IMPACT EVALUATION OF SUPPORT TO COLLECTIVE ACTION FOR AGRICULTURAL VALUE CHAIN DEVELOPMENT IN NEPAL

David A. Raitzer and Odbayar Batmunkh

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David Raitzer (draitzer@adb.org) is an economist and Odbayar Batmunkh (obatmunkh@dons.usfca.edu) is a consultant at the Economic Research and Regional Cooperation Department, Asian Development Bank (ADB).

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ASIAN DEVELOPMENT BANK

6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines
Tel +63 2 8632 4444; Fax +63 2 8636 2444
www.adb.org

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ABSTRACT

Matching grant programs administered to agricultural groups and cooperatives have emerged as a means of helping smallholder farmers to commercialize in Nepal. These programs help farmers to access information on new technologies, overcome barriers to productive investment, and connect with output markets, although the combinations of support received by individual households vary. This study disentangles the causal effects of different elements of support through an inverse probability weighted two-way fixed effects analysis of data from a panel of 2,268 households, of which 47% belong to 246 farmer groups in three provinces. It finds that group membership without receiving support has important effects on commercialization and income, as does receiving any support. The forms of support with largest effects on production, income, and/or human capital include production training, marketing support, and a combination including both training and assets. In contrast, only modest or even negative effects are detected from provision of either inputs or credit in isolation.

Keywords: matching grants, microcredit, extension, asset transfer, agriculture

JEL codes: Q12, Q13, Q14, Q16

I. INTRODUCTION

Two billion people around the world are dependent on small-scale agriculture and live in households that cultivate less than 2 hectares of land (FAO 2015). This small scale causes these farmers to have high transaction costs to engage with value chain actors and limits the collateral that can be used to access credit markets. The absence of access to credit, information, and services has impeded many of these households from undertaking the investments necessary to engage in commercial agricultural markets. Without the ability to competitively commercialize, those dependent on small-scale agriculture remain among the poorest populations globally.

In the absence of possibilities to easily expand farm sizes, development actors often seek to enhance the value of agricultural products cultivated on small farms by directly addressing these information and service constraints (ADB 2010). One key means of doing so is the use of productive asset transfers, which often combine the provision of an asset that can help improve agricultural productivity or quality with technical and/or business training and interventions to help reduce transaction costs to engage with input and output markets. Often these transfers take the form of matching grant programs, in which program beneficiaries are expected to complement support with their own resources.

Despite increased emphasis on multidimensional support for value chain development, there is limited empirical evidence relating to the effects of agricultural value chain interventions apart from research and extension services in developing Asia. Previous studies have mostly evaluated business development grants outside of Asia. Bruhn, Karlan, and Schoar (2018) evaluated the impact of business consulting services and matching grants in Mexico and found positive effects on profits and employment generation. Mullally and Maffioli (2016) estimated the effects of matching grants on the livestock sector in Uruguay and found that firms that received the grants and extension services improved their management practices and thus improved production and sales.

In Nepal, Kafle, Songsermsawas, and Winters (2021), drawing on Kafle, Krah, and Songsermsawas (2018), estimated the impact of value chain development support for high-value crops in rural parts of the country. The study finds that the interventions increased agricultural income of households by enabling them to sell larger quantities of crops than before, but at lower prices. A 2013 systematic review that attempted to comprehensively identify impact evaluations on "business development grant systems" for agriculture identified no study that rigorously estimated treatment effects (Ton et al. 2013). A later 2016 systematic review (Cravo and Piza 2016) identified 40 papers that studied small and medium-sized enterprise (SME) support interventions around the world and found significant impacts on business outcome indicators and employment generation in most of those papers. However, they underlined that many of the studies included in the literature review utilized methods that cannot fully account for the effects of confounding factors, such as selection bias.

Matching grants are often oriented toward agricultural cooperatives and farmer groups, as this enables programs to reach more farmers at lower transaction cost, and because those groups are considered as means to exploit potential economies of scale via coordinated production or marketing. There is mixed evidence on whether group membership is beneficial to farmer production and commercialization. Although a number of studies, such as Abebaw and Haile 2013; Chagwiza, Muradian, and Ruben 2016; Ma and Abdulai 2016; Ma, Abdulai, and Goetz 2018; Michalek, Ciaian, and Pokrivcak 2018; and Mojo, Fischer, and Degefa 2017, show positive effects of cooperative or group

membership on economic outcomes, other literature, such as Addai, Owusu, and Danso-Abbeam 2014; Blekking et al. 2021; Hun et al. 2018; and King and Ortmann 2007, show negative, limited, or neutral effects.

Negative effects of cooperative/group membership may occur when support channeled via groups is coopted by empowered actors within groups, or constrained by principal-agent problems between members and leadership (Banerjee et al. 2001, Sebhatu et al. 2020). In addition, the provision of inputs and assets that are private goods constitute intervention in competitive markets that may lead to distortions, deadweight losses, and substitution for use of credit that ultimately stifle the development of credit markets (Sberro-Kessler 2019). Evidence is needed to understand whether these concerns are justified and ascertain if value chain interventions are truly improving agricultural performance. In addition, as support to value chain development takes many forms, much remains to be understood about the comparative effectiveness of measures and packages deployed.

A. Nepal Context

With 83% of the population of Nepal living in rural areas (Central Bureau of Statistics 2012) and 64% of the total population engaged in the agriculture sector, agriculture is an essential source of livelihood in Nepal (ADB 2018). The agriculture sector of Nepal is characterized mostly by subsistence farming, low farm size, and low investment, which results in a low productivity trap that is amplified by the country's rugged topography and limited connectivity. In the context of low returns and high business risks, the private sector is reluctant to invest in the agriculture sector. Absent investment, production has low inputs and low productivity, which limit marketable surplus. In the presence of topographical barriers that limit market access, market connectivity is limited, and transaction costs to commercialize are high relative to the small quantities that can be marketed. As a result, production is dominated by low value cereals for subsistence consumption to ensure food security, and revenues are insufficient to invest in productivity-enhancing technology and break out of this trap (Tiwari et al. 2008). Because of limited prospects to improve livelihoods via agriculture, many Nepalese men and women migrate abroad for work on annual or seasonal basis (Tamang, Paudel, and Shrestha 2014).

B. Description of Matching Grant Programs

Nepal's 2015 Agriculture Development Strategy[1] focuses on developing all stages of the value chain from inputs to outputs, with an emphasis on inclusive value chain linkages in poor regions (Ministry of Agricultural Development 2015). In Karnali, Lumbini, and Sudurpashchim provinces, poverty prevalence is above the national average, so they have been the focus of a number of value chain improvement projects (UNDP 2014). To accelerate agricultural commercialization, multilateral donor organizations and the Government of Nepal have funded at least seven different projects in western Nepal between 2014 and 2018, which shared a common matching grant modality. This approach relies on agricultural groups (cooperatives, farmer groups, and producer associations) to apply for matching grants with intention to procure productive assets.[2]

[1] The Asian Development Bank (ADB) supported the development of Nepal's Agriculture Development Strategy (2015-2035) with technical assistance (TA 7762-NEP).

[2] Some of the donor programs operating in the project areas supported agri-enterprises and other entities, in addition to farmer groups and cooperatives. That support is beyond the scope of this analysis.

Under this process, each group submitted a collective application that contained a technical and a financial proposal to fund specific investments in assets that could enable higher value production and/or marketing of agricultural outputs. The investments to be funded by the projects were to be complemented by investments by the applicants. Assistance was provided by the programs to applicants for the formulation of proposals. Submitted proposals were subjected to technical and financial screening, and successful applicants were given financial support for costs in the proposal, as well as complementary training. The training often included "extension" on improved production practices or marketing, as well as financial literacy and business skills training.

Between 2014 and 2018 the matching grant modality was implemented in at least three projects that were funded or supervised by the World Bank (Agricultural Food Security Project [AFSP] and Project for Agricultural Commercialization and Trade [PACT]; Rani Jamara Kulariya Irrigation Project); and one project funded by each of the following donors: ADB (Raising Incomes of Small and Medium Farmers Project [RISMFP]), the United States Agency for International Development (Knowledge-Based Integrated Sustainable Agriculture in Nepal [KISAN]), the International Fund for Agricultural Development (High Value Agriculture Project [HVAP]), and the Government of Nepal (Prime Minister Agriculture Modernization Project [PMAMP]). The large number of projects being implemented in the same geographic area raised the possibility of overlapping support. Some projects, including RISMFP, included rules to discourage the same groups from applying to multiple programs.

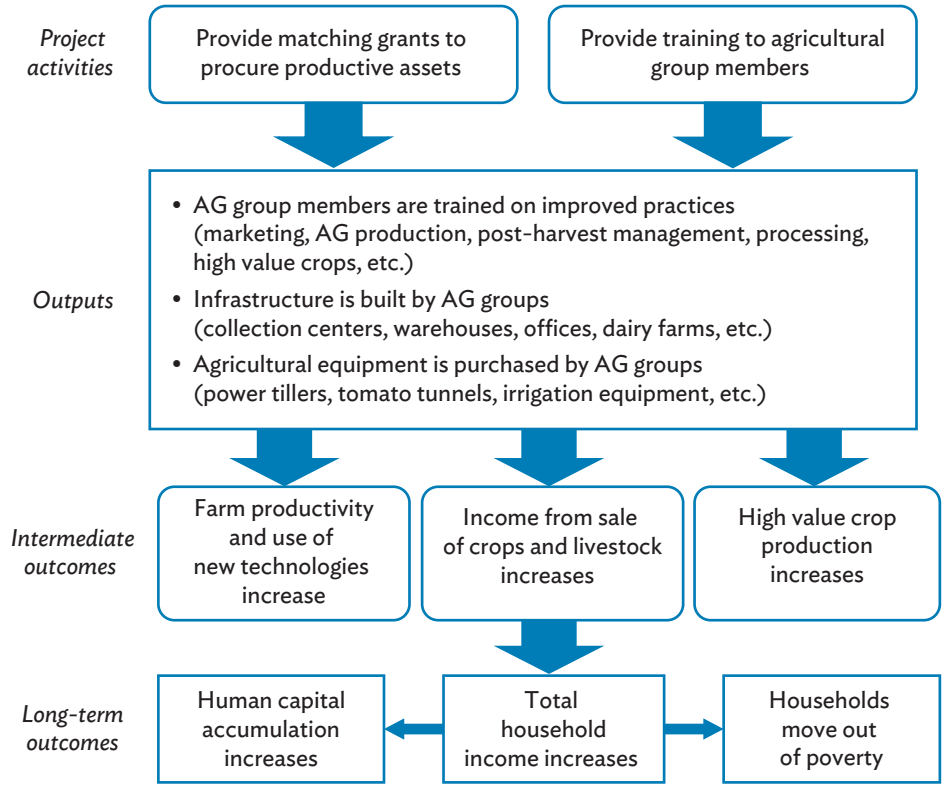
RISMFP, PACT, and HVAP provided training to groups that were successful in their applications, but the intensity of training and institutional capacity building provided to the beneficiary groups also varied widely from one project to another. The size of the grants differed by project, ranging from $5,000 to $200,000, as did the value chains covered. Figure 1 illustrates the theory of change[3] that underpins this approach.

Following the theory of change in Figure 1, the projects are expected to lead to additional training and assets and inputs for production, which introduce new technologies, leading to greater high value crop production and increased sales. The overall increase in the sales of high-value crops should translate into higher agricultural income for beneficiary households, which improves consumption, food security, and human and social capital accumulation.

It should be noted that this is an idealized theory of change reflecting all components of project support. However, from the perspective of beneficiaries, not all areas of support may be received, as not all cooperative and group members may participate in the funded value chain activities, and not all those who participate may receive all the elements of support. As a result, there can be substantial heterogeneity in which types of support channeled via groups are actually received by specific farm households. The types of support received may have very different outcomes.

[3] This depiction generalizes the theory of change to cover all seven projects, but deviations on beneficiary targeting, documentation requirements, and training provision still exist.

Figure 1: Project Theory of Change



AG = agriculture.
Source: Authors.

C. Hypotheses

Nepal is a context in which transportation costs are high, farm holdings are small and fragmented, and transaction costs for access to information and formal credit, input, and output markets are high. Farmer groups and cooperatives have potential to serve as intermediaries that reduce these costs through collective and coordinated action such as savings and credit services, joint input procurement, agricultural information transfer, and coordinated sales. Participation in groups can thus be expected to have beneficial effects even in the absence of material or financial support.

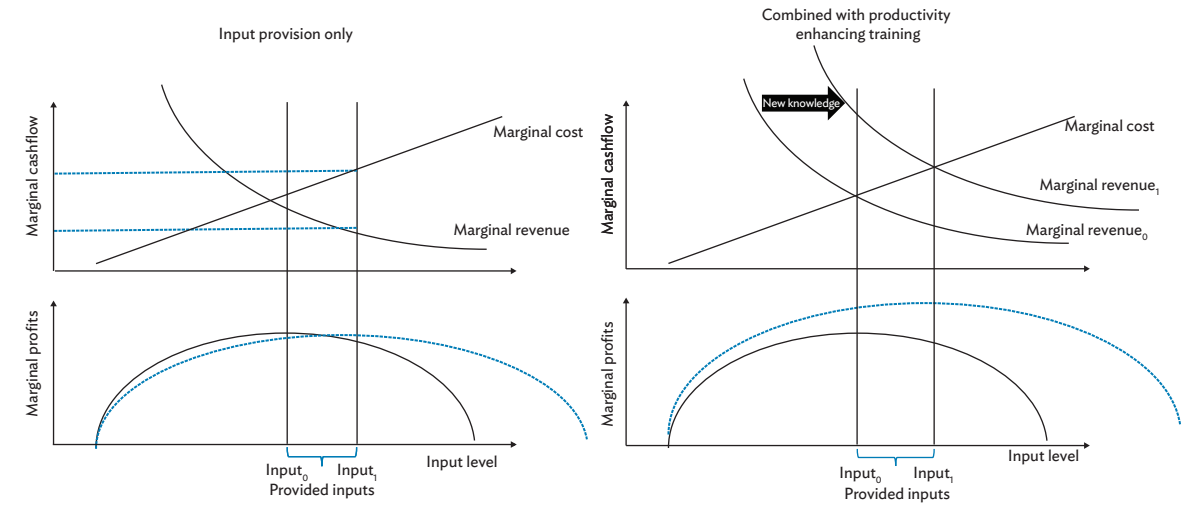
Agricultural production value depends on a mixture of fixed assets and variable inputs allocated to a range of products possibly cultivated and utilized according to the skills and information set possessed by the farmer. Fixed assets include factors such as land, machinery, and storage facilities, while variable inputs include use of chemical and organic inputs, labor, fuel, and water. Given inputs, output is defined by a production function for each farmer. This production frontier is constrained by the information or technology stock available to the farmer, and the level of equilibrium input usage is defined by the intersection of the production frontier with the market price.

As can be seen in the left panel of Figure 2, provision of an input alone subsidizes production costs and leads to an increase in input usage along the production function to a point where private marginal costs are equal to the output price, but total costs including the subsidy exceed the price. Much of the effect of the subsidy is offset by the declining gains of additional inputs. This suggests that the effects are transient, as when the subsidy is withdrawn, the marginal costs will increase, and optimal input usage from the farm perspective will return to previous levels.

Likewise, in the absence of training, farmers may not be expected to shift practices in response to credit alone, as the fundamentals of the production function remain unchanged. In the case of credit alone, the usage of credit is likely to affect nonagricultural behavior.

On the other hand, a change in agricultural technology can lead the entire curve to shift to the right, in which case the intersection of optimal usage with the price is at a higher level, as seen in the right panel of Figure 2. A change in technology can be offered through training and might be facilitated by providing inputs on a demonstration basis, so that technologies are initially applied when farmers might consider them risky. This suggests that the provision of inputs is likely to be ineffective without training, and that training might achieve the same change in input use without the inputs provided.

Figure 2: Effects of Input Provision



Source: Authors.

At the same time, farmers can freely access many inputs through input retailers, and training that relates to those inputs may duplicate existing knowledge. Assets may have larger barriers to adoption. Studies on the adoption of innovations suggest that adoption is slower for innovations that are indivisible or lumpy, such as these types of assets, because farmers cannot trial their use on a partial basis, so that risk is higher and decisions are less reversible (Vanclay 1992). In addition, lumpy investments are more affected by cash flow constraints than investments that can be made in small increments. Credit might be expected to help enable these investments to be made, but emerging evidence suggests that the poor are often too risk averse to borrow to invest in costly assets with uncertain returns (Carter and Michuda 2019).

This implies that the greater barrier to adoption of assets may lead to a larger differential between actual and potential productivity than the smaller barriers to adoption of inputs. Assets may also embed technology in new machinery and equipment, but understanding is often needed to utilize the technology so that a combination of training plus assets may lead to an even larger effect than training plus inputs.

Theory on the diffusion of innovations suggests that initial adopters of new technologies will be those who have more ability to bear risk, higher social status, other community leadership positions, more education, and better access to information—all characteristics associated with agricultural performance, commercialization, and income (Rogers 2010). These characteristics are likely to be more pronounced the more that support implies a larger change of technology. As asset transfer coupled with training can be expected to have the largest effects on production for the reasons noted, it follows that the effects of this support will be larger among those who start with better performance and higher income.

These considerations suggest the following hypotheses:

(i) Participation in farmer groups/cooperatives will result in improvements to agricultural production and commercialization even without support from a specific project.
(ii) The provision of inputs or credit alone will be unlikely to substantially change agricultural production practices and income.
(iii) The addition of training to other support will substantially raise agricultural productivity.
(iv) There will be synergistic effects of training and the provision of assets, which will be higher than the effects of training and variable inputs.
(v) Effects of support, particularly for asset transfer and training, are likely to be higher for households that have higher agricultural income at baseline.

II. METHODOLOGY

The intention of the study is to isolate the effects of support to farmers via collective action from confounding factors, including that farmer groups and farmer beneficiaries were purposively selected by programs from self-selected applicants. With many programs operating simultaneously, randomization of intervention assignment is not feasible, since members of the control population excluded from one program may still apply to another program to receive a similar intervention. Moreover, even in contexts with fewer programs operating, attempts at randomization of matching grants have failed repeatedly due to problems in soliciting excess quality applications (Campos et al. 2013). In this context, quasi-experimental methods are used to isolate the effects of support. Unlike Kafle, Krah, and Songsermsawas (2018), the analysis takes into account multiple sources of interventions, rather than consider activities supported by one donor in isolation, and instead focuses on the effects of permutations of interventions received via farmer groups.

A. Identification Strategy

This study evaluates many different treatments, as support to farmers via grants to farmer groups and cooperatives is heterogenous. First, there is the aspect of whether farmers decide to join groups, as a crucial element of the theory of change is that farmer group membership is itself beneficial. In this case, treatment is joining a group, but to isolate the effect of membership, the treatment is on a pool that did not receive other support.

To understand the effect of receiving support on those who are already members of groups, the sample needs to be restricted to those who do not join or leave groups, and treatment becomes receiving support packages. Those packages themselves are heterogenous, as various production stages, products, and types of support are offered. For example, support could be production and/or marketing, and it could be for crops or livestock. It may involve fixed assets, variable inputs, or various types of training. To isolate the effects of different types of support, each category needs to be considered against a comparison of group members who did not receive any support. To capture synergies between membership and support, comparison is also performed between never-members and supported new group members as an additional treatment.

The causal approach employed relies on two-way fixed effects regressions, in which the trends over time of nonparticipants are assumed to be similar to those of participants, absent the program (the "parallel trends assumption"). The approach drops out the constant effects of any time invariant differences between participants and nonparticipants, so that confounding could only occur via time variant variables. This is specified as follows:

$$Y_{it} = \alpha_i + \gamma_t + \beta X_{it} + \epsilon_{it} + \vartheta Z_{it}$$

where *Y* is the outcome variable, *X* is the treatment variable of household *i* at time *t*, and *Z* is a vector of exogenous covariates. In this model α_i and γ_t are unit and time fixed effects, and β and ϑ are estimated parameters.

The model includes covariates to cover rainfall in each production season in the location, local price variation in inputs and outputs, the presence of other projects, and production damage events, such as drought. To further narrow the scope of the parallel trends assumption, the two-way fixed effects technique is complemented by the use of inverse probability weights, which equalize the observable characteristics of participants and nonparticipants prior to the program. This means that the only potential source of confounding relates to unobserved time variant variables related to selection into the program.

To do so, baseline household characteristics and endline treatment data are used to construct covariate balancing propensity scores (CBPS), which serve as the basis of weights for the regressions (Imai and Ratkovic 2014). The following functional form was used to predict selection into group membership or donor support:

$$X_{it} = \beta_o + \beta_1 \omega 1_{t-1} + \cdots + \beta_n \omega n_{t-1} + \varepsilon_i$$

where *X* is the treatment variable of household *i* at time *t*, $\omega 1$ to ωn is the list of baseline variables that predict selection into treatment, and ε_i is the error term.

Predictor variables include the characteristics of the person that is most involved in agriculture at baseline, household farm details, income profile of household, low caste status, and road and electricity access, to predict selection into treatment. Since the grants are given to the farmer groups and cooperatives, the success of each group in attracting funding is dependent on the effective governance of each group, and the analysis includes a governance index for each group to predict the probability of receiving support. The full list of variables used is provided in Appendix 3.[4] Covariate balancing propensity scores were used to calculate inverse probability weights and then applied to the fixed effects model, such that observable baseline imbalances are minimized (as illustrated in Appendix Tables A1–A4).

The above approach is valid for continuous outcome variables that are normally distributed. However, outcomes that are only observed for a subset of the observations, such as income from sales of agricultural products, are skewed and contain many zero values. In these cases, Poisson inverse probability weighted fixed effects models were used. These models assume a Poisson distribution, in which the mean expected outcome value can be written as:

$$E(Y_{it}) = \theta_i \lambda_{it}$$

where static factor θ_i are fixed effects and dynamic factor λ_{it} introduces observable characteristics. The latter can be expressed as:

$$\lambda_{it} = e^{(\beta_0 + \hat{\beta} W_{it})}$$

where β_0 is the intercept and W_{it} is a vector of explanatory variables, including covariates and the intervention of interest.

The above approaches provide estimates at the sample mean. At the same time, effects on the distribution beyond the mean are of interest to understand how treatment effects vary within the treated population. This is particularly relevant in the case of collective action, as it is important to understand whether interventions lead to benefits that are widely shared or that increase inequality among the intended beneficiaries. To answer this question in a generalizable manner, an unconditional estimate of the intervention treatment effects on different quantiles is required. As first noted by Firpo, Fortin, and Lemieux (2009), recentered influence functions (RIFs) provide a means to provide unconditional estimates at different quantiles. An influence function assesses the effect of removing or adding an observation on the value of an outcome statistic, and when the statistic is added to the function, it becomes a RIF, defined as:

$$RIF(Y; q_\tau, F_Y) = q_\tau + \frac{\tau - 1\{Y \leq q_\tau\}}{\int Y(q_\tau)}$$

where Y is the outcome variable and q_τ is the value of the outcome variable at quantile τ. F_Y is the cumulative distribution function of Y. $\int Y(q_\tau)$ is the density of Y at quantile τ. $1\{Y \leq q_\tau\}$ identifies whether outcome value Y is below q_τ.

The generalized unconditional quantile regression approach developed by Firpo, Fortin, and Lemieux (2009) replaces the raw values of the dependent variable in an ordinary least squares (OLS) regression with the RIF, which is regressed on the covariates of the model. As the RIF can be specified at different quantiles, estimates can be made at different points in the distribution. This is useful to understand whether benefits are captured by farmers that are wealthier or are more commercialized within the groups.

[4] The Appendix can be accessed here: https://www.adb.org/publications/collective-action-agricultural-value-chain-development-nepal.

B. Sampling

The following four districts in Karnali, Lumbini, and Sudurpashchim provinces of Nepal serve as the geographic focus of the study: Banke, Baidati, Kailali, and Surkhet. Two of these districts are in the *Terai* (lowland region), and two are in the hilly regions. The districts were selected based on monitoring data from RISMFP, HVAP, KISAN, and PACT and to be representative of the two predominant geographic regions of Nepal. The intention of sampling was to capture sufficient variability in expected treatment to enable the use of fixed effects approaches over two survey rounds. At the time of study initiation, the matching grant programs were only being initiated, and a couple of the programs had performed pilot initial application processes, from which grants had not yet been selected. Settlements were chosen in the locations containing the groups that had submitted proposals to the pilot processes, and then they were matched to two other settlements with similar background characteristics, in terms of dominant crops, distance to market, population, and presence of agricultural groups. Within the selected settlements, farm households were randomly selected for enumeration.

C. Data

Three questionnaires were utilized for data collection: a household farm survey, a farmer group or cooperative survey, and a settlement level survey, in two survey rounds. The primary instrument is the household survey, which covers basic demographic characteristics of the household along with detailed agriculture and consumption modules. A group-level questionnaire was designed to capture the details of support received by the agricultural groups and the support that groups provided to their members. The final instrument is the settlement survey, which was designed to capture general characteristics of each settlement and information on wages of agricultural laborers and prices of main crops in each settlement to be used as covariates in regressions.

At baseline there were 204 groups interviewed and 246 at endline, but only 87 of those groups were interviewed in both survey rounds, as the endline group was sampled on the basis of membership reported in the household survey, whereas the baseline was sampled based on location. Many agricultural cooperatives were only providing savings and credit services when they were not receiving support for a specific donor-funded value chain promotion activity. Of the 87 panel agricultural groups, 91% identified agricultural activities as the main reason for group formation, with the second most common reason being savings and credit activities (59%). At baseline 1 in 5 cooperatives interviewed were providing only savings and credit, and that number reduced to 1 in 10 at endline.

The main unit of analysis is the household. Surveys of 162 wards and 2,268 households were conducted in April 2014, prior to many matching grant activities, and in July 2018, when several programs were nearing completion. The survey team was instructed to also interview every active agricultural group in which the endline households had membership. By the end of data collection more than 90% of groups mentioned in the household survey were reached. The endline survey was able to reach 96% of baseline households, giving an attrition rate of 4% (those households were replaced).

Treatment and comparison groups for membership effects were defined by limiting the sample to comparable households without donor support. This subsample includes households that are not in agricultural groups in either survey round but does not include households that left agricultural group membership sans donor support. The subsample designed to detect the impact of donor support consists of households that were members of agricultural groups both at baseline and endline (*always-members*) or were not members both at baseline and endline (*never-members*), so as to avoid confounding the effect of joining groups.

Table 1 below shows that 15% of households joined a group when they were revisited during the endline survey, while 18% of households were members of an agricultural group at baseline but had left all agricultural groups at endline. The remaining households are split evenly between those that were *always-members* of an agricultural group, and those that were *never-members* of a group.

Table 1: Group Membership

Membership Status	No. of HHs	%
HH joined new group	343	15
HH left group	413	18
HH always member of group	733	32
HH never member of group	779	34
Total	2,268	100

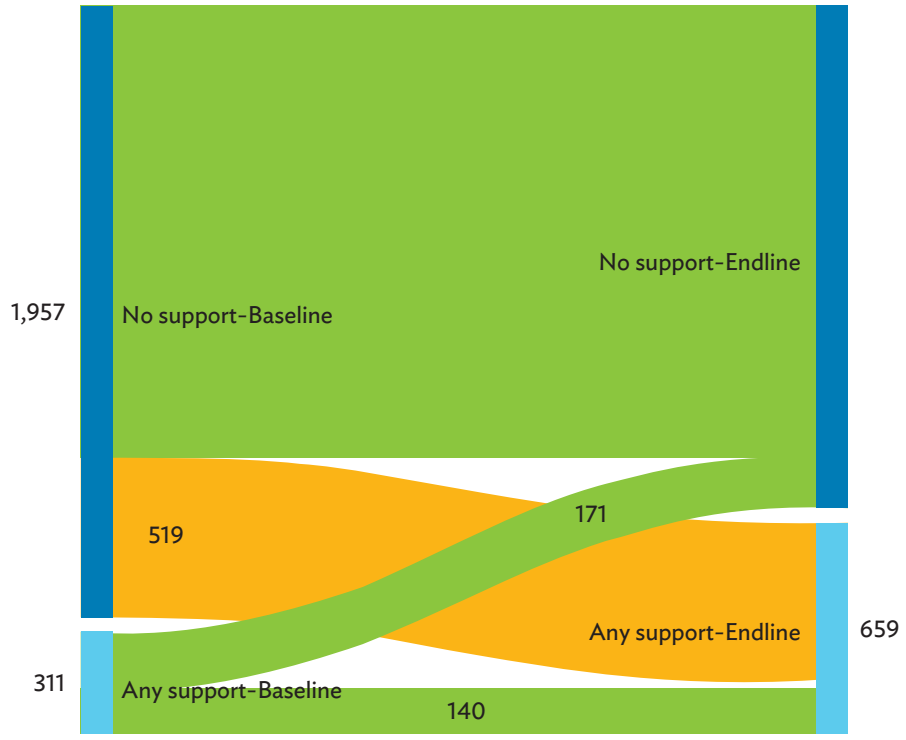
HH = household.
Source: Authors' analysis of household endline survey, 2018.

Figure 3 illustrates the same household change in agricultural group membership status. A similar share of baseline households did not change their membership status, but the share of households that joined a group at endline was higher than the share that left an agricultural group. Figure 4 shows that the majority of farmers did not receive support in either baseline or endline, but a much higher share of farmers began receiving support at endline when they didn't receive support at baseline.

Figure 3: Change in Agricultural Group Membership Status

Source: Authors.

Figure 4: Change in Donor Support Status



Source: Authors.

III. RESULTS

A. Sample Characteristics

1. Households

The household survey reveals that households are relatively diversified in terms of income, with wages plus remittances constituting a larger share of cash income than agriculture (Table 2). Agriculture itself has limited commercialization, with only around half of households selling any portion of their harvested crops, and a majority of the cereal production for households' own consumption. At baseline, despite small average farm sizes of 0.67 hectares, most of the cultivated land is owned by the household (80%) and most households are self-sufficient in rice production. Technological uptake is limited, with only 16% of farmers reporting ownership of agricultural machinery, such as power tillers and threshers, and 59% of the farm area is reported as irrigated.

Table 2: Household Description

Variable	Mean
Income Sources Share	
Wages	0.25
Sale of livestock	0.15
Sale of crops	0.13
Other agricultural revenue	0.03
Land rental revenue	0.00
Remittances	0.21
Business	0.10
Other	0.12
Farm-Related Variables	
Farm area in hectares	0.67
Share of farm area owned	0.80
Area sharecropped in hectares	0.16
Share of farm area sharecropped	0.10
Area of farm irrigated	0.44
Share of farm area irrigated	0.59
Hired any labor	0.36
Owns agricultural machine	0.16
Quantity of rice purchased (kg)	25.10
Quantity of rice self-produced (kg)	1,266
Number of observations	2,268

kg = kilogram.
Source: Household baseline survey, 2014.

Despite the subsistence nature of agriculture, agricultural engagement, facility access, and prices increased over the study period (Appendix Tables A5–A7). Wages paid to agricultural laborers have increased across all types of crop cultivation-related work by almost 50% from 2014 rates. At endline, the share of household income from wages increased to 37% with other variables like share of income from sale of crops staying constant. The sale price of important staple crops has also increased, with the price of fine rice increasing by 20% from average baseline prices in 2014.

2. Interventions Received

The size of agricultural groups in terms of numbers of member has increased from baseline to endline (Appendix Table A8). This increase was mostly driven by a greater participation of women in group activities and especially in leadership positions, with lower enrollment of new male members compared with females.

Agricultural group managers reported that the most common type of support at endline was financial support and training, while probability of receiving materials as support decreased. Responses also suggest that there is nontrivial overlap in donor support, with groups receiving any external training reporting 1.4 donors at baseline, which increases to 2.8 donors at endline. The increase in intensity of support was also observed in comprehensive external support (CES) category, which is defined as a group receiving financial, training, and material support. At baseline only 8% of groups reported receiving CES, while at endline this number increased to 26%[5] and, more importantly, the number of different donors that provide CES also doubled.

The provision of agricultural inputs has increased from baseline to endline, while the provision of training, marketing, and material support did not change for the 87 panel groups (Appendix Table A9). At endline most groups provided seed (78%), pesticide (36%), and fertilizer (43%) as inputs. The number of group members utilizing collection centers increased, and the number of members receiving loans from the groups has almost tripled. Table 3 shows that most of the training the groups provided consisted of a single lecture conducted by a member of the same agricultural group, and that the most popular topics of training were vegetable production and seed production.

Table 3: Agricultural Groups–Training by Provider

Training Type	DADO	NGO	Group member	Other	Total
Farm demo same village	1	2	5	0	8
Farm demo other village	2	1	3	0	6
Single lecture	19	1	52	1	73
Multiple sessions	2	0	1	0	3
Total	24	4	61	1	90

DADO = District Agricultural Development Office, NGO = nongovernment organization.

Note: During federalization some DADO offices were converted to Agriculture Knowledge Centers (AKC), while rest were shuttered.

Source: Authors' analysis of farmers' group endline survey, 2018.

The prevalence and the extent of support to households via agricultural groups has increased from baseline to endline, with the probability of receiving any external support increasing from 14% at baseline to 29% at endline. Although most matching grant programs targeted comprehensive agricultural support, from the beneficiary perspective, support is more partial. Most of the households that reported receiving support via an agricultural group received inputs from the programs (607 households); out of those households, 295 received only inputs without accompanying training or assets. After that, the most common types of support were production training (193 households), provision of productive assets (172 households), and credit (150 households). The most common combination of inputs and other support types include households who got inputs and production training (110 households), followed by those that received inputs and assets (84 households) and 67 households who received inputs, assets, and training. Any marketing support was received by 91 households, and out of those, 60 households received marketing training (Table 4).

[5] These numbers are based on all farmer groups surveyed, rather than the panel of farmer groups.

Table 4: Combinations of Support Reported by Households

Agricultural Group Membership					
	Baseline		Endline		Moved into treatment
Member of AG group	1,146	51%	1,076	47%	343
Joined AG groups sans support			113	5%	113
Support					
Any support	311	14%	659	29%	519
Joined AG groups and received support			193	9%	193
Any credit from AG group	360	16%	150	7%	103
Any production training	57	3%	193	9%	181
Any inputs	246	11%	607	27%	503
Any assets	130	6%	172	8%	151
Any marketing support	0	0%	91	4%	91
Inputs (only)	98	4%	295	13%	281
Credit from any source (only)	691	30%	412	18%	265
Inputs + assets + any except production training	68	3%	84	4%	80
Inputs + production training + any except assets	19	1%	110	5%	108
Inputs + production training + assets + any	29	1%	67	3%	63
Number of observations	2,268		2,268		

AG = agriculture.
Source: Authors' analysis of household baseline (2014) and endline (2018) surveys.

B. Baseline Balance

To understand whether program participants differ at baseline in observable characteristics, baseline differences are tested. Households that are *never-members* or *always-members* of an agricultural group and those that joined a group at endline but didn't receive support are mostly balanced on baseline values of covariates (Appendix Table A1), with the latter group having lower share of farm irrigated but had plots that were closer to their homes at baseline. These differences become insignificant when CBPS weights are applied (Appendix Table A2).

Baseline balance checks on covariates for the subsample that was *always-member* of an agricultural group, and either did or did not receive any support at endline shows significant baseline imbalance for these two groups as shown in Appendix Table A3 without weighting. However, the two groups become balanced when CBPS-derived weights are applied, with exception of households receiving support having lower probability of having remittances or a household business (Appendix Table A4). This suggests that the CBPS weighting helps to control for observable confounders.

C. Mean Effects[6]

1. Agricultural Group Membership

Group membership in and of itself has moderate effects on key outcomes. Joining a group sans support increases borrowing from an agricultural group, but does not increase the probability that the household has a loan. This suggests that some households that join groups do so to receive lending, even if lending is not reported as "support" and appears to be fungible with other credit sources (Table 5). These households also exhibit changes in their crop production, including increasing the area cultivated with both improved and nonformal seed. They also increase area under sharecropping arrangements. This implies that when households join an agricultural group sans support, they are seeking to expand both the scale and productivity of crop production, which they are now 175% more likely to sell via groups. The revenue from sale of all crops increases by 43% for these households, and the probability that the household is commercialized also increases (Table 6).

Total income increases by 23%, and asset ownership significantly rises. Child labor also increases, both off farm and on farm. Households are spending this increased income on more assets and there is a 41% increase in nonfood spending (Table 7). The total value of self-consumed crops increases by 28%, indicating that these households improve food security. However, technical efficiency and profits do not increase, suggesting that outcomes are driven by production expansion at the extensive margin, rather than shifts to the production function.

2. Any Agricultural Group Support

Those who receive support have no change in borrowing, which suggests that support is not displacing the use of credit, and this pattern is mirrored for most individual forms of support. Households with any support increase per hectare adjusted crop production costs by 86% and do not expand sharecropping (Table 5). The revenue from sale of all crops increases by a larger amount than households without support. Additionally, the households with any support see a 124% increase in revenue from sale of cereals, 44% increase from high-value crops, and a 83% increase in revenue from sale of other crops. Sales via cooperatives also significantly rise. However, technical efficiency remains unchanged.

Household profit from other agricultural activities, such as beekeeping, also increases by 7% (Table 6). Households with any support are less likely to self-report as being poor, and perceive that they are making meaningful movement out of poverty. Household income also increases by 25% and asset ownership significantly rises. Child labor off farm also falls.

3. Joined Group and Got Any Support

Households that join groups and get support have many similar outcomes to existing members who receive support. As for that group, technical efficiency does not rise, but nonformal seed cropped area expands, input use intensifies, and production value and revenue rises (Table 5). Unlike prior members, there is a significant rise in commercialization, and increases in sales of other and high value crops are far stronger (Table 6). However, unlike existing members, there is no overall effect on household income or assets. This suggests that most effects for this group are driven by support, rather than the acquisition of

[6] Appendix Table A11 provides more details on all effect estimates, including means with and without the interventions, numbers of observations, and R^2. Appendix Table A12 illustrates the coefficients on covariates in the fixed effects model.

membership, and that, as new members, the effects of support are smaller than for those with established relationships in the group.

4. Credit Provision

Credit is often combined with other types of support, so there is a substantial difference in effects between households that receive only credit and those that receive credit plus other support (Table 5). When households receive any credit support from agricultural groups, including any other support, then there is a significant increase in overall probability of the household taking out loans from all sources. Paid labor use, area, production and productivity increase, but it is not clear if this is due to credit or the other elements of support.

To ascertain the pure effect of credit, the responses in the credit module are used, with the intervention redefined as receiving credit from any source, but no other support via agricultural groups. Households that received only credit support appear not to use the support to benefit agricultural production. Only receiving credit is associated with reduction in wage income and expansion of food and nonfood expenditure. This suggests that credit is often being used for consumption smoothing during negative shocks. There is no effect on overall household income.

5. Marketing Support

Households receiving marketing support via training and/or fixed assets display a strong response in terms of agricultural production practices and performance. Production costs significantly rise, as does the use of hybrid seed and technical efficiency (Table 7). The amount of milk produced also increases, suggesting that some of the marketing support is related to livestock programs. The value of all crops produced per hectare increases by 25% for those that received any marketing support (Table 6).

Marketing support increases commercialization by 32% and increases the revenue from the sale of crops and the profit from sale of crops by 142% and 13%, respectively. Revenue from cereals, other crops, and high value crops all increase. This support also had positive impacts on long-term outcomes, such as an improvement in the school grade for a child's age and a reduction in the share of adults working as agricultural laborers on other people's land (Table 7). Agricultural income increases by 12%, and household income increases by 35%. Asset ownership also strongly increases.

6. Input Provision

Inputs are often provided as part of multifaceted support, but they also are provided alone. Households that only receive inputs have increases in area (to a limited extent), input usage, hybrid seed usage, and usage of a new rice variety in the last 3 years. Revenue from sales of crops increases, driven solely by an increase in sales of cereal crops. However, there are no changes in crop technical efficiency, profits, or agricultural income, which suggests that the production function has not shifted (Table 5). Even though agricultural income does not rise, total income increases are driven by increases in non-agricultural income, which suggests that the support is fungible and enables investments outside of agriculture. The only other effects of inputs support are a reduction in share of children working off farm and share of adults who are jobless. When those who receive inputs include those who received other forms of support, there are more effects, but these appear to be driven by the complementary support, rather than inputs per se.

7. Asset Provision

Most asset support is complemented by other measures, such as inputs or training, so it is not possible to distinguish an assets only treatment. Nonetheless, asset support appears to be associated with much larger effects than input support. If households received any assets, then they are more likely to take out loans. This is probably to come up with the matching grants for the donor-supported programs. These households see improved agricultural practices, such as higher probability of checking crop prices using phones, more area planted with hybrid seeds, and higher production costs per hectare (Table 5). Revenue from sale of livestock and crops increases, followed by an increase in livestock and animal products. However, the profit from sale of crops does not increase, even given the 162% increase in share of crops sold via cooperatives or advanced contract, although agricultural income increases by 14% (Table 6). These positive impacts are countered by an increase in share of children working on the farm, although the share working off-farm falls. Per-capita consumption of the household increases by 18% and share of adults working as agricultural laborers decreases (Table 7). Household income rises by 28%, as does per capita consumption. As expected due to the nature of the intervention, asset ownership significantly rises, but it does so to a smaller degree than for marketing support or training.

8. Production Training Provision

The results indicate substantial effects of production training, although this training often is layered onto other forms of support. If households receive any production training, they see better agricultural practices such as increased usage of phones to check price of crops, utilizing new rice varieties, and increasing crop production costs (Table 5). Technical efficiency and value of produced crops also increase, along with crop sale revenue, profits, and commercialization. Sales increases for crops include cereals, other crops, and high value crops. Sales via cooperatives also increase significantly. Changes in cropping drive significant agricultural income increases of 17%. No change in the area planted with hybrid or nonformal seed was detected, so effects appear to be based on improved agronomy, rather than varieties. Income rises for those who receive production training by 41%, and asset ownership increases strongly. The value of self-consumed crops and total food spending also increase.

9. Combined Support

Households more often receive packages of several forms of support than individual types of support, and certain categories of support are almost always provided in combination with others. For example, production training is rarely provided without inputs or assets, and assets are rarely provided without inputs. In some cases, treatment effects identified for the previous categories may be driven by particular additional interventions that are often co-packaged, and there may be complementarities between forms of support.

When inputs are accompanied by production training (but not assets), significant effects on agricultural practices emerge, and these effects are much larger than when only inputs are provided. However, the effects remain similar or smaller in magnitude to production training provision, suggesting that most effects are driven by training, rather than inputs. The effects are also far smaller than when assets are also included, which suggests that assets are critical to effectiveness.

The final treatment permutation includes households that received inputs, production training, and assets. These households display large changes in agricultural practices. Households that receive this

combination are more likely to use phones to check crop prices and plant a new rice variety in the last 3 years. These households are less likely to hire paid labor and increase the area under hybrid crops (Table 5). Production costs per hectare and value of produced crops increase. These households become significantly more commercialized and display improvements in revenue from sale of livestock and crops, especially cereals and high value crops (Table 6). Total household income increases by 49%, driven largely by the 25% increase in agricultural income in conjunction with larger increases in off farm income. Asset ownership strongly increases. With higher own farm income, the share of adults working as agricultural laborers on others' land falls, and the share of households self-reporting as poor falls. Grade for age significantly improves, and the share of children working on farm falls, suggesting that households invest more in education of children (Table 7).

Table 5: Borrowing and Agricultural Practices

Outcome label	Group Membership Coefficient	Any Support Coefficient	Joined Group and Got Any Support Coefficient	Any credit from AG Group Coefficient	Any Production Training Coefficient	Any Inputs Coefficient	Any Assets Coefficient	Any Marketing Support Coefficient	Inputs (only) Coefficient	Credit from Any Source (only) Coefficient	Inputs + Prod Training + Any Except Assets Coefficient	Inputs + Prod Training + Assets +Any Coefficient
Borrowing												
Model: Fixed Effects ATT Weighted												
Household has loans	25%	11%	−2%	59%*	24%	9%	74%**	46%*	−13%	—	−32%	108% **
Borrowed from an agricultural group or cooperative	210% *	−16%	−28%	192%**	−11%	−19%	122%	62%	−39%	—	−89% **	113%
Agricultural Practices												
Model: Fixed Effects ATT Weighted												
Used phone to check price crops	0%	47% *	21%	11%	58%	33%	66%	48%	29%	−18%	17%	155% ***
Used new rice variety in last 3 years	13%	10%	10%	−13%	19%	12%	20%	2%	25%	−5%	−10%	53% **
Household used paid labor	1%	−6%	−11%	−5%	−4%	3%	−1%	−14%	10%	9%	20%	−28% *
Total area cultivated in hectares in log transformed	11% ***	11% ***	9% ***	18% ***	14% **	10% ***	20% **	13% ***	8% **	1%	13% ***	29% ***
Cropping intensity	−6% **	2%	−1%	−1%	7%	2%	2%	9%	0%	−3%	7%	8% *
Model: Poisson Fixed Effects ATT Weighted												
Area under hybrid crops in hectares	118% *	69% *	2%	63%	45%	103% **	145% **	153% ***	114% *	−4%	−49%	597% ***
Area with nonformal seed in hectares	33% ***	29% **	28% **	51% **	−2%	32% **	26%	5%	39% **	−1%	6%	0%
Area under sharecropping in hectares	93% **	21%	21%	−13%	−52%	21%	11%	−35%	25%	32%	−89% ***	−82%
Production costs for top 6 crops	48% **	64% ***	67% ***	87% *	121% ***	78% ***	157% ***	216% ***	32%	21%	17%	225% ***
Milk production in liters	20%	24%	71% ***	21%	12%	15%	67% *	91%	−11%	11%	−64% ***	31%

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Table 5 *continued*

	Group Membership Coefficient	Any Support Coefficient	Joined Group and Got Any Support Coefficient	Any credit from AG Group Coefficient	Any Production Training Coefficient	Any Inputs Coefficient	Any Assets Coefficient	Any Marketing Support Coefficient	Inputs (only) Coefficient	Credit from Any Source (only) Coefficient	Inputs + Prod Training + Any Except Assets Coefficient	Inputs + Prod Training + Assets +Any Coefficient
Crop Value and Production Costs												
Model: Fixed Effects ATT Weighted												
Technical efficiency: value of all crops	0%	1%	1%	6% ***	4% **	1%	0%	4% ***	0%	0%	4% ***	−1%
Technical efficiency: value of all crops inflation adjusted	0%	1%	1%	6% ***	3% **	1%	0%	3% ***	1%	0%	4% ***	−1%
Production costs per hectare log transformed	58%	86% *	69% *	91%	257% ***	142% ***	250% ***	403% ***	102% *	21%	17%	368% ***
Total crop production costs imputed log transformed	54%	66% **	72% **	50%	133% ***	90% ***	129% ***	245% ***	65% *	−2%	49%	215% ***
Value of all crops log transformed	37% ***	27% ***	25% **	86% ***	61% ***	29% ***	48% ***	69% ***	16%	−2%	56% ***	64% ***
Value of all crops inflation adjusted log transformed	37% ***	28% ***	27% ***	89% ***	63% ***	31% ***	49% ***	70% ***	17% *	−1%	59% ***	65% ***
Value of all crops per hectare log transformed	6%	0%	6%	25% **	19% ***	6%	6%	25% ***	−2%	−3%	19% **	8%

— = undefined, * = p < 0.10, ** = p < 0.05, *** = p < 0.01, AG = agriculture, ATT = average treatment effect on the treated, Prod = production.

Source: Authors' calculations using data from household baseline (2014) and endline (2018) surveys.

Table 6: Revenue and Profit

Outcome label	Group Membership Coefficient	Any Support Coefficient	Joined Group and Got Support Coefficient	Any Credit from AG Group Coefficient	Any Production Training Coefficient	Any Inputs Coefficient	Any Assets Coefficient	Any Marketing Support Coefficient	Inputs (only) Coefficient	Credit from Any Source (only) Coefficient	Inputs + Prod Training + Any Except Assets Coefficient	Inputs + Prod Training + Assets +Any Coefficient
Revenue and Profit												
Model: Fixed Effects ATT Weighted												
Household is commercialized	30%*	11%	20%*	27%**	16%*	11%	14%*	32%***	12%	−8%	26%**	32%***
Share of crops sold via cooperatives or advanced contract	175%***	116%**	86%	27%	298%**	84%**	162%**	101%	−17%	11%	68%	—
Total income log transformed	23%**	25%**	8%	26%	41%***	29%***	28%**	35%***	29%**	4%	13%	49%**
Total revenue log transformed	34%**	24%**	11%	41%*	47%***	31%***	36%**	45%***	24%*	12%	12%	62%***
Agricultural income log transformed	4%	5%	0%	4%	17%***	6%	14%**	12%*	0%	−4%	3%	25%***
Agricultural income per hectare log transformed	1%	−2%	−1%	−3%	7%**	−1%	6%	3%	−4%	−2%	−3%	10%**
Agricultural income per capita log transformed	5%	4%	2%	2%	15%**	5%	12%	13%**	−2%	−4%	4%	19%**
Model: Poisson Fixed Effects ATT Weighted												
Revenue from sale of livestock	25%	11%	−3%	−12%	58%	8%	123%**	7%	−14%	−20%	−40%*	212%***
Revenue from sale of other crops	67%	83%*	383%***	105%	182%**	96%	192%***	495%***	−6%	26%	314%**	97%
Revenue from sale of high value crops	−2%	44%*	176%***	87%	151%***	93%***	5%	113%**	22%	−43%	78%	394%***
Revenue from sale of cereals	56%	124%***	48%**	134%**	71%**	142%***	130%***	189%***	125%***	−32%	25%	128%***
Revenue from sale of all crops	43%*	83%***	93%***	67%*	101%***	95%***	119%***	142%***	66%**	−30%	41%*	174%***
Profit from sale of crops	1%	1%	1%	4%	11%***	2%	4%	13%***	1%	−2%	6%	17%***
Profit from all livestock activities	7%	9%	1%	1%	10%	9%	24%*	−2%	1%	−6%	−7%	28%*
Non-agricultural income	−4%	28%*	−4%	21%	58%*	28%*	26%	7%	48%***	20%	62%**	81%**
Income from wages	−3%	19%	−12%	27%	26%	18%	28%	46%	39%*	−13%	26%	70%
Profit from other agricultural activities	−1%	7%*	5%	12%	4%	6%*	4%	0%	8%*	−5%*	4%	5%

— = undefined, * = p < 0.10, ** = p < 0.05, *** = p < 0.01, AG = agriculture, ATT = average treatment effect on the treated, Prod = production.

Source: Authors' calculations using data from household baseline (2014) and endline (2018) surveys.

Table 7: Labor Force Participation and Other Long-Term Outcomes

Outcome label:	Group Membership Coefficient	Any Support Coefficient	Joined Group and Got Support Coefficient	Any Credit from AG Group Coefficient	Any Production Training Coefficient	Any Inputs Coefficient	Any Assets Coefficient	Any Marketing Support Coefficient	Inputs (only) Coefficient	Credit from Any Source (only) Coefficient	Inputs + Prod Training + Any Except Assets Coefficient	Inputs + Prod Training + Assets + Any Coefficient
Assets Accumulation and Other Spending												
Model : Fixed Effects ATT Weighted												
Asset index: all assets	9%**	7%***	4%	−4%	16%***	7%**	10%**	15%***	4%	6%*	9%**	19%***
Spending on school fees log transformed	62%	−13%	74%	108%	−32%	0%	18%	−51%	−9%	9%	28%	−17%
Spending on vocational training log transformed	5%	0%	26%	100%**	−17%	0%	2%	−18%	−2%	20%	3%	−25%
Spending on health log transformed	17%	11%	−7%	−52%	2%	0%	−22%	60%	7%	53%	−3%	63%
Spending on AG assets log transformed	−6%	4%	11%	−4%	80%	0%	24%	59%	−14%	27%	13%	403%**
Child and Adult Labor Participation												
Model: Fixed Effects ATT Weighted												
Share of children working on farm	0.11*	0.03	0.02	−0.02	−0.07	0.04	0.12*	0.03	0.03	0.03	−0.10	−0.20***
Share of children working off farm	0.09**	−0.05*	−0.04	−0.03	0.00	−0.06**	−0.08**	−0.06	−0.08**	0.01	−0.02	0.01
Grade for child's age	−0.22	0.01	0.17	−0.69***	0.16	−0.15	0.28	0.56***	−0.16	0.15	0.02	0.36*
Share of adults migrant workers	0.01	0.00	−0.04*	0.01	0.00	0.00	0.00	−0.01	0.01	0.01	−0.02	0.05*
Share of adults jobless	−0.04	−0.04*	0.02	0.02	−0.06	−0.05**	0.00	−0.01	−0.07**	0.00	−0.01	−0.06
Share of adults working as AG laborers	−0.01	0.00	−0.02	0.00	−0.01	0.00	−0.03***	−0.02***	0.00	−0.01	−0.02*	−0.02
Share of adults employed in jobs	0.03	0.02	0.05**	−0.02	0.06	0.04	0.00	0.05	0.03	0.03	0.07**	0.02
Share of adults working in own business	0.01	0.00	0.04**	0.00	0.04	0.01	−0.02	0.03	0.01	0.03	0.04*	0.00

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Table 7 *continued*

Outcome label:	Group Membership Coefficient	Any Support Coefficient	Joined Group and Got Support Coefficient	Any Credit from AG Group Coefficient	Any Production Training Coefficient	Any Inputs Coefficient	Any Assets Coefficient	Any Marketing Support Coefficient	Inputs (only) Coefficient	Credit from Any Source (only) Coefficient	Inputs + Prod Training + Any Except Assets Coefficient	Inputs + Prod Training + Assets + Any Coefficient
Consumption												
Model: Fixed Effects ATT Weighted												
Per capita consumption log transformed	14%*	−2%	1%	8%	1%	0%	18%*	4%	−5%	21%***	8%	2%
Total value of self-consumed crops	28%***	18%**	10%	83%***	39%***	20%**	38%***	32%**	11%	12%	43%***	30%
Total spending on nonfood items	41%**	13%	21%*	11%	11%	18%*	36%**	9%	10%	48%***	12%	14%
Total spending on food items	4%	8%	−9%	−4%	27%*	9%	54%***	25%*	1%	23%**	5%	42%*
Food Security and Poverty												
Model : Fixed Effects ATT Weighted												
Household self identifies as poor	21%	−25%**	−11%	−17%	−26%	−23%*	−6%	−41%*	−21%	−4%	−19%	−62%

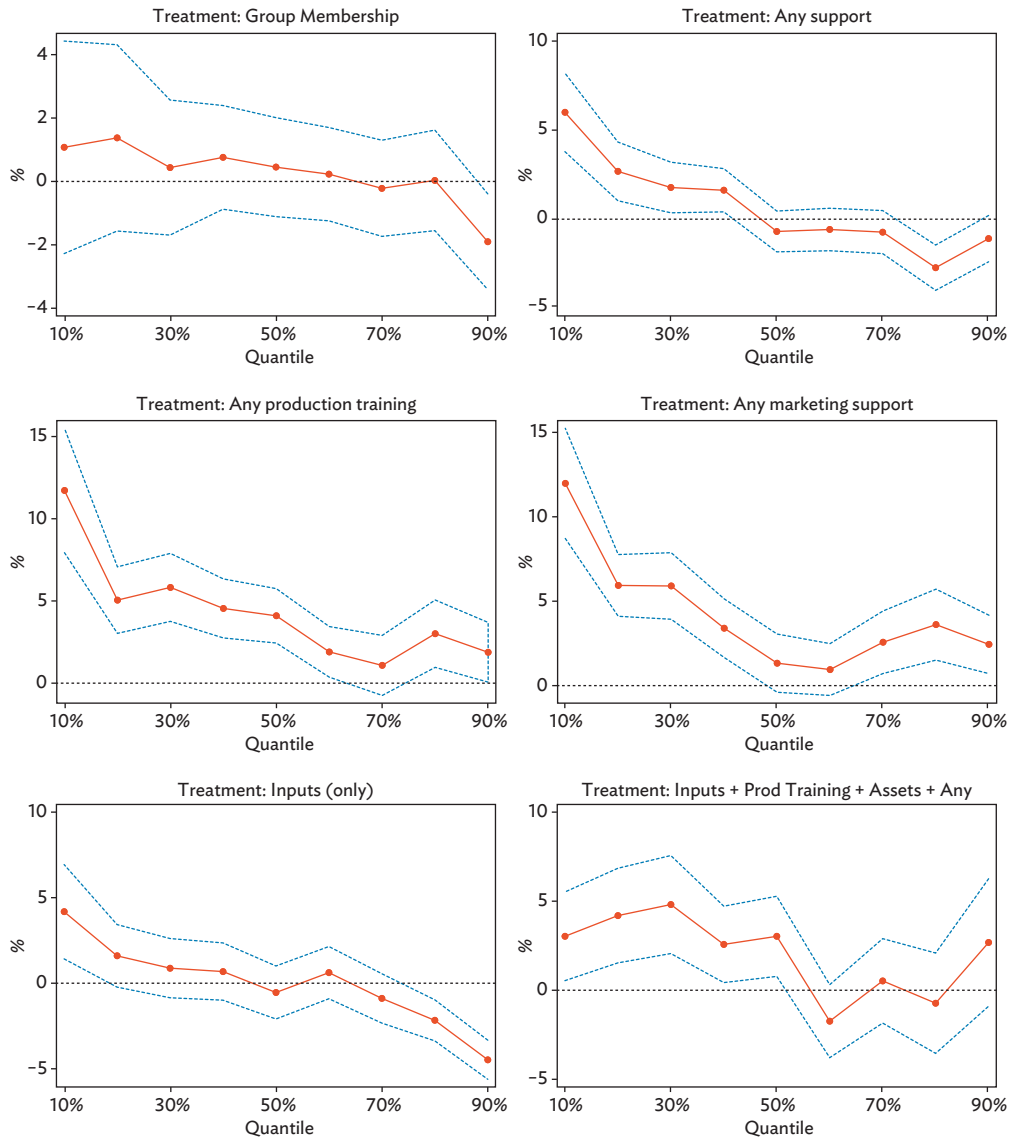
* = p < 0.10, ** = p < 0.05, *** = p < 0.01, AG = agriculture, ATT = average treatment effect on the treated, Prod = production.

Source: Authors' calculations using data from household baseline (2014) and endline (2018) surveys.

D. Distributional Effects[7]

To go beyond average impacts for each treatment arm, quantile regression disaggregates effects by quantiles of the outcome variable. Consistent with effects at the mean, group participation and input provision do not increase technical efficiency at nearly any point in the distribution. However, support including training or marketing has significant effects, particularly for those with lowest technical efficiency, consistent with a movement of those households that are farther from the productivity frontier (Figure 5).

Figure 5: Quantile Disaggregation – Technical Efficiency: Value of All Crops

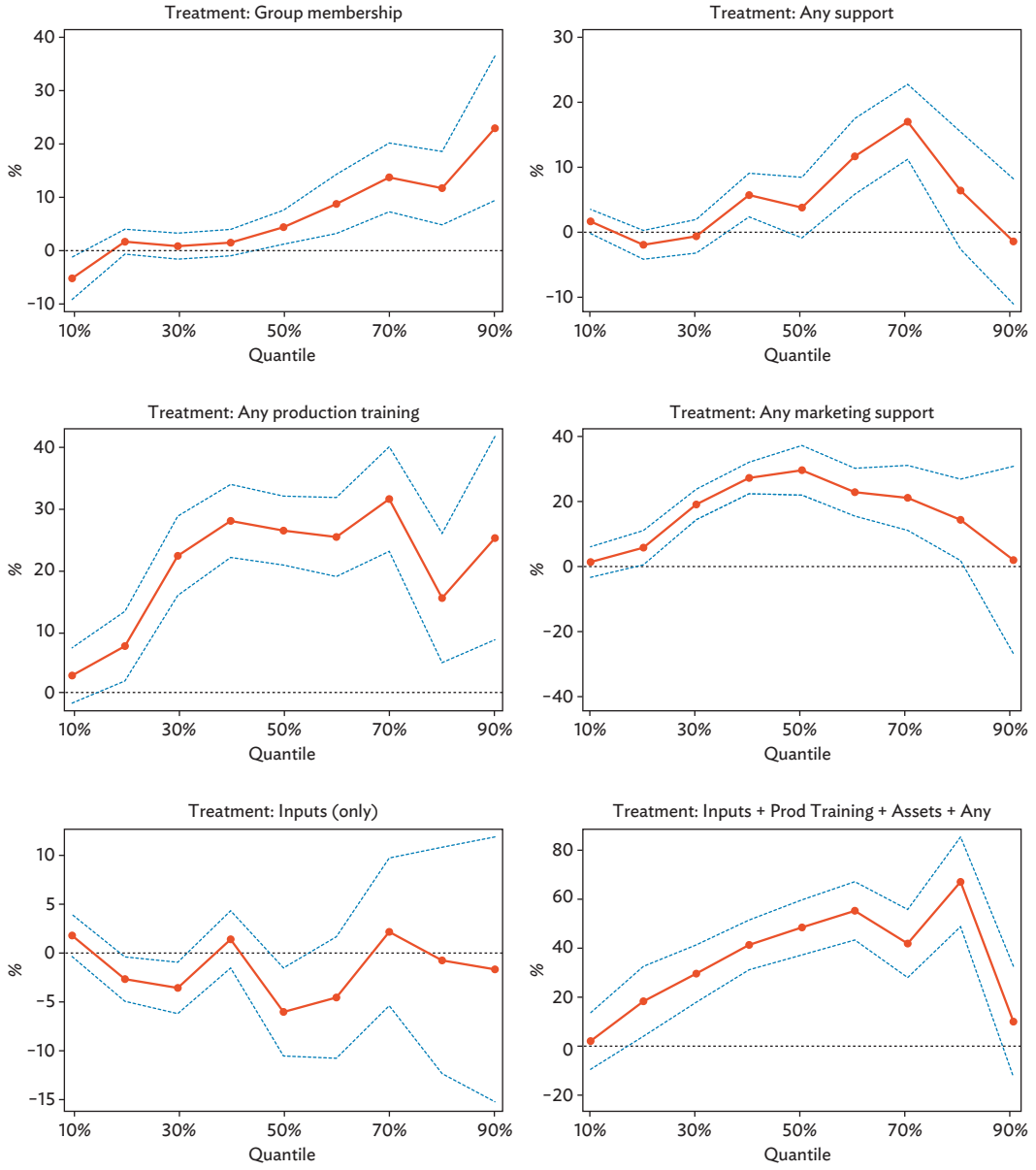


Source: Authors' calculations using data from household baseline (2014) and endline (2018) surveys.

[7] Appendix Tables A13–A15 provide more details on all effect estimates, including predicted values with and without the interventions, numbers of observations, and R^2.

Agricultural income displays very different distributional responses to technical efficiency, and it should be noted that technical efficiency may not have a direct relationship with income, as an inverse relationship between farm size and productivity is often observed, so that smaller farmers have higher productivity (Barrett, Bellemare, and Hou 2010). Across membership and all types of support with significant effects, effects are larger for those with higher agricultural income at baseline (Figure 6). The association of baseline agricultural income with effects on income is strongest at low-income levels, with the association falling off at around the median income level.

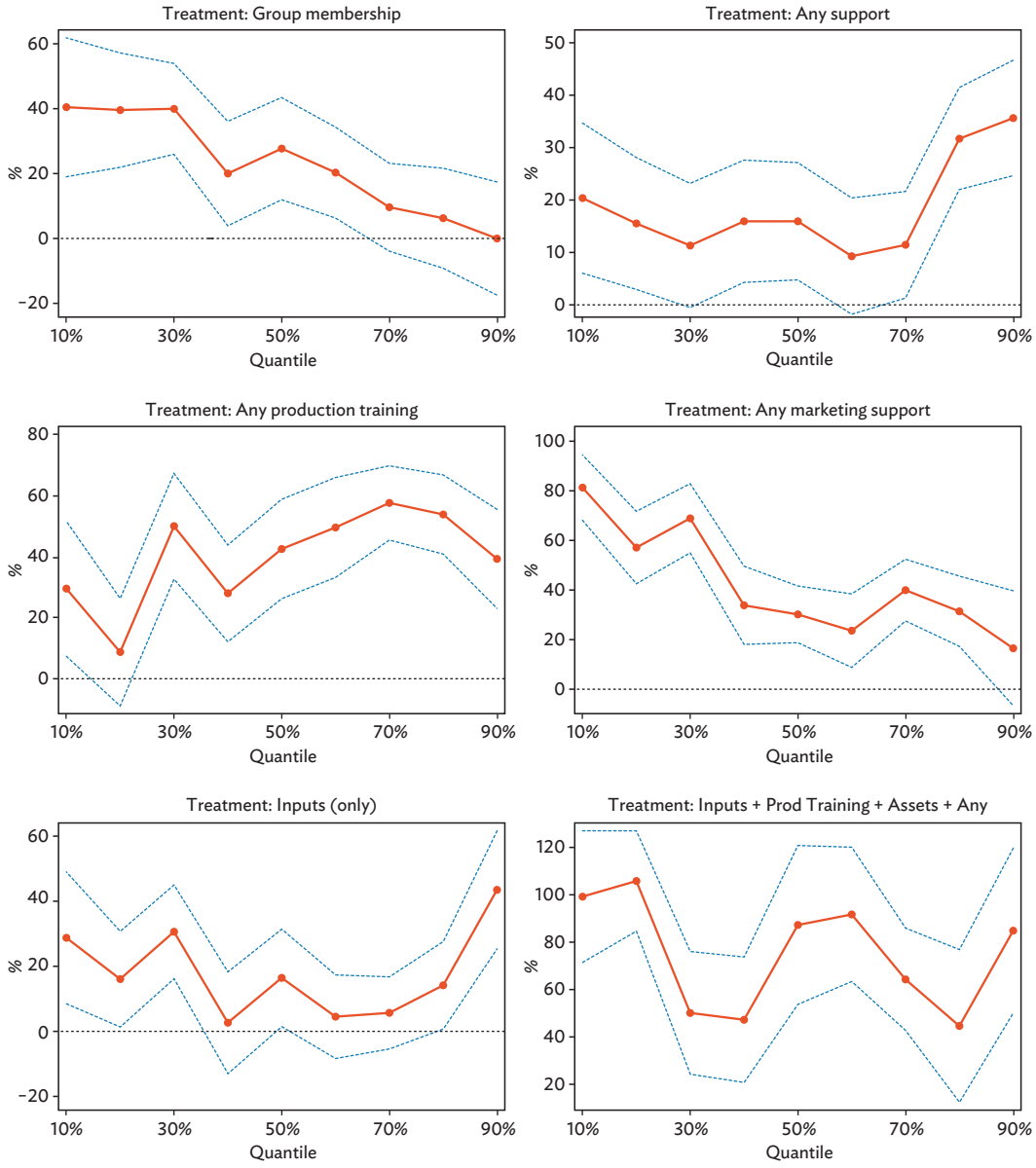
Figure 6: Quantile Disaggregation – Agricultural Income (Log Transformed)



Source: Authors' calculations using data from household baseline (2014) and endline (2018) surveys.

Patterns for effects on total household income are much less clear than are patterns regarding agricultural income (Figure 7). Whereas effects on agricultural income correlate with baseline agricultural income, effects from membership and marketing interventions have an inverse relationship with baseline total income, and other interventions do not have a strong relationship. Part of this disparity may accrue because poorer households have a higher share of total income from agriculture than richer households, which have other sources of income that are less directly affected by the evaluated interventions. Marketing support may be particularly pro-poor because of the low initial commercialization status of the poorest households.

Figure 7: Quantile Disaggregation – Total Household Income (Log Transformed)



Source: Authors' calculations using data from household baseline (2014) and endline (2018) surveys.

E. Robustness Checks

The results are robust to the specification and estimation method. Use of an average treatment effect on the treated (ATT) weighted conditional logit fixed effects model instead of an ATT weighted linear probability fixed effects model for binary outcomes leads to similar signs and significance (Appendix Table A16). Dropping covariates from the outcome fixed effects models, if anything, increases the magnitude and significance of most coefficients (Appendix Tables A17 and A18).

IV. DISCUSSION

A. Consideration of Results Against Hypotheses

In accordance with the hypotheses, results indicate that participation in farmer groups or cooperatives has beneficial effects on the agricultural production and commercialization of households. Effects of group membership appear to differ according to the initial status of households, however, with agricultural benefits captured by higher-income households, and other benefits accruing to lower-income households. As evidenced in results for support received by members, groups appear to be effective conduits for support, although the study finds limited synergy between group membership and support.

As expected, credit provision *per se* has minimal effects on agricultural production, and credit is utilized outside of agriculture. Provision of inputs enables some increase of input application and cereal sales, but does not improve technical efficiency or agricultural income broadly.

Training is confirmed to be an essential element of effective support. Marketing support embedding training either directly to households, or indirectly as part of support to groups enables large increases in agricultural performance, commercialization, and income, and similar patterns are observed for production training. As hypothesized, a combination of training and asset provision is found to have the largest effects on agricultural and household outcomes. In contrast, input provision is not a major driver of outcomes when combined with training. The magnitude of effects largely correlates with initial agricultural income, as per the postulates of innovation diffusion theory. This is found across all measures embedding training to improve production practices.

Surprisingly, the magnitude of effects of support is often greater on total household income than on agricultural income. At the same time, effects are often insignificant for wage income, although coefficients are often positive, and effects on nonagricultural income appear to be strong for the most effective interventions. As these sources of other income are balanced at baseline by the propensity score weighting, the regressions control for general trends and time invariant factors, and the covariates in the model control for other interventions and exogenous changes over time, the effects on nonagricultural income can be interpreted as attributable to agricultural support. This suggests that agricultural support may have spillover effects for households. Engagement in commercialized agriculture and exposure to agricultural markets may help to equip households with the assets, information, and skills necessary to engage more broadly in the labor market and other entrepreneurial activities.

B. Comparison with Other Literature

Results are consistent with the findings of many other studies. The strong magnitude of overall effects of combined support on income is similar to findings of Kafle, Krah, and Songsermsawas (2018). Although there was excitement about the effects of credit provision to the rural poor in the 1990s that was confirmed by initial impact evaluation results, such as by Pitt and Khandker (1996), many other subsequent studies found minimal improvement to productive investments by the poor from enhanced financial access in agriculture and beyond (Duvendack et al. 2011, Banerjee et al. 2015a). Input provision or subsidies absent other support have often been found to have limited effects on agricultural outcomes in South Asia, especially compared with other means of support (Paudel and Crago 2017; Fan, Gulati, and Thorat 2008). In contrast, a substantial pool of studies has affirmed the effects of farmer training, particularly under demand-driven and interactive arrangements, such as farmer field schools (Waddington et al. 2014).

The absence of expected effects of many microfinance interventions for poor, subsistence, and agriculturally dependent households has led to a renewed emphasis on productive asset transfers coupled to other forms of support, including training. Recent evidence suggests that this type of support, in which assets are supported by grants, rather than credit, lead to stronger outcomes for smallholder farmers (Tadesse and Zewdie 2019, Takeshima and Yamauchi 2012). A prominent variant of this is the "graduation approach," which complements those two measures with temporary consumption support and has been documented in a series of randomized controlled trials to significantly improve household income and other outcomes (Banerjee et al. 2015b). The magnitude of income effects found in the first set of trials is similar to those documented for the combination of training, input, and asset provision in this study.

V. CONCLUSION

This study finds significant effects on a range of outcomes from support to agricultural groups and cooperatives in Nepal. Among the types of support analyzed, multidimensional support to productive assets and training stands out as having the largest effects on many outcomes ranging from agricultural production practices to household income. Marketing support is also found to be particularly effective. These approaches underpin the major matching grant schemes operating in many areas of Nepal, which seek to pair productive asset support with training and marketing support, and so this study helps to affirm their effectiveness.

While the study generally affirms this approach, it also reveals potential areas for refinement. From the beneficiary perspective, support is often partial, and the frequency of the most effective support combination (assets combined with training) is relatively low. Most households that receive support did so in the form of inputs, of whom nearly half received no training. Of those who received asset support, half also reported no training. Of individual support elements, training is found to have the most substantial and significant effects, and is critical to the effectiveness of other measures. Much more focus on training and less of a focus on inputs would allow support to be much more effective in the future.

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Impact Evaluation of Support to Collective Action for Agricultural Value Chain Development in Nepal

Smallholder agricultural commercialization programs often channel support through agricultural groups and cooperatives. This study empirically estimates the causal effects of different permutations of support provided to farmers via farmer groups and cooperatives in Nepal. Results indicate that group membership without receiving support has important effects on commercialization and income, as does receiving any support. The forms of support with largest effects on agriculture, income, and human capital include production training, marketing support, and a combination including both training and assets, whereas only modest or even negative effects are detected from provision of either inputs or credit in isolation.

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6 ADB Avenue, Mandaluyong City
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