above the average		0.49	
Youth gross income in crop activities (in hundreds of international dollars, 2023 values)	15.76	17.76	13.76
Probability of youth engaging in crop activities	0.89	0.89	0.89
Youth gross income in livestock activities (in hundreds of international dollars, 2023 values)	0.75	1.01	0.49
Probability of youth engaging in livestock activities	0.32	0.43	0.22

Note. Values are sample means weighted using the analytical weights generated by PSM. The number of observations is 1,361 households (750 treated and 611 control groups), except for the youth impact which is computed only on the 778 treated households.

E – IPWRA estimation

Table E1. AEP-Youth impact - ATET estimates.

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
Average Treatment Effect on Treated (ATET)	84.35***	0.08***
	(13.79)	(0.02)
Potential Outcome Mean (POM)	127.47***	0.80***
	(13.31)	(0.02)
Outcome equation: Control group		
Youth is household head (=1)	25.22	-0.09
	(18.96)	(0.12)
Youth is female (=1)	-56.94***	-0.05
	(15.72)	(0.11)
Youth age	3.51	0.03**
	(2.16)	(0.01)
Youth with no formal education (=1)	-45.1	0.83
	(44.69)	(0.51)
Youth with primary education (=1)	14.04	-0.03
	(35.87)	(0.14)
Youth worked in farm activity at baseline (=1)	-69.94	-0.21
	(46.89)	(0.22)
Youth was a student at baseline (=1)	-98.23**	-0.31
	(41.85)	(0.22)
Youth was unemployed at baseline (=1)	-119.78***	-0.61**
	(44.38)	(0.24)
Youth worked in wage employment at baseline (=1)	-139.76***	-0.33
	(49.43)	(0.24)
Number of household members at baseline	-2.50	-0.06
	(6.93)	(0.04)
Dependency ratio at baseline	10.36	0.21**
	(14.65)	(0.08)
If household owned land at baseline (=1)	-7.79	-0.06
	(18.92)	(0.12)
Land owned at baseline (Ha.)	-0.07	0.01
	(0.57)	(0.01)
If household owned livestock at baseline (=1)	22.74	0.60***
	(31.46)	(0.15)
Livestock owned at baseline (TLU)	4.38	0.00
	(3.03)	(0.02)
PCA index of durable assets at baseline (normalized 0-1)	248.59**	0.06
	(109.70)	(0.36)
MCA index of housing characteristics at baseline (normalized 0-1)	-44.34	-1.35***
	(61.33)	(0.33)
Household experienced a shock in previous 12 months (=1)	14.81	0.09
	(19.25)	(0.14)
If household accessed to loan (=1)	20.73	0.43***
	(28.49)	(0.13)

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
Total seasonal rain 2023	0.01	0.00
	(0.01)	(0.00)
No. of dry dekads during rainy season 2023	-6.15	-0.19
	(16.74)	(0.13)
Avg. mean temperature during agricultural season 2023	1.35	-0.07*
	(5.51)	(0.04)
Avg. EVI during agricultural season 2023	-20.43	-0.15
	(143.64)	(0.74)
Travel time to the next 5-10k city (in minutes)	-0.02***	0.00
	(0.01)	(0.00)
Constant	-13.76	2.27*
	(194.81)	(1.18)
Outcome equation: Treated group		
Youth is household head (=1)	48.57	-0.01
	(30.62)	(0.16)
Youth is female (=1)	22.1	0.28**
	(25.54)	(0.13)
Youth age	1.16	0.03***
	(2.26)	(0.01)
Youth with no formal education (=1)	-89.99**	0.37
	(38.41)	(0.51)
Youth with primary education (=1)	-68.26***	-0.06
	(17.36)	(0.13)
Youth worked in farm activity at baseline (=1)	-70.71*	-0.01
	(40.64)	(0.14)
Youth was a student at baseline (=1)	-49.27	-0.34**
	(42.91)	(0.15)
Youth was unemployed at baseline (=1)	-77.28	-0.17
	(84.28)	(0.32)
Youth worked in wage employment at baseline (=1)	-85.79**	-0.02
	(41.39)	(0.25)
Number of household members at baseline	3.32	-0.09***
	(6.56)	(0.03)
Dependency ratio at baseline	1.44	0.13
	(16.91)	(0.09)
If household owned land at baseline (=1)	23.71	0.24*
	(26.64)	(0.13)
Land owned at baseline (Ha.)	0.22	0.01
	(0.56)	(0.01)
If household owned livestock at baseline (=1)	90.90***	0.58***
	(28.08)	(0.17)
Livestock owned at baseline (TLU)	6.89	0.02*
	(4.55)	(0.01)
PCA index of durable assets at baseline (normalized 0-1)	14.27	-0.35
	(153.84)	(0.59)

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
MCA index of housing characteristics at baseline (normalized 0-1)	261.46***	-0.50
	(69.12)	(0.46)
Household experienced a shock in previous 12 months (=1)	-6.19	-0.09
	(20.00)	(0.14)
If household accessed to loan (=1)	55.82**	0.20*
	(23.54)	(0.10)
Total seasonal rain 2023	0.01	0.00***
	(0.01)	(0.00)
No. of dry dekads during rainy season 2023	33.84	0.27
	(24.35)	(0.18)
Avg. mean temperature during agricultural season 2023	6.21	0.01
	(5.95)	(0.04)
Avg. EVI during agricultural season 2023	-79.11	1.77**
	(117.15)	(0.76)
Travel time to the next 5-10k city (in minutes)	-0.03***	-0.00**
	(0.01)	(0.00)
Constant	-214.29	-0.82
	(189.55)	(1.39)
Selection Equation		
Youth is female (=1)	0.12*	0.12*
	(0.07)	(0.07)
Youth age	0.02**	0.02**
	(0.01)	(0.01)
Youth with no formal education (=1)	-0.10	-0.10
	(0.23)	(0.23)
Youth with primary education (=1)	-0.04	-0.04
	(0.08)	(0.08)
Youth worked in farm activity at baseline (=1)	-0.08	-0.08
	(0.13)	(0.13)
Youth was a student at baseline (=1)	-0.24	-0.24
	(0.15)	(0.15)
Youth was unemployed at baseline (=1)	-0.35**	-0.35**
	(0.16)	(0.16)
Youth worked in wage employment at baseline (=1)	-0.24*	-0.24*
	(0.14)	(0.14)
Number of household members at baseline	-0.03*	-0.03*
	(0.02)	(0.02)
Dependency ratio at baseline	0.07	0.07
	(0.04)	(0.04)
If household owned land at baseline (=1)	-0.08	-0.08
	(0.06)	(0.06)
If household owned livestock at baseline (=1)	-0.02	-0.02
	(0.07)	(0.07)
PCA index of durable assets at baseline (normalized 0-1)	0.71**	0.71**
	(0.35)	(0.35)

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
MCA index of housing characteristics at baseline (normalized 0-1)	0.24	0.24
	(0.24)	(0.24)
Avg. of cumulative annual rainfall 2006-2015	0.00	0.00
	(0.00)	(0.00)
CoV of cumulative annual rainfall 2006-2015	-1.75	-1.75
	(4.54)	(4.54)
Avg. of annual mean temperature 2006-2015	0.12	0.12
	(0.08)	(0.08)
CoV of avg. annual mean temperature 2006-2015	140.65**	140.65**
	(66.08)	(66.08)
Avg. of Enhanced Vegetation Index (EVI) 2006-2015	1.32**	1.32**
	(0.61)	(0.61)
CoV of Enhanced Vegetation Index (EVI) 2006-2015	-2.04	-2.04
	(2.46)	(2.46)
Travel time to the next 5-10k city (in minutes)	0.00**	0.00**
	(0.00)	(0.00)
Constant	-5.07**	-5.07**
	(2.31)	(2.31)
No. of observations:	2,023	2,023
Treated	1,055	1,055
Control	968	968

Note. ATET is estimated using IPWRA, including covariates in the selection and outcome equations. POM indicates the potential outcome mean. Standard errors are clustered at the sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

Table E2. FORMAPROD impact - ATET estimates.

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
Average Treatment Effect on Treated (ATET)	5.33***	0.03
	(1.85)	(0.02)
Potential Outcome Mean (POM)	13.45***	0.91***
	(1.40)	(0.02)
Outcome equation: Control group		
Youth is female (=1)	1.22	-0.57***
	(1.79)	(0.17)
Youth age	-0.28*	0.00
	(0.16)	(0.02)
Youth with no formal education (=1)	-3.02	-0.67***
	(1.93)	(0.24)
Youth with primary education (=1)	-3.05	-0.16
	(2.25)	(0.33)
Youth married at baseline (=1)	-0.52	0.16
	(2.27)	(0.24)

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
Youth worked in farm activity at baseline (=1)	6.80	1.02
	(6.35)	(0.70)
Youth was a student at baseline (=1)	0.26	0.18
	(5.89)	(0.67)
Youth was unemployed at baseline (=1)	1.85	-0.4
	(5.98)	(0.71)
Youth worked in wage employment at baseline (=1)	0.58	-0.59
	(6.49)	(0.72)
Number of household members at baseline	-0.77	-0.02
	(0.47)	(0.04)
Dependency ratio at baseline	2.69***	0.07
	(1.02)	(0.08)
Hectares managed by youth at baseline	4.40***	
	(1.58)	
Livestock assets index at baseline	16.90*	
	(10.24)	
MCA index of housing characteristics at baseline (normalized 0-1)	18.56**	-1.01
	(7.70)	(0.90)
Avg. max temperature during agricultural season	-0.13	-0.07*
	(0.46)	(0.04)
Total rainfall during the agricultural season	0.00	0.00**
	(0.00)	(0.00)
Tropical warm humid area (=1)	-1.20	0.20
	(2.65)	(0.24)
Primary school in the village (=1)	2.81	0.36
	(3.67)	(0.30)
Health facility in the village (=1)	3.03	-0.12
	(5.21)	(0.31)
Household experienced a shock in previous 12 months (=1)	-3.55	0.85**
	(4.91)	(0.35)
Area with a development programme of agricultural value chains (=1)	-0.28	0.25
	(5.05)	(0.29)
If household accessed to loan (=1)	15.28*	
	(8.88)	
Constant	15.27	1.96
	(19.21)	(1.65)
Outcome equation: Treated group		
Youth is female (=1)	-2.53	-0.08
	(1.89)	(0.16)
Youth age	-0.24	0.03
	(0.28)	(0.02)
Youth with no formal education (=1)	-3.86**	0.06
	(1.79)	(0.17)
Youth with primary education (=1)	-6.34**	0.09

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
	(2.64)	(0.29)
Youth married at baseline (=1)	1.31	0.20
	(2.83)	(0.20)
Youth worked in farm activity at baseline (=1)	-18.67	0.95**
	(21.56)	(0.46)
Youth was a student at baseline (=1)	-18.06	0.53
	(20.90)	(0.40)
Youth was unemployed at baseline (=1)	-19.23	0.85*
	(21.01)	(0.44)
Youth worked in wage employment at baseline (=1)	-18.06	0.85**
	(21.60)	(0.39)
Number of household members at baseline	0.24	0.00
	(0.48)	(0.03)
Dependency ratio at baseline	-2.49***	-0.06
	(0.91)	(0.07)
Hectares managed by youth at baseline	14.27***	
	(2.95)	
Livestock assets index at baseline	8.18	
	(6.30)	
MCA index of housing characteristics at baseline (normalized 0-1)	10.5	0.67
	(7.74)	(0.72)
Avg. max temperature during agricultural season	-0.14	0.04
	(0.34)	(0.05)
Total rainfall during the agricultural season	0.00	0.00
	(0.00)	(0.00)
Tropical warm humid area (=1)	-4.46	-0.42
	(2.96)	(0.27)
Primary school in the village (=1)	1.36	-0.46**
	(2.41)	(0.20)
Health facility in the village (=1)	-4.05*	-0.49**
	(2.26)	(0.22)
Household experienced a shock in previous 12 months (=1)	4.11	0.29
	(2.92)	(0.32)
Area with a development programme of agricultural value chains (=1)	5.65*	0.35
	(3.06)	(0.29)
If household accessed to loan (=1)	-0.80	
	(2.29)	
Constant	43.59*	-1.19
	(25.80)	(1.50)
Selection Equation		
Youth is female (=1)	-0.23**	-0.23**
	(0.09)	(0.09)
Youth age	0.05***	0.05***
	(0.01)	(0.01)

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)	Probability of youth engaging in income-generating activity
Youth with no formal education (=1)	-1.13***	-1.13***
	(0.11)	(0.11)
Youth with primary education (=1)	-1.16***	-1.16***
	(0.14)	(0.14)
Youth married at baseline (=1)	-0.25***	-0.25***
	(0.10)	(0.10)
Youth worked in farm activity at baseline (=1)	0.64	0.64
	(0.44)	(0.44)
Youth was a student at baseline (=1)	0.71	0.71
	(0.46)	(0.46)
Youth was unemployed at baseline (=1)	0.52	0.52
	(0.45)	(0.45)
Youth worked in wage employment at baseline (=1)	0.61	0.61
	(0.50)	(0.50)
Number of household members at baseline	0.01	0.01
	(0.02)	(0.02)
Dependency ratio at baseline	0.03	0.03
	(0.04)	(0.04)
Hectares managed by youth at baseline	-0.12*	-0.12*
	(0.06)	(0.06)
Livestock assets index at baseline	0.12	0.12
	(0.24)	(0.24)
MCA index of housing characteristics at baseline (normalized 0-1)	-0.03	-0.03
	(0.42)	(0.42)
Avg. of max temperature (1980-2013)	-0.03	-0.03
	(0.04)	(0.04)
Ratio of CoV of avg. max temp. during 3 years before programme to LR	-0.85*	-0.85*
	(0.51)	(0.51)
Avg. of cumulative annual rainfall (1980-2013)	0.00	0.00
	(0.00)	(0.00)
Ratio of CoV of avg. rain during 3 years before programme to LR	0.23	0.23
	(0.27)	(0.27)
Tropical warm humid area (=1)	-0.48**	-0.48**
	(0.24)	(0.24)
Primary school in the village (=1)	0.03	0.03
	(0.23)	(0.23)
Health facility in the village (=1)	0.49*	0.49*
	(0.28)	(0.28)
Constant	0.76	0.76
	(1.55)	(1.55)
No. of observations:	1,361	1,361
Treated	750	750
Control	611	611

Note. ATET is estimated using IPWRA, including covariates in the selection and outcome equations. POM indicates the potential outcome mean. Standard errors are clustered at the

sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

Table E3. AEP-Youth impact - ATET estimates disaggregated by income-generating activity.

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)			Probability of youth engaging in income-generating activity		
	Crop	Livestock	Non-farm	Crop	Livestock	Non-farm
Average Treatment Effect on Treated (ATET)	5.22	53.75***	25.39***	-0.04	0.18***	0.04*
	(3.38)	(8.05)	(9.78)	(0.03)	(0.02)	(0.02)
Potential Outcome Mean (POM)	16.57***	40.22***	70.69***	0.36***	0.37***	0.45***
	(2.58)	(6.91)	(10.32)	(0.03)	(0.03)	(0.03)
Outcome equation: Control group						
Youth is household head (=1)	9.76***	-1.38	16.84	-0.06	-0.24*	0.09
	(3.77)	(7.04)	(15.66)	(0.14)	(0.13)	(0.18)
Youth is female (=1)	-6.80**	-9.41	-40.74***	-0.17**	-0.19	0.08
	(2.99)	(5.99)	(12.58)	(0.09)	(0.13)	(0.10)
Youth age	-0.05	0.02	3.54**	0.02	0.03***	0.00
	(0.32)	(0.81)	(1.65)	(0.01)	(0.01)	(0.01)
Youth with no formal education (=1)	18.49	-4.92	-58.67***	0.69	-0.88**	0.47
	(18.95)	(22.83)	(22.19)	(0.45)	(0.42)	(0.30)
Youth with primary education (=1)	-2.07	-22.97**	39.08	0.07	-0.35**	0.21*
	(4.47)	(9.02)	(33.28)	(0.13)	(0.15)	(0.11)
Youth worked in farm activity at baseline (=1)	10.56**	16.99*	-97.49**	0.31*	0.41**	-0.91***
	(4.28)	(10.27)	(42.07)	(0.16)	(0.17)	(0.17)
Youth was a student at baseline (=1)	10.00*	-8.86	-99.37***	0.26	0.3	-0.89***
	(6.05)	(10.15)	(37.34)	(0.22)	(0.23)	(0.20)
Youth was unemployed at baseline (=1)	9.11	-3.33	-125.57***	-0.29	0.24	-0.96***
	(7.69)	(11.84)	(41.55)	(0.30)	(0.29)	(0.20)
Youth worked in wage employment at baseline (=1)	6.46	-9.41	-136.81***	0.42*	0.02	-0.92***
	(5.01)	(11.40)	(45.42)	(0.25)	(0.20)	(0.23)
Number of household members at baseline	1.87**	1.44	-5.81	0.05	-0.04	-0.09*
	(0.88)	(3.67)	(5.50)	(0.04)	(0.04)	(0.04)
Dependency ratio at baseline	-2.50	6.79*	6.07	0.01	0.12	0.13
	(2.12)	(3.62)	(12.58)	(0.06)	(0.08)	(0.09)
If household owned land at baseline (=1)	6.33	-7.41	-6.7	0.60***	-0.19*	-0.14
	(4.34)	(6.79)	(15.71)	(0.11)	(0.11)	(0.12)
Land owned at baseline (Ha.)	0.17	0.16	-0.39	-0.01**	0.00	0.01*
	(0.22)	(0.36)	(0.51)	(0.01)	(0.00)	(0.00)
If household owned livestock at baseline (=1)	-4.81	32.30***	-4.74	-0.48***	1.31***	0.12
	(3.74)	(11.49)	(24.37)	(0.15)	(0.12)	(0.10)
Livestock owned at baseline (TLU)	-0.29	3.96*	0.71	-0.01	0.02	0.00
	(0.21)	(2.17)	(1.57)	(0.02)	(0.02)	(0.01)
PCA index of durable assets at baseline (normalized 0-1)	-15.42	89.49	174.51**	0.30	-0.11	-0.43
	(11.67)	(56.54)	(80.12)	(0.49)	(0.39)	(0.43)
MCA index of housing characteristics at baseline (normalized 0-1)	3.58	23.25	-71.17	-0.97***	-0.24	-0.65**
	(11.32)	(21.87)	(50.45)	(0.37)	(0.37)	(0.32)
	-2.46	-5.67	22.94	0.13	0.06	0.11

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)			Probability of youth engaging in income-generating activity		
	Crop	Livestock	Non-farm	Crop	Livestock	Non-farm
Household experienced a shock in previous 12 months (=1)	(4.41)	(8.77)	(14.91)	(0.12)	(0.11)	(0.11)
If household accessed to loan (=1)	6.62*	17.44	-3.34	0.23	0.13	0.12
	(3.90)	(10.96)	(21.69)	(0.14)	(0.12)	(0.11)
Total seasonal rain 2023	0.00**	0.00	0.01**	0.00**	0.00	0.00
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
No. of dry dekads during rainy season 2023	2.51	-9.01	0.36	0.12	-0.03	0.00
	(3.81)	(12.79)	(10.84)	(0.12)	(0.18)	(0.10)
Avg. mean temperature during agricultural season 2023	1.87*	2.35	-2.87	0.00	-0.01	-0.09***
	(0.99)	(2.45)	(4.92)	(0.02)	(0.04)	(0.03)
Avg. EVI during agricultural season 2023	61.54**	-58.57	-23.4	1.88**	-1.34*	-0.67
	(27.69)	(52.05)	(123.57)	(0.75)	(0.74)	(0.60)
Travel time to the next 5-10k city (in minutes)	0.00	-0.01***	-0.01**	0.00	0.00	-0.00***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Constant	-82.85**	-17.73	86.82	-2.25**	-0.75	3.10***
	(38.74)	(102.35)	(165.98)	(1.15)	(1.39)	(1.02)
Outcome equation: Treated group						
Youth is household head (=1)	6.01	15.16	27.39	0.03	-0.21*	0.15
	(3.87)	(19.88)	(19.73)	(0.13)	(0.12)	(0.12)
Youth is female (=1)	-17.01***	19.77	19.34	-0.46***	0.05	0.33***
	(3.01)	(15.67)	(20.80)	(0.12)	(0.08)	(0.10)
Youth age	0.02	0.05	1.09	0.01	0.01	0.01
	(0.38)	(1.34)	(1.53)	(0.01)	(0.01)	(0.01)
Youth with no formal education (=1)	-21.23***	-40.18	-28.58	-0.26	-0.16	0.13
	(4.97)	(27.82)	(22.90)	(0.34)	(0.33)	(0.31)
Youth with primary education (=1)	-4.23	-45.66***	-18.37	0.17	-0.15	0.11
	(5.85)	(11.44)	(12.71)	(0.13)	(0.14)	(0.12)
Youth worked in farm activity at baseline (=1)	7.34	26.23	-104.28***	0.13	0.57***	-0.78***
	(4.51)	(27.96)	(27.21)	(0.10)	(0.11)	(0.11)
Youth was a student at baseline (=1)	0.42	34.24	-83.93***	0.04	0.36**	-0.74***
	(7.06)	(34.07)	(24.94)	(0.15)	(0.17)	(0.14)
Youth was unemployed at baseline (=1)	-0.06	-6.37	-70.86	-0.29	0.47*	-0.72**
	(6.70)	(38.29)	(60.30)	(0.28)	(0.29)	(0.33)
Youth worked in wage employment at baseline (=1)	-5.82	48.18	-128.15***	-0.43*	0.61***	-0.66***
	(5.74)	(33.68)	(28.56)	(0.26)	(0.17)	(0.17)
Number of household members at baseline	0.75	4.20	-1.63	-0.09***	-0.05*	-0.04
	(1.34)	(4.10)	(4.47)	(0.02)	(0.02)	(0.02)
Dependency ratio at baseline	1.99	-5.04	4.50	0.19**	0.11	-0.01
	(2.58)	(8.01)	(13.65)	(0.08)	(0.08)	(0.06)
If household owned land at baseline (=1)	10.20**	-4.01	17.52	0.58***	-0.30***	0.13
	(4.11)	(14.53)	(19.98)	(0.10)	(0.10)	(0.11)
	0.09	0.18	-0.05	0.00	0.01	0.00

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)			Probability of youth engaging in income-generating activity		
	Crop	Livestock	Non-farm	Crop	Livestock	Non-farm
Land owned at baseline (Ha.)	(0.14)	(0.41)	(0.28)	(0.00)	(0.00)	(0.00)
If household owned livestock at baseline (=1)	0.4	66.33***	24.17	-0.02	1.37***	0.04
	(5.82)	(20.48)	(15.39)	(0.13)	(0.10)	(0.09)
Livestock owned at baseline (TLU)	-0.53**	1.36	6.06*	-0.03**	-0.01	0.00
	(0.22)	(1.66)	(3.23)	(0.01)	(0.01)	(0.01)
PCA index of durable assets at baseline (normalized 0-1)	-47.92***	1.4	60.79	-0.68	-0.32	-0.54
	(15.11)	(100.31)	(91.84)	(0.53)	(0.45)	(0.45)
MCA index of housing characteristics at baseline (normalized 0-1)	-7.57	144.55***	124.47***	-0.59*	0.04	0.28
	(12.43)	(45.79)	(40.66)	(0.33)	(0.30)	(0.27)
Household experienced a shock in previous 12 months (=1)	-2.16	5.21	-9.24	0.17	-0.04	0.23**
	(4.84)	(12.64)	(16.19)	(0.13)	(0.10)	(0.10)
If household accessed to loan (=1)	10.15*	35.49**	10.18	0.25**	0.16**	0.17**
	(5.22)	(17.40)	(14.55)	(0.11)	(0.08)	(0.08)
Total seasonal rain 2023	0.00	-0.01	0.02**	0.00	0.00	0.00*
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
No. of dry dekads during rainy season 2023	-1.54	-7.93	43.31***	-0.04	0.20*	0.16
	(4.92)	(15.93)	(15.42)	(0.15)	(0.10)	(0.14)
Avg. mean temperature during agricultural season 2023	-1.94	4.04	4.10	-0.02	-0.04	-0.03
	(2.26)	(3.34)	(4.94)	(0.04)	(0.03)	(0.04)
Avg. EVI during agricultural season 2023	22.03	-76.77	-24.37	1.67***	0.06	-0.07
	(25.39)	(72.34)	(100.66)	(0.64)	(0.61)	(0.65)
Travel time to the next 5-10k city (in minutes)	-0.01***	0.00	-0.01***	-0.00**	0.00**	-0.00***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	55.89	-116.41	-153.77	-0.41	0.28	0.26
	(51.39)	(89.60)	(173.60)	(1.23)	(0.85)	(1.18)
Selection Equation						
Youth is female (=1)	0.12*	0.12*	0.12*	0.12*	0.12*	0.12*
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Youth age	0.02**	0.02**	0.02**	0.02**	0.02**	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Youth with no formal education (=1)	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)
Youth with primary education (=1)	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Youth worked in farm activity at baseline (=1)	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
Youth was a student at baseline (=1)	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Youth was unemployed at baseline (=1)	-0.35**	-0.35**	-0.35**	-0.35**	-0.35**	-0.35**
	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
	-0.24*	-0.24*	-0.24*	-0.24*	-0.24*	-0.24*

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)			Probability of youth engaging in income-generating activity		
	Crop	Livestock	Non-farm	Crop	Livestock	Non-farm
Youth worked in wage employment at baseline (=1)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Number of household members at baseline	-0.03*	-0.03*	-0.03*	-0.03*	-0.03*	-0.03*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Dependency ratio at baseline	0.07	0.07	0.07	0.07	0.07	0.07
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
If household owned land at baseline (=1)	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
If household owned livestock at baseline (=1)	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
PCA index of durable assets at baseline (normalized 0-1)	0.71**	0.71**	0.71**	0.71**	0.71**	0.71**
	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
MCA index of housing characteristics at baseline (normalized 0-1)	0.24	0.24	0.24	0.24	0.24	0.24
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)
Avg. of cumulative annual rainfall 2006-2015	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CoV of cumulative annual rainfall 2006-2015	-1.75	-1.75	-1.75	-1.75	-1.75	-1.75
	(4.54)	(4.54)	(4.54)	(4.54)	(4.54)	(4.54)
Avg. of annual mean temperature 2006-2015	0.12	0.12	0.12	0.12	0.12	0.12
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
CoV of avg. annual mean temperature 2006-2015	140.65**	140.65**	140.65**	140.65**	140.65**	140.65**
	(66.08)	(66.08)	(66.08)	(66.08)	(66.08)	(66.08)
Avg. of Enhanced Vegetation Index (EVI) 2006-2015	1.32**	1.32**	1.32**	1.32**	1.32**	1.32**
	(0.61)	(0.61)	(0.61)	(0.61)	(0.61)	(0.61)
CoV of Enhanced Vegetation Index (EVI) 2006-2015	-2.04	-2.04	-2.04	-2.04	-2.04	-2.04
	(2.46)	(2.46)	(2.46)	(2.46)	(2.46)	(2.46)
Travel time to the next 5-10k city (in minutes)	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-5.07**	-5.07**	-5.07**	-5.07**	-5.07**	-5.07**
	(2.31)	(2.31)	(2.31)	(2.31)	(2.31)	(2.31)
No. of observations:	2,023	2,023	2,023	2,023	2,023	2,023
Treated	1,055	1,055	1,055	1,055	1,055	1,055
Control	968	968	968	968	968	968

Note. ATET is estimated using IPWRA, including covariates in the selection and outcome equations. POM indicates the potential outcome mean. Standard errors are clustered at the sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

Table E4. FORMAPROD impact - ATET estimates disaggregated by income-generating activity.

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)		Probability of youth engaging in income-generating activity	
	Crop	Livestock	Crop	Livestock
Average Treatment Effect on Treated (ATET)	4.84***	0.49***	0.00	0.20***
	(1.86)	(0.18)	(0.02)	(0.04)
Potential Outcome Mean (POM)	12.92***	0.53***	0.89***	0.22***
	(1.40)	(0.14)	(0.02)	(0.02)
Outcome equation: Control group				
Youth is female (=1)	1.55	-0.32	-0.42**	-0.25*
	(1.81)	(0.22)	(0.18)	(0.14)
Youth age	-0.27*	-0.01	0.00	0.00
	(0.16)	(0.02)	(0.02)	(0.02)
Youth with no formal education (=1)	-3.47*	0.45*	-0.50**	0.11
	(1.92)	(0.26)	(0.21)	(0.17)
Youth with primary education (=1)	-3.22	0.17	-0.23	0.30
	(2.24)	(0.26)	(0.29)	(0.24)
Youth married at baseline (=1)	-0.28	-0.24	-0.07	-0.29
	(2.27)	(0.27)	(0.28)	(0.22)
Youth worked in farm activity at baseline (=1)	6.81	-0.01	1.37**	0.45
	(6.17)	(0.43)	(0.69)	(0.40)
Youth was a student at baseline (=1)	0.49	-0.23	0.17	0.61
	(5.66)	(0.45)	(0.65)	(0.41)
Youth was unemployed at baseline (=1)	1.91	-0.06	-0.33	0.59
	(5.81)	(0.46)	(0.70)	(0.42)
Youth worked in wage employment at baseline (=1)	0.40	0.19	-0.12	0.37
	(6.27)	(0.64)	(0.71)	(0.45)
Number of household members at baseline	-0.81*	0.04	0.01	0.03
	(0.47)	(0.03)	(0.04)	(0.03)
Dependency ratio at baseline	2.83***	-0.14	0.05	-0.12
	(0.99)	(0.09)	(0.08)	(0.09)
Hectares managed by youth at baseline	4.05***	0.34		0.23*
	(1.55)	(0.24)		(0.12)
Livestock assets index at baseline	15.14	1.76*	3.81***	1.35***
	(10.23)	(0.98)	(0.26)	(0.48)
MCA index of housing characteristics at baseline (normalized 0-1)	17.11**	1.45	-0.66	-1.34*
	(7.77)	(0.95)	(0.72)	(0.70)
Avg. max temperature during agricultural season	-0.07	-0.05	-0.02	-0.10***
	(0.46)	(0.06)	(0.04)	(0.03)
Total rainfall during the agricultural season	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Tropical warm humid area (=1)	-0.79	-0.41	0.43*	-0.06
	(2.62)	(0.30)	(0.25)	(0.21)
Primary school in the village (=1)	2.11	0.70	0.38	-0.07
	(3.66)	(0.46)	(0.30)	(0.25)
Health facility in the village (=1)	3.67	-0.64*	-0.04	-0.12
	(5.28)	(0.33)	(0.33)	(0.31)
	-3.68	0.12	1.32***	-0.38

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)		Probability of youth engaging in income-generating activity	
	Crop	Livestock	Crop	Livestock
Household experienced a shock in previous 12 months (=1)	-0.25	-0.02	0.06	-0.2
	(5.19)	(0.29)	(0.35)	(0.31)
Area with a development programme of agricultural value chains (=1)	13.97	1.32		-0.39
	(9.10)	(1.10)		(0.26)
If household accessed to loan (=1)	13.58	1.69	-0.49	2.45*
	(19.33)	(2.24)	(1.69)	(1.31)
Constant				
Outcome equation: Treated group				
Youth is female (=1)	-2.43	-0.10	-0.30**	0.11
	(1.88)	(0.21)	(0.13)	(0.12)
Youth age	-0.29	0.05*	0.02	0.01
	(0.28)	(0.03)	(0.02)	(0.01)
Youth with no formal education (=1)	-3.34*	-0.53***	0.09	-0.18
	(1.75)	(0.17)	(0.15)	(0.12)
Youth with primary education (=1)	-6.56***	0.21	0.06	0.11
	(2.32)	(0.81)	(0.28)	(0.21)
Youth married at baseline (=1)	1.21	0.11	0.30	0.00
	(2.82)	(0.25)	(0.19)	(0.12)
Youth worked in farm activity at baseline (=1)	-17.16	-1.51	1.55***	0.58
	(19.73)	(1.93)	(0.54)	(0.55)
Youth was a student at baseline (=1)	-17.03	-1.02	0.93*	0.5
	(19.10)	(1.93)	(0.55)	(0.56)
Youth was unemployed at baseline (=1)	-17.39	-1.85	1.45***	0.28
	(19.21)	(1.89)	(0.56)	(0.57)
Youth worked in wage employment at baseline (=1)	-15.75	-2.31	1.66***	-0.05
	(19.83)	(1.90)	(0.57)	(0.58)
Number of household members at baseline	0.20	0.04	-0.01	0.03
	(0.47)	(0.05)	(0.04)	(0.03)
Dependency ratio at baseline	-2.40***	-0.09	0.00	-0.08*
	(0.87)	(0.11)	(0.07)	(0.05)
Hectares managed by youth at baseline	14.32***	-0.05		-0.14
	(2.88)	(0.14)		(0.09)
Livestock assets index at baseline	5.24	2.94***	4.29***	1.82***
	(5.99)	(0.84)	(0.59)	(0.39)
MCA index of housing characteristics at baseline (normalized 0-1)	11.8	-1.30	0.89	-0.44
	(7.55)	(0.83)	(0.63)	(0.41)
Avg. max temperature during agricultural season	-0.01	-0.12***	0.03	-0.06*
	(0.34)	(0.05)	(0.04)	(0.03)
Total rainfall during the agricultural season	0.00	0.00	0.00**	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Tropical warm humid area (=1)	-3.5	-0.96***	-0.29	-0.14
	(2.88)	(0.32)	(0.19)	(0.18)
Primary school in the village (=1)	0.68	0.68**	-0.49***	0.11

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)		Probability of youth engaging in income-generating activity	
	Crop	Livestock	Crop	Livestock
	(2.38)	(0.34)	(0.17)	(0.16)
Health facility in the village (=1)	-4.33**	0.28	-0.33*	0.07
	(2.12)	(0.37)	(0.19)	(0.19)
Household experienced a shock in previous 12 months (=1)	3.58	0.52*	-0.13	0.23
	(2.84)	(0.30)	(0.32)	(0.23)
Area with a development programme of agricultural value chains (=1)	4.75	0.89*	0.11	0.03
	(3.06)	(0.51)	(0.26)	(0.20)
If household accessed to loan (=1)	-2.12	1.33*		-0.11
	(2.07)	(0.77)		(0.30)
Constant	39.58*	4.02	-1.27	-0.17
	(24.06)	(2.63)	(1.30)	(1.15)
Selection Equation				
Youth is female (=1)	-0.23**	-0.23**	-0.23**	-0.23**
	(0.09)	(0.09)	(0.09)	(0.09)
Youth age	0.05***	0.05***	0.05***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)
Youth with no formal education (=1)	-1.13***	-1.13***	-1.13***	-1.13***
	(0.11)	(0.11)	(0.11)	(0.11)
Youth with primary education (=1)	-1.16***	-1.16***	-1.16***	-1.16***
	(0.14)	(0.14)	(0.14)	(0.14)
Youth married at baseline (=1)	-0.25***	-0.25***	-0.25***	-0.25***
	(0.10)	(0.10)	(0.10)	(0.10)
Youth worked in farm activity at baseline (=1)	0.64	0.64	0.64	0.64
	(0.44)	(0.44)	(0.44)	(0.44)
Youth was a student at baseline (=1)	0.71	0.71	0.71	0.71
	(0.46)	(0.46)	(0.46)	(0.46)
Youth was unemployed at baseline (=1)	0.52	0.52	0.52	0.52
	(0.45)	(0.45)	(0.45)	(0.45)
Youth worked in wage employment at baseline (=1)	0.61	0.61	0.61	0.61
	(0.50)	(0.50)	(0.50)	(0.50)
Number of household members at baseline	0.01	0.01	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.02)
Dependency ratio at baseline	0.03	0.03	0.03	0.03
	(0.04)	(0.04)	(0.04)	(0.04)
Hectares managed by youth at baseline	-0.12*	-0.12*	-0.12*	-0.12*
	(0.06)	(0.06)	(0.06)	(0.06)
Livestock assets index at baseline	0.12	0.12	0.12	0.12
	(0.24)	(0.24)	(0.24)	(0.24)
MCA index of housing characteristics at baseline (normalized 0-1)	-0.03	-0.03	-0.03	-0.03
	(0.42)	(0.42)	(0.42)	(0.42)
Avg. of max temperature (1980-2013)	-0.03	-0.03	-0.03	-0.03
	(0.04)	(0.04)	(0.04)	(0.04)
	-0.85*	-0.85*	-0.85*	-0.85*

	Gross income of youth-led activity, in hundreds of international dollars (2023 values)		Probability of youth engaging in income-generating activity	
	Crop	Livestock	Crop	Livestock
Ratio of CoV of avg. max temp. during 3 years before programme to LR				
	(0.51)	(0.51)	(0.51)	(0.51)
Avg. of cumulative annual rainfall (1980-2013)	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Ratio of CoV of avg. rain during 3 years before programme to LR	0.23	0.23	0.23	0.23
	(0.27)	(0.27)	(0.27)	(0.27)
Tropical warm humid area (=1)	-0.48**	-0.48**	-0.48**	-0.48**
	(0.24)	(0.24)	(0.24)	(0.24)
Primary school in the village (=1)	0.03	0.03	0.03	0.03
	(0.23)	(0.23)	(0.23)	(0.23)
Health facility in the village (=1)	0.49*	0.49*	0.49*	0.49*
	(0.28)	(0.28)	(0.28)	(0.28)
Constant	0.76	0.76	0.76	0.76
	(1.55)	(1.55)	(1.55)	(1.55)
No. of observations:	1,361	1,361	1,361	1,361
Treated	750	750	750	750
Control	611	611	611	611

Note. ATET is estimated using IPWRA, including covariates in the selection and outcome equations. POM indicates the potential outcome mean. Standard errors are clustered at the sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

F – Robustness checks

Table F1. AEP-Youth impact – Robustness check.

	IPWRA (1)	RA	IPW	IPWRA (2)
Average Treatment Effect on Treated (ATET)	84.35***	83.05***	88.89***	86.64***
	(13.79)	(13.78)	(13.90)	(14.06)
Potential Outcome Mean (POM)	127.47***	128.78***	122.94***	154.96***
	(13.31)	(13.25)	(11.33)	(13.90)
Selection equation	YES	NO	YES	YES
Outcome equation	YES	YES	NO	YES
No. of observations	2,023	2,023	2,023	1,652
Treated	1,055	1,055	1,055	925
Control	968	968	968	727

Note. IPWRA (1) is the model estimated in the analysis; RA indicates the Regression Adjustment model; IPW indicates Inverse-Probability Weighting; IPWRA (2) is the IPWRA model estimated only on observations with positive gross income. Standard errors are clustered at the sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

Table F2. FORMAPROD impact – Robustness check.

	IPWRA (1)	RA	IPW	IPWRA (2)
Average Treatment Effect on Treated (ATET)	5.33***	5.20***	4.71**	5.35***
	(1.85)	(1.79)	(2.14)	(1.96)
Potential Outcome Mean (POM)	13.45***	13.58***	14.07***	14.71***
	(1.40)	(1.37)	(1.82)	(1.46)
Selection equation	YES	NO	YES	YES
Outcome equation	YES	YES	NO	YES
No. of observations	1,361	1,361	1,361	1,232
Treated	750	750	750	702
Control	611	611	611	503

Note. IPWRA (1) is the model estimated in the analysis; RA indicates the Regression Adjustment model; IPW indicates Inverse-Probability Weighting; IPWRA (2) is the IPWRA model estimated only on observations with positive gross income. Standard errors are clustered at the sampling unit and reported in parentheses. Asterisks indicate the level of statistical significance: * < 0.10; ** < 0.05; *** < 0.01.

Table F3. Average individual-level impacts by educational levels.

	AEP-Youth	FORMAPROD
Youth with no formal education	31.05	5.67
Youth with primary education	-1.50	2.79

Note. Values are sample means of the individual impacts expressed in hundreds of international dollars (2023 values).