RI

Philippines

Second Cordillera Highland Agricultural Resource Management Project
(CHARMP2)

Authors:

Marup Hossain, Vibhuti Mendiratta, Athur Mabiso,
Hugues Robinson Toguem

IFAD
Investing in rural people

Acknowledgements

List of acronyms

AFFS	Agroforestry Farmer Field Schools
ATET	Average Treatment Effect on the Treated
CAR	Cordillera Administrative Region
CHARMP	Cordillera Highland Agricultural Resource Management Project
CHARMP2	Second Cordillera Highland Agricultural Resource Management Project
FFS	Farmer Field Schools
FGD	Focus Group Discussions
FIES	Food Insecurity Experience Scale
GAP	Good Agricultural Practices
HDD	Household Dietary Diversity
HDI	Human Development Index
IA	Impact Assessment
IFAD	International Fund for Agricultural Development
IPs	Indigenous Peoples
IPWRA	Inverse Probability Weighted Regression Adjustment
M&E	Monitoring and Evaluation
MFI	Micro-finance institution
MT	Mainstreaming Theme
OG	Overarching Goal
OSM	OpenStreetMap
PHP	Philippine Peso
RQ	Research Questions
SO	Strategic Objective
ToC	Theory of Change
VC	Value Chain

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Executive summary

The Cordillera Administrative Region (CAR) in northern Philippines mostly hosts traditional Indigenous Peoples (IP) communities, where poverty rates are historically high partly because of its landlocked location, rugged terrain and poor access roads. A significant portion of the population in the CAR is dependent on subsistence agriculture, facing challenges such as deforestation, climate change, and poor access to market and technical support services.

To address these challenges, the International Fund for Agricultural Development (IFAD) launched the Second Cordillera Highland Agricultural Resource Management Project (CHARMP2) in 2008, which continued until 2021. The objective of CHARMP2 is to improve the livelihoods of poor households from the indigenous communities in the CAR through sustainable agricultural and agri-business development, improve land tenure security and food security, and conservation of watersheds and highland forests. To this end, CHARMP2 has provided a package of assistance at both community and household levels. The project delivered five components: (i) social mobilization & participatory investment planning; (ii) agroforestry and watershed management; (iii) agriculture, agribusiness and income-generating activities; and (iv) rural infrastructure development.

IFAD conducted an ex-post impact assessment (IA) of the CHARMP2 project to measure the attributable impacts of the project on its beneficiaries. The current IA study is part of the IFAD 11 Impact Assessment Series undertaken by the Research and Impact Assessment Division (RIA) of IFAD. Under the IFAD 11 IA series at least 15 percent of IFAD's portfolio of project investments closing during the IFAD 11 Replenishment period (i.e., 2019-2021) are evaluated through the ex-post impact assessment framework, in line with the Development Effectiveness Framework (DEF) of IFAD. This study was conducted between July 2021 and March 2022. The study entailed administering household and barangay-level surveys to collect data from 2,000 households (1,000 beneficiary households and 1,000 comparison households) and 100 barangays (50 beneficiary barangays and 50 comparison barangays). To select suitable comparison households that did not benefit from CHARMP2, the study combined a GPS coordinates-based household listing exercise complemented with a screening interview. For data analysis, the Inverse-Probability Weighted Regression Adjustment (IPWRA) method was used to identify impact estimates. Impacts of CHARMP2 are estimated on a set of indicators identified through the project's Theory of Change (ToC) and generate detailed lessons to be taken into account for future projects.

Results show that the CHARMP2 program beneficiaries have higher access to program benefits (15%), number of training services (125%), and loans (12%) compared to non-beneficiary households. Given the observed increase in benefits, it is no surprise that the CHARMP2 project has led to higher economic mobility, as observed by 32% higher gross income and 33% more productive assets among beneficiary households compared to non-beneficiary households. Results also indicate higher crop income among beneficiary households, which seems to not be driven by yield rate, but rather by other factors such as higher income from non-seasonal crops, higher land area cultivated and adoption of cash-oriented crops. In addition, even though the programme did not explicitly target livestock activities, it had positive impacts on livestock asset holdings, livestock activity participation (an 8 percentage point increase) and income from livestock.

Beneficiary households are 13% more likely to engage in selling their products in the market, although we do not find a significant change in their crop and livestock sales amount in the market. We find a lower level of food insecurity (improved food security) among the beneficiary households. Beneficiary households are also 4 percentage points more likely to recover from a shock than comparison households. Finally, it appears the

CHARMP2 project has generated only a moderate improvement in income controlled by women, but no such improvement in their asset ownership.

In terms of the main objective of the CHARMP2, improving the livelihoods of the poor households in the CAR, it appears that the project has achieved its goals by increasing household income of beneficiary households. There are a few lessons learned from this project, which can be useful to future designs of similar types of projects.

First, the project boosted household income including income from crops and livestock of its beneficiaries significantly. Higher income from crops was driven by commercial crops and more land under cultivation, not the yield rate. This implies that community level infrastructure projects have substantial potential for income gains and beneficial impacts on economic mobility of households.

Second, we find the program helps beneficiaries to engage in economic activities not directly targeted by the program, namely livestock, indicating the existence of spill-over effects. CHARMP2 had positive impacts on livestock asset holdings, livestock activity participation, and income from livestock. At the same time, households are also found to engage in more commercial crop farming. The development of community infrastructure, thus, promoted income diversification and made it more lucrative to engage in other activities. This is an important lesson learnt for the design of future community infrastructure programs.

Third, although 50% of the targeted beneficiaries of the CHARMP2 are women, we do not find concrete evidence of women empowerment in terms of asset ownership or income and sales controlled by them. Again, it may be the case that the program's benefits were mainly concentrated at the community level and women farmers were not able to benefit as opposed to male farmers. This highlights the need of tailoring the program components to address the differential constraints that women face as opposed to men. Future projects need to tailor components that address specific constraints that women may face. Lastly, limited impacts on resilience call for a more holistic approach to strengthening it.

Introduction

The Second Cordillera Highland Agricultural Resource Management Project (CHARMP2) is an IFAD-funded project implemented by the Department of Agriculture of the Government of Philippines in the Cordillera Administrative Region, Philippines. The CHARMP2 project was implemented in areas where poverty is most severe in all six provinces of the region, namely Abra, Apayao, Benguet, Ifugao, Kalinga, and Mountain Province. The project builds on the first Cordillera Highland Agricultural Resource Management Project (CHARMP), which contributed to reducing poverty among indigenous peoples (IPs) in the highlands of the Cordillera Region in the northern Philippines.

The objective of CHARMP2 is to improve the livelihoods of poor rural women and men in indigenous communities in the upland areas of the Cordillera Administrative Region through sustainable agricultural and agri-business development, improved land tenure security and food security, and conservation of watersheds and highland forests. The project aims to (i) increase the household income through sustainable agricultural development; and (ii) enhance quality of life at the community level by improving land tenure security, food security and watershed conservation. The CHARMP2 Project has five components: (i) Social Mobilization & Participatory Investment Planning; (ii) Agroforestry and Watershed Management; (iii) Agriculture, Agribusiness and Income Generating Activities; (iv) Rural Infrastructure Development and (v) Project Management and Coordination. Each barangay (village) targeted under the CHARMP2 program has received a package of assistance to address both community and household-level needs for poverty reduction.

CHARMP2 was initially approved for funding by IFAD in April 2008, with an original completion date of December 2015. Following the approved additional financing in 2016, the project's implementation was extended until June 30, 2021. The project was co-financed by IFAD and other domestic sources, as shown in Table 13 in the Appendix. IFAD covered about 51% of the project cost through direct funds, grants, and loans. Among others, the Philippines government covered 20% of the project cost, while the local government units covered an additional 12% of the project cost. In terms of the cost breakdown by project components (Table 14 in the Appendix), the rural infrastructure development (component 4) has the highest share, with about 55% of the total cost. Community watershed conservation, forest management, and agroforestry (component 2) comprised 16% of the total cost followed by another 11% by agriculture and agribusiness development, and income-generating activities (component 3).

According to the project completion report, the CHARMP2 project has been implemented in 188 Barangays from 37 highland municipalities in six provinces of the CAR. The total number of persons receiving services from the CHARMP2 project is estimated at 239,585 of which about 93% are indigenous people. About 51% of the project beneficiaries are women while only 2% of the beneficiaries are youth (age between 15 and 24 years).

This study presents the results of an ex-post impact assessment (henceforth referred to as IA) of the CHAMPR2 Project conducted between July 2021 to March 2022. We administered household- and barangay-level surveys to collect data from the period of November 2020 and December 2021. In addition, we also collected retrospective data on a few key indicators (e.g. asset and housing quality) for the pre-program period (2010). In total, 2,000 households were interviewed (1,000 beneficiary households and 1,000 comparison households) while the barangay-level survey collected data from 100 barangays (50 beneficiary barangays and 50 comparison barangays). To identify the causal effects of the CHARMP2 program, we first combine GPS coordinates-based household listing with a screening interview to select comparison households. We then apply the Inverse-Probability Weighted Regression Adjustment (IPWRA) method to estimate impacts. We estimate

the CHARMP2 impacts on a set of indicators identified through the project's Theory of Change (ToC) and generate detailed lessons to be taken into account for future projects.

The current effort of conducting an impact assessment of the CHARMP2 project is in the light of the shared willingness of all the actors involved to improve the understanding of the project's performance in achieving its objectives. At the same time, this effort fulfils the commitment made by IFAD and the broader development community to rigorously measure the impact of agricultural development interventions across the world. Conducting the CHARMP2 IA thus serves the dual purpose of upholding accountability and informing ongoing improvements in programme implementation (Gertler et al., 2016), which is likely to benefit both IFAD and other actors in the development community. In addition, providing evidence of the CHARMP2's impact constitutes an invaluable opportunity for local government entities to learn which mechanisms are more effective in generating benefits and building resilience of the communities in the CAR.

The remainder of the report comprises the ToC of the CHARMP2 project and the associated research questions addressed by this study; details of the impact assessment design and data; descriptive statistics of the sample; the results; and finally, the conclusions and policy recommendations.

Theory of Change and Main Research Questions

In this section, we first detail the ToC, focusing on the project's support through various components. Based on our understanding of the project, we then outline the main research questions that the impact assessment aims to answer.

Theory of Change

The CHARMP2 Project has five components wherein each barangay (village) targeted under the CHARMP2 program has received a package of assistance. The first component entails a participatory social assessment and land use mapping exercise to assess community interest and development challenges as well as to develop an investment plan. The investment plan is a document that reflects the timelines and order of ranking of the community's priorities. Once validated in the community general assembly, the investment plan is presented to the barangay Council to be integrated into the barangay development plan.

The second component of CHARMP2 focused on providing support to conserve community watersheds, which were identified by the communities themselves as critical water sources for irrigation and domestic use, providing farmers training on agroforestry through Agroforestry Farmer Field Schools (AFFS) and developing agroforestry plots, where they grow various agroforestry species (including coffee, rambutan, citrus and lanzones – also known as langsat). Finally, this component also supports the development of innovative watershed conservation mechanisms, including applying innovative concepts such as "Rewarding the Upland Poor in Asia for Environmental Services" (RUPES), documentation of indigenous forest management systems and pilot community forestry management. This component also provided land titling services to improve land tenure security and enhance sustainable investments in land resources.

The third component focused on increasing agricultural production and commercialization of entrepreneurs to increase their profits and incomes. Entrepreneurs received financial capital and capacity building through their livelihood interest groups. This component consisted of four sub-components: provision of agricultural support services, promotion of agribusiness and marketing, micro-finance and income-generating activities, and enterprise promotion.

The fourth component focused on market access infrastructure, including rural roads, footpaths, footbridges and tramlines, irrigation infrastructure, and domestic water access systems. This component was integrated with the activities under the other components as a package for each targeted community. Priority was given to the infrastructure that had created larger economic returns to the communities while mitigating adverse environmental effects. This component also included activities to train the beneficiaries on how to manage the installed or rehabilitated infrastructure sustainably. The fifth and final component on effective project management and coordination was included to ensure that the main four components were effectively implemented to achieve the desired outputs and development outcomes.

Based on the above components of the CHARMP2 project, the following ToC is formulated, shown in Figure 1. A ToC helps to explain how various activities serving as inputs can deliver outputs, outcomes, and ultimately the expected impacts of a project. In each stage of the ToC, some important assumptions are listed as they highlight the factors that may have caused the impact pathways to break down. The ToC shows that the CHARMP2 household and barangay level activities and outputs affect both household and barangay level outcomes.

The activities implemented under CHARMP2 are expected to affect outputs and outcomes at both household and barangay levels. At the household level, the project is expected to lead to increased adoption of new

agricultural technologies, market participation, productivity and financial literacy. At the same time, the CHARMP2 is also expected to improve the barangay level outcomes such as market access, adaptation to climate change and community level infrastructure management. These improved outcomes are expected to have an impact, again at the household and barangay levels, on income, food security, empowerment, and resilience.

The CHARMP2 has integrated community level infrastructural development initiatives with household level training provisions to maximize the program benefits. The existing evidence also supports this type of integrated approach for agricultural and rural development. For instance, in a literature review study, Jouanjean (2013) concludes that investment in hard infrastructure (roads, communication and energy supply) may not be sufficient for successful market integration and development. A more holistic approach that considers complementarities between hard and soft (extension and standards-related services) work better for agricultural development and poverty reduction. Furthermore, the local resource-based approach to infrastructure (re)construction and maintenance, as adopted in the CHARMP2, is expected not only to create job opportunities, but also to enable higher delivery and maintenance rates as well as development of the local markets and the economy through promoting entrepreneurship and connectivity (ILO, 2020). Thus, it appears that the CHARMP2 has put together a well thought program design with an objective to improve the livelihoods of poor rural women and men in the CAR.

Figure 1. Theory of Change (ToC) of the CHARMP2

INPUTS AND ACTIVITIES	OUTPUTS	OUTCOMES	IMPACTS
Participatory Investment Planning • Community-level business plan • Inclusion into the Barangay development plan • Inclusion of marginalized people **Agroforestry and Watershed Management** Conserve community watersheds Promotion of agroforestry through Farmers Field Schools Pilot community forestry management **Income Generating Activities** Provision of agricultural support services Promotion of agribusiness and marketing Micro-finance and income generating activities Enterprise promotion. **Rural Infrastructure Development**	**Household-Business Level** • Entrepreneurs are trained on production technologies • Entrepreneurs are provided with information and skills on business management • Improve access to finance • Increased connection among buyers and sellers • Increased engagement in income generating activities **Barangay Level** • Improved roads, footpaths, footbridges, and tramline • Improved irrigation infrastructure and domestic water access facility • Increased forestry coverage	**Household-Business Level** • Adoption of new technologies • Increased productivity • Increased market participation • Increased savings • Improved business management capacities • Increased group participation • Increased financial literacy • Climate-informed planning used at the household level **Barangay Level** • Improved access to markets • Increased climate-informed planning • Increased ability to manage community resources and infrastructure • Improved climate adaptation	**Household-Business Level** • Increased income • Increased food security • Increased resilience • Empowerment of women • Empowerment of indigenous groups • Reduced poverty **Barangay Level** • Ability to maintain and expand activities • Sustainable livelihoods • Strengthened adaptive capacity of the target communities • Increased resilience

ASSUMPTIONS			
• There is sufficient demand to participate in the project • There is sufficient demand for training • Cultural norms allow women and indigenous people to participate	• Training is appropriate and will lead to adoption • Inputs are available to take advantage of new skills • Technologies are adequate for local circumstances • Members are willing to participate and contribute to association	**Household Level** • Markets for inputs, credit, output, etc. exist and function well • Producers face no other barriers to improving productivity such as soil quality, capital, weather conditions etc. • Change in mentality towards women's role in society **Barangay Level** • Sufficient ability to access markets • Reasonable support by local government • Women and marginalized people can access leadership roles	

Project Coverage and Targeting

The CHARMP2 project has been implemented in the Cordillera Administrative Region, Philippines. The CHARMP2 project has been implemented in areas where poverty is most severe in all six provinces of the region, namely Abra, Apayao, Benguet, Ifugao, Kalinga, and Mountain Province (Figure 2). According to the project completion report, the CHARMP2 project has been implemented in 188 Barangays from 37 highland municipalities. The total number of persons receiving services from the CHARMP2 project is estimated at 239,585, of which about 93% are indigenous people. About 51% of the project beneficiaries are women, while only 2% of the beneficiaries are youth.

Figure 2. Provinces benefiting from CHARMP2

The designations employed and the presentation of the material in this map do not imply the expression of any opinion whatsoever on the part of IFAD concerning the delimitation of the frontiers or boundaries, or the authorities thereof.

Map compiled by IFAD | 03-02-2022

The project typically selects the Barangays that have high poverty rates and delivers the community level program supports depending on the barangays' needs. To select beneficiary households, the project used some criteria as shown in Table 1.. The project usually targets households who have a member in livelihoods groups, are smallholders and are interested in agroforestry or agribusiness-based economic activities.

Table 1. Household Targeting Criteria in the CHARMP2 Project

Serial	Questions	Eligible
1	Were you a member of any livelihood group or association?	Yes
2	Is the land size below one hectare?	Yes
3	Are any women in your household involved in farming activities?	Yes
4	Does this household belong to any indigenous people's group?	Yes
5	Does the household receive any benefit from the government/NGOs program?	No
6	Will you join in IFAD program?	Yes
7	Will join training on agroforestry or agribusiness, etc., and commit the substantial time?	Yes

Research Questions

Following the ToC above, the current IA will address the following research questions:

1. Did the CHARMP2 interventions lead to increased income for the beneficiary households?

2. Did the CHARMP2 interventions increase agricultural productivity (output per unit of land) of the beneficiary households?

3. Did the CHARMP2 activities lead to increased market access and sales for the beneficiary households?

4. Did the CHARMP2 activities increase the households' resilience to shocks?

5. Did the program achieve the inclusion/empowerment of women, youth and vulnerable groups?

6. Did CHARM2 improve household food security and dietary diversity among beneficiary households?

7. Did CHARMP2 increase the adoption of climate adaptation practices among the beneficiary households?

Each of the research questions above can be mapped to IFAD's overarching goal, strategic objectives and mainstreaming themes, as shown in Table 15 in the Appendix.

Impact assessment design: Instruments, data and methodology

Instruments and impact indicators

4.1 Questionnaires

A detailed questionnaire was developed to capture variables at the household level. This household questionnaire gathered extensive information, first on the household members and their socio-demographic characteristics and then on the household's economic livelihoods and production activities. Information on crops grown and the use of crops (consumption, storage, sales, etc.) was also collected at the household level. Questions on climatic shocks and other shocks as well as financial support and other transfers were also asked in the household questionnaire. A separate brief questionnaire was developed to capture variables at the barangay level. The barangay questionnaire captured information on development activity, infrastructure, price of common goods, etc., at the barangay level.

4.2 Primary outcome indicators

The key outcome indicators are determined in line with IFAD's overarching goal (OG) and strategic objectives (SO), as outlined in IFAD's Strategic Framework (IFAD, 2016). Additional key outcome indicators track the project's performance as it relates to mainstreaming themes (MT), which include gender, nutrition, and resilience to shocks. All indicators can be traced and linked to IFAD's contribution to the UN's Sustainable Development Goals. Table 2. lists the primary outcome variables used in this study. In addition, impacts of the CHARMP2 program will be estimated on other outcome variables that are important to understand the causal pathways leading to the impacts on the primary indicators, as described in the theory of change.

Table 2. List of primary outcome variables

Variable/Indicator	Units of measure	Link to IFAD overarching goal (OG), strategic objective (SO) or mainstreaming theme (MT)
Gross income	Philippine Peso (PHP)	OG (economic mobility)
Asset index	Asset indexes	OG (economic mobility)
Value of crop production	Philippine Peso (PHP)	SO 1 (productive capacities)
Agricultural productivity	Rice Production per hectare (kg/ha); Crop production per hectare(peso/ha)	SO 1 (productive capacities)
Value of sales	Philippine Peso (PHP)	SO 2 (beneficial market access)
Ability to recover from shocks	Ability to recover index	SO 3 (resilience to climate change/shocks)

Variable/Indicator	Units of measure	Link to IFAD overarching goal (OG), strategic objective (SO) or mainstreaming theme (MT)
Food Insecurity Experience Scale (FIES)	FIES score	MT (food security)
Household Dietary Diversity Score (HDDS)	Sum of food groups consumed (count)	MT (nutrition)
Women's empowerment	Women-managed income (PHP) Women-owned assets (binary)	MT (empowerment)

For household income, the Rural Income Generating Activities methodology to compute the total income indicator is used (Carletto, et al. 2007). Income at the household level is calculated as the sum of the value of crop production (after subtracting the value of inputs), the value of livestock income, employment income, enterprise income, and other income, including transfers. The overall asset index that is computed encompasses four sub-indices to give a comprehensive picture of household economic status. These indices include a durable asset index, a productive asset index, a livestock asset index and a housing asset index. Principal components analysis is used to compute the first three indices.

The Food Insecurity Experience Scale (FIES) developed by the FAO is adopted in the analysis of food security at the household level (Cafiero et al, 2018). Regarding dietary diversity, this is measured at the household level following FAO's guidelines, which reflect a household's ability to access 12 food groups. Two reference periods, namely, the previous 24 hours and last week are used to generate this measure.

As a proxy for resilience, an indicator of the ability to recover from shocks encountered over the last 12 months is used. This resilience measure is adjusted by the severity of each shock to allocate different weights depending on shock severity. In addition to the overall resilience measure, the individual shocks encountered are analysed separately.

Sampling and data collection

5.1 Sampling

The sampling strategy in this impact assessment is guided by the protocols prepared by the research and impact assessment (RIA) division of IFAD. Based on previous IA studies conducted by RIA, it was determined that the final sample of this study would be set at 2,000 households from 100 barangays, equally split between beneficiary and comparison groups. Given the set sample size, an ex-ante power calculation was conducted to ascertain whether the sample of 2,000 households clustered in 100 barangays would be sufficient to detect the effect. For details on the power calculation, see the impact assessment plan (Hossain et al. 2021).

5.2 Municipality and Barangay selection

The research team first listed all the 1,172 barangays under 77 municipalities of the six provinces. Then, some barangays were sequentially dropped for the following reasons:

1. The previous round of the CHARMP project (CHARMP1) had been implemented at the municipality level in 3 areas. Since this IA would like to draw comparison barangays from the municipalities where the CHAMP2 was implemented, these three municipalities are dropped as there were no comparison barangays. With this, 1,137 barangays remained under 74 municipalities of the 6 provinces.

2. Ninety-five barangays were dropped because CHARMP1 was implemented in those barangays, but not CHARMP2. Since these barangays are contaminated with treatment, they are dropped. As a result, 1,042 barangays remained under 72 municipalities in the 6 provinces.

3. Fifteen barangays were dropped because less than 50 beneficiaries were listed in those barangays. At this stage, 1,027 barangays remained under 72 municipalities in 6 provinces.

4. 706 barangays were dropped where the CHARMP2 project was not implemented at any barangays in the entire municipality.

   Finally, 321 barangays remained under 29 municipalities of 6 provinces, 97 of those are CHARMP2 barangays, and 224 are not CHARMP2 barangays.

5.2.1 Beneficiary Barangay selection

The IA study needs to select 50 beneficiary barangays out of 97 available barangays. To this end, we use a proportional sampling strategy, where more barangays are taken from provinces with more CHARMP2 beneficiaries. To do this, the research team first estimated the number of barangays needed per Province based on their beneficiary share, as shown in column 6 of Table 3. Next, the number of barangays needed per Municipality is calculated based on their beneficiary share within each Province, as shown in column 8 of Table 3. With this approach, four Municipalities end up with no selected beneficiary barangay. Because the research team wanted to keep as many municipalities as possible, 4 barangays were reduced from Municipalities where more than three barangays were selected, these barangays were to each of these four municipalities where no barangays were selected initially. After determining the required barangays per Municipality, the research team randomly selected the required number of barangays available from each Municipality. Table 4 lists the selected barangays by Municipality and Province.

5.2.2 Comparison Barangay Selection

The research team kept an equal number of comparison barangays per Municipality as for the beneficiary group. While there are 204 comparison barangays available for selection, the research team selected only those barangays that are more comparable to the beneficiary barangays. A logistic regression is implemented in this regard, where the dependent variable is a binary indicator of whether a barangays is a beneficiary or comparison barangays. Independent variables include different development indicators at the barangays level and municipality fixed effects. The list of variables used in the logistic regression is listed in table 5. Next, the probability of being a beneficiary barangay is estimated from the regression analysis. Finally, the barangays with higher treatment probabilities are selected in line with the required number per Municipality. Table 6 lists the selected barangays by Municipality and Province. The geographical distribution of the beneficiary and comparison barangays is shown in Figure 3.

5.2.3 Beneficiary Household selection

We collect the full list of households who received benefits from the CHARMP2 monitoring and evaluation (M&E) data. There were a total number of 9,202 beneficiaries of CHARMP2 in the 50 selected beneficiary

barangays. We then randomly draw 20 households per barangay as our study sample. We also draw another 10 households per barangay as a replacement sample in case any household cannot be reached during the survey.

5.2.4 Comparison Household selection

Unlike in the beneficiary barangays, we do not have any comparable household list in the comparison barangays, nor do a population census list, that we could have used to draw comparison households. To this end, we follow a two-stage procedure to select comparison households as below:

1. We list all the built-up areas in the 50 comparison barangays using the OpenStreetMap (OSM) built-up records. As is well known, the spatial coverage and accuracy of OSM data are not evenly distributed across all regions, with rural areas often having poorer quality and quantity. Therefore, we also conduct a manual listing of built-ups from Google Earth Pro. We overlay the OSM and manual listing built-up points to generate the total built-up area list in the comparison barangays. During the listing exercise, we drop the built-up records such as schools and markets. In total, we list 18,466 built-up records in the 50 barangays.

2. Next, we randomly select 20 built-up locations per barangay. To ensure that the comparison households are similar to beneficiary households, enumerators first visited the locations and implemented a short screening interview using the questions listed in Table 15. If a household becomes eligible based on the screening questions (5 out of 7), enumerators conducted the full interview. If a household becomes ineligible, then the enumerators conducted the screening interview on the nearest household and followed the same protocol as long as they got an eligible household in that location.

For four barangays, the research team was not able to list all 20 built-up locations using satellite imagery. Focus group discussions (FGD) were held in these four barangays to complete the identification of 20 locations.

Impact Identification

Our goal is to estimate the impacts of the CHARMP2 project on the economic outcomes of project participants. Therefore, we focus on estimating the average treatment effect on the treated (ATET). ATET measures the average difference in the outcomes of interest between beneficiary and comparison groups and can be defined as follows:

$$\text{ATET} = E\{Y_{i1} - Y_{i0}|T_i = 1\} = E(Y_{i1}|T_i = 1) - E(Y_{i0}|T_i = 1) \tag{1}$$

where $E(.)$ indicates the expected value, Y_{i1} and Y_{i0} are potential outcomes under beneficiary and comparison scenario, and T is the treatment status (= 1 if beneficiary, = 0 if comparison). Like in any impact assessment study, the identification of the impact of the CHARMP2 program on an outcome variable Y depends on how one can generate the value of Y for each beneficiary household had the CHARMP2 program never existed, known as the counterfactual outcome Y(0). These counterfactual values Y (0) could then be subtracted from the actual values observed Y (1) for all beneficiaries to estimate the effect of the CHARMP2 program, τ=Y (1)-Y (0). However, because the counterfactual outcome cannot be observed for the treated observation, in a non-experimental setup, like the CHARMP2 program, counterfactual values can be constructed based on values from a comparison group, assuming that the comparison households are comparable to the beneficiary households. Therefore, it is important to ensure that the beneficiary and comparison households are

comparable in terms of their observable and unobservable characteristics in influencing program participation and outcome variables.

In this study, we built a comparison group taking into both observable and unobservable differences among the beneficiary and comparison households. By drawing the comparison households from the random built-up locations and implementing the screening interview, we ensured that the comparison households are similar to the beneficiary households in two ways:

1. A random list of households, just like we draw a random list of beneficiary households from the full beneficiary list.
2. Comparison households were also willing to participate in the CHRMP2 program (based on one of the screening questions)

The former approach potentially makes beneficiary and comparison households comparable, at least from an unobservable point of view. Assuming that there is only a selection of observables remain, we implement the Inverse Probability Weighted Regression Adjustment (IPWRA)that take pre-program observable differences into account and estimate the impacts of the CHARMP2 program on various outcomes.

Inverse Probability Weighted Regression Adjustment (IPWRA)

IPWRA combines inverse probability weights and regression adjustment to improve the comparability of beneficiary and comparison groups (Wooldridge 2010). In the IPWRA method, after computing the IPW, the following weighted regression is used to estimate the predicted value of the outcome for the beneficiary and the comparison group:

$$Y_i = \alpha + \beta T_i + \gamma X_i + \delta(X_i - E[X_i \mid T_i = 1])T_i + \zeta_i \tag{2}$$

where Y represents the outcome for household i, T indicates the treatment status for household i, X_i is the vector of comparison variables and $E[X_i \mid T_i = 1])$ is their average for the treated households, and εi is the error term. β is the coefficient of the treatment indicator. The comparison variables in the vector X_i consist of factors that are expected to influence the outcome variable, but not have been affected by the CHARMP2 intervention. Finally, the ATET estimate is calculated by taking the difference in the predicted values for the beneficiary and comparison groups.

Profile of the study area and sample

Before moving to the results, we first present the profile of the sample. As mentioned before, the study comes from all the six provinces in the CAR region where the CHARMP2 program was implemented. Figure 3 shows the approximate locations of beneficiary and comparison households in each province. As expected, the comparison households are located near the beneficiary households in each province and municipality.

Figure 3. Location of the Study Sample
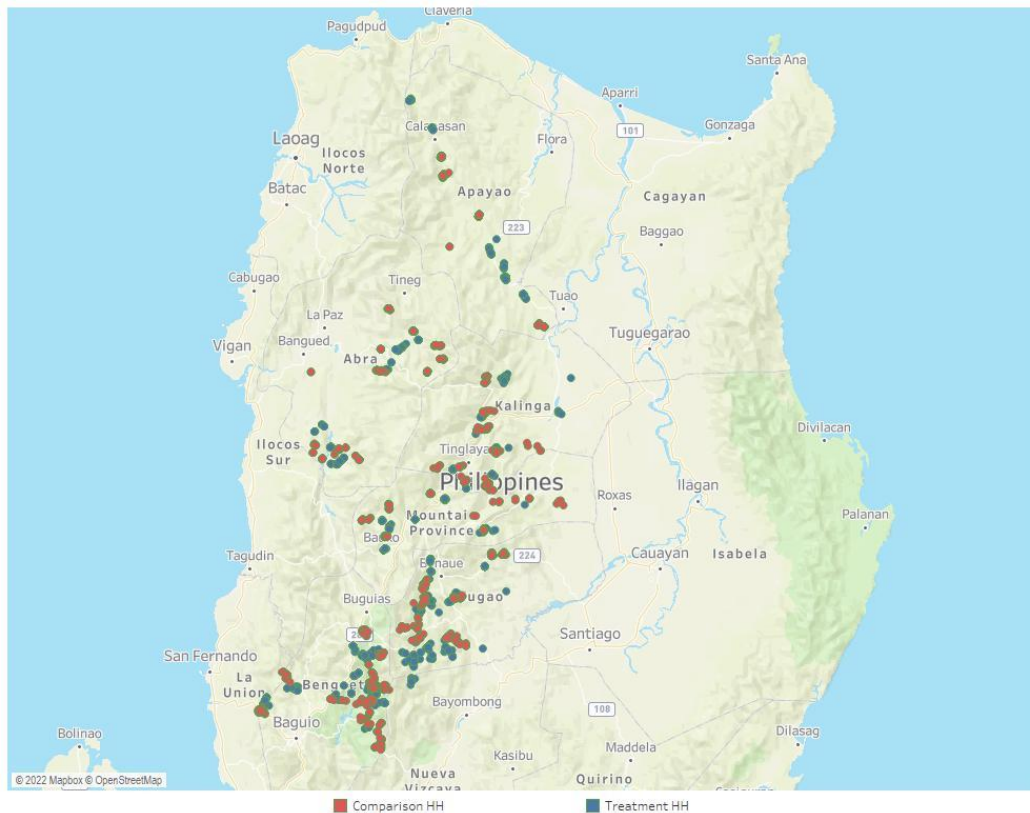
Table 3 shows the current demographic characteristics of the beneficiary and comparison households, as well as any statistical differences that may exist. Furthermore, the differences in pre-program asset holdings, housing quality, access to sanitation, electricity, and drinking water are also shown in the table. It appears that household member composition is similar between the beneficiary and comparison groups. About 17% and 13% of households are headed by women in beneficiary and comparison group respectively. The household heads in the beneficiary group are slightly older, on average, than their counterparts in the comparison group. Looking at the asset holding pattern during the pre-program period, we find that the beneficiary households owned higher number of productive and household assets, while the comparison households had higher livestock assets, on average. Note that in all the cases, the difference in the mean values of the assets is not quite large. Finally, in terms of access to basic infrastructure (electricity, water, and sanitation) and housing quality, we do not observe many differences between the beneficiary and comparison groups except for water access and wall structure of the dwellings. From the raw differences in the demographic, asset, and infrastructure variables, overall, it appears that the study design has performed well enough to generate a well-balanced comparison of households that can be used to identify the impacts of the CHARMP2 program.

Table 3. Household Profile by Treatment Status

	(1)	(2)	(3)	(4)	(5)	(6)
	Beneficiary		Comparison		Mean diff.	p-value
	Mean	N	Mean	N		
Number of children	0.99	1000	1.03	1000	-0.050	(0.399)
Number of males	2.54	1000	2.48	1000	0.060	(0.373)
Number of females	2.24	1000	2.18	1000	0.060	(0.348)
Female headed household	0.17	1000	0.13	1000	0.040	(0.011)**
Age of household head	53.42	1000	51.73	1000	1.690	(0.005)***
Productive asset index 2010	0.02	1000	0.01	1000	0.010	(0.067)*
Household asset index 2010	0.06	1000	0.04	1000	0.030	(0.000)***
Livestock asset index 2010	0.43	1000	0.46	1000	-0.030	(0.000)***
Electricity 2010	0.72	907	0.74	837	-0.010	(0.485)
Water access 2010	0.90	907	0.93	837	-0.030	(0.021)**
Flush toilet 2010	0.87	907	0.86	837	0.020	(0.279)
Concreate wall 2010	0.44	907	0.50	837	-0.050	(0.022)**
Concreate roof 2010	0.88	907	0.88	837	0.000	(0.863)
Concreate floor 2010	0.40	907	0.40	837	0.000	(0.846)

Note: Demographic variables (household members and household head characteristics) are continuous in nature. Asset variables are calculated based principal component analysis method. Column 5 shows mean differences between two groups. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Results

Balance in matching indicators

In this section, we check the balance of the variables used to match households to ensure that beneficiary and comparison households are comparable. We also check whether there is sufficient common support in the probability of program participation by the beneficiary and comparison households—a crucial requirement in the propensity score matching-based methods.

We first report the descriptive statistics of the matching covariates in Table 16 of the Appendix after adjusting for households' program participation probabilities (weighted differences). Columns (5) and (6) report the statistical differences in mean values and associated P-values for the covariates used in the propensity score matching by household's treatment status. We find that after matching is performed, there are no statistical differences in the covariates used except for the livestock holdings. Similarly, panel A of

Figure **4** shows the reduction in the standardized relative bias for the matched sample, which is significantly lower than the suggested threshold of 25% (Rubin 2001) for all the variables except for the livestock holdings. Panel B of

Figure **4** shows the ratio of the average variances of matching variables is close to one, as suggested in the literature.

Panel B
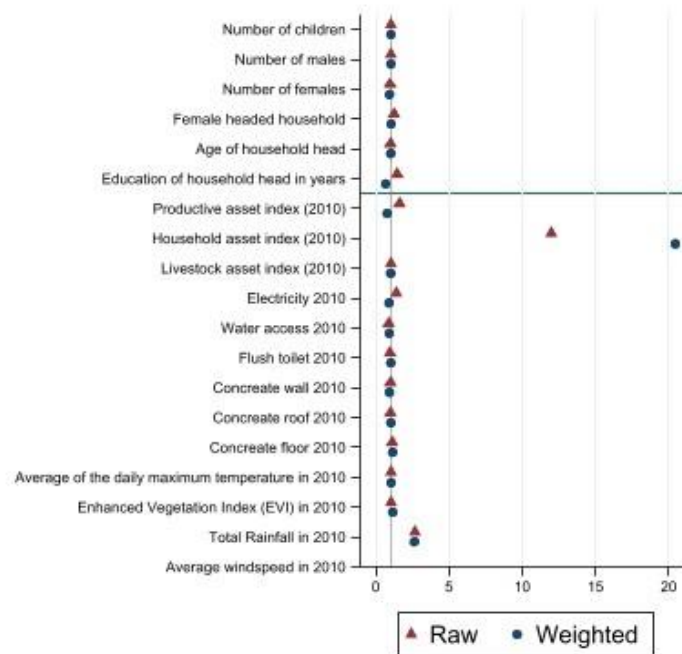
Figure 5 reports the distribution of the probability of program participation for beneficiary and comparison households. The kernel densities of probability show that there is substantial overlap between beneficiary and comparison groups.

All the results suggest that the study design generated comparable beneficiary and comparison groups to identify the impacts of the CHARMP2 program. Furthermore, as mentioned before, random selection followed by the verification process potentially removed the unobservable differences, if any, among the beneficiary and comparison households. Therefore, any differences in the outcome variables can be meaningfully attributed to the impact of the CHARMP2 project.

Figure 4: Standardized Difference and Variance Ratio in Matching Variables

Panel A
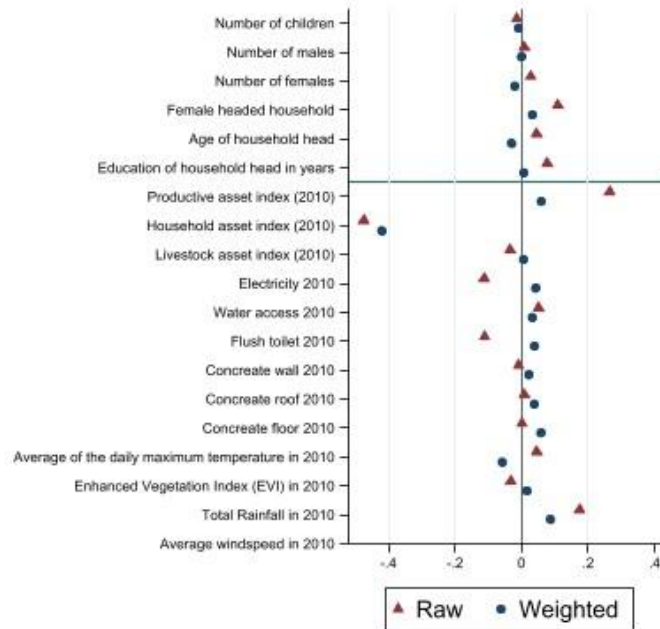
Panel B
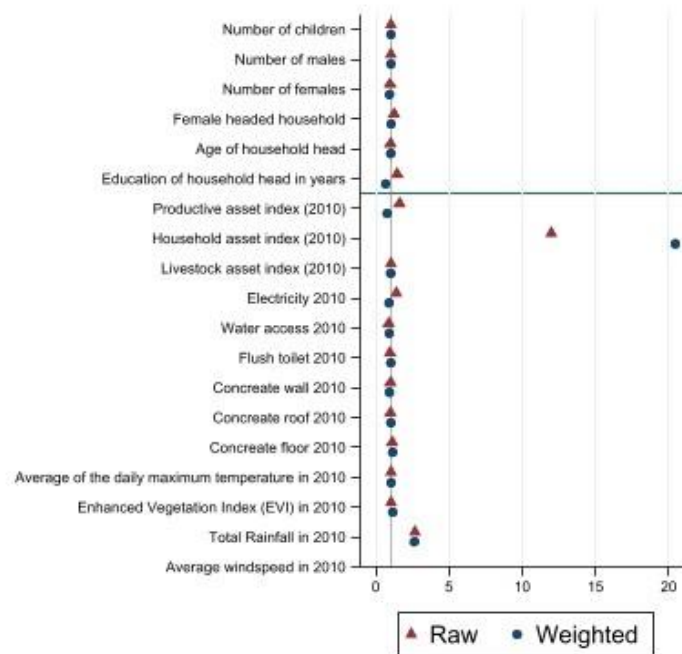
Figure 5. Distribution of the probability of program participation
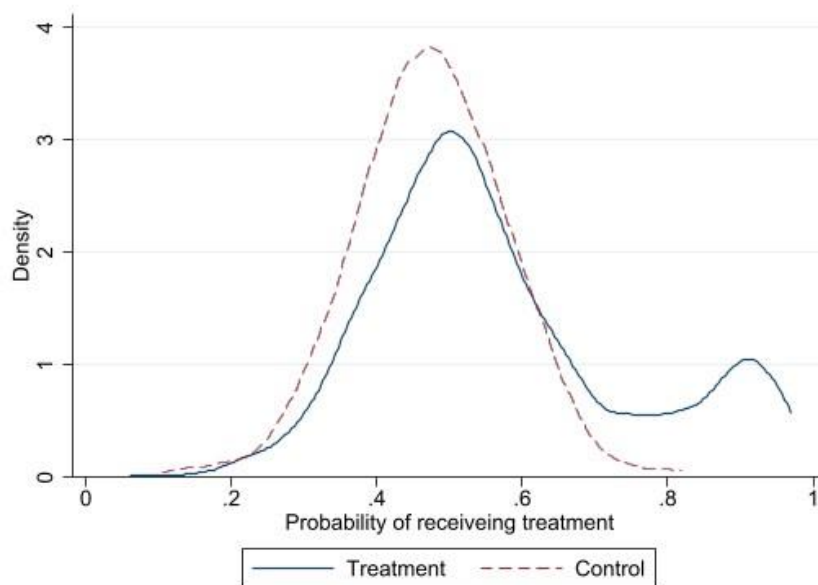
Overall impacts of CHARMP2

This section presents the impacts of CHARMP2 project on the intermediate and main outcome variables. Showcasing the impact of the CHARMP2 project on intermediate outcomes (i.e., the benefits that the program provided in the beneficiary areas) will set the stage that the project has provided support to the beneficiary households and, thus, we can expect impacts of the projects on main outcome variables. The main outcomes are related to IFAD's overarching goal (economic mobility) and strategic objectives on productive capacities, market access, and resilience to climatic shocks.

Furthermore, we show the impacts of the CHARMP2 project on mainstreaming themes of IFAD. First, we report the project's impact on nutrition (proxied by household dietary diversity and food insecurity experience). Second, we show the impacts of the CHAMRP2 on gender equality and women's empowerment (measured in terms of gender-disaggregated impacts).

Impact on Intermediate outcomes: Access to CHARMP2 Programs

As reported in the section on ToC, the CHARPM2 project has delivered both household and community level support through different components. The main support provided by the program were extension services/training, access to finance and community infrastructures. We have collected household-level data on program benefits, training exposure, and access to finance information for both beneficiary and comparison households. In this section, we estimate the impact of the CHARMP2 project on these intermediate outcomes.

Table 4 shows the impact of the program on the number of benefits (individual and overall) that households received during the project period. Overall, the number of benefits that the CHARMP2 project has provided the beneficiary households during the project period was 12% higher than comparison households. We find that beneficiary households reportedly received more support for reforestation or agroforestry, warehouse/solar dryers, and matching grants. The benefits of reforestation or agroforestry are about 94% higher whereas the warehouse/solar dryers support is 184% higher for the beneficiary group compared to the mean values in the comparison group (Table 17 in the Appendix).

In addition, it appears that beneficiary households received 69% more trainings (specific topics and overall) relative to comparison households. We find that beneficiary households reported receiving a higher number of trainings on production-related activities (25%), marketing (191%), access to credit (222%), reforestation (522%), agroforestry (203%), natural (284%), and land tenure security (429%) relative to the comparison households (Table 18 in the Appendix). The large boost in certain trainings (e.g., reforestation, land security) is driven by the fact that these training are virtually non-existent in the comparison areas. Finally, beneficiary households were also more likely to receive training and practised training on land reclamation and protection, which led to them having a higher likelihood of holding more secure land documentation (see

Table *19* in the Appendix).

Table 4. Number of Benefits, Training and Loans Received (last 10 years)

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Total number of benefits received	0.24**	2.06	11.70	1743
	(0.101)			
Total number of trainings received	1.25***	1.80	69.32	1743
	(0.156)			
Total number of loans received from various sources	0.15***	0.56	26.41	1743
	(0.051)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Mean indicates the potential outcome that beneficiary households would have had if they had not benefited from the programme and it is expressed in the outcome's original unit. Impact shows the percentage change compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Impact estimates also show that the access to finance has improved for beneficiary households relative to comparison households. Beneficiary households received 26% more loans from 2010 to 2020 (Table 5). It also appears that the beneficiary households were able to get more loans from the local microfinance institutions (167%) as well as from the CHARMP program (Table 20 in the Appendix). In Table 5, we show the impacts on the amount of loans received from different sources as well as their aggregates. As expected, we find a 101% increase in the total amount of loans received by beneficiary households relative to comparison households. Similarly, there is a 183% increase in the amount of loans received from local Micro-finance Institutions (MFIs).

Table 5. Loan received from different sources (last 10 years)

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Total number of loans received from various sources	0.15***	0.56	26.41	1743
	(0.051)			
Total amount of loan from various sources	0.70*	52.65	101.48	1743
	(0.368)			
Total amount of loan from Bank	0.06	0.30	19.28	1743
	(0.151)			
Total amount of loan from MFI	0.29**	0.16	183.31	1743
	(0.131)			
Total amount of loan from Cooperative	0.11	6.86	12.18	1743

	(1)	(2)	(3)	(4)
	Coefficient	**Counterfactual value**	**Impact (%)**	**N**
	(0.335)			
Total amount of loan from CHARMP2	0.12***	0.00	--	1743
	(0.036)			
Total amount of loan from Money lender	0.17	0.26	69.18	1743
	(0.149)			
Total amount of loan from other sources	0.21	2.14	25.86	1743
	(0.268)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Mean indicates the potential outcome beneficiary that households would have had if they had not benefited from the programme and it is expressed in the outcome's original unit. Impact shows the percentage change compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

From the results on intermediate outcomes, it appears that the CHARMP2 program has provided intended benefits in the beneficiary communities. Impact estimates confirm the hypothesis that beneficiary households received benefits from all the components of the CHARMP2 program.

Economic Mobility (Overarching Goal)

We examine the impact of the CHARMP2 project on income and asset indicators, aligning to the goal of economic mobility. For income, we check total income as well as incomes from individual activities to examine if the project has created any substitution or complementarity among different activities. Furthermore, we check the impacts on income shares from different income sources. For asset holdings, we build indices disaggregated into productive, households/durables, and livestock assets using principal component analysis.

Table 6 shows the impact of the CHARMP2 project on total and individual incomes. We find that the CHARMP2 project has led to 32% higher gross income for the beneficiary households relative to comparison households. Looking at the gross incomes from different activities, we find that crop farming income is 118% higher for the beneficiary households than for the comparison households. Furthermore, the livestock income of beneficiary households is also higher (75%) relative to comparison households. Finally, we noticed a lower transfer income (by 40%) for the beneficiary households compared to comparison households. It also appears that the impact estimates on net incomes are statistically insignificant, while the impact of gross income is positive and significant. One of the reasons for this discrepancy could be that households often overestimate the costs of production, which might lead to negative or imprecise impact estimates for net income indicators.

Results on the impact of CHARMP2 on income shares by sources are presented in Table 21 of the Appendix. It appears that the share of income from crop farming is 22% higher for beneficiary households. Moreover, the share of income from livestock in total income is 49% higher for beneficiary households relative to comparison households. This is accompanied by a lower share in total income from enterprises (41%) and transfers (30%).

Table 6. Impact on Different Income Categories

	(1) Coefficient	(2) Counterfactual value	(3) Impact (%)	(4) N
Gross total income	0.28***	82665.46	32.37	1743
	(0.069)			
Net total income	0.24	33007.24	26.87	1743
	(0.229)			
Gross income from crop farming	0.78***	3170.48	118.63	1743
	(0.232)			
Net income from crop farming	0.96**	371.29	161.64	1743
	(0.429)			
Gross income from livestock & livestock products	0.56***	2481.31	74.95	1223
	(0.177)			
Net income from livestock & livestock products	0.72	3.39	108.29	1223
	(0.770)			
Total wages earned	0.63*	1026.93	87.31	1743
	(0.357)			
Gross income from enterprises	-0.37	65924.46	-30.59	200
	(0.344)			
Net income from enterprises	1.09	1710.23	198.26	200
	(1.351)			
Income from transfers (public + private)	-0.52**	5818.82	-40.25	1743
	(0.238)			
Other income	-0.04	98.94	-4.14	1743
	(0.256)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. Impact shows the percentage change compared to the counterfactual value. Income is measured in Philippines Peso. Other income consists of income from properties, investments or savings as well collected goods. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

We also examine impact of the project on crop income by the type of crop (Table 22 in the Appendix). We find that income from export-oriented crops is significantly higher for beneficiary households relative to comparison households. Similarly, revenue from non-seasonal crops is higher for treated groups, although not statistically significant. Furthermore, we find that beneficiary households cultivate more cash crops (e.g., carrot, tomato, Banana) as well as the total number of crops in a crop calendar year than the comparison group.

Finally, we find that the productive asset holding is 33% higher for the beneficiary households, whereas livestock asset holdings of beneficiary households are 95% higher. In addition, we find that crop-operated land (cultivated land) is about 37% higher for beneficiary households relative to comparison households (Table 7).

Table 7. Impact on Asset Holdings

	(1)	(2)	(3)	(4)
	Coefficient	**Counterfactual value**	**Impact (%)**	**N**
All assets	0.02	0.16	10.29	1743
	(0.011)			
Productive assets	0.01*	0.03	33.34	1743
	(0.005)			
Household/durable assets	0.00	0.22	1.90	1743
	(0.013)			
Livestock assets	0.04***	0.05	94.61	1743
	(0.007)			
Crop land (hectare)	0.22***	0.59	36.39	1743
	(0.072)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Mean indicates the potential outcome beneficiary households would have had if they had not benefited from the programme. Impact shows the percentage change compared to the counterfactual value. All asset indicators are estimated using the principal component analysis method. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Thus, overall, CHARMP2 appears to have generated a positive impact on the incomes of beneficiary households and as such is largely successful in enhancing their economic mobility. Total income, crop income, as well as the crop income share are higher among CHARMP2 project beneficiaries. In addition, even though the programme did not explicitly target livestock activities, there are positive impacts of the project on livestock asset holdings, livestock activity participation (an 8 percentage point increase) and income from livestock. It is, thus, conceivable that the development of community infrastructure made it lucrative to diversify and engage in other types of activities such as livestock as well as led to commercialization of farming as farmers started to engage in the cultivation of cash and non-seasonal crops.

Productive capacities – (Strategic Objective 1)

About 90% of the households in this study are involved in crop farming activity and about 61% of them produce rice. To this end, we test the yield rate in crop farming activity as a measure of productive capacity. We generate two yield indicators: crop yield per hectare in Peso and rice yield per hectare in kilograms.

Table **8** shows that there was a 58% increase in crop yield rate, although the rice yield rate, the main crop in the study area, has not increased significantly. This result is not totally surprising given that the majority of

the individual level benefits that CHARMP2 has provided is related to extension service through farmers field school (FFS). Existing evidence suggests that FFS programmes implemented over longer periods had no positive effects (Waddington and White, 2014), perhaps because of mis-targeting and problems in recruiting and training appropriate FFS facilitators.

In the previous section, we find that crop income is higher for beneficiary households as compared to comparison households. This raises the question of how the crop income is higher while the crop yield rate has not changed at all. One explanation is that the beneficiary households have increased their crop cultivated area with program support. Indeed, we find that there is a significant increase in operated land under crop farming activity (Table 7). This again partially explains the boost in crop income.

Another channel could be that beneficiary households have produced more export-oriented, cash, and non-seasonal crops instead of their staple crops. Together, these results indicate that higher crop income among beneficiary households is perhaps not driven by yield rate, but by other factors such as higher income from livestock and non-seasonal crops, higher land area cultivated and adoption of cash-oriented crops.

Table 8. Impact on crop and Rice Yields

	(1) Coefficient	(2) Counterfactual value	(3) Impact (% or pp)	(4) N
Yield per hectare (Peso/hectare)	0.46*	9832.40	58.16	1743
	(0.243)			
Rice yield (KG/hectare)	-0.19	1880.41	-17.16	1138
	(0.188)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Mean indicates the potential outcome beneficiary households would have had if they had not benefited from the programme and it is expressed in the outcome's original unit Impact shows the percentage change compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Beneficial Market Access - (Strategic Objective 2)

The project intended to connect farmers to markets through the financing of market access infrastructure, including rural roads, footpaths, footbridges and tramlines, irrigation infrastructure, and domestic water access systems. This component of the project comprised 55% of the total financing indicating significant resources being spent to promote market sales. As such, we assess the impact of CHARMP2 project on the second strategic objective, that is, market sales and market participation. The results are shown in Table 9.

Not surprisingly, beneficiary households are 13 percentage points more likely to engage in selling their products in the market as compared to comparison households. At the same time, both crop and livestock sales were estimated to be 29% and 40% higher respectively among beneficiary households as compared to comparison households, although both estimates are statistically insignificant. The findings in the previous section that there is a significant increase in operated land under crop farming activity as well as a higher probability of beneficiary households cultivating cash crops seems to have led to a higher probability of market participation by beneficiary households.

Table 9. Impact on Sales and Market Participation

	(1)	(2)	(3)	(4)
	Coefficient	**Counterfactual value**	**Impact (% or pp)**	**N**
Whether participated in market sales	0.13***	0.56	0.13	1743
	(0.033)			
Crop sales	0.26	17618.49	29.13	794
	(0.194)			
Livestock sales	0.34	5636.78	40.17	542
	(0.275)			
Enterprise (agricultural and non-agricultural) related sales	-0.03	11.71	-3.31	200
	(0.030)			
Total sales	0.02	23439.14	1.70	1171
	(0.148)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. "Whether participated in market sales" is a binary indicator. Rest of the outcome variables are continuous in nature. Impact shows the percentage point change for binary indicators and percent change other indicators, all compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Resilience to shocks (Strategic Objective 3)

Through the development of community infrastructure as well as providing support to conserve community watersheds, it is expected to lead to improved irrigation infrastructure and the availability of a domestic water access facility. At the same time, the agroforestry farmer field schools (AFFS) provided farmers training on agroforestry and developed agroforestry plots which are expected to increase forestry coverage. These are expected to lead to increased climate-informed planning and improved climate adaptation and consequently increased resilience.

We present the impact on resilience to climate and non-climate shocks and income diversification in year prior to the survey in Table 10. We do not find any significant differences in the probability of experiencing a climate shock and any shock in last year between beneficiary households and comparison households. However, beneficiary households reportedly faced a 10% lower probability of facing a non-climatic shock compared to the comparison households.

Among households reporting having experienced a shock, we estimate the impact of the programme on the household's self-reported ability to recover from a shock. We also use the corrected ability to recover from a shock which is based on the self-reported information of exposure to shocks and ability to recover from shocks, but they are corrected for the potential subjectivity of the response and differences in exposure intensities. Using the raw indicator on ability to recover from shocks, we do not find any significant impacts of the program on resilience. However, we do find that beneficiary households are 4% points more likely than comparison households to recover from a shock (corrected). This result is driven by the ability to recover from both climate (3%) and non-climate (10%) shocks. These findings suggest that there was no difference in

the likelihood of experiencing a shock and at the same time, the program seems to have limited impacts on beneficiary households' ability to recover from shocks.

Table 10 also shows impact of the CHARMP2 on income diversification, measured through the estimation of the Gini-Simpson Index, which is used extensively in the literature. It ranges from zero, meaning no diversification, to one, meaning complete diversification. We find that income diversification is about 6% higher for the beneficiary households compared to the comparison households. While this is indicative of a limited impact, it is consistent with previous findings on higher participation in livestock activities as well as moving away into cultivation of cash and non-seasonal crops.

Table 10. Impact on Resilience (last 12 months)

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (% or pp)	N
Experienced a shock	-0.03	0.91	-3.23	1743
	(0.022)			
• Climate shock	0.02	0.75	2.31	1743
	(0.031)			
• Non-climate shock	-0.07**	0.71	-9.53	1743
	(0.032)			
Ability to recover from climatic and non-climatic shocks (raw)	0.03	0.76	4.43	1552
	(0.033)			
• Climate shocks	0.01	0.71	1.92	1349
	(0.035)			
• Non-climate shocks	0.05	0.69	6.59	1153
	(0.040)			
Ability to recover from climatic and non-climatic shocks (corrected)	0.09***	2.04	4.40	1552
	(0.033)			
• Climate shocks	0.07**	2.07	3.20	1349
	(0.033)			
• Non-climate shocks	0.19***	1.89	10.19	1153
	(0.045)			
Gini-Simpson Index of income diversification	0.03*	0.42	6.08	1740
	(0.014)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. "Experienced a shock" and "Ability to recover from climatic and non-climatic shocks (raw)", climate or non-climate are binary indicators. Rest of the outcome variables are continuous in nature. Impact shows the percentage point change for binary indicators and percent change

other indicators, all compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Nutrition: Food security and Dietary Diversity (Mainstreaming theme)

We assess attributable impacts of the CHARMP2 project on food and nutrition security using key indicators widely used in the literature, namely Household Dietary Diversity Score (HDDS) and food insecurity experience scale (FIES). The results are shown in Table 11. While there was no impact of the project on the overall HDDS, there seems to be a positive impact on consumption of fruits, legumes, nuts, seeds, milk and milk products. Also there is a reduction in the consumption of spices, condiments and beverages which can be associated with healthier diet (see Table 24 in the Appendix). There is limited impact of the project on nutrition as it did not explicitly target nutrition. As shown in column 2 of Table 11, the HDDS for the counterfactual is already relatively high at 9 food groups out of 12. Thus, further increasing the HDDS would require dedicated interventions that cover many aspects (including those related to behavior change).

We find that food insecurity is lower by 22% among beneficiary households as compared to comparison households, implying a positive impact of the CHARMP2 project. This improvement in food security among beneficiary households is driven by a lower likelihood of three indicators-- being worried about food, not eating healthy food and eating fewer foods (see Table 25 in the Appendix).

Table 11. Impact on Dietary Diversity and Food Security

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
HDDS (7 days)	0.05	9.05	0.56	1742
	(0.146)			
Food insecurity experience scale (FIES) score (12 months)	-0.25***	1.12	-22.22	1743
	(0.096)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. Impact shows the percent change compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Gender Equality and Women's Empowerment (Mainstreaming theme)

We examine whether the CHARMP2 program has any impact on women empowerment. To this end, we first measure female-controlled income in different income-generating activities – we consider an income as female-controlled income if the activity from which income is generated is mainly decided by a woman. In addition, we also measure women's asset ownership—a binary indicator if most of the assets (14 assets from productive and durable categories) in the households are owned by women.

Table 12 shows that women-controlled livestock income is 83% higher for the beneficiary households compared to comparison households. Other than livestock activity, we do not find any significant effect on female-controlled income. This result suggests that the increase in livestock income that was observed earlier was driven by livestock income controlled by women. Similarly, we estimate the amount of market sales from the women-controlled activity and find that the beneficiary households have 58% higher women-controlled market sales. Finally, we do not find any impact of the CHARMP2 program on women's asset ownership.

Table 12. Impact on Gender Equality and Women's Empowerment

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Female controlled gross income	0.11	20.88	11.55	1743
	(0.359)			
Female controlled crop revenue	-0.16	2.71	-15.52	1606
	(0.260)			
Female controlled Self-employment income	1.56	2.80	390.63	200
	(1.254)			
Female controlled wage income	-0.43	5.94	-35.60	1743
	(0.325)			
Female controlled livestock income	0.50**	1.11	83.62	1223
	(0.238)			
Female controlled other income	-0.11	0.91	-16.27	1743
	(0.163)			
Female controlled total market sales	0.40*	1.46	58.02	1743
	(0.241)			
Female controlled asset ownership	-0.01	0.35	-0.01	1743
	(0.030)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. Impact shows the percent change compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Robustness checks

In this section, we test the robustness of the impact estimates in three alternative ways. First, we use a short set of matching variables. Second, we cluster the standard errors at the barangay level in the first specification. Third, we use the Nearest Neighbour Matching method as an alternative to the IPWRA method.

Short Matching Variable set

In our main analysis, the matching variable set includes indicators on housing quality (wall, roof, floor) and access to electricity, sanitation, and water. We did not collect pre-program (2010) information on these indicators from 254 households, because these households were part of other households at that time (i.e., the current households were not formed in 2010). Since these indicators are important for matching purposes, we drop those 254 households from the analysis and estimate the IPWRA estimates using the full matching variable set. In this section, we include the 254 households but drop the pre-program (2010) indicators and estimate the impact of CHARMP2 using a short set of matching variables.

Clustered Standard Errors

We cluster the standard errors at the Barangay level within the IPWRA framework, which we did not account for in our main analysis. Note that the main reason for not clustering at the barangay level is that the geographical level of program implementation is not clearly defined. Although the program M&E has beneficiary records at the barangay level, the program can be implemented in several barangays under a municipality at a time.

Nearest Neighbour Matching (NNmatch)

The Nearest Neighbour Matching method estimates the ATET by imputing the missing potential outcome for each beneficiary household by using the outcome of a similar household(s) from the comparison group. It takes each treated household and searches for the comparison household(s) with the closest p-score. After getting a match(s) for a beneficiary household, it computes the difference in the outcome variable between each treated and comparison pair. Finally, it averages these differences across the number of treated units to compute the ATET estimate. If the matching takes place with several comparison households, nearest neighbour matching calculates the weighted differences in means for each beneficiary household.

Table 26 in the Appendix shows the results from the robustness checks. Columns 1 to 3 show the impact estimates from the IPWRA without clustering, IPWRA with clustering, and nearest neighbour method specification, respectively, all using the full set of matching variables. Columns 5 to 7 show the impact estimates from the IPWRA without clustering, IPWRA with clustering, and nearest neighbour method specification, respectively, all using the short set of matching variables. It appears that the use of a short matching variable set changes both the sign and precision of the impact estimates, although there is no clear pattern. Next, clustering the standard errors at the barangay level changes the precision of the impact estimates. However, the main findings remain valid. Finally, the NNmatch method generates similar results as the IPWRA method. For some variables, we find that the NNmatch estimates are statistically significant, unlike the IRWRA estimates.

Conclusion

The CHARMP2 project intended to improve the livelihoods of poor households from the indigenous communities in the CAR through sustainable agricultural and agri-business development, improved land tenure security and food security, and conservation of watersheds and highland forests. The ex-post impact assessment (IA) of the project was conducted between July 2021 and March 2022. Results show that the CHARMP2 program beneficiaries have higher access to program benefits (15%), training services (125%), and access to loans (12%) compared to non-beneficiary households.

The project has led to 32% higher gross income and is 33% higher productive assets for beneficiary households relative to comparison households, driven by more land under cultivation and more engagement in farming of cash and non-seasonal crops. Beneficiary households are found to be 13% more likely to engage in selling their products in the market, although there is no significant change in their crop and livestock sales amount in the market. While the project did not impact the ability of beneficiary households to recover from shock, it did help beneficiaries diversify their income by promoting livestock activities as well as commercialization of farming.

In addition, the project was able to improve food security of beneficiary households, with limited impacts on nutrition. It appears the CHARMP2 project has generated only a moderate improvement in women controlled livestock income, but no such improvement in the overall women controlled total income and asset ownership.

There are a few lessons learned that can be useful to the next round of similar types of projects. First, the project had boosted household income including income from crops and livestock of its beneficiaries significantly. This implies that community-level infrastructure projects have substantial potential for income gains and beneficial impacts on economic mobility of households.

Second, we find that the program helps beneficiaries to engage in economic activities not directly targeted by the program, indicating the existence of spillover effects. For instance, it appears that CHARMP2 had positive impacts on livestock asset holdings, livestock activity participation, and income from livestock. At the same time, households are also found to engage in more commercial crop farming. The development of community infrastructure, thus, promoted broad-based market access leading to income diversification and made it more lucrative to engage in other activities. This is an important lesson learnt for the design of future community infrastructure programs.

Third, although 50% of the targeted beneficiaries of the CHARMP2 are women, we do not find concrete evidence of women empowerment in terms of asset ownership or income and sales controlled by them. It may be the case that the program benefits were mainly concentrated at the community level, which may not necessarily translate into benefits for women at the individual level. Therefore, tailoring the program components that address both community- as well as individual-level needs (including specific constraints that women face) will be important, to empower women.

Finally, there is scope to improve the impact of the project on resilience, in particular household's ability to recover from shocks. Thus, there is a growing and persistent need for a more holistic approach to strengthening resilience, designing programs that pay closer attention to potential risks of different types of shocks as well as the households' level of exposure. Acute and chronic shocks may need to be addressed in complementary ways, including a wide range of tools such as social safety nets, insurance and loans/credit in addition to adaptive production practices.

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Appendix

Table 13. CHARMP2 Project Finance

Financier	Project Disbursements	Proportion
IFAD	$22.31	37
IFAD Grant	$0.50	1
IFAD Loan	$7.62	13
OFID	$10.00	17
LGUs	$6.95	12
Beneficiaries	$0.28	0
Government	$12.16	20
Total	$59.82	100

Table 14. CHARMP2 Project Cost Breakdown by Components

Component	Total	Proportion
Social mobilization, participatory planning of investments, and land titling	$5.44	9
Community Watershed Conservation, Forest Management and Agro-forestry	$9.66	16
Agriculture and Agribusiness Development, and Income Generating Activities	$6.34	11
The Rural Infrastructure Development	$32.99	55
Project Management and Coordination	$5.40	9
TOTAL	$59.82	100

Table 15. Mapping of research questions with IFAD goal, strategic objectives and mainstreaming themes

Research Question	SO1	SO2	SO3	Overarching Goal	Mainstreaming Themes and other
a) Gross income				X	
b) Productivity	X				
c) Market access		X			
d) Recovery from shocks			X		X: Climate
e) Women's empowerment					X: Gender
f) Food security					X: Nutrition
g) Climate adaptation					X: Climate

Table 16. Balance in matching variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Beneficiary		Comparison			
	Mean	N	Mean	N	Mean diff.	p-value
Number of children	0.93	906	0.94	837	-0.01	(0.847)
Number of males	2.54	906	2.54	837	-0.00	(0.982)
Number of females	2.22	906	2.25	837	-0.03	(0.670)
Female headed household	0.17	906	0.16	837	0.01	(0.505)
Age of household head	54.45	906	54.83	837	-0.38	(0.548)
Productive asset index (2010)	0.02	906	0.02	837	0.00	(0.881)
Household asset index (2010)	0.07	906	0.06	837	0.01	(0.219)
Livestock asset index (2010)	0.42	906	0.46	837	-0.03	(0.000)***
Electricity 2010	0.72	906	0.72	837	0.00	(0.907)
Water access 2010	0.90	906	0.89	837	0.01	(0.383)
Flush toilet 2010	0.87	906	0.86	837	0.01	(0.507)
Concrete wall 2010	0.44	906	0.42	837	0.02	(0.411)
Concrete roof 2010	0.88	906	0.87	837	0.01	(0.648)
Concrete floor 2010	0.40	906	0.38	837	0.02	(0.423)

Table 17. Number of benefits received (last 10 years)

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
User group	0.01	0.62	1.30	1743
	(0.035)			
Land tenure security	-0.01	0.52	-1.59	1743
	(0.034)			
Reforestation or agroforestry	0.28***	0.29	93.83	1743
	(0.041)			
Irrigation	-0.04	0.45	-8.96	1743
	(0.043)			
Warehouse/solar dryers	0.06**	0.03	184.05	1743
	(0.023)			
Marketing	-0.06**	0.14	-42.82	1743
	(0.024)			
Matching grant	0.01*	-0.00	-251.78	1743
	(0.003)			

Table 18. Number of trainings received on different topics (last 10 years)

	(1)	(2)	(3)	(4)
	Coefficient	**Counterfactual value**	**Impact (%)**	**N**
Production	0.29***	1.15	25.12	1743
	(0.101)			
Harvesting	0.04	0.08	42.61	1743
	(0.026)			
Animal/forestry/forestry	0.02	0.11	20.91	1743
	(0.028)			
Marketing	0.04***	0.02	190.77	1743
	(0.012)			
Access to credit	0.09***	0.04	221.85	1743
	(0.019)			
Reforestation	0.29***	0.06	521.65	1743
	(0.021)			
Agroforestry	0.30***	0.15	203.05	1743
	(0.027)			
Natural disaster (climate change, erosion.)	0.16***	0.06	284.29	1743
	(0.024)			
Land tenure security	0.03***	0.01	429.46	1743
	(0.009)			
Fishery	-0.01	0.10	-9.73	1743
	(0.024)			

Table 19. Land protection and validation documents

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual Value	Impact (%)	N
Received training on land reclamation and protection	0.02***	0.00	0.02	1743
	(0.004)			
Practiced training on land reclamation and protection	0.01***	0.00	0.01	1743
	(0.003)			
Hold any documents for land parcel (own land)	0.03	0.62	0.03	2924
	(0.023)			
Hold any documents for land parcel (others land)	0.01	0.04	0.01	2924
	(0.010)			
Hold any documents for land parcel (any land)	0.04*	0.66	0.04	2924
	(0.022)			

Note: Dependent variables are binary in nature. Training indicators are at the household level, while thy land document indicators are at the parcel level. Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Mean indicates the potential outcome that beneficiary households would have had if they had not benefited from the programme and it is expressed in the outcome's original unit. Impact shows the percentage change compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Table 20. Number of loans received from different sources (last 10 years)

	(1)	(2)	(3)	(4)
	Coefficient	**Counterfactual value**	**Impact (%)**	**N**
Total number of loans received from various sources	0.15***	0.56	26.41	1743
	(0.051)			
Bank	0.01	0.03	32.26	1743
	(0.014)			
MFI	0.04**	0.02	166.72	1743
	(0.018)			
Cooperative	0.04	0.30	13.78	1743
	(0.041)			
CHARMP2	0.01***	-0.00		1743
	(0.004)			
Money lender	0.02	0.03	52.29	1743

	(1)	(2)	(3)	(4)
	Coefficient	**Counterfactual value**	**Impact (%)**	**N**
	(0.015)			
Other	0.03	0.18	17.20	1743
	(0.028)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Mean indicates the potential outcome beneficiary that households would have had if they had not benefited from the programme and it is expressed in the outcome's original unit. Impact shows the percentage change compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Table 21. Impact on Income Shares

	(1)	(2)	(3)	(4)
	Coefficient	**Counterfactual Value**	**Impact (%)**	**N**
Crop farming	0.05***	0.25	21.53	1743
	(0.016)			
Livestock	0.02***	0.05	49.02	1743
	(0.009)			
Enterprises	-0.03*	0.06	-40.73	1743
	(0.014)			
Wage	0.03	0.33	10.24	1743
	(0.022)			
Transfers	-0.07***	0.25	-29.66	1743
	(0.017)			
Other sources	-0.01	0.06	-13.56	1743
	(0.008)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Mean indicates the potential outcome that beneficiary households would have had if they had not benefited from the programme and it is expressed in the outcome's original unit. Impact shows the percentage change compared to the counterfactual value. Values of outcome variables range between 0 to 1. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Table 22. Impact on Crop Income (in pesos) by Crop Types

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Seasonal	-0.03	258.64	-3.27	1612
	(0.206)			
Non seasonal	0.57**	4.54	77.42	1612
	(0.228)			
Export	0.11	0.29	40.95	1612
	(0.104)			
Non export	0.08	681.21	8.53	1612
	(0.167)			
Horticulture	0.28	8.55	32.88	1612
	(0.227)			
Non horticulture	-0.12	170.28	-10.97	1612
	(0.208)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. Impact is reported in percentage change. Income is measured in Philippines Peso. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Table 23. Impact on Crop Choices

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Rice/Palay	0.03	0.62	0.03	1743
	(0.027)			
Corn	-0.00	0.06	-0.00	1743
	(0.016)			
Carrots	0.04***	0.01	0.04	1743
	(0.009)			
Cabbage	0.02	0.04	0.02	1743
	(0.013)			
Beans	-0.01	0.12	-0.01	1743
	(0.023)			
Tomato	0.03*	0.07	0.03	1743
	(0.017)			
Banana	0.04***	0.03	0.04	1743
	(0.012)			

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Number of crops cultivated per households	0.16**	1.24	12.93	1743
	(0.063)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. All outcome variable other than "Number of crops cultivated per households" are binary indicators. Impact shows the percentage point change for binary indicators and percent change other indicators, all compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Table 24. Impact on Dietary Diversity (last 7 days)

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
HDDS (7 days)	0.05	9.05	0.56	1742
	(0.146)			
Cereals	-0.00	0.99	-0.00	1743
	(0.007)			
White tubers and roots	0.03	0.58	0.03	1743
	(0.034)			
Vegetables	0.01	0.98	0.01	1743
	(0.008)			
Fruits	0.06**	0.74	0.06	1743
	(0.027)			
Meat	0.02	0.80	0.02	1743
	(0.026)			
Eggs	-0.02	0.88	-0.02	1743
	(0.021)			
Fish and other seafood	0.03	0.79	0.03	1743
	(0.024)			
Legumes, nuts and seeds	0.05	0.71	0.05	1743
	(0.032)			
Milk and milk products	0.05	0.47	0.05	1743
	(0.034)			
Oils and fats	-0.04	0.67	-0.04	1743
	(0.030)			

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Sweets	-0.03	0.77	-0.03	1743
	(0.028)			
Spices, condiments and beverages	-0.08**	0.64	-0.08	1743
	(0.031)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. All outcome variable other than "HDDS (7 days)" are binary indicators. Impact shows the percentage point change for binary indicators and percent change other indicators, all compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Table 25. Impact on Food Security (last year)

	(1)	(2)	(3)	(4)
	Coefficient	Counterfactual value	Impact (%)	N
Food insecurity experience scale (FIES) score	-0.25***	1.12	-22.22	1743
	(0.096)			
Worried about food	-0.12***	0.41	-0.12	1743
	(0.030)			
Did not ate Healthy food	-0.03	0.23	-0.03	1743
	(0.026)			
Ate only a few food	-0.06**	0.24	-0.06	1743
	(0.028)			
Skippd meals	-0.01	0.03	-0.01	1743
	(0.011)			
Ate less food than wanted	0.00	0.06	0.00	1743
	(0.017)			
Run out of food	-0.02	0.10	-0.02	1743
	(0.019)			
Went bed while hungry	-0.01	0.03	-0.01	1743
	(0.010)			
Didn't eat for a whole day	-0.00	0.01	-0.00	1743
	(0.008)			

Note: Coefficient shows the impact estimate from the IPWRA specification. Standard errors are in the parentheses, and not adjusted for intra-cluster correlation. Counterfactual value indicates the potential outcome beneficiary households would have had if they had not benefited from the programme, and it is expressed in the outcome's original unit. All outcome variable other than "Food insecurity experience scale (FIES) score" are binary indicators. Impact shows the percentage point change for binary indicators and percent change other indicators, all compared to the counterfactual value. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.

Table 26. Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Long Matching Variables List				Short Matching Variables List			
	IPWRA	IPWRA-Cluster	NNmatch	Observation	IPWRA	IPWRA-Cluster	NNmatch	Observation
	Income							
Total	0.28***	0.28**	0.14***	1743	0.07	0.07	0.03	1999
	(0.069)	(0.138)	(0.054)		(0.046)	(0.099)	(0.051)	
Crop	0.78***	0.78**	0.15	1743	0.57***	0.57*	0.21	1999
	(0.232)	(0.371)	(0.167)		(0.141)	(0.308)	(0.155)	
Livestock	0.56***	0.56*	0.72***	1223	-0.02	-0.02	0.55***	1332
	(0.177)	(0.336)	(0.139)		(0.116)	(0.183)	(0.136)	
Wage	0.63*	0.63	0.36	1743	-0.52**	-0.52	-0.28	1999
	(0.357)	(0.760)	(0.264)		(0.233)	(0.558)	(0.239)	
Enterprise	-0.37	-0.37	-0.67***	200	-0.57**	-0.57**	-0.48**	222
	(0.344)	(0.399)	(0.175)		(0.228)	(0.263)	(0.189)	
Transfers	-0.52**	-0.52	-0.60***	1743	0.49**	0.49	-0.22	1999
	(0.238)	(0.372)	(0.196)		(0.194)	(0.394)	(0.180)	
	Asset holdings							
All asset index	0.02	0.02	0.02***	1743	-0.01	-0.01	0.01	1999
	(0.011)	(0.018)	(0.007)		(0.007)	(0.017)	(0.007)	
Productive asset index	0.01*	0.01	0.01**	1743	0.01*	0.01	0.01	1999
	(0.005)	(0.006)	(0.004)		(0.003)	(0.005)	(0.004)	
Household asset index	0.00	0.00	0.02	1743	-0.01	-0.01	-0.00	1999
	(0.013)	(0.024)	(0.010)		(0.008)	(0.024)	(0.009)	
Livestock asset index	0.04***	0.04***	0.03***	1743	0.01	0.01	0.02***	1999
	(0.007)	(0.015)	(0.004)		(0.005)	(0.007)	(0.004)	

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Long Matching Variables List				**Short Matching Variables List**			
	IPWRA	**IPWRA-Cluster**	**NNmatch**	**Observation**	**IPWRA**	**IPWRA-Cluster**	**NNmatch**	**Observation**
Crop land (hectare)	0.22***	0.22**	0.14***	1743	0.16***	0.16*	0.08*	1999
	(0.072)	(0.108)	(0.053)		(0.046)	(0.090)	(0.048)	
				Market access				
Crop sales	0.26	0.26	0.03	794	0.22*	0.22	0.17*	956
	(0.194)	(0.212)	(0.120)		(0.132)	(0.180)	(0.098)	
Livestock sales	0.34	0.34	0.61***	542	0.33	0.33	0.49**	587
	(0.275)	(0.414)	(0.225)		(0.224)	(0.325)	(0.210)	
Enterprise sales	-0.03	-0.03	-0.06***	200	-0.05***	-0.05**	-0.04**	222
	(0.030)	(0.035)	(0.015)		(0.020)	(0.023)	(0.016)	
Total sales	0.02	0.02	0.23*	1171	-0.00	-0.00	0.10	1364
	(0.148)	(0.197)	(0.117)		(0.125)	(0.167)	(0.108)	
				Food security				
HDDS (7 days)	0.05	0.05	0.21*	1742	-0.28***	-0.28	0.20*	1998
	(0.146)	(0.339)	(0.119)		(0.098)	(0.287)	(0.114)	
FIES	-0.25***	-0.25	-0.36***	1743	0.04	0.04	-0.13*	1999
	(0.096)	(0.200)	(0.080)		(0.064)	(0.185)	(0.068)	
				Resilience				
Ability to recover from shocks	0.03	0.03	0.02	1552	-0.03	-0.03	-0.01	1791
	(0.033)	(0.056)	(0.023)		(0.020)	(0.047)	(0.021)	
Ability to recover from shocks	0.01	0.01	0.07**	1349	-0.03	-0.03	0.02	1559
	(0.035)	(0.070)	(0.027)		(0.023)	(0.072)	(0.025)	
Ability to recover from shocks	0.05	0.05	0.02	1153	-0.03	-0.03	-0.03	1328

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Long Matching Variables List				Short Matching Variables List			
	IPWRA	IPWRA-Cluster	NNmatch	Observation	IPWRA	IPWRA-Cluster	NNmatch	Observation
	(0.040)	(0.078)	(0.030)		(0.027)	(0.067)	(0.028)	
Ability to recover from shocks (corrected)	0.09***	0.09	0.04*	1552	0.04*	0.04	0.03	1791
	(0.033)	(0.060)	(0.025)		(0.021)	(0.050)	(0.024)	
Ability to recover from shocks (corrected)	0.07**	0.07	0.08***	1349	0.03	0.03	0.06***	1559
	(0.033)	(0.060)	(0.024)		(0.021)	(0.055)	(0.024)	
Ability to recover from shocks (corrected)	0.19***	0.19**	0.18***	1153	0.11***	0.11*	0.11***	1328
	(0.045)	(0.085)	(0.038)		(0.030)	(0.063)	(0.035)	
Gini-Simpson Index	0.03*	0.03	0.04***	1740	0.03***	0.03	0.02*	1992
	(0.014)	(0.023)	(0.010)		(0.010)	(0.021)	(0.010)	
Women Empowerment (Female income)								
Total	0.11	0.11	-0.38	1743	-0.15	-0.15	-0.01	1999
	(0.359)	(0.618)	(0.269)		(0.233)	(0.460)	(0.246)	
Crop	-0.16	-0.16	-0.37*	1606	-0.02	-0.02	-0.20	1836
	(0.260)	(0.321)	(0.194)		(0.161)	(0.257)	(0.175)	
Enterprise	1.56	1.56	2.66***	200	1.24	1.24	2.73***	222
	(1.254)	(1.599)	(0.769)		(0.802)	(1.130)	(0.677)	
Wage	-0.43	-0.43	-0.49**	1743	-0.40*	-0.40	-0.24	1999
	(0.325)	(0.500)	(0.245)		(0.214)	(0.382)	(0.220)	
Livestock	0.50**	0.50	0.79***	1223	0.28	0.28	0.65***	1332
	(0.238)	(0.345)	(0.198)		(0.182)	(0.244)	(0.181)	
Other	-0.11	-0.11	-0.52***	1743	-0.15	-0.15	-0.19*	1999

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Long Matching Variables List				Short Matching Variables List			
	IPWRA	IPWRA-Cluster	NNmatch	Observation	IPWRA	IPWRA-Cluster	NNmatch	Observation
	(0.163)	(0.229)	(0.126)		(0.104)	(0.168)	(0.109)	

Note: Coefficient shows the impact estimates from the IPWRA (with and without cluster) or NNmatch specifications. Standard errors are in the parentheses. Asterisks indicate the level of statistical significance: * at 10 per cent; ** at 5 per cent; *** at 1 per cent.