IMPACT EVALUATION OF A MULTI-INTERVENTION DEVELOPMENT PROJECT: EFFECTS ON ADOPTION OF AGRICULTURAL TECHNOLOGIES AND LEVELS OF TRUST

By

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ABSTRACT

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In this dissertation I conduct an impact evaluation of a complex rural development project in Central America with more than one intervention taking place at the same time, purposive program placement, and project participant freedom to self-select to project interventions. For this purpose I use quasi-experimental panel data techniques – difference-in- difference, propensity score matching difference-in-differences, and propensity score weighted regression – to correct for selection bias due to self-selection by project participants and purposive selection of project beneficiaries. Project impacts two years after implementation began are indicated by early behavior changes in the adoption of agricultural technologies and practices, as outcomes to be evaluated after two years of project implementation. The project had impacts on adoption of soil and water agricultural conservation practices, use of improved storage technologies, and number of households with savings. These outcomes are likely to lead to long-term project impacts. Project impacts differ according to wealth, as measured by area of cultivated land.

Results suggest that the designers of multi-intervention rural development projects should consider targeting different groups, based upon beneficiaries' characteristics, instead of promoting the full set of interventions to all beneficiaries. Impact evaluations of multi-intervention development projects should also account for how project interventions will differ in the likely time lapse before behavioral changes can generate long term outcomes.

In addition, I investigate how participation in group-based rural development project interventions affects levels of trust, a potential indirect outcome of rural development projects. To measure trust effects, I conducted a field-based trust experiment with integrated attitudinal trust questions. The results suggest that group-based rural development project interventions are likely to increase trust levels among farmers in the same village. Higher trust levels are expected to contribute to rural development and increased agricultural income by facilitating market exchange via reduced transaction costs and increased information sharing.

To my parents Alvaro and Amparo, and my brothers Andres and Carlos.

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KEY TO ABBREVIATIONS

A4N: Agriculture for Basic Needs (an integrated rural development project)

ATE: Average Treatment Effect

ATT: Average Treatment Effect on the Treated

BNI: Basic Needs Index

CRS-LACRO: Catholic Relief Services – Latin America and the Caribbean Office

CRS: Catholic Relief Services

DID: Difference in Difference

ECA: Farmer field school, from its acronym in Spanish

Epan: Epanechnikov

FD: First Difference

FIDER: Fundación de Investigación y Desarrollo Rural

GSS: Generalized Social Survey

hh: Household(s)

INIDE: Instituto Nacional de Información de Desarrollo (of Nicaragua)

IV: Instrumental Variable

LLR: Local Linear Regression

LSMS: Living Standards Measurement Study

Mz: *Manzana* (unit of land area = 1.73 acres)

NGO: Non Governmental Organization

NN: Nearest Neighbor

OLS: Ordinary Least Squares

PS: Propensity Score

PSM: Propensity Score Matching

PSM-DID: Propensity Score Matching Difference in Difference

PSU: Primary Sampling Unit

PSW: Propensity Score Weighting

qq: quintal(s) (unit of weight =100Kg)

RDD: Regression Discontinuity Design

ROSCA: Rotating Savings and Credit Association

Chapter 1 Introduction

Every year, billions of dollars are spent on development projects around the world with the aim of improving the wellbeing of the poor. Yet rural areas in the developing world still lag behind, with high rates of poverty and inequality (International Fund for Agricultural Development, 2010). In recent years there has been an increasing attention on the role of agriculture in reducing poverty, since a high percentage (more than 70%) of the poor live in rural areas and depend on agriculture for their livelihoods. Adoption of improved agricultural technologies and practices is likely to reduce poverty (Feder, Just, & Zilberman, 1985), as is confirmed by recent impact evaluation studies (Bravo-Ureta, Almeida, Solís, & Inestroza, 2011; Canavire-Bacarreza & Hanauer, 2013; Cavatassi, Salazar, González-Flores, & Winters, 2011; Del Carpio, Loayza, & Datar, 2011; Dillon, 2011; E. Duflo, Kremer, & Robinson, 2008; Mendola, 2007; Nkonya, Phillip, Mogues, Pender, & Kato, 2012; Nkonya et al., 2012). Increased trust, a form of social capital, is also likely to increase income, because it facilitates transactions, particularly in environments where formal institutions are not well developed (Fafchamps, 2006). Improvements in the levels of trust among rural communities are likely to improve the dissemination of new technologies and reduce transaction costs, further helping to increase rural income (Grootaert & Narayan, 2004; Lyon, 2000).

For project implementers and donors, as well as for governments, international organizations and non-governmental organizations (NGOs), it is important to have answers to questions as to how effective are their poverty reduction interventions and which interventions have the most impact.

For impact evaluation of complex, multi-intervention, rural development projects, a rigorous impact assessment looks into overall impacts on the different outcomes the project aims to change. But the different components of the project will entail different time elapse to achieve project impacts. Promotion of new technologies and practices implies that the successful adoption of those needs to occur before impacts are translated into increases in agricultural income and household wealth. A complete strategy for analyzing impacts first measures changes of behavior – measured as adoption of agricultural technologies and practices – in the short term and overall effects of these changes in the long term.

Rural development project impacts are not limited to increases in outcomes such as adoption of technologies, or increases in agricultural income. Rural development projects using the strategy of organizing the beneficiaries in groups or associations, can also contribute with outcomes related to social capital formation. For instance, the interaction among beneficiaries in group-based interventions boosts the level of trust among themselves and of other people. This outcome is likely to facilitate future endeavors for common goals. Moreover, due to the link between trust and economic development (Dearmon & Grier, 2009; Fafchamps, 2006, 2006; Fukuyama, 2001; Özcan & Bjørnskov, 2011), increased trust facilitates transactions, reducing its costs, contributing to rural development projects' goal of increased income.

In this dissertation I conduct an impact evaluation of the Agriculture for Basic Needs (A4N) project in Nicaragua, a rural development project that promoted more than one intervention at the same time. A4N provided poor farmers with a set of skills to achieve sustainable production and to increase agricultural income. To assess the impact of this project, I use panel data econometric techniques for the analysis of a household survey of project participants and non-participants, conducted in 2010 and 2012. The project promoted agricultural conservation, post-

harvest management, vegetable gardens, saving and lending. Since the evaluation took place after two years of project implementation, I evaluated changed behavior, measured as adoption of agricultural technologies and practices. The timing of project impacts was considered. Otherwise the results of the evaluation on long-term outcomes at early stages of project implementation could lead to misleading results of no project impacts.

The main strategy of promoting interventions by A4N used group formation. This strategy of forming producer groups facilitates dissemination of the practices promoted by the project and interaction among project participants to achieve common goals. It also corrects for market failure, such as lack of access to credit (e.g. formation of saving and lending groups). This strategy is prone to achieve the direct effects of adoption of the technologies and practices promoted, but also indirect effects from interaction among beneficiaries promoted by the project. Such interaction is likely to boost trust and social capital within villages, which in turn will make more likely that members of a village to continue working together on efforts to achieve common goals, even after project ends.

My goal of this dissertation is to conduct an impact evaluation of the interventions of the Agriculture for Basic Needs (A4N) project in Nicaragua, looking into project outcomes related to adoption of agricultural technologies and practices promoted by the project likely to lead to long term impacts on agricultural income and farm productivity. For this analysis, different methods that use panel data are implemented to correct for participant selection bias due to purposive selection of participants. I also look into indirect impacts of the A4N project, using experimental economics as a tool for impact evaluation to determine impacts on trust levels, due to participation in group-based interventions.

Specific research objectives are as follows:

1. To measure the impact of the A4N interventions in Nicaragua on outcomes related to adoption of improved agricultural practices and practices, likely to lead to long-term outcomes such as agricultural income and farm productivity.
2. To evaluate the indirect impacts of the project on project beneficiaries' trust levels.

This dissertation proceeds as follows: Chapter 2 and Chapter 3 were written as self-contained essays. Chapter 2 evaluates the impact of the A4N project on outcomes related to adoption of agricultural technologies and other selected practices. It uses panel data methods and considers the timing of project impacts for conducting impact evaluation. Chapter 3 uses experimental methods to explore how participation in group based project interventions affects the levels of trust among members of the same village. Finally, Chapter 4 presents the main conclusions of the dissertation. The dissertation also contains a set of appendices with background information and extensions to the contents of the two essays.

Chapter 2 Impact Assessment with Opt-in Interventions: Evidence from a rural development project in Nicaragua

2.1 Introduction

In spite of efforts to reduce poverty worldwide, rural areas still lag behind. Of the 1.4 billion people living with less than $1.25 a day in 2005, around 70% lived in rural areas (International Fund for Agricultural Development, 2010). Adoption of improved agricultural technologies has the potential to reduce poverty, either directly by increasing production for home consumption, raising revenues from sales, or reducing production costs for the adopters of the technology, and/or indirectly by reducing prices of food, increasing wages in agricultural production, or through linkages with other economic sectors (de Janvry & Sadoulet, 2002; Minten & Barrett, 2008).

Questions on how effective are the strategies promoted by development projects at achieving the goal of poverty reduction are of particular interest to governments, project implementers and donors. Impact evaluations of projects promoting improved agricultural technologies have been conducted with the goal of answering these questions. Several studies find that improved seed varieties increases household consumption and expenditures (Becerril & Abdulai, 2010; Mendola, 2007); technological changes brought by agricultural conservation projects increase technological efficiency (Cavatassi et al., 2011; Solis, Bravo-Ureta, & Quiroga, 2008); and the use of improved storage technologies reduces stored grain losses (Gitonga, De Groote, Kassie, & Tefera, 2013).

Sometimes rural development projects promote multiple interventions to achieve the goal of poverty reduction. Techniques for evaluating projects with this design are available to determine the impact of each intervention and some combinations (Cuong, 2009; Lechner, 2001; Wooldridge, 2010). Data collection requires a sample size that allows for meaningful inferences about these effects. Yet when project participants self-select into different program interventions, it is difficult *ex ante* to forecast levels of participation. These challenges make difficult to conduct evaluations of rural development projects with multiple interventions, and may explain why the literature on impact evaluation of these projects is scant.

When two or more agricultural technologies are promoted as a package and the elements of the package are divisible, project participants may adopt elements of this package instead of the package as a whole (Byerlee & Hesse de Polanco, 1986; Feder et al., 1985). To achieve project goals, such as increase in agricultural productivity and agricultural income, increases in adoption rates of improved technologies is required (Teklewold, Kassie, & Shiferaw, 2013). But adoption is not automatic upon exposure to a project treatment. Learning about the benefits of different technologies does not imply that project beneficiaries will adopt them. This is because of costs associated with adoption (Feder et al., 1985). Resource constraints also affect adoption, so farm households may be willing but unable to adopt the recommended technologies (Nowak, (1992).

Different project interventions are also likely to vary in the time horizons for achieving impacts (King & Behrman, 2009; Tjernström, Toledo, & Carter, 2013). For instance, agricultural conservation practices and structures will take a long time before stabilizing soils can stabilize crop yields. In contrast, interventions such as improved storage can lead to fairly rapid reduction of storage losses. These different periods of elapsed time from project start date to moment of project impact mean that consideration must be given to two issues: 1) what outcomes to

evaluate at different stages of project implementation, and 2) how to identify early indicators of project effectiveness.

Our objective in this research is to conduct an impact evaluation of a rural development project with multiple interventions. In using data from just two years after project initiation, the evaluation aims to identify early outcomes to determine whether the project strategy – promoting multiple interventions for all beneficiaries – changed behavior, as measured by impacts on adoption of improved agricultural technologies. We test for heterogeneity of project impacts according to relative wealth, as measured by the area of cultivated land. With this study we contribute to the literature on impact evaluation of rural development projects with multiple, opt-in interventions.

The project to be evaluated, called Agriculture for Basic Needs (A4N), promoted agricultural conservation practices and structures, post-harvest management, nutritious crops in kitchen gardens, and saving and lending groups, among other interventions. Farm households in participating villages had the opportunity to opt in to a set of A4N interventions. A4N was implemented in four countries of Central America. We focus on the evaluation of A4N in Nicaragua, a country characterized by high concentration of the poor in rural areas, and by low levels of agricultural productivity (World Bank, 2008), which is the case for many developing countries (International Fund for Agricultural Development, 2010).

Project beneficiaries were not randomly assigned. Instead, they self-selected into project interventions, so selection bias was a concern for impact evaluation. Since experimental design was not feasible, the program evaluation uses quasi-experimental methods. Difference in difference (DID), propensity score matching difference in difference (PSM-DID) and propensity

score weighting (PSW) are quasi-experimental methods that can be used to control for time invariant, unobservable characteristics and to correct for selection bias on observables (Smith & Todd, 2005).

Our results suggest that the project increased the adoption of agricultural practices that are likely to translate into longer-term impacts of increase in farm productivity and agricultural income. The results also suggest that project interventions should be targeted according to the resource constraints that households face, instead of being promoted to all households.

This chapter is organized as follows: section 2.2 presents the project to be evaluated; section 2.3 describes a conceptual framework for the analysis of project impacts; section 2.4 describes the survey data used for analysis; section 2.5 addresses the problem of impact evaluation and presents the methods we use for evaluating project impacts; section 2.6 presents results and finally section 2.7 concludes.

2.2 The Agriculture for Basic Needs (A4N) Project

The A4N project was a three year integrated rural development project implemented in four Central American countries during 2009-2012. This research focuses on the project in Nicaragua. It was managed by Catholic Relief Services (CRS) and implemented in the field by its partners Caritas and the Foundation for Research and Rural Development (FIDER). Information on the study site and location is found in Appendix A, and more detailed description of the A4N project can be found in Appendix B.

The A4N project aimed to provide farmers with a set of skills for achieving sustainable farm production and increased agricultural income, training farmers on farmer field schools, producer groups, and saving and lending groups, as well as providing technical assistance at the farm. The project promoted agricultural conservation practices and construction of agricultural conservation structures, training in post-harvest management, storage practices, use of metallic silos for storage of grains, and training in small livestock management (husbandry, feed production, vaccination regimes, manure collection). Participation in farmer innovation groups, implementation of trial plots with improved varieties of maize and beans, improved farming practices, nutritious vegetable crops in kitchen gardens (cabbage, carrots, onion, tomatoes and green leafy vegetables). The project also addressed market failure by promoting saving and lending groups to establish the habit of saving and to increase access to credit.

The project provided beneficiaries with agricultural assets, such as metallic silos, construction material for animal enclosures, water harvesting structures, plastic water tanks and water filters, and small animals, such as poultry, pigs and goats. Project interventions were available for all project participants, the project encouraged participants in different project activities to

participate on other project interventions; for instance, producer groups were encourage to form saving groups. The project also encouraged members of the same household to participate in multiple project interventions.

The A4N project first targeted villages considered poor, in terms of limited access to basic services such as water and sanitation, predominance of small land holdings and reliance on production of staple grains (maize and beans). These villages are located in areas of natural resource degradation with relatively high vulnerability to natural disasters. Within these villages, in order to be eligible to participate in the A4N project, households were expected to be characterized by most of the following official eligibility criteria:

- Cultivated land area less than two *manzanas* (1 Mz = 1.73 acres).
- Cultivated land on steep slopes.
- Lack of access to any of the following public services: piped water, sanitation, and electricity.
- Materials for house walls not brick or concrete; roof not concrete, zinc or brick; floor not concrete, ceramic or tile.
- Household experiences hunger during some period of the year.
- Household head is female.
- Household includes children younger than five years old.

In spite of these formal eligibility criteria, the A4N's village-level managers found it difficult to exclude participation of village members. So the program allowed some technically ineligible individuals to participate, in the hope that they would help to spread A4N interventions during and after program implementation.

Two different processes led to nonrandom participation in specific A4N interventions. First, official eligibility criteria that were not evenly enforced, so households permitted to participate in the A4N project vary on observable traits. Second, the self-selection of individuals into specific A4N interventions means that unobservable traits may also affect participation assignments.

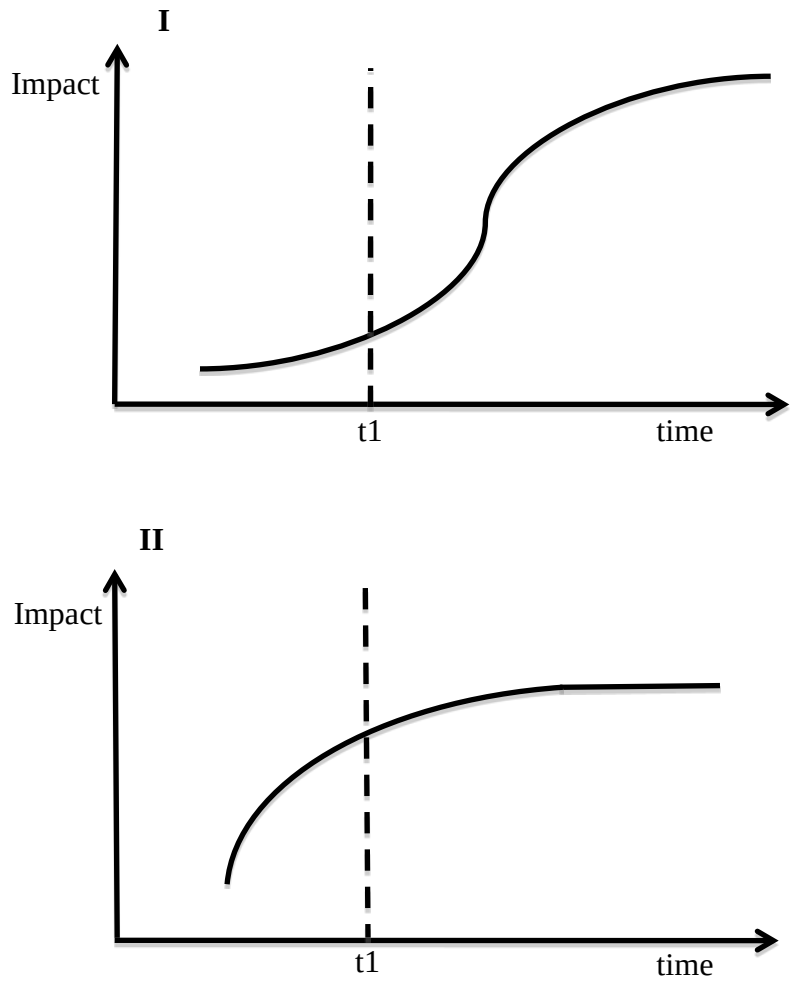
2.3 Conceptual framework

Development projects with multiple interventions like A4N provide treatment in the form of exposure to training and provision of inputs. As beneficiaries, farmer households learn about new technologies and practices, allowing them to update the information they use for solving an inter-temporal utility maximization process (Besley & Case, 1993; Feder et al., 1985). They make decisions on input allocation in each period as part of a process of learning by doing and learning by using (Feder et al., 1985). Adoption of new technologies and practices implies changes in costs. These costs could take the form of labor (e.g. building agricultural conservation structures), purchased inputs (e.g. high yield seed varieties, fertilizer), or acquiring information about the new technology, both on its use and its benefits (Sunding & Zilberman, 2001).

Farmer households that are both willing and able to adopt a given technology will do so. But the time that must elapse for adopters to realize project impacts will differ for different technologies. Figure 1, panel I, illustrates the impact of a technology with benefits that happen long after adoption. Whereas Figure 1, panel II, shows a technology that leads to impacts in the short term, close to adoption. Practices such as the construction of terraces and stone barriers, which are agricultural conservation structures, imply significant up-front investments by project beneficiaries for construction and maintenance. Benefits in the form of averted yield decline and

reduced yield variability are realized only gradually and unevenly, with the greatest benefits occurring under rare, extreme rainfall conditions. The contrary will occur with the adoption of the use of metallic silos for storage. Once the silos have been provided by the project and farmers trained in their use, the costs are the time that needed to prepare the grain for storage. Reduced storage losses can be realized in less than a year.

Figure 1. **Impact trajectories of different project interventions**.



Adapted from King and Behrman (2009)

If the project is evaluated at an early stage, say time *t1* in Figure 1, we are able to observe adoption of the technologies and practices promoted by the project and their early benefits. For a conservation technology like the one on Panel I, early impacts will be small, regardless of the degree of adoption; for a storage technology like the one in Panel II, early impacts tend to be relatively much larger. With this difference in mind, we evaluate project impacts on the adoption of a range behaviors promoted, including agricultural conservation structures and practices, improved storage technologies, vegetable kitchen gardens, and membership in savings and credit associations. We also evaluate early outcomes from these practices, specifically the number of households that experiencing stored grain losses or food scarcity, and households with savings.

2.4 Evaluating project impacts

We approach program evaluation though Rubin's potential outcome framework (Rubin, 1974). The objective of program evaluation is to determine how the intervention or applied treatment affects a desired outcome, evaluating the treatment effect against a counterfactual. Participation of individual *i* in the project is referred to as a "treatment" given by $w_i=1$, so $w_i=0$ if the individual has not been exposed to treatment. The observed outcome for individual *i* is:

Equation 1 $$y_i = w_i y_{1i} + (1 - w_i) y_{0i}$$

which means that the outcome for an individual who participates is y_{1i} and if she does not participate the outcome is y_{0i}. The treatment effect of the program intervention is:

Equation 2 $$\tau_i = \Delta y_i = y_{1i} - y_{0i}$$

But the resulting outcome attributable to a program cannot be observed in an individual participating and not participating in the program at the same time. Therefore, the problem of program evaluation is a problem of missing data, and the program effect cannot be calculated for the same individual, but instead requires constructing a counterfactual to calculate average treatment effects across individuals in a sample from the population.

The parameters of interest are the average treatment effect on the population, ATE, and the average treatment effect on the treated, ATT. The ATE is the difference between the expectation of the outcome with and without the program. For an individual, given a vector of characteristics **x,** it is:

Equation 3 $$ATE = E(\tau(\mathbf{x})) = E(y_1 \mid \mathbf{x}) - E(y_0 \mid \mathbf{x})$$

The ATE measures the effect of the treatment on both participants and non-participants. The average treatment effect on the treated, ATT, is the expected value of the outcome for those who participated in the program, conditional on the individual characteristics that determine program participation, **x**:

Equation 4 $$ATT = E(\tau(x) \mid w = 1) = E(y_1 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 1)$$

As already mentioned, $E(y_0|\mathbf{x}, w=1)$, the expected outcome of the treated if they were not exposed to the treatment, cannot be observed directly. However, we can observe $E(y_0|\mathbf{x}, w=0)$, the expected outcome of the untreated, given that they were not exposed to the treatment. Subject to the assumption of no selection bias, in the absence of the program, those who participated in the program would have had equal outcomes to those who did not:

Equation 5 $$E(y_0 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 0) = 0$$

However, if program selection has not been made randomly then selection bias occurs, and individuals exposed to the treatment will systematically differ from those not exposed to the treatment. Hence, program impact appears as a consequence of these differences, distorting the measure of the benefits from the program.

Selection bias can be a consequence of difference in characteristics between participants and non-participants: Some differences can be observed by the researcher, such as housing characteristics, land allocated to agricultural production, and topographical location of fields. These characteristics are by the program, and they determined eligibility for program participation. Other differences are not observed by the researcher and can be assumed not to change over time, including such individual characteristics as motivation, cognitive learning ability, and attitudes towards innovation.

To estimate the ATE we use difference in difference (DID) estimation. In order to estimate program impacts, we compare the ATE to two measures of the ATT, propensity score matching difference-in-difference (PSM-DID) and propensity score weighted regression (PSW) (Heckman, Ichimura, & Todd, 1997; Smith & Todd, 2005). When eligibility of treatment is not random, the ATE and the ATT

can differ, but as will be shown later in our estimation results, in this case the ATE and the ATT are identical. In the following sections, we explain how DID, PSM-DID and PSW control for different sources of selection bias. A more detailed description of the problem of impact evaluation, an overview of the different methods for impact evaluation and the methods used in this paper can be found in Appendix C.

2.4.1 Propensity score based methods:

Propensity score matching (PSM) consists of choosing the comparison group according to the probability of being selected for a treatment, given a set of observable pre-treatment characteristics and outcome values that do not change with program intervention but that affect program placement. The main assumptions for propensity score matching are:

1) Unconfoundedness:

   Equation 6 $y_0, y_1 \perp w \mid \mathbf{x}$

   where y_0 is the outcome for non-participants and y_1 is the outcome for participants, w is participation and **x** represents a set of variables that may influence participation. Program outcomes are independent of program participation, conditional on **x**.

2) Mathematically, there is common support (overlap) between the probability distributions of program participants and non-participants (Caliendo & Kopeinig, 2008; Imbens & Wooldridge, 2008; Martin Ravallion, 2008)**:**

   Equation 7 $0 < \Pr(w = 1 \mid \mathbf{x}) < 1$

To estimate the propensity score (PS), we include a rich set of variables that determine both participation in the project and pretreatment outcomes to reduce bias in estimates (Heckman, Ichimura, Smith, & Todd, 1998).

Propensity score matching assumes that after controlling for observable characteristics, outcomes are mean independent of participation in the program. But it is likely that there are systematic differences in outcomes for participants and non-participants due to unobservable characteristics, known as bias on unobservables.

Assuming that unobserved heterogeneity is time invariant and uncorrelated with treatment assignment, we can control for this source of bias using the PSM-DID estimator defined by Smith and Todd (2005). By using the PSM-DID estimator we control for observable sources of bias by building our comparison group using PSM as well as time invariant characteristics, by taking the difference of outcomes before and after treatment. The PSM-DID estimator, defined by Smith and Todd (2005), is as follows,

Equation 8 $$\hat{\tau}_{ATT,PSM-DID} = \frac{1}{N1}\sum_{i\in I_1\cap S_p}\left\{(y_{1it}-y_{1it-1}) - \sum_{j\in I_0\cap S_p}\varphi(i,j)(y_{0it}-y_{01it-1})\right\}$$

As an additional robustness check, we compare the matching estimates with the propensity score weighted (PSW) regression (Wooldridge, 2010), in the panel data context we take the difference between outcomes before and after treatment:

Equation 9 $$\hat{\tau}_{ATT,PSW} = \frac{1}{N}\sum_{i=1}^{N}\frac{(w_i - \hat{\Pr}(\mathbf{x}_i))(y_{it}-y_{it-1})}{\hat{\rho}(1-\hat{\Pr}(\mathbf{x}_i))}$$

For Equation 8 and Equation 9 the subscripts *1* and *0* refer to treated and untreated respectively, S_p refers to the common support, *t* refers to the time period, N to the total number of observations, $\varphi(.)$ is a weight that depends on the matching method used, $\Pr(x_i)$ is the propensity score and ρ refers to the proportion of treated observations in the sample (N_1/N).

2.4.2 Regression based methods.

The main assumption of DID is that the unobserved differences between participants and non-participants are invariant in time. Examples would be particular individual characteristics like motivation and cognitive ability. By taking the first difference we removed time invariant unobservable characteristics. Then obtaining the difference between periods *t* and *t-1*, the unobservable characteristics, assumed invariant in time are eliminated, correcting for this source of bias in the program impact estimation (Wooldridge, 2010):

Equation 10 $$\Delta y_{it} = \alpha_0 + \tau w_{it} + \boldsymbol{\beta}\Delta \mathbf{x}_{it} + \Delta u_{it}$$

where $\Delta y_{it}=y_{it}-y_{it-1}$, $\Delta \mathbf{x}_{it}=\mathbf{x}_{it}-\mathbf{x}_{it-1}$ and $\Delta u_{it}=u_{it}-u_{it-1}$. We obtain the program impact by the regression of the change in the outcome variable *y* the project participation variable *w*, and the change in a set of time varying covariates *x*. The first difference equation will be consistent if $E(\Delta \mathbf{x}_{it}'\Delta u_{it})=0$. The parameter of interest to estimate the ATE is τ.

The difference in difference estimator assumes parallel trends for both treatment and control in the absence of the treatment (Abadie, 2005). Therefore, correcting for differences between the two groups requires controlling for covariates related to household characteristics (Abadie, 2005). To take care of possible differences of covariates between treatment and control, we include some time varying household characteristics as in Equation 10 for estimating program impacts.

2.4.3 Heterogeneity of program impacts.

Our study focuses on the average effect of a program on the treated. Yet the average can miss program impacts that vary among subsets of individuals or households. Even if our results on the program average effect for some outcomes are not statistically significant, given the wide range of interventions within A4N, households with certain characteristics might have benefited differentially. For example, the poorest groups might have benefited from most of the project interventions, or to the contrary, the better off beneficiaries might have gotten the most from the project. This analysis is conducted for different groups identified in the sample, according to a pretreatment indicator of wealth or income generating capacity. We estimate project impact on outcome *y* for each of group g.

Equation 11 $\Delta y_{it,g} = \alpha_0 + \tau w_{it,g} + \boldsymbol{\beta}\Delta\mathbf{x}_{it,g} + \Delta u_{it,g}$

Equation 11 is identical to Equation 10, but Equation 11 includes the term g, which designates group g. These groups will be identified according to a pretreatment indicator of wealth or income generating capacity. The parameter τ_g is the parameter of interest—the estimate of project impact on outcome *y* for each of group g[1].

[1] The heterogeneity of program effects can also be estimated as follows:
$\Delta y_{it} = \alpha_0 + \tau w_{it} + \boldsymbol{\beta}\Delta\mathbf{x}_{it} + \delta D_{ig} + \rho w_i D_{ig} + \Delta u_{it}$
Where the parameter g indicates the different groups, and D a set of dummy variable to identify each of these groups (excluding the one used as reference group). The parameter of interest is given by ρ, the interaction of each group dummy variable with the treatment variable w, which is the equivalent of obtaining τ_g in Equation 11.

2.5 Survey data use for evaluation of impacts

The dataset was based on two-stage sampling of treatment and non-treatment villages, where "treatment" refers to being offered the package of interventions under the A4N project. We randomly selected villages from the list of beneficiary villages, and chose similar non-participant villages using the population and agricultural census data from Nicaragua. A detailed description of the sample design can be found in Appendix D. The sampled villages were selected according to the population weights of each of the municipalities where the project intervened. Non-participant villages were identified according to national census data on poverty levels, as measured by the index of unmet basic needs, the importance of staple crops, small landholdings (Instituto Nacional de Información de Desarrollo, 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g, 2008h), and location in the same agrarian zones (Nitlapan, 2001). From each village we randomly selected 10 treated households in the participant villages and 10 to 15 households in the non-participant villages, depending on village size. In A4N participant villages, CRS provided lists of treated households. We collected data in 2010, after the project starting date in August 2009. In non-participant villages, sample lists were developed in consultation with village leaders, who were requested to identify households that would meet the eligibility criteria of the A4N program. We found no eligible but untreated households in the treatment villages to include in the sample.

A baseline survey measured livelihoods and income for the agricultural year 2008-09, before and during project implementation (project started activities in August 2009). A follow up round of the survey did the same for the agricultural year 2010-11, the second year after project implementation. The survey also collected information on the different technologies and practices implemented by farmers in their plots. The survey was conducted in the departments of

Estelí, Jinotega and Matagalpa, located in the northeast of Nicaragua. A list with the information included in the survey can be found in Appendix E, the household survey instruments both in English and Spanish can be found in Appendix F, and the village survey can be found in Appendix G. The final balanced panel includes 578 households, 284 in participant villages and 294 in non-participant villages (See Table D5 in Appendix D). The abandonment rate between the two rounds of the survey was 7%, and we did found no evidence of systematic attrition (See Table D 4 in Appendix D). More non-participant households were interviewed intentionally, in order to permit the trimming of observations when applying propensity score matching. A survey of village characteristics was conducted among village leaders in each of the 63 villages.

The data set was reduced from the original set of 578 observations due to dropping two outliers, for a total of 576 observations. For the PSM-DID and PSW analysis, missing data for the estimation of the PS (11 observations) and the trimming of observations with PS above 0.90 and below 0.10 (11 observations) was conducted (Imbens & Wooldridge, 2008; Wooldridge, 2010). The total number of observations used for the PSM-DID and PSW analysis is 554.

2.6 Results: A4N project impacts.

The estimation of project impacts starts with estimating the probability of participation in the project using a logit model. These estimated probabilities will later be used for propensity score matching. Balancing tests after matching are presented to measure the degree of differences between treatment and control households. Then we show the estimated impacts for intermediate outcomes related to the adoption of the technologies and practices promoted by the project. Finally, we estimate project impacts by terciles of area of cultivated land.

Project treatment effects were estimated using DID, PSM-DID and PSW. The point estimates are very similar for most of the outcomes across the methods used. We present these results showing first the regression approach with DID and compare these results with PSM-DID and PSW in order to compare regression-based method results with PS based methods results.

The DID estimation includes as control variables household size, average of years of education of household members and cultivated land[2]. Then we estimate program impacts using PSM-DID kernel Epanechnikov (kernel(epan)), nearest neighbor with replacement, using five neighbors (NN(5)), and local linear regression with the tricube kernel (LLR), to conduct sensitivity analysis of the matching results. We estimated program impact using the difference in the outcome variables before and after the project as dependent variable, for both continuous and binary outcomes. Treatment refers to whether the household was exposed to the package of interventions promoted by the project[3]. Before presenting the results for the average treatment effects, we present the estimation for the propensity score of probability of participating in the A4N project.

[2] We also conducted fixed effects estimation, and the results did not differ from the DID ones. Therefore we consider that violation of the strict exogeneity assumption is not a concern (Wooldridge, 2010).

[3] Information on participation in other projects was collected in one of the household survey questions. To test for attribution to the A4N project of impacts that are due to other projects, we estimated the correlation of participation in A4N and participation in other development projects. We found no correlation (ρ=-0.03), so misattribution is not a concern. We also estimated DID including a dummy variable for participation in other projects and did not find this variable statistically significant.

2.6.1 Propensity score estimation

The probability of program participation or propensity score was estimated using a logit model with the data from 272 treated and 282 non-treated households. Upon application of Dehejia and Wahba's (2002) algorithm for estimating the propensity score (see Appendix H), it was determined that no interaction terms and higher level terms were justified to improve the estimation, so the logit model was estimated with all covariates entering linearly.

The logit model estimates the probability of program participation (Table 1). Focusing on variables that are statistically significant (p-value less than 0.10), the A4N households were more likely to be female-headed and to have lower value of farm infrastructure but also less inadequate services as defined by the basic needs index (housing lacking piped water and interior toilet). A4N households tended to be situated in villages closer to markets but with fewer large farms and less likely to have a health facility. These variables reflect some pretreatment differences between treatment and comparison households (see Table I 1 in Appendix I). A detailed description of the pretreatment characteristics of the treatment and comparison households can be found in Appendix I**.**

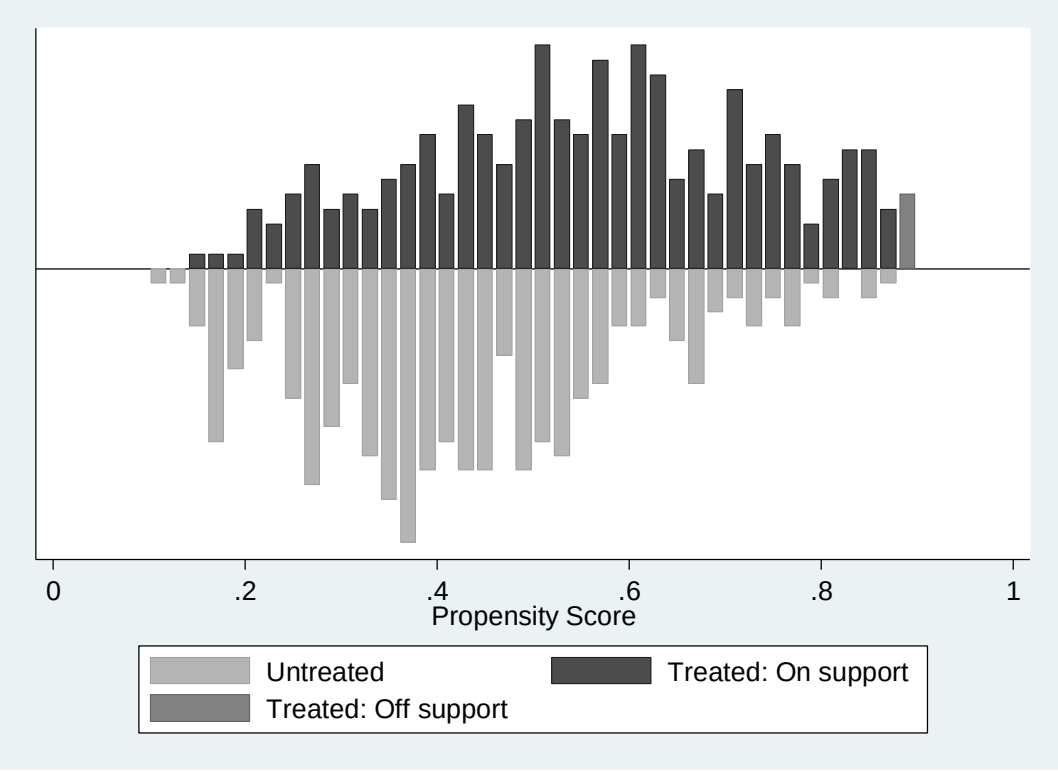
Table 1. Logit model for estimating the propensity score or probability of participation in A4N.

Dependent variable: Participation in A4N		
Explanatory variables	**Coefficient**	**Standard error**
Farm characteristics		
Cultivated land Mz	0.03	(0.03)
Steep slope=1	0.18	(0.20)
hh characteristics		
Inadequate services=1	-0.51**	(0.22)
Inadequate housing=1	0.11	(0.29)
Electricity=1	-0.05	(0.22)
Hunger=1	0.34*	(0.20)
Head female=1	1.19***	(0.31)
Children under 5 years old (number)	0.06	(0.15)
Head age (years)	0.00	(0.01)
Head education (years)	-0.01	(0.04)
Household size (persons)	-0.05	(0.06)
Persons per room	-0.02	(0.06)
Value of productive assets		
Infraestructure (C$/1000)	-0.09*	(0.06)
Livestock (C$/1000)	-0.02*	(0.01)
Equipment (C$/1000)	0.00	(0.02)
Village charcteristics		
Population 2009	0.00	(0.00)
Dist. to Market (Km/10)	-0.05***	(0.01)
Dist. to paved road (Km/10)	0.02	(0.01)
Health facility=1	-0.82***	(0.26)
Farms producing basic grains 2003 (percentage)	-0.18	(0.63)
Lanholdings less than 10Mz 2003 (percentag)	2.25***	(0.50)
Constant	-0.20	(0.84)
Log likelihood	-345	
n	554	

Levels of significance ***1%, **5%, *10%
Standard error in parenthesis
hh means household
1 Mz=1.73 Acres
The exchange rate for 2011 was U$1=C$22.42
Source: A4N Baseline Household Survey 2010.

The predicted probabilities of selection into the A4N participant and non-participant groups are presented in Figure 2**.** The non-participant distribution contains more observations with propensity scores below 0.6, and a disproportionate number of observations with propensity scores below 0.4. In spite of this, there is substantial overlap, so we have comparison observations to match treatment ones.

Figure 2. Estimated propensity score or probability of program participation.



Matching of participant and non-participant observations using according to the values of the propensity score, was conducted using STATA's psmatch2 (Leuven & Sianesi, 2012). The results for the balancing tests (Caliendo & Kopeinig, 2008; Wooldridge, 2010) after matching with replacement are provided in Table 2. Matching improved overlap between the marginal distributions of the covariates. As evidence, the percentage bias decreases for the covariates below the benchmark of 25% for covariate balance (Imbens & Wooldridge, 2008).

Table 2. Balancing tests of pretreatment covariates used for estimation of the propensity score.

	Before Matching			After Matching		
	Mean			Mean		
Variable	**A4N**	**non-A4N**	**%bias**	**A4N**	**non-A4N**	**%bias**
Area of cultivated land (Mz)	3.29	3.50	-2.68	3.32	3.37	-1.6
Steep slope=1	0.32	0.32	-25.87	0.32	0.37	-9.7
Inadequate services=1	0.66	0.79	21.39	0.67	0.66	3.6
Inadequate housing=1	0.88	0.85	60.10	0.88	0.86	4.4
Electricity=1	0.61	0.63	15.32	0.60	0.58	4.9
Hunger=1	0.39	0.32	-17.89	0.38	0.40	-4.2
Head female=1	0.20	0.07	-73.06	0.18	0.22	-12.8
Children less than 5 years old (number)	0.51	0.51	-24.23	0.51	0.41	14.1
Head age (years)	49	48	68	49	49	-1.2
Head education (years)	2.83	3.04	3.13	2.84	2.79	1.7
Household size (persons)	5.20	5.36	49.55	5.20	4.99	9.3
Persons per room	3.82	3.86	40.94	3.84	3.85	-0.6
Infrastructure (C$/1000)	0.52	1.48	-11.12	0.53	0.47	3.3
Livestock (C$/1000)	6.71	9.07	-17.33	6.80	6.08	5.7
Equipment (C$/1000)	1.76	2.08	-49.91	1.80	2.09	-6.2
Population 2009	637	640	16.68	645	678	-5.9
Dist. to Market (Km/10)	14.09	16.29	38.19	14.34	14.46	-1.5
Dist. to Paved road (Km/10)	9.53	8.95	-0.99	9.56	8.63	10
Health facility=1	0.21	0.28	-37.29	0.21	0.21	0.7
Farms producing basic grains 2003 (proportion)	0.86	0.88	71.93	0.86	0.87	-4.9
Landholdings less than 10Mz 2003 (proportion)	0.59	0.52	64.34	0.58	0.54	18

1 Mz = 1.73 Acres

U$1=C$22.42

$$*\%bias = \frac{\bar{x}_{1j} - \bar{x}_{0j}}{\sqrt{s_{1j}^2 - s_{0j}^2}} * 100$$

Source: A4N Baseline Household Survey 2010, Baseline Village Survey 2010

2.6.2 Project impacts on outcomes related to adoption of technologies and practices.

With the goal of determining whether there was a project impact in the adoption of promoted practices, the evaluation of intermediate outcomes focuses on six groups of outcomes: (1) agricultural conservation structures, (2) agricultural conservation practices, (3) post-harvest grain storage, (4) kitchen gardens, (5) saving and credit, and (6) food scarcity[4]. Table 3 presents detailed definitions of the outcomes to be evaluated (Table 3, for further details, see Table J 1 in Appendix J). Table 4 and Table 5 present the results for the different methods use for estimating program impacts, DID, PSM-DID using three methods— kernel (epan), NN(5) and LLRmatching—to compare the sensitivity of estimates to different matching methods (Abadie & Imbens, 2008), and PSW regression.

The results are robust to different estimation methods, as can be seen by the similar point estimates and levels of significance obtained for project treatment effects. Overall, the results using DID[5] for estimating the ATE were almost identical to the results using PSM-DID and PSW for estimating the ATT. This was expected because the sampling frame explicitly included a set of control villages and households for comparison with similar characteristics to the A4N ones according to poverty and population indicators. The comparison group was similar by construction to the treatment group according to observable characteristics. Additionally, the ATE and the ATT do not differ in this case because we were able to collect data on project beneficiaries for data collection (more on this in Appendix C and Appendix D).

[4] We did not conduct impact evaluation on the use of improved maize and beans varieties due to unreliable data on the names of the varieties planted by farmers collected in the survey.
[5] For details in the DID estimation results for this section see Appendix K.

Table 3. Definition of intermediate outcome variables and units of measurement.

Outcome Variables	Unit	Definition
Agricultural Conservation Structures (built between 2009 and 2011)		
All structures	m/Mz	Difference length built in agricultural conservation structures 2011-2009
Stone barriers/terraces	m/Mz	Difference length built in stone barriers and terraces 2011-2009
Live barriers	m/Mz	Difference length built in live barriers 2011-2009
Ditches	m/Mz	Difference length built in ditches 2011-2009
Agricultural Conservation Practices		
All practices	1=yes, 0=no	The household has implemented at least one cons ag practice in one of the plots under its management
Minimum tillage	1=yes, 0=no	The household has implemented minimum tillage at least in one plot
Zero tillage	1=yes, 0=no	The household has implemented zero tillage at least in one of its plots
Vermiculture	1=yes, 0=no	The household has implemented vermiculture at least in one of its plots
Cover crops	1=yes, 0=no	The household has implemented cover crops at least in one of its plots
Storage Practices		
hh experienced stored grain losses	1=yes, 0=no	The household has experienced stored grain losses. Only for households that stored grain.
hh stored grain in metallic silos	1=yes, 0=no	The household uses metallic silos for grain storage. Only for households that stored grain
Number of metallic silos	number	Number of metallic silos owned by the household
Kitchen Garden		
hh had a kitchen garden	1=yes, 0=no	Household has a kitchen garden
Savings and Credit		
hh has savings	1=yes, 0=no	Household had savings on January 1st
hh has credit	1=yes, 0=no	Household had credit on January 1st
Food Scarcity		
hh experience food scarcity	1=yes, 0=no	Household experienced a period of the year when they could not cook one of the daily meals

hh means household. 1 Mz = 1.73 acres

The construction of agricultural conservation *structures* and the use of agricultural conservation practices for soil and water conservation increased thanks to the project, as shown in Table 4. Agricultural conservation *structures* represent significant investments of capital and labor with a gradual payoff. The adoption of their construction under the A4N project was measured by the change in length of rows built structures per unit of cultivated land (meters/Mz). The information was obtained with a recall question in 2011 on the length of agricultural conservation *structures* built over the past two years. This question was asked for each of the plots under the management of the household. On average the increase in agricultural conservation *structures* was 77m/Mz, measured by first differences (Table 4); the estimates for PSM-DID and PSW are similar, and all are highly statistically significant. This increase was explained mostly by the increase in area under stone barriers and terraces (24m/Mz), live barriers (16m/Mz), and ditches (7m/Mz) (Table 4).

Agricultural conservation *practices* included reduced tillage, vermiculture and cover crops, all three of which are require less capital and labor than the construction of terraces, barriers, or ditches. The adoption of *practices* was measured by changes in whether the household was implementing one or more of the practices promoted by A4N on at least one of the plots managed by the household. On average there was not an overall impact in the use of these practices, but there was significant substitution of minimum tillage for zero tillage. The percentage of households using minimum tillage in at least one of their plots decreased by 14%, whereas this percentage increased by 19% for zero tillage (Table 4). In addition, there was an increase in households implementing vermiculture and cover crops in at least one of their plots.

Table 4. Project impacts on construction of agricultural conservation structures and on agricultural conservation practices.

		PSM-DID			
Difference outcome variables	**DID**	**kernel (epan)**	**NN(5)**	**llr (tricube)**	**PSW**
Agricultural Conservation Structures					
All structures m/Mz	77***	76***	75***	73***	72***
	(25)	(25)	(27)	(27)	(27)
Stone barriers or terraces m/Mz	24***	24***	23**	22**	24**
	(10)	(10)	(10)	(11)	(10)
Live barriers m/Mz	16***	17***	17***	17***	17***
	(5)	(5)	(6)	(5)	(5)
Ditches m/Mz	7***	7***	8***	7***	7***
	(3)	(3)	(3)	(3)	(3)
Agricultural Conservation Practices					
All practices[1]	0.04	-0.02	-0.03	-0.02	0.00
	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)
Minimum tillage[1]	-0.14***	-0.17***	-0.16**	-0.17**	-0.15***
	(0.05)	(0.07)	(0.08)	(0.07)	(0.05)
Zero tillage[1]	0.19***	0.19***	0.20***	0.18***	0.18***
	(0.0	(0.07)	(0.07)	(0.07)	(0.07)
Vermiculture[1]	0.05***	0.05**	0.05**	0.05**	0.04***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Cover crops[1]	0.03***	0.04*	0.04*	0.04*	0.04*
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)

[1] For binary outcomes the difference takes values -1, 0 and 1.
Levels of significance ***1%, **5%, *10%
NN refers to nearest neighbor, LLR to local linear regression
untrimmed sample n=567, trimmed sample n=546
A total of 265 pairs formed with PSM-DID
Mz = 1.73 acres

The project had a significant, positive effect on adoption of metallic silos for grain storage. On average there was an increase of 11% in the share of households using metallic silos for storage (Table 5). Presumably associated with this, the number of households that experienced stored grain losses fell by 11% to 16%, based the four estimates with p-values below 0.15. The

increased use of metallic silos translated into a reduction on stored grain losses within the first two years of the A4N project, and it is possible that project beneficiaries were still in the process of learning how to best apply postharvest management practices to avoid losses. The successful adoption of these practice can lead to further reduction of losses of grain stored for consumption (Gitonga et al., 2013).

The project had a significant impact in the percentage of households with savings, which increased by 14% (Table 5). This is not an agricultural technology intervention, but this was a very successful intervention of the project that aimed to stabilize income flow over the year and to provide funds in times of household food scarcity. This outcome is mostly a result of the formation of saving and lending groups promoted by the project. Savings gains are likely to reduce vulnerability to asset liquidation in times of food scarcity, and consumption smoothing (Kaboski & Townsend, 2005). Savings accumulation can also be used for productive investments (e.g., in agricultural assets) (Chowa & Elliott III, 2011).

Table 5. Project impacts on storage practices, kitchen gardens, savings and credit and food scarcity.

Difference outcome variables	DID	PSM-DID kernel (epan)	PSM-DID NN(5)	PSM-DID llr (tricube)	PSM-DID PSW
Storage Practices					
Experienced stored grain losses [1,2]	-0.16***	-0.11~	-0.07	-0.13~	-0.11~
	(0.06)	(0.08)	(0.08)	(0.09)	(0.08)
hh stored grain in metallic silos [1,2]	0.11***	0.10**	0.11**	0.10*	0.09~
	(0.04)	(0.05)	(0.05)	(0.05)	(0.06)
Number of metallic silos owned	0.14***	0.13***	0.12**	0.13***	0.13***
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)
Kitchen garden					
hh had a kitchen garden [1]	0.04	0.04	0.04	0.04	0.04
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
Savings and credit					
hh has savings [1]	0.14***	0.13***	0.13***	0.12***	0.13***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)
hh has credit [1]	-0.01	-0.01	-0.03	-0.03	0.00
	(0.04)	(0.05)	(0.06)	(0.05)	(0.05)
Food scarcity					
hh experienced food scarcity [1]	-0.06	0.04	0.05	0.05	0.04
	(0.05)	(0.05)	(0.06)	(0.05)	(0.04)

[1] For binary outcomes the difference takes values -1, 0 and 1

[2] Correspond only to the households that stored grain, non-trimmed sample n=476, trimmed sample n=460

Levels of significance ***1%, **5%, *10%, ~ 15%.

NN refers to nearest neighbor, LLR to local linear regression

hh means household

Untrimmed sample n=575, trimmed sample n=554

A total of 265 pairs formed with PSM-DID

2.6.3 Heterogeneity if project impacts by area of cultivated land.

Continuing with the analysis of project impacts, we look at the distribution of project effects across households of varying asset levels. It is possible that even if average treatment effects for the agricultural income and household wealth related outcomes were not statistically significant, some groups benefited more (or less) than others (Khandker, Koolwal, & Samad, 2010). The sample was divided into approximate terciles using the information on the pretreatment area of cultivated land. Farmland, an important asset, is the key input for agricultural production. The first group is composed of households with less than 1.5 Mz (small area) of cultivated land, the second one with households with between 1.5 Mz and 3 Mz of land (medium area) and the third one with households with more than 3 Mz of cultivated land (large area).

Table 6 presents the estimated coefficients of average treatment effects for each of the three groups formed using the area of cultivated land in 2009. The DID, PSM-DID and PSW estimates of average treatment effects are all very similar, so for this analysis we simply report FD, for households in each size category of cultivated land. The DID estimation uses the same explanatory variables as those included in the estimation of overall program effects: household size, average of years of education of household members and cultivated land.

Table 6. Project impacts by area of cultivated land on outcomes related to adoption of practices and technologies.

	<=1.5Mz n=191		1.5<land<=3Mz n=199		>3Mz n=186	
Outcomes	**Coef**	**se**	**Coef**	**se**	**Coef**	**se**
Agricultural Conservation structures						
All structures m/Mz	111	(73)	41***	(16)	74***	(27)
Stone barriers m/Mz	3	(27)	27**	(12)	31***	(11)
Live barriers m/Mz	16	(15)	13***	(5)	18***	(7)
Ditches m/Mz	11**	(5)	4**	(2)	8	(8)
Agricultural conservation practices						
All practices[1]	0.20**	(0.09)	-0.03	(0.08)	-0.06	(0.06)
Minimum tillage[1]	-0.08	(0.09)	-0.05	(0.09)	-0.30**	(0.09)
Zero tillage[1]	0.20**	(0.08)	0.15	(0.08)	0.19*	(0.08)
Vermiculture[1]	0.05**	(0.03)	0.02	(0.02)	0.08*	(0.04)
Cover crops[1]	0.03	(0.02)	0.02	(0.02)	0.03	(0.02)
Storage Practices						
Stored grain losses[1]	-0.06	(0.12)	-0.28***	(0.09)	-0.12	(0.09)
Stored in metallic silos[1]	0.06	(0.06)	0.15**	(0.06)	0.10	(0.08)
Number of metallic silos owned	0.07	(0.07)	0.16**	(0.07)	0.21*	(0.10)
Kitchen garden						
hh has a kitchen garden[1]	0.12**	(0.05)	-0.02	(0.04)	0.02	(0.05)
Saving and credit						
Saving[1]	0.22***	(0.07)	0.08	(0.06)	0.09	(0.08)
Credit[1]	0.10	(0.07)	-0.03	(0.07)	-0.13	(0.09)
Food scarcity						
Experienced period of hunger[1]	-0.03	(0.08)	-0.06	(0.08)	-0.08	(0.08)

[1] For binary outcomes the difference takes values -1, 0 and 1

Mz = 1.73 acres

hh means household

Note 1: the total sample of 576 observations was divided in terciles, and for each tercile there was an approximate equal share of treatment and comparison observations.

Note 2: The heterogeneity of program effects was also estimated by DID for the whole sample including two dummy variables for two terciles of cultivated land and two interaction terms between those and the treatment variable. The results for the coefficients of the interaction terms and levels of significance were identical to the ones obtained here.

The results pointed to notable differences in impact by asset level. Households with large and medium area of cultivated land built higher densities of agricultural conservation structures, whereas households with small area were more likely to increase their use of agricultural conservation practices. On average, households with medium and large cultivated area built 41m/Mz and 74m/Mz of agricultural conservation structures (see Table 6). The implementation of agricultural conservation practices in at least one of the plots under the management of the household increased by 20% among the households with small area, and 20% of these households also increased the use of zero tillage. In contrast, 30% of households with larger area decreased their use of minimum tillage, and 19% increased the use of zero tillage (Table 6). These results are consistent with results of studies about decisions of carrying out agricultural conservation investments, which depend on access to land and labor, as well as land tenure security (Gebremedhin & Swinton, 2003), indicating that differences in household characteristics matter for household decisions of take up of project interventions.

The households with medium cultivated area are the ones most likely to increase adoption of improved grain storage practices and to experience decreased stored grain losses. A total of 30% more of medium area households experienced reduced losses of stored grain, and 16% more of these households stored grain in metallic silos (Table 6).

Households with small cultivated area were the ones to add kitchen gardens and to gain savings. The ATT for households with kitchen gardens was not statistically significant for the whole sample, but 12% more households with small land area have kitchen gardens thanks to the project (Table 6), which in turn helps to improve food security. Also these households are the ones that take advantage of the creation of savings and lending groups, with a 22% increase in households with savings.

These results suggest that household resource constraints may limit adoption of certain practices. Capital is required to undertake the investments in construction of agricultural structures, including the hiring of labor. For households with small cultivated area, practices that do not require this level of investment, such as participation in savings groups or growing small vegetable gardens, constitute practices that they are more likely to adopt.

Finally, we also analyzed project impacts on agricultural income and change in household wealth. Looking at both overall project impacts and impacts by area of cultivated land, the project had no statistically meaningful impact on these outcomes. This finding is not surprising just two years after project implementation. If we did not think carefully about the project timing and the time lapse needed for impacts to occur, we might have concluded that the project had no impact. The detailed analysis of these analyses is provided on Appendix L.

2.7 Conclusion

Using different methods, DID, PSM-DID and PSW, we find identical results. Stability of project impact estimates across the methods used was expected, due to careful design of the impact evaluation with comparison households selected to construct a valid counterfactual for analysis.

We focused on the adoption of improved agricultural technologies to measure changes in behavior, as early indicators of project impact. We found that adoption did increase for many of the technologies promoted. If these behavioral changes are maintained over time, they are likely to translate into increases in agricultural productivity and agricultural income by several mechanisms: Investments in agricultural conservation structures and adoption of agricultural conservation practices are both likely to lead to long-term stabilization of yields. Adoption of

improved storage technologies, the associated reduction in the number of households experiencing stored grain losses, and increases in households with savings should all lead to more stable, rising cash flows and reduced of risks of food scarcity and asset liquidation.

However, rates of adoption of project technologies were not the same across households of different asset levels. The analysis of project impacts by farm size reveals that they vary according to the household's area of cultivated land. Hence, the targeting of project interventions by participant asset level can increase rates of adoption of practices by tailoring interventions to household resources. Such an approach could increase project impacts for different groups of beneficiaries, instead of promoting all the interventions for all the beneficiaries—a more cost-effective strategy.

An important recommendation from this impact assessment is that the heterogeneity across project interventions of the expected time lapse before participants experience benefits should be considered both for project design and for impact evaluation. As shown here, the realization of gains for some interventions (e.g. construction of stone barriers and terraces) takes much longer than others (e.g. storage in metallic silos). Therefore, development projects that promote multiple interventions may want to set poverty relief objectives that explicitly incorporate the timing of expected benefits from adoption of specific practices. In an environment of donor impatience to see rapid impacts, such an approach would calibrate donor expectations to a realistic sequence of intermediate impacts that culminate in long-term desired outcomes.

Chapter 3 Trust and Group Participation in Rural Development Activities[6]

3.1 Introduction

Many studies have suggested that important linkages exist between trust and development. At the national level, trust has been shown to have positive robust effects on income (Baliamoune-Lutz, 2011) and has been shown to play a role in increasing investment. Research also indicates that high levels of trust can encourage group formation and improve coordination in order to carry out research and innovation projects (Dearmon & Grier, 2009). Finally, trust has been found to improve human development (Özcan & Bjørnskov, 2011) and is associated with the adoption of environmental sustainability projects (Owen & Videras, 2008). At the community level, trust has been linked with effective and sustainable management of natural resources (Bouma, Bulte, & van Soest, 2008).

Generalized trust (that is, trust towards strangers) is typically seen as reducing transactions costs via facilitating information sharing and increased efficiency (Fafchamps, 2006). But another complementary view of trust, called personalized trust, is formed through repeated interaction among non strangers. Putman (2003) notes that studies of rural development have shown that a "vigorous network of indigenous grassroots associations can be as essential to growth as physical investment, appropriate technology, or "getting prices right.". Personalized trust impacts economic growth and is required for sustained economic development. Knack and Zak (2003) develop a general equilibrium model to illustrate that when trust is lower the amount invested by

[6] This chapter was written with the collaboration of Professor Robert Shupp; it is a coauthored work submitted for journal publication.

economic agents is low, which affects savings, and that these low levels of savings would not be sufficient for sustained output growth. In addition, Grootaert & Narayan (2004) find that trust, measured as membership in different groups or organizations increases household welfare and reduces poverty.

Personalized trust appears to be important in improving individual and group quality of life, especially in rural development situations. In fact, development projects frequently use the strategy of group formation to promote project interventions such as producer groups that aim to correct for market failure and savings and lending groups. These groups are formed and encouraged by development projects for two primary reasons: 1) because the success of the intervention in some way relies on group participation and cooperation (for instance, savings and lending groups or sustainable management of a resource), or 2) because groups make it easier to disseminate the intervention and possibly improve its effectiveness via information sharing among participants. While these are good reasons to encourage group formation in development projects, we suggest (as others have before) that there is an additional potential benefit from group formation, which is the encouragement and development of increased trust and social capital and its potential benefits. For example, informal microfinance groups such as Rotating Accumulating Savings and Credit Associations, or ROSCAs, have been shown to have impacts beyond correcting for financial market failures. Etang, Fielding and Knowles (2011) find evidence of the impact of participation in ROSCAs on trust in Cameron. Other benefits generated from these groups extend to the provision of social security and insurance, physical and institutional infrastructure, recreation, community development, and health and education (Bouman, 1995).

In general, groups, through increased trust, have the potential to increase incomes, and generate empowerment and political action, which can help the poor escape poverty (Thorp, Stewart, & Heyer, 2005). Group formation provides the experience of working together, enhancing trust and enabling individuals, not only to work towards current goals, but also to work together in the future towards other personal or community objectives. Enhancing trust and building long lasting capacities should enable development project beneficiaries to continue working jointly towards common goals. If this is the case, then while rural development projects frequently rely on the existing social capital and trust in target areas, they should also focus on generating greater levels of trust and social capital among said beneficiaries. If accomplished, the beneficiary groups and their community are likely to be less dependent on the presence of an external development agent to continue working together and in this sense, the impacts of the project – both through its interventions and through the more general impacts of increased trust – are more likely to last after the project is over.

Assuming that increased levels of trust can potentially alter the success and longevity of rural development project impacts, then the question becomes whether the sort of groups typically used and promoted by rural development projects, such as producer groups and savings and lending groups, actually improve levels of trust and potential cooperation and social capital among beneficiaries and their communities, or whether development projects should incorporate further interventions specifically focused on improving trust and cooperation. In this study, we measure how group participation in a rural development project affects levels of trust. Trust has traditionally been measured in two different ways: 1) through survey questions, such as the Generalized Social Survey (GSS) trust questions designed to measure generalized trust and 2) via individual behavior in incentivized trust game experiments. The trust game has been used

extensively to measure trust under different settings with different groups of participants (Cardenas & Carpenter, 2008; Danielson & Holm, 2007; Gächter, Herrmann, & Thöni, 2004; Schechter, 2007; Vollan, 2011). In addition, the two methods have been used jointly to compare and contrast the two methods in different settings (Capra, Lanier, & Meer, 2008; Etang, Fielding, & Knowles, 2012; Gächter et al., 2004; Glaeser, Laibson, Scheinkman, & Soutter, 2000; Johansson-Stenman, Mahmud, & Martinsson, n.d.).

The GSS trust question asks, "Generally speaking, do you consider that most people can be trusted, or that you cannot be too careful in dealing with people?" In studies conducted by Capra, Lanier and Meer (2008), Gatcher, Herrmann and Thoni (2004), Glaeser, Laibson, Sheinkman, and Soutter (2000), it has been found that attitudinal questions that make reference to a specific group of people, such as "strangers", rather than to "most people", as in the GSS trust question, tend to be better predictors of behavoir in trust games. That said, these studies also argue that both attitudinal questions and economic experiments are complementary, rather than exclusive methods for measuring trust, since they allow for checking consistency of answers to survey questions with behavoir.

In this study we use both methods. Specifically, we apply the trust game and survey questions to investigate whether farmers involved in group based interventions promoted by the "Agriculture for Basic Needs" (A4N) project in Nicaragua reveal different levels of trust than farmers who were not exposed to the A4N group interventions. We explore these effects on trust levels among farmers in the same village. We use the trust question from the GSS to measure farmers' levels of trust towards people in general and an additional attitudinal question to measure trust towards people in the same village. Our implementation of the trust game experiment follows Berg, Dickhaut and McCabe (1995); it is a one shot, double blinded design

where both sender and receiver do not know who they are paired with. We use the proportion of the endowment sent as a measure of trust and the proportion returned as a measure of trustworthiness.

Overall, we find evidence that participants involved in the group-based interventions of a rural development project (as represented by the A4N groups) have higher levels of personalized trust than participants who were not involved, but the evidence is weak. Our findings suggest; 1) the need for further investigation of group based interventions on trust and 2) that, if rural development projects are interested in increasing levels of trust among project participants and communities, specific interventions designed at increasing trust levels may be required. We also find that women are more trusting than men and that increased levels of education are associated the lower levels of trust as measured by proportion of endowment sent.

The rest of the chapter is organized as follows. First we provide a short description of the A4N project and its strategy of group promotion. Second, we describe our experimental design, and then we present the results. Finally we discuss the results and draw conclusions.

3.2 The Agriculture for Basic Needs project (A4N)

Catholic Relief Services (CRS) and its partners, Caritas and the Foundation for Research and Rural Development (FIDER), implemented the Agriculture for Basic Needs (A4N) project in Nicaragua during 2010-12. The primary aim of A4N was to provide rural low-income farmers with a set of skills for achieving sustainable farm production and increased agricultural incomes. The A4N project worked mostly with smallholder farmers. The average participating farmer has about 5.2 acres of land and grows mostly maize and beans. Farms with livestock (93% of total)

primarily raise poultry and small animals, and on average use 50% or more of their agricultural production for home consumption.

To accomplish the program objectives, A4N interventions promote agricultural conservation and nutritious crops, improved crop varieties, animal husbandry (for poultry and pigs), integrated pest management and practices to diminish post-harvest crop loss. Other program interventions include saving and lending groups, post-harvest processing, expanded participation in markets, and promotion of farmer innovation groups. The A4N project was initiated in August of 2009 and was formally completed in August of 2012. Given the project's goals as described above, the A4N project targeted villages that are considered poor. As such, the villages involved in A4N were characterized by high levels of unsatisfied basic needs, are typically located in areas of natural resource degradation, and are highly vulnerable to extreme weather events such as landslides, drought and excessive rain.

The overarching strategies for the A4N project were to promote group organization and interaction, to build capacity in saving and lending, to introduce enhanced agricultural technologies, and to provide technical assistance to farmers. As such, farmers in the A4N villages were invited and encouraged to form groups focused on one or more of the following project supported objectives: saving and lending, learning sustainable agricultural technologies, and innovation and learning. Once a farmer group was formed, the A4N project provided technical and financial support in the form of training in agricultural technologies or in microfinance, depending on the kind of group, supplies such as agricultural inputs for plot trials, record-keeping books, and financial support for group initiatives such as starting a new business. In addition, each group was assigned a project field officer who regularly attended group meetings to assist with group organization and to provide training as needed. While the field

officer was there to help, it is important to note that each group determined its own direction within the confines of the project, with the hope that the groups would promote interaction between farmers and illustrate the advantages of working together to achieving joint goals successfully.

While group members received training and assistance from the project, members were active in setting group objectives and in determining group needs. In this sense, the A4N groups went beyond getting farmers together for training activities by encouraging members to actively participate in setting and achieving goals.

3.3 Experimental design and procedures

The main objective of this research is to investigate the possibility that participation in A4N type intervention projects, that is, those focused on improving farmer income through improved village level investment and the transfer of enhanced production techniques via direct training and participation in farmer groups, may also lead to increased levels of cooperation and coordination via increased levels of interpersonal trust. Given this focus, our experimental design involves two treatments that vary only in whether participants were involved in the A4N group based interventions or not. Specifically, we implement trust experiments (see description below) in eight villages in Nicaragua, half of these villages where involved in the A4N project while the other half were not (Table 1 lists participating villages along with number of participants).

This study was conducted under a project that is evaluating the economic impact of the overall A4N project in agricultural incomes and household wealth. Under this project we also collected secondary information on the Nicaragua's population and Nicaragua's agricultural census, and

primary information from a household survey. Using pre-treatment characteristics (2009) from both sources of secondary and primary data, we selected the villages where we conducted the economic experiment. For the A4N villages we used A4N project data to elaborate the lists of subjects to be invited to the sessions. For the non-A4N villages we elaborated lists with village leaders on eligible subjects to participate in the economic experiment.

The non-A4N villages selected to conduct the economic experiments were chosen to have similar characteristics to A4N villages. The eight non-A4N and A4N villages were selected such that they had similar socio-economic characteristics. Four A4N villages were randomly selected from a group of 13 villages, and four non-A4N villages were selected from 10 non-A4N ones. Comparison of the larger groups of 13 A4N and 10 non-A4N villages using data from Nicaragua's population census 2005 and Nicaragua's agricultural census 2003 (see Appendix N) shows that the null hypothesis of equal means cannot be rejected for a range of household wealth indicators . The eight villages included in the experiments were located in the Department of Estelí in the same agro-ecological zone. They were similar in terms of access to water, sanitation and electric power, as well as in area of landholdings and production of basic grains. For these eight villages we did not conduct t-tests for equal means due to the small number of observations. The characteristics for the eight villages where the games took place can be seen in Appendix N.

Apart from matching A4N and non-A4N villages on general characteristics, we used two other selection criteria. First, we selected villages such that they were geographically separated in order to minimize the possibility that farmers in one village might discuss the activity with farmers in another village. Second, we selected A4N villages that had more than one A4N group

formed (see Appendix O), with the goal of avoiding only having participants from a single group in a given session. The correlation coefficient between the number of groups per village and the village population is 0.41, indicating that a higher number of groups is associated with a higher population in the village (Appendix O).

Table 7. Village pretreatment characteristics.

Village	Population 2005	Households 2005	% inadequate housing 2005	% houses no electricity 2005	% houses no piped water 2005	% households produce basic grains 2003	% farms with landholding >10 Mz 2003
A4N:							
Las Gavetas	156	39	41%	5%	86%	100%	25%
Rosario Abajo	613	126	74%	88%	53%	8%	45%
Tomabu	585	128	74%	30%	96%	100%	78%
Las Cuevas	699	114	60%	18%	95%	91%	52%
Non-A4N:							
Las Puertas	200	38	67%	86%	84%	100%	38%
San Lorenzo	296	58	34%	41%	87%	73%	23%
Las Lajas	-	-	-	-	-	73%	40%
El Quebracho	125	25	93%	53%	17%	94%	58%

Source: Instituto Nacional de Estadisticas y Censos (INIDE) Nicaragua
Ministerio Agropecuario y Forestal (MAGFOR) Nicaragua

A total of eight sessions (one session in each selected village) were conducted during May of 2012 with between 17 and 22 farmers participating in each session (see Table 8). For sessions in A4N villages, farmer participants were recruited randomly from community lists of farmers participating in groups promoted and supported by the A4N project. Similarly, for sessions in non-A4N villages, farmer participants were chosen randomly from community lists of farmers with similar demographic characteristics to the A4N farmers.

Table 8. Session Villages and Number of Participants.

	Village	Participants
A4N	Las Gavetas	19
	Rosario Abajo	21
	Tomabú	20
	Las Cuevas	17
Non A4N	Las Puertas	17
	San Lorenzo	20
	Las Lajas	22
	El Quebracho	17

The trust game used in this study is based on a version of the trust game developed by Berg, Dickhaut and McCabe (1995). This version of the trust game is a one shot game, with no communication, where all participants remain anonymous in that they do not know whom they are playing with. As in most trust games, participants are divided into two types (senders and receivers) and each sender is paired with one receiver. In addition, both senders and receivers are given equal initial endowments. The sender is then asked to decide what portion of their endowment they would like to send to the receiver. The sender can send all or none and knows that whatever portion they do not send they will get to keep. The sender, and receiver, also knows that the amount sent (or invested) is, in this case, tripled before it is given to the receiver. For example, if the sender sends $10, the receiver will get $30. In this way, the receiver will now have their endowment plus three times what the sender sent. In the second step of the game, the receiver can return some amount of what they have (endowment plus three times what the sender sent) back to the sender.

Clearly, the Pareto optimal outcome is for the sender to send all of their endowment and have it tripled as this creates the largest pot of money for receiver and sender to divide (that is, the total would be four times the initial endowment). If the receiver behaves in an equitable fashion, they would return half and both sender and receiver double their money relative to their initial

endowment. On the other hand, using backward induction, and assuming each player seeks to maximize his monetary self-interest, the Nash equilibrium involves the sender not sending anything under the assumption that the receiver will be selfish and return zero. As has been shown repeatedly, neither of these outcomes represents actual behavior. Cardenas and Carpenter (2008) report results from trust games conducted in developing countries where senders sent, on average, between 30% and 73% of their endowment and receivers returned between 18% and 50% of what was available to them. This implies that senders are, to some extent, willing to "trust" that receivers will be fair (or more accurately not completely selfish) and will return some amount. Typically, the amount sent by senders is interpreted as a measure of "trust" – that is the greater the proportion of their endowment senders send, the higher their level of trust or confidence. Similarly, the amount returned by the receiver can be interpreted as a measure of trustworthiness.

Conducting lab experiments in the field can present challenges and we used helpers and followed procedures similar to those adopted by Lopez and Ramos (Lopez, Maria C, personal communication May 17th 2012) and Cardenas and Ramos (2006). Specifically, experimental sessions were held at houses and schools in the selected villages. As participants arrived at a session, they were given a randomly assigned subject number to be used for identification purposes throughout the experiment. Once all participants had arrived, a consent form was handed out and read aloud (Appendix P). The instructions were explained to the participants and examples of different possible outcomes were provided on a paperboard to help enhance understanding and elicit questions (see Appendix Q for game procedures in the field). The instructions were provided to all the subjects together, to ensure everyone had the same information from the very beginning of the activity. This could affect our results since subjects

were in the same room together before being split up. It was emphasized that the examples provided were not the only possible outcomes, and that each of them could make their own decisions. Once the examples were completed, the group was split and pairs were randomly selected via subject numbers. At this point, participants were asked not to talk about the game or their decisions either during the session or after.

We explained clearly to subjects that their decisions would remain anonymous (that is, that none of the other participants would know who they were paired with) both during and after the game. The endowment of C$100 Nicaraguan Córdobas (C$), approximately $4.30, and potential earnings from the experiment are not insignificant in that C$100 is approximately the daily agricultural worker wage in the area. To make sure the participants were clear that they would be paid in real money, it was also emphasized that the fake bills were just to be use during the game, and that the fake bills would be replaced by real ones of the same denomination at the end of the experiment.

As noted earlier, experiment helpers were used during the sessions due to the expected literacy level of participants. The average level of education in the study site is 4.5 years of schooling. In a rural field setting such as this, several explanations of the instructions are required to ensure understanding of the activity. The helpers played three primary roles. First, they circulated during the explanation of the experimental instructions and examples helping to give further explanations and answer questions in simple language. This helped avoid having participants discuss the activity with each other before making their decisions. Second, when senders and receivers were called individually to make their decisions, the helpers sat with them and went over the instructions again and helped them complete their decision if required. Finally, the helpers acted as enumerators while participants filled in a short survey, which we discuss below.

It should be noted that these helpers were not from the study site, and not known by villagers. We recognize that having helpers when subjects are making their decisions is likely to influence their choices, but as mentioned it was required to ensure understanding of the activity.

Below are the specific procedures (after providing instructions and examples) for an experimental session (instruments use in the field can be found in Appendix R):

- Groups were divided into senders and receivers. Groups were sent to separate rooms along with a helper.
- In the sender room, participants were randomly called one at a time (by participant number) to a separate, private area where a helper assisted them while they made their decision about how much from their endowment to send to the receiver.
- Each sender was given a total of C$100 ($4.3), in 10 fake bills of C$10 and two envelopes – one for them to keep while the other would be sent to the receiver. The sender then decided how to split their endowment, they were told to put in a white envelope the amount they were going to send to the receiver. They were also given blank fake bills, to put together with the amount the ones that account for the amount that they were sending. They were told to put what they were keeping on a color envelope, to take that envelope with them and were told not to open, share or exchange this envelope with anyone else.
- After all senders finished making their decision, the envelopes were taken to a separate room and the amounts sent were recorded and tripled and the envelopes were taken to the private area where now receivers were called for making their decisions. Each receiver was randomly called by participant number, to a separate and private area where a helper handed the enveloped with the tripled amount to the receiver, the helper reminded the

receivers that the amount that was in the envelope is what was sent to them by the sender multiplied by three and that now they have a total which was equal to the amount in that envelope plus the endowment of C$100 they already received. The helper reminded the receiver the instructions of the game, and assisted each receiver while they were making their decision. They made sure that each receiver knew they could send the amount they wanted and that this decision was going to be kept confidential. Helpers explained to the receiver that from the amount available to them, they were to put what they were returning in a white envelope, and keep the rest.

- After each of the receivers made their decisions, subjects were asked to stay to fill out a short survey on socioeconomic characteristics and farming activities. After filling in the survey they were called one by one to a separate room to receive their earnings of the game.

We conducted the survey in two parts (survey instrument can be found in Appendix S). First, in order to make sure that the trust questions included in our survey were answered before both senders and receivers got any feedback on their decisions, we gave the trust question portion of the survey to receivers while senders were making their decisions. Similarly, while receivers were making their decisions, a helper in the sender's room distributed and helped senders answer the trust questions. During all parts of the survey, the helper read aloud the questions and possible answers while participants marked their answers with an X on an answer form. The questions and answer choices were read several times, and further explanation was given if participants were still in doubt of the meaning of the questions and answers they were presented with.

The trust questions on the survey included a trust question taken from the General Social Survey (GSS). The GSS has been conducted yearly since 1972, and it has been used as source of data for studies on societal trends. The same trust question has been asked regularly since the survey was launched and this question has been used extensively to relate state trust with revealed trust measures (Capra et al., 2008; Gächter et al., 2004; Glaeser et al., 2000). In addition to this GSS trust question, we included a question regarding trust attitudes towards people in their villages. Both questions are listed below.

- Generally speaking, do you consider that most people can be trusted, or that you cannot be too careful in dealing with people?

  1 Most people can be trusted

  2 You cannot be too careful when dealing with people

- People in your village trust most people in your village.

  1 Strongly disagree

  2 Disagree

  3 Neither agree nor disagree

  4 Agree

  5 Strongly agree

The second part of the survey, conducted at the end of the activity, included questions on socioeconomic and demographic characteristics of participants in the trust game (Appendix S). After each participant finished the survey with a helper, they went individually to a separate private area to receive their earnings from the game, they were asked to leave the place quietly and to not to talk with other participants about the game and their earnings.

In the following sections we will present the results from the survey questions and the trust game. Note that the analysis focuses primarily on sender behavior (measure of trust) and not receiver behavior (measure of trustworthiness) because of the one shot nature of our experimental design.

3.4 Results

3.4.1 Subject characteristics

As shown in Table 9, on average, A4N and non-A4N subjects do not differ in most socioeconomic characteristics, implying that both A4N and non-A4N participants were drawn from the same population. However, the groups do differ in terms of gender. The A4N group is 29% men while the non A4N is 47% men. We sent invitations to a balanced proportion of men and women, however it turns out that more women showed up in the A4N villages in comparison to the non-A4N villages. The other significant difference between the groups was in terms of the percentage of subjects who stated they were members of a group or association (100% in the A4N group vs. 36% in the non A4N group). Of course, this difference was expected due to the fact that for the A4N group we recruited only subjects that had participated in an A4N group based intervention.

3.4.2 Stated trust questions.

As shown in Table 10, the answers to the GSS trust question indicate that participants in both treatments tend to think people in general cannot be trusted as only 10% and 13%, A4N and non A4N respectively, answer positively to the statement “most people can be trusted”, this level of

trust seems small, Etang, Fielding & Knowles (2012) report that in the world values survey for 1999-2002, 35% of Americans and 19% of Africans respondents answer that they consider "most people can be trusted". The difference between the two treatments is not statistically significant. In contrast, participants mostly agreed with the statement "most of the people in your village trust other village members" (91% of A4N and 84% of non A4N agree/strongly agree). Again, although the difference is in the expected direction (that is, participation in group based interventions increased stated perceptions of village level trust) and close to p-value=0.20, the difference between the two groups is not statistically significant. As such, with regard to stated levels, participation in group based interventions (as represented by the A4N groups here) does not appear to impact stated levels of trust significantly.

Table 9. Socioeconomic characteristics of A4N and non-A4N participants

Variable	A4N n=76		Non-A4N n=75		p value*
	Mean	Std. Dev.	Mean	Std. Dev.	
Group or association member	1.00	0.00	0.36	0.48	0.00
Age (years)	44	13	43	15	0.47
Male gender	29%	45%	47%	50%	0.02
Years lived in village	33	18	34	19	0.71
Education (years)	5.19	3.78	4.84	4.01	0.41
Household size (number of members)	5.11	2.21	4.97	2.09	0.85
Agricultural sales value C$ 2012	7650	5360	6940	5930	0.57
Cultivated land with maize and beans 2012 (Mz)	1.17	0.70	1.04	0.69	0.30

*p values are for test of equal proportions for binary variables, and for the Mann–Whitney U test
The exchange rate March 2012 was U$1=C$23.21

Table 10. Results: trust questions

Variable		A4N n=76 Mean	A4N n=76 Std. Dev.	Non-A4N n=75 Mean	Non-A4N n=75 Std. Dev.	p value*
General Social Survey question						
GSS_trust	Percentage of participants who answer most people can be trusted	10%	31%	13%	34%	*0.60*
Agreement with "people in your village trust most people in your village"						
VILL_trust	Percentage of participants who answer agree and strongly agree	91%	29%	84%	37%	*0.21*

*p values are for test of equal proportions for binary variables, and for the Mann–Whitney U test

Table 11. Results: trust experiment

Variable		A4N n=39 Mean	A4N n=39 Std. Dev.	Non-A4N n=38 Mean	Non-A4N n=38 Std. Dev.	p value*
Trust game results						
Amount sent P1 to P2	Amount sent in C$ of 2012	51.03	15.35	45.79	19.12	*0.10*
Proportion returned P1 to P2	Amount returned divided by amount sent multiplied by three plus initial endowment	0.32	0.12	0.35	0.14	*0.30*

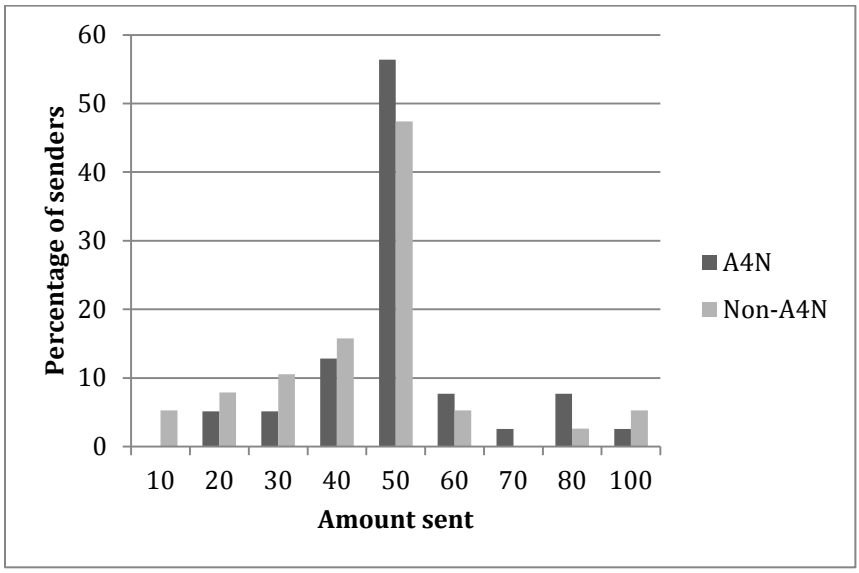
*p values are for test of equal proportions for binary variables, and for the Mann–Whitney U test
The exchange rate March 2012 was U$1=C$23.21

3.5 Trust experiment results.

3.5.1 Overall results.

In this section we first focus on the overall results from the trust game experiment. Recall that sender behavior (proportion of the endowment sent) in the trust game experiments is a revealed (as opposed to stated) measure of trust. As shown in Table 11, on average A4N senders sent more than non-A4N senders, and this difference is statistically significant at 10% level. The average amount sent by participants in the A4N treatment was C$51 (51% of their endowments), slightly higher than half of the endowment that was provided to them. A total of 56% of A4N senders sent half of their endowment to recipients (see Figure 3). Non-A4N senders sent on average C$46 (46%) while 47% sent half of their endowment to recipients. Also note in Figure 3 that higher proportions of non-A4N senders sent less than C$50, while higher percentages of A4N senders sent more than C$50 (except for those senders who sent 100%). In terms of proportion returned by receivers (frequently thought of as a measure of trustworthiness), we find no significant difference (see Table 11). A4N receivers returned on average 32% of their available resources, about C$80, and non-A4N receivers returned 35% or about C$84. The proportion sent and returned that we obtained are consistent with previous results, as pointed out by Alesina and La Ferrara (2002), who note that in most trust games the sender sends about half of their endowment and the receivers returned about 30% of what they received, more or less the same amount that was sent to them.

Figure 3. Percentage of senders by amount sent, A4N and non-A4N participants in the trust game



The exchange rate March 2012 was U$1=C$23.21

3.5.2 A4N vs. Non A4N group analysis.

In this section we begin to explore the impact of group membership (both A4N-based and non-A4N based) on trust levels via comparisons of unconditional means. We recognize that parsing the data like this leads to relatively small sample sizes, but we believe looking at the data this way allows us to illustrate some interesting characteristics and nuances in the data that may indicate interesting future research possibilities and considerations. The following section, (3.5.3), investigates the significance of these group effects in a more comprehensive multivariate analysis.

As shown in Table 12 (first row), there are non-A4N treatment participants that are also members of groups (36%) not associated with the A4N project. While we expect these groups to be different in terms of their impact on trust levels of members, we can investigate this directly

by comparing the proportion sent by non A4N subjects who indicate participation in a group, with the proportion sent by A4N subjects who all participated in A4N based groups. As shown in Table 12, non A4N in group subjects sent 43%, whereas A4N subjects sent 51% and this difference is significant with p=0.07, suggesting that A4N based groups (with their focus on group directed activities) may indeed be different in their impact on group member trust levels. Furthermore, as shown in table 24, the proportion sent by subjects not in a group (47%) is larger than the proportion sent by subjects in a non A4N group (43%) – the opposite of what would be expected if being in any type of group induces higher levels of trust. Finally, we can partially and indirectly address the selection bias problem (that is, that more trusting subjects in the A4N villages were the ones who decided to participate in the A4N group interventions) by noting that in the non A4N villages, the less trusting individuals (as measured by proportion sent) were members of groups.

Table 12. Group analysis

	A4N			Non-A4N			
	n	mean	sd	n	mean	sd	p-value*
Proportion sent (group)	39	0.51	0.15	12	0.43	0.18	*0.07*

	Proportion sent						
	Group			Non Group			
	n	mean	sd	n	mean	sd	p-value*
Pooled A4N and non-A4N	51	0.49	0.16	26	0.47	0.2	*0.61*
Only non A4N	12	0.43	0.18	26	0.47	0.2	*0.34*

*p values are for the Mann–Whitney U test for equal means.

3.5.3 Determinants of the proportion sent

In Table 13, we present the results for a set of multivariate regressions to explore determinants of the proportion sent in the trust game. The first regression (column 1), seeks to determine if socioeconomic characteristics of the senders are significant in explaining the proportion sent. We find that gender and education (level in years and its square) are statistically significant, whereas characteristics such as age, and years in the village are not. With regard to gender, we find that women are more trusting than men in that on average, men sent less than women (C$8.6 in regression 1). The evidence from the literature on gender and trust in experiments is not conclusive. Using trust experiments with undergraduate students, Buchan, Croson, & Solnick (2008), Schwieren & Sutter (2008), Bonein & Serra (2009) and Chaudhuri & Gangadharan (2007) have found that men act more trusting than women, whereas Capra, Lanier and Meer (2008) and Garbarino and Slonim (2009) find the opposite.

The impact of education on proportion sent is more complicated. The regression (1) suggests a decreasing relationship, at an increasing rate. Each additional year of education leads to less being sent (approximately C$4) but the squared term indicates that the more educated people are, the more they send – at a rate of C$0.2/year. This implies that at the average years of education (5 years), ceteris paribus, game participants send C$2 less than people with no education. Only after 9 years of education (5.3% of our participants) – almost double the average education of our sample – does the effect of education become positive. This result is consistent with Schechter (2007) who also finds a negative relationship between education and amount sent in Paraguay. However Etang, Fielding and Knowles (2011) find a significant positive effect between education and amount sent in Cameroon.

Regressions 2 and 3 add variables to explore the impact of group participation. Regression 2 simply adds a dummy variable for participation in the A4N group based interventions[7] while regression 3 adds a dummy variable for participation in group (A4N or not). As shown in table 25, and consistent with earlier results, participation in the A4N groups, while not statistically significant at traditional levels, borders on significant with a p-value of 0.15. Even after controlling for gender (and other socioeconomic characteristics), we still find that participation in A4N group interventions increases the proportion sent, albeit with lower significance. Given that women sent significantly more than men overall, some of the difference in proportion sent is driven by the higher percentage of women in the A4N sample.

While the revealed trust differences (as measured by trust game behavior) in this study are only weakly significant, another similar recent study by Etang, Fielding and Knowles (2011), found more significant increases in trust among long term self-directed ROSCA (savings and investment) group members. We suspect that the lack of strong significance in our study (relative to Etang, Fielding and Knowles, 2011) may be related to the fact that the A4N groups in our study are relatively young and therefore the process of enhancing trust is at an earlier stage of development.

[7] Since we do not have good instruments for these variables, we are not minimizing selection bias of our estimates, and if there are differences in unobservable characteristics between A4N and non-A4N our estimates could be bias.

Table 13. Determinants of the proportion sent

Dependent variable: proportion sent, n=77					
Independent variables	1	2	3	4	5
Age	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Gender (man=1)	-0.086**	-0.073*	-0.077*	-0.092**	-0.086*
	(0.043)	(0.042)	(0.044)	(0.043)	(0.043)
Years in village	0.001	0.001	0.001	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education	-0.043***	-0.046***	-0.042***	-0.045***	-0.043***
	(0.014)	(0.013)	(0.014)	(0.014)	(0.013)
Education square	0.002***	0.003***	0.002***	0.003***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
In A4N Group (Yes=1)		0.052~			
		(0.036)			
Group (non-A4N) (Yes=1)			-0.059		
			(0.055)		
GSS trust				0.05	
				(0.061)	
Village trust					-.000
					(0.041)
Constant	0.641***	0.625***	0.623***	0.632***	0.642***
	(0.120)	(0.122)	(0.120)	(0.123)	(0.122)
R^2	0.1663	0.1871	0.1910	0.1751	0.1663

***significant at 1% **significant at 5% *significant at 10% ~p-value=0.15
Robust standard error in parenthesis[8].
These regressions correspond to OLS results.

On the other hand, participation in a group (non-A4N), as represented by the Group variable in regression 3, is not statistically significant. Suggesting that the more trusting individuals are not

[8] We clustered standard errors at the village level. This procedure made standard errors smaller and variables such as in A4N group significant at 10% level. Due to the small sample size and small number of cluster, this procedure is probably not recommendable. We also conducted bootstrapping using wild bootstrap (Cameron, Gelbach, & Miller, 2008) procedure with 400 repetitions. The confidence intervals obtained were narrower and the p-values were very close to those obtained using OLS with robust standard errors.

necessarily the ones who join groups. Note that adding these group variables does not impact the sign or significance of the demographic variables relative to regression 1.

Regressions 4 and 5 explore whether subject answers to the stated trust questions can explain proportion sent at the individual level. Two variables, GSS trust (toward people in general) and Village trust (towards people in the same village), are added in regressions 4 and 5 respectively. While the village trust question results are consistent with the behavior in the trust experiment overall (that is, non A4N participants state lower levels of trust and send less), the answers do not appear to predict individual behavior given that neither variable is statistically significant. Participation in the A4N group based intervention does not lead to higher levels of stated trust (as measure by the survey questions) and that the answers do not explain behavior in the trust game. This is, however, consistent with previous findings in studies by Gatcher, Herrmann, & Thoni (2004), Capra, Lanier and Meer (2008) and Glaeser, Laibson, Sheinkman, & Soutter (2000).

3.6 Conclusion

Farmers involved in A4N group based interventions reveal different levels of trust than farmers who were not exposed to these interventions, as measured both by participation in a trust game and through survey questions. Initial analysis of the trust game data suggests that on average those participants in the A4N group based interventions sent a significantly higher proportion of their endowment. However, further multivariate analysis reveals that this difference is, in part, attributable to other characteristics such as gender, which has been shown to influence trust levels.

If group based interventions increase trust, then perhaps rural development projects should focus more attention on interventions that promote group formation given their potential to positively impact participant and village level welfare and agricultural incomes, which are primary goals of such intervention programs. In addition to confirming the positive impact of group-based interventions on trust, further research needs to investigate and quantify the significance (and to some extent the existence) of the link between increased trust levels and intervention goals such as increased income. This study highlights the emerging generalized link between group-based interventions, trust, and development outcomes and we consider it as an initial investigation to further explore this link in rural development projects. Finally, further research on the emerging generalized link between trust and productivity, could benefit from inclusion of baseline data (that is, pre intervention) and a better way to deal with potential selection bias.

If this emerging link between trust and development outcomes is confirmed and significant, we believe that the impact of group based interventions on trust should be considered more formally in development project design and, consequently, impact evaluations. In particular, in rural developing countries setting, where formal institutions are not yet developed and economic

activity relies on informal institutions, group participation is likely to increase localized opportunities in relatively smaller communities, facilitating network formation and information sharing. Furthermore, the enhanced cooperation and communication among individuals participating in groups, due to increased personalized trust should not only benefit participating individuals, but also their community as a whole. Overall, we believe that this paper illustrates the potential of focusing more formally on building trust and makes the case that the enhancement of trust among beneficiaries of rural development projects should potentially be considered a program strategy designed to achieve increases in agricultural income and household wealth.

Chapter 4 Conclusions

In this dissertation I use quasi-experimental panel data econometric methods and a field experiment to evaluate the economic impacts of a complex rural development project in Nicaragua. The research contributes to the literature on impact evaluation of pro-poor rural development projects with multiple interventions. The quasi-experimental panel data econometric approach is relevant for projects with a design that 1) exposes beneficiaries to more than one intervention at the same time, and 2) allows project beneficiaries to self-select into different project interventions. The field experiment offers a formal means to measure growth in trust among project beneficiaries, recognizing that community-level trust can reduce transactions costs and enhance economic development.

The panel data-based impact evaluation addresses the challenge of measuring the effectiveness of multiple project interventions over a relatively short period. Focusing sequentially on how beneficiaries must first change behavior (e.g., by adopting agricultural technologies and practices promoted by the project) that ultimately will lead to increases in agricultural income and household wealth. However, the timing of different interventions and their gestation to impact varies. The time elapsed to project impacts is shorter for some interventions (e.g. improved storage) than for others (e.g. construction of stone barriers) (Figure 2). Timing of project impacts should be considered for impact evaluation, otherwise results could be misleading (e.g. no project impacts on agricultural income), especially when the project is evaluated at an early stage of implementation (see Appendix M).

Adoption of improved agricultural technologies, such as investments in agricultural conservation structures and implementation of agricultural conservation practices, can lead to the stabilization of crop yields that would otherwise decline. Use of metallic silos for grain storage, growing vegetables in small gardens, and household savings accumulation, can increase cash income and reduce the risk of asset liquidation in times of food scarcity. Such behavioral changes can be expected to lead to increases in agricultural income and asset accumulation, if the adoption is successful and continues after the project ends.

The analysis conducted answered the question on whether the strategy of simultaneous promotion of more than one intervention was successful. The results suggest that indeed it was for some of the technologies and practices promoted. However, impacts differ by terciles of wealth, as measured by area of cultivated land. Households in the lower tercile were most active in adopting of conservation agricultural practices, savings and kitchen gardens, the middle tercile adopted the most postharvest management practices, and the middle and high terciles adopted the most construction of agricultural conservation structures.

The trust experiment shows that the benefits of the project are seen not only in the take up of the technologies and practices promoted, but also in the project strategy of promoting the new technologies to project beneficiaries. The formation of producer groups and saving groups is likely to have an impact in increasing the levels of trust within a village, and contribute to the sustainability of project impacts after the project ended. Results of the trust experiment suggest that the interaction among farmers in the same village increases personalized trust. Trust increases the odds that beneficiaries of the project keep working together towards common goals, mobilizing village resources towards the diffusion of attractive technologies, and incentivizing the formation of saving groups.

The results of the trust experiment reveal that group-based interventions lead to higher trust levels among participants. This group-based intervention approach to promoting adoption of technologies and use of better practices deserves further exploration in other settings. Due to the link between trust and economic development (Dearmon & Grier, 2009; Fafchamps, 2006; Horváth, n.d.), this strategy from rural development projects contributes not only to the diffusion of new and better technologies but also to accomplish long term goals of poverty reduction. Pro-poor rural development projects could employ this strategy for both purposes, to increase income and to increase trust levels. Project designers should consider not only this strategy but also the evaluation of its success via experimental economics methods.

In sum, this dissertation has tackled the impact evaluation of a rural development project considering the impacts on outcomes related with the adoption of technologies and practices promoted by the project and on outcomes related to the levels of trust among farmers from the same village. The results suggest that the project triggered changes in behavior related to agricultural and non-agricultural practices, and likely changes in trust levels that will likely translate into long-term outcomes such as increases in agricultural income and household wealth. The results also suggest ways to improve the design of complex rural development projects that promote more than one intervention at the same time by means of group-based interventions. Specifically, such projects should aim: 1) to target interventions to different groups of the population, to increase take up of interventions and adoption of promoted practices and technologies, and 2) to promote group-based interventions with the aim of increasing trust to further impact income. The results also suggest ways to improve impact evaluations. Impact evaluations of projects with group training around multiple interventions should: 1) account for

the varying time lapses to realize impacts of different interventions and 2) use experimental economics methods to estimate impacts on trust levels for project beneficiaries.

APPENDICES

Appendix A Study site description.

Nicaragua is one of the poorest countries in Latin America, with 46% of its total population below the poverty line and 15% in extreme poverty. Out of Nicaragua's total population, 68% live in rural areas characterize for high poverty rates. A total of 70% of rural households in Nicaragua are poor. Rural areas are also characterize for high levels of inequality, explained by the disparities in agricultural productivity between smallholder farmers and medium and large farmers (World Bank, 2008).

Nicaragua is characterized by severe malnutrition problems (World Bank, 2008). The staple foods in the study area are beans and maize. Fruits and vegetables are consumed sporadically. On special occasions, meat and other proteins are eaten, but not regularly. It is common for households in the area to experience food scarcity during the months of April to July. Farmers look for off farm labor income as their main coping strategy. The main sources of income are sales of staple crops and small animals.

The study site is located in the departments of Estelí, Jinotega and Matagalpa in the northwest of Nicaragua (see Figure A 1). The project conducted interventions in 44 communities located in eight municipalities in the study area. Its target was to serve 2,500 smallholder farmers.

Figure A 1. Map with location of study area.

Source: Google maps, 2013.

The biophysical setting is very diverse, depending on whether the communities are located in highlands or lowlands. Heavy rains, rocky soils and steep slopes characterize the former, while the lowlands are semi-arid with eroded soils. Traditional agricultural production practices prevail both in the lowlands and the highlands. There are two main rainy season periods for production

of crops, *primera* between May and August and *postrera*, between September and December. Staple crops, such as maize and beans, are produced in both. In the highlands, production of vegetables also takes place. Where irrigation is available, crops are grown in an additional season, *riego* or *apante*, between January and May, the dry months of the year.

According to the Census of 2005, Estelí, Jinotega and Matagalpa are characterized by high incidence of poverty, with 60% or more of its population with at least one unsatisfied basic need (Instituto Nacional de Información de Desarrollo, 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g, 2008h). Smallholdings of less than 10 *manzanas* (1 Mz = 1.73 acres) are prevalent, where farmers mostly tend annual crops and the breeds of small livestock (i.e., not cattle) (Instituto Nacional de Información de Desarrollo, 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g, 2008h).

Appendix B. The Agriculture for Basic (A4N) Needs Project.

The Agriculture for Basic Needs (A4N) project was a three year integrated rural development project implemented in four Central American countries – Guatemala, Honduras, El Salvador and Nicaragua – during August 2009- August 2012. It was managed by Catholic Relief Services (CRS) and implemented in the field by its partners, Caritas Jinotega, Caritas Matagalpa and the Foundation for Research and Rural Development (FIDER).

This research focuses in Nicaragua. The project identified as major problems diminishing productivity, declining incomes, hunger and unhealthy diets, and vulnerability to shocks. These problems were seen as the result of limited ability to innovate and adapt, low agricultural productivity and environmental degradation, limited access to financial services, limited access to markets for agricultural products, and weak community based organizations (Catholic Relief Services, Latin America and Caribbean Regional Office, 2009). To overcome these problems and constraints, the A4N program aimed to provide farmers with a set of five skills for achieving sustainable farm production and increased agricultural income. The skill sets and the interventions promoted (Catholic Relief Services, Latin America and Caribbean Regional Office, 2009) were as follows:

1. Group management: Participation on any of the following groups:
    - Saving and lending groups
    - Producer groups
    - Farmer innovation groups and farmer field schools
    - Water user committees and watershed management boards

2. Saving and lending: Participation on saving and lending groups.
3. Marketing: Training in marketing skills on farmer field schools and innovation groups.
4. Basic experimentation and innovation skills for accessing new technology: Participation in farmer innovation groups (CIALes), implementation of trial plots with improved varieties (high yielding, drought resistant) and bio-fortified varieties of maize and beans, improved farming practices, nutritious vegetable crops in kitchen gardens (cabbage, carrots, onion, tomatoes and green leafy vegetables).
5. Agricultural production and natural resource management skills: training on agricultural conservation practices and on construction of agricultural conservation structures, training on post-harvest management and storage practices, use of metallic silos for storage of grains, training on integrated pest management, training in small livestock management (husbandry, feed production, vaccination regimes, manure collection). Beekeeping and seed production.

The project provided beneficiaries with agricultural assets, such as metallic silos, construction material for animal enclosures, water harvesting structures, plastic water tanks and water filters, and small animals, such as poultry, pigs and goats. It also provided assets to groups of farmers and help with building and management of farmer cooperatives and farmers groups to facilitate access to agricultural inputs, building of grain milling facilities and provided inputs for seed producer and bee keeping groups. The project also conducted village level interventions such as provision of rural aqueducts, construction of water harvesting structures, and legalization of land property (this last item in partnership with local governments). In some cases the project also helped build irrigation systems that benefited groups of beneficiaries in the villages. However the village level and group level interventions were not implemented in all the villages and with all

the farmers groups. Household level project interventions promoting the 5 skills set were available for all eligible households participating in the project.

The strategy of the project was training farmer households on components of the five skill sets, instead of a deep training on each skill set. Participant farmers were trained in the promoted practices in farmer field schools and innovation groups. The project trained promoters from different villages and then these promoters replicated the knowledge at their villages. There also were producer groups involved with other activities of the project, such as seed production and bee keeping. The project also provided technical assistant to individual farmers, not necessarily involved with the producer groups. Group formation was not only used for promoting agricultural technology, but also to promote saving and lending groups. The project encouraged participants in producer groups and saving groups to participate in different project activities, producers group members were encourage to form saving groups, saving groups member were encourage to participate in marketing or agricultural related activities.

The A4N project first targeted villages considered poor, in terms of limited access to basic services such as water and sanitation, predominance of small land holdings and production of staple grains (maize and beans). These villages are located in areas of natural resource degradation with relatively high vulnerability to natural disasters. Within these villages, in order to be eligible to participate in the A4N program, households were expected to be characterized by most of the following official eligibility criteria:

- Cultivated land area less than two *manzanas* (1 Mz = 1.73 acres).
- Cultivated land on steep slopes.

- Lack of access to any of the following public services: piped water, sanitation, and electricity.
- Materials for house walls not brick or concrete; roof not concrete, zinc or brick; floor not concrete, ceramic or tile.
- Household experiences hunger during some period of the year.
- Household head is female.
- Household includes children younger than five years old.

In the particular case of the A4N program, project managers found it difficult to exclude the participation of village members who are not officially eligible, so the program allowed for technically ineligible individuals to participate in the hope that they would facilitate spreading the benefits of the interventions during and after program implementation.

Once in the program, participants could elect whether to participate in one or more of various program interventions. In the case of A4N program, the impact evaluation must account for potential selection bias from two sources—selection into the A4N project via official eligibility criteria and self-selection into specific A4N activities by A4N participants.

Appendix C. Impact evaluation methods.

C 1. The problem of impact evaluation

We approach program evaluation though Rubin's potential outcome framework (Rubin, 1974). The objective of program evaluation is to determine how the intervention or applied treatment affects a desired outcome, evaluating the treatment effect against a counterfactual. Participation of individual *I* in the project is referred to as a "treatment" given by w_i=1, so w_i=0 if the individual has not been exposed to treatment. The observed outcome for individual *I* is:

Equation C 1 $y_i = w_i y_{1i} + (1 - w_i) y_{0i}$

which means that the outcome for an individual who participates is y_{1i} and if she does not participate the outcome is y_{0i}. The treatment effect of the program intervention is

Equation C 2 $\tau_i = \Delta y_i = y_{1i} - y_{0i}$

But the resulting outcome attributable to a program cannot be observed in an individual participating and not participating in the program at the same time. Therefore, the problem of program evaluation is a problem of missing data, and the program effect cannot be calculated for the same individual, but instead requires constructing a counterfactual to calculate average treatment effects across individuals in (a sample from) the population.

The parameters of interest are the average treatment effect on the population, ATE, and the average treatment effect on the treated, ATT. The ATE is the difference between the expectation of the outcome with and without the program. For an individual, given a vector of characteristics **x,** it is:

Equation C 3 $ATE = E(\tau(\mathbf{x})) = E(y_1 \mid \mathbf{x}) - E(y_0 \mid \mathbf{x})$

ATE measures the effect of the treatment on both participants and non-participants. The average treatment effect on the treated, ATT, which is the expected value of the outcome for those who participated in the program, conditional on the individual characteristics that determine program participation, **x**:

Equation C 4 $ATT = E(\tau(\mathbf{x})) = E(y_1 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 1)$

As already mentioned, E(y_0|**x**, w=1), the expected outcome of the treated if they were not exposed to the treatment, cannot be observed directly, whereas we can observe E(y_0|**x**, w=0), the expected outcome of the untreated, given that they were not exposed to the treatment. We can define:

Equation C 5 $E(y_1 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 0) = E(y_0 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 0) + ATT$

Therefore,

Equation C 6 $ATT = E(y_1 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 0) + E(y_0 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 0)$

Subject to the assumption of no selection bias, in the absence of the program, those who participated in the program would have had equal outcomes to those who did not.

Equation C 7 $E(y_0 \mid \mathbf{x}, w = 1) - E(y_0 \mid \mathbf{x}, w = 0)$

When eligibility to participate in a program has been randomly assigned, outcomes are independent of treatment. As a result, the ATE and the ATT are the same, and we can estimate these parameters by simple differences in means.

However, if program eligibility has not been randomly assigned, but rather is granted conditional on a given set of individual characteristics, then selection bias occurs, and individuals exposed to the treatment will systematically differ from those not exposed to the treatment. Hence, program outcomes can confound these initial differences with the effects of program intervention, distorting the measure of the benefits from the program.

Selection bias is a consequence of the difference in characteristics between participants and non-participants. It causes ATE and ATT to differ. The researcher can observe some characteristics, such as housing features, land allocated to agricultural production, and topographical location of fields. Other characteristics are not observed by the researcher and can be assumed not to change over time, including such individual characteristics as motivation, cognitive learning ability, and attitudes towards innovation. Based on the observability of characteristics that underpin selection bias, methods are available to correct for it, allowing the researcher to closely approximate program impacts.

Two assumptions about program assignment mechanisms underlie the two major classes of quasi-experimental methods to correct for selection bias used in this research when conducting program evaluation (Imbens & Wooldridge, 2008). The first is that expected values of outcomes, y, conditional on covariates, $\mathbf{x}$, are independent of program assignment w. This is known as the conditional independence assumption, unconfoundedness or selection on observables. The second is that unobserved characteristics that affect selection are time invariant. This is referred

to as the selection on un-observables. The challenge is to correct for these two sources of selection bias when conducting impact evaluation, to estimate program impacts correcting for the two sources of selection bias mentioned above.

C 2. Overview of Program Evaluation methods

There exist different methods to conduct impact evaluation, for determining the treatment effects and to correct for selection bias. This section provides an overview of some of these methods.

Randomization has been implemented for the evaluation of anti-poverty programs in certain instances (N. Ashraf, Giné, & Karlan, 2009; Nava Ashraf, 2009; Banerjee, Cole, Duflo, & Linden, 2007; E. Duflo, Kremer, & Robinson, 2009; Kremer, 2003; Lai, Sadoulet, & de Janvry, 2011). The main feature of this method is to draw two random samples, a treatment group and a control group. Since individuals have been randomly assigned to the treatment and control groups, the mean expectations of outcomes on treatment effect will only depend on their exposure to the treatment. This way there is no selection bias to correct for (Esther Duflo, Glennerster, & Kremer, 2007).

Randomized experiments require the close participation of the organization that implements the program. As a result, these evaluations have been conducted with close involvement of governments and NGOs, since the method requires application of randomization in the project design. Randomization of exposure to treatments also implies that project participants who are used as controls do not benefit from the program that is being evaluated (Buddelmeyer & Skoufias, 2004; M. Ravallion & Chen, 2005). As a result, some organizations find randomization of exposure to treatment benefits to be ethically objectionable.

When experimental designs are not feasible, program evaluation can be designed using quasi-experimental methods. Among the methods that correct for selection bias on un-observables, an effective one is panel data regression analysis using difference in difference (DID) estimators. This approach uses a baseline survey and one or more follow up surveys. It calculates an impact estimate by comparing the sample data between program participants and non-participants, calculating the difference between the mean outcomes of each group before and after the intervention, and then calculating the difference between these two differences. By comparing differences between groups at different points in time, the procedure removes any bias related to unobservable common time trends.

When program placement is likely to be correlated with the outcome variable or with the characteristics of the program participants, another method that is used is the instrumental variable (IV) method. This method consists of using a variable or variables that are correlated with program placement but not correlated with unobservable characteristics of program participants, thereby correcting for endogeneity or bias on unobservables.

Propensity score matching (PSM) and regression discontinuity design (RDD) are two of the quasi-experimental methods that can be used to correct for selection bias on observable characteristics. For PSM the characteristics of the comparison group (individuals not participating in the program) prior to program interventions are used to determine their probability of participating in the program. Therefore, eligibility for program participation becomes an exogenous variable. The propensity score, the estimated probability of being selected for program participation, is used to match members of the comparison group and with members of the treatment group and to estimate impacts as the difference in outcomes between these two groups.

For RDD, program participants are chosen according to a threshold value for a given characteristic that determines program eligibility. This method is employed to select a comparison group with similar characteristics to the ones of the treated. This could be accomplished by a sharp regression discontinuity design, where the assignment is a deterministic function of the covariate used for selecting program participants, or by fuzzy regression discontinuity design, where the probability of being eligible does not necessarily have to change from zero to one at the threshold, producing a jump on the probability distribution between participants and not participants. Both RDD and PSM are used when there is cross sectional data available for the treatment and the comparison group to conduct the evaluation.

The A4N program did not assign participants randomly. Rather, it focused on benefiting poor smallholder farmers, who were selected by the program managers. Purposive selection of potential participants took place with the participation of municipality officials and community leaders, elaborated lists of households who complied with program eligibility criteria (specified in the program description). These farmers were invited to meetings at their communities where the program was presented, after which they decide whether to participate in specific program interventions. In the language of program evaluation, they self-selected into program interventions of interest based on characteristics that are likely to be unobservable, such as personal motivation.

For the impact evaluation of the A4N project, we use two sets of methods based on different assumptions. We use regression based methods and propensity score methods to control for observable characteristics and time invariant unobservable characteristics. The methods used are described in the next section.

C 3. Methods used to estimate project impacts

To estimate a program impact on intermediate outcomes related to adoption of agricultural technologies and practices, I apply panel data econometric methods, beginning with regression using the difference in difference (DID) estimator. DID is a traditional regression method for impact assessment. With panel data, this method can be used to estimate the ATE, based in the assumption that unobserved differences between participants and non-participants are invariant in time. Examples of such traits include individual characteristics, like motivation and cognitive ability.. I compare the results from simple DID to those from four methods that attempt to correct for selection bias based on observables: three forms of PSM-DID (using different matching methods), and PSW to check for robustness. These methods estimate the ATT, based in the conditional independence assumption that outcomes are independent of the treatment when conditioned on a set of observable characteristics. The theory behind these five methods is set forth below.

C.3.1. Regression based methods:

Following Wooldridge (2010), assuming a linear relation between the outcome variable, the unobserved heterogeneity and the covariates or characteristics of the households, we can write:

Equation C 8 $y_{it} = \beta_0 + \tau w_{it} + \boldsymbol{\beta}\mathbf{x}_{it} + c_i + u_{it}$

Where *y* indicates the outcome variable, w is a binary variable that indicates participation in the project, and **x** is a matrix of time varying covariates, c is the unobserved heterogeneity and *u* is the error term. By taking the difference we removed time invariant unobservable characteristics c_i. Then obtaining the first difference between periods t and t-1, the unobservable characteristics,

assumed invariant in time are eliminated, correcting for this source of bias on the program impact estimation. The difference in difference estimation equation could be written as (Wooldridge, 2010):

Equation C 9 $$\Delta y_{it} = \alpha_0 + \tau w_{it} + \boldsymbol{\beta}\Delta \mathbf{x}_{it} + \Delta u_{it}$$

where $\Delta y_{it}=y_{it}-y_{it-1}$, $\Delta \mathbf{x}_{it}=\mathbf{x}_{it}-\mathbf{x}_{it-1}$ and $\Delta u_{it}=u_{it}-u_{it-1}$. With two time periods it does not matter if we difference *w*, since participation in the program will be 0 for all the observations in the first time period, and will take values 0 and 1 depending on whether it is a comparison or a treatment observation. We obtain the program impact by the regression of the change in the outcome variable *y* the project participation variable *w*, and the change in a set of time varying covariates *x*. The first difference equation will be consistent if $E(\Delta \mathbf{x}_{it}'\Delta u_{it})=0$. The parameter of interest is τ.

The difference in difference estimator assumes parallel trends for both treatment and control in the absence of the treatment (Abadie, 2005). Therefore, correcting for differences between the two groups requires controlling for covariates related to household characteristics (Abadie, 2005). To take care of possible differences of covariates between treatment and control, include some time varying household characteristics as in Equation C 9, and use DID for estimating program impacts.

C.3.2. Propensity Score based methods.

The main assumptions for estimating the impact of the program are for constructing the counterfactual using propensity score matching are:

1) Unconfoundedness:

   Equation C 10 $y_0, y_1 \perp w \mid \mathbf{x}$

   where y_0 is the outcome for non-participants and y_1 is the outcome for participants, w is participation and **x** represents a set of variables that may influence participation. The sign $\perp$, denoting orthogonality, means that program outcomes are independent of program participation, conditional on **x**.

2) Mathematically, there is common support (overlap) between the probability distributions of program participants and non-participants (Caliendo & Kopeinig, 2008; Imbens & Wooldridge, 2008; Martin Ravallion, 2008)**:**

   Equation C 11 $0 < \Pr(w = 1 \mid \mathbf{x}) < 1$

Propensity score matching (PSM) consists of choosing the comparison group according to the probability of being selected for a treatment, given a set of observable pre-treatment characteristics and outcome values that do not change with program intervention but that affect program placement. The expected probability of program participation is

Equation C 12 $\Pr(w = 1 \mid \mathbf{x}) = G(\mathbf{x}\boldsymbol{\beta})$

Here, $0 < G(\mathbf{x}\boldsymbol{\beta}) < 1$, G refers to the probability distribution function, where **x** represents a vector of explanatory variables and $\boldsymbol{\beta}$ is a parameter vector. In this case, the explanatory variables refer to program eligibility criteria, household characteristics, village characteristics,

farm characteristics, and wealth. Including a rich set of variables that determine both participation in the project and pretreatment outcomes reduces bias in estimates (J.J. Heckman, Ichimura, Smith, & Todd, 1998) .

With these estimated probabilities we check for the overlap of the probability distributions of selection into the two groups, by plotting the estimated probability distributions of the treated and comparison groups. Overlap is crucial to be able to implement propensity score based methods, the failure of this assumption is a major source of bias in impact evaluation estimates, basically because the counterfactual is not similar to the treatment group to conduct valid comparison. In addition we trim the observations with an estimated PS above 0.90 and below 0.10 to improve overlap. With this trimmed sample we re-estimate the PS and conduct matching.

We conduct balancing tests to check for the similarity of the marginal distributions of the covariates used to estimate the PS. The tests aim to determine whether the matching procedures have served the purpose of making participants and non-participant groups more similar. Covariates are compared via a measure of standardized bias or normalized differences in means defined as follows (Caliendo & Kopeinig, 2008; Wooldridge, 2010):

Equation C 13 $$normdiff = \frac{\bar{x}_{1j} - \bar{x}_{0j}}{\sqrt{s_{1j}^2 - s_{0j}^2}} * 100$$

on the numerator of the expression we have the sample averages for x_1 and x_0 of variable j for the groups of participants (1) and non-participants (0), and s_1 and s_0 are estimated standard errors for variable j for participants and non-participants. An absolute value of percent bias above 25 is typically interpreted to mean that the two groups are not similar by those covariates (Wooldridge, 2010). We also conducted two-sample t-tests for equal means. The advantage of

the standardized difference of means with respect to the t-test, is that the former does not depend on the sample size. We compare these bias measures before and after matching.

To estimate the ATT we match participants to non-participants using the estimated propensity scores using four different matching methods. We use two kernel estimators (Epanechnikov and normal or Guassian with bandwith 0.06), local linear regression (tricube kernel and bandwith 0.8), and nearest neighbor (NN) with replacement. Bootstrapped standard errors are calculated for all four matching estimates to compare the sensitivity of estimates to different matching methods (Abadie & Imbens, 2008).

Kernel and local linear regression (LLR) are non-parametric matching methods. Kernel matching uses a weighted average of all the observations in the comparison group to construct the counterfactual outcome for each treated observation, whereas LLR estimates a nonparametric locally weighted regression using for comparison observations in the neighborhood of the treated ones (Smith & Todd, 2005). The weights depend on the type of kernel function chosen. An advantage of kernel and LLR matching methods is that they reduce the variance of the estimates by using more information. However, a problem arises if there is insufficient overlap between the distributions of the treated and comparison groups, as poor matches may be used for comparison, resulting in biased estimates.

Nearest neighbor matching with replacement consists of matching each treated observation with one or more having the nearest value of estimated propensity score, so a control observation may be used more than once. When using more than one NN, the estimator constructs a counterfactual mean with the closest comparison observations. Matching with replacement using more than one NN reduces bias in the estimates but increases its variance (Caliendo & Kopeinig,

2008; Smith & Todd, 2005). Unlike kernel and LLR methods, NN matched observations all have the same weight. NN matching tends to work best with a large sample of comparison observations to match treated ones with.

Propensity score matching assumes that after controlling for observable characteristics, outcomes are mean independent of participation in the program. But it is likely that there are systematic differences in outcomes for participants and non-participants due to unobservable characteristics, known as bias on unobservables. Assuming that unobserved heterogeneity is time invariant and uncorrelated with treatment assignment, we can control for this source of bias using the PSM-DID matching estimator, defined by Smith and Todd (2005).

Smith and Todd (2005) compared longitudinal methods with cross-sectional PSM methods and found that PSM-DID perform best in correcting for selection bias, when compared with experimental results. By using the PSM-DID estimator we control for both observable sources of bias by building our comparison groups using PSM and time invariant characteristics, by taking the difference of outcomes before and after treatment.

As an additional robustness check, we compare the matching estimates with the propensity score weighted (PSW) regression (Wooldridge, 2010), basically using the DID estimator weighting the regression by the PS.

Appendix D. Sample design and data collection.

The panel data set consists of survey data covering the 2008-2009 crop year, collected during June to August 2010, and a follow up survey of the same households covering the 2010-2011 crop year, collected during February to March 2012. Both rounds of the survey asked respondents to recall their agricultural activities and assets during the previous year. Although the project started in August 2009, the baseline survey asked about asset ownership at the start of 2009 and about activities during the *apante*, *primera* and *postrera* crop seasons, the last of which ended before the project began. Hence, the baseline dataset covers management and outcomes that were determined before the A4N project began. The data for 2011 corresponds to recall data during the project's second year. One problem with recall data is that as more time elapses, what respondents remember can be biased. In particular, information on consumption diminishes the longer the time of recall (Deaton, 2009). It seems that this problem is less significant with other information, such as agricultural production and household assets. Since the period of recall is about one year, recall bias on the information reported is believed not to be severe; farmers participating on the survey felt able to recall the information requested.

The sample includes 30 treatment (A4N) villages, randomly selected from the list of 44 villages where the project was active, and 33 comparison (non-A4N) villages that were randomly selected from a list of 40 villages similar to the treatment ones. The statistical primary sampling units (PSU) are the villages. Data was collected for 10 households in each A4N village and between 10 and 15 households in each non-A4N village. Lists of beneficiary households in the A4N villages were obtained from the project staff in Nicaragua. Since the project began in

August 2009 and the baseline survey took place in July 2010, A4N provided us with the list of treated households. We found no eligible households in the treated villages that were not listed in the beneficiaries list. From the lists of households, those with cultivated land holdings between 0.25 and 4 *manzanas* (1 Mz = 1.73 acres) were chosen and randomly ordered for the survey. We collected a sample of the population with access to land, because we were interested in the interventions that promoted agricultural activities.

For the baseline survey, the target sample size was of 700 households, with 300 treated households and 400 comparison households, enough to permit anticipated attrition without compromising subsequent statistical analyses. The sample included 100 more non-A4N households than A4N households, anticipating the trimming of observations that is carried out when conducting propensity score matching (see Table D 1).

In constructing a balanced panel, with observations for the two time periods on the same households, failure to collecting data on the same household in both periods of time (attrition) was likely. Reasons include migration or refusal to participate again in the survey.

Some attrition is inevitable and should be factored into planning sample size. For this survey a probable attrition rate of 10% was expected. In developed countries, attrition rates between the first and the second year of household surveys have been found to be between 12% and 15%, but the rate is assumed to be lower for developing countries (Deaton, 1997).

Table D 1. Sample Size for the A4N project evaluation in Nicaragua

	A4N	Non A4N	TOTAL
Villages	30	33	63
Households	10	10 or 15*	
Total households	300	400	700

*According to village size.

The number of villages surveyed in the eight A4N municipalities is proportional to the population weight of each municipality in the total. Using a projection of the population to 2010, from the Nicaragua Census 2005 (Instituto Nacional de Información de Desarrollo, 2008a, 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g, 2008h), the distribution of A4N villages per municipality obtained is shown in Table D 2.

Table D 2. Population weights used in sample design.

Municipality	Estimated A4N population 2010	Population weights	A4N villages per municipality	Non A4N villages per municipality
Estelí	1590	9%	3	5
La Trinidad	4152	25%	8	10
San Nicolás	822	5%	1	1
Jinotega	5291	31%	9	6
San Rafael del Norte	673	4%	1	4
Esquipulas	2916	17%	5	4
Terrabona	455	3%	1	1
San Isidro	1037	6%	2	2
Total	**16935**	**100%**	**30**	**33**

Source: Instituto Nacional de Información de Desarrollo (2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g, 2008h).

To compare A4N and non-A4N villages information on total population, number of households, access to public services (water, electricity and sanitation), proportion of agricultural units growing staple grains, and proportion of agricultural units with less than 10 Mz was compared for treated and comparison villages using t-tests for equal means (using a t-test based on samples of unequal variance). The results suggest that hypotheses of equal mean traits between of villages could not be rejected (Table D 3).

Table D 3. Test for equal means for treatment and comparison villages.

	Sample Average			
Variables	**Treatment**	**Comparison**	**Difference**	**p-value***
Population 2005	530	430	98	0.54
Number of households 2005	104	84	19	0.49
% inadequate housing 2005	53%	58%	-6%	0.24
% no electricity 2005	57%	56%	2%	0.83
% no potable water 2005	59%	66%	-7%	0.34
% staple grains 2003	87%	84%	3%	0.53
% landholding<10Mz 2003	50%	58%	-8%	0.14

*for t-test with unequal variance
Source: Instituto Nacional de Información de Desarrollo (2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g).

The non A4N villages were selected to meet two criteria: 1) they are located in the same agricultural zones as the A4N villages (Nitlapan, 2001), and 2) they are located in areas with similar poverty levels (Instituto Nacional de Información de Desarrollo, 2008a, 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g, 2008h). A list of 45 proposed similar villages was vetted with the A4N management team in Nicaragua. They recommended the elimination of villages they considered ineligible for A4N, because of poverty levels, access to water for irrigation and main economic activities different than agriculture. In order to develop lists of non A4N farm households comparable to the A4N households, we hired field officers to visit the villages and elaborate lists of qualifying households, based on farm size (0.25 to 4 Mz), whether the farmers

grew basic grains on 2009, whether household head was female, and whether the household had access to public water and electricity and included children younger than 5 years old.

Data was collected via surveys at both the household level and the village level. The first household survey included a total of 302 households in 30 treatment villages and 366 households in 33 comparison villages. After an analysis of the baseline data, 41 comparison observations were excluded for being considered as invalid comparisons (Peralta, Swinton, & Maredia, 2011), and 8 observations (treatment and comparison) were excluded as extreme cases with more than 40 Mz of cultivated land. We aimed to follow up on all 619 households for the 2012 return survey. However, only 578 households could be reached for the follow-up, resulting in an abandonment rate of 7% (41 observations). In some cases the household members migrated to work in other areas of the country or moved to another village, but we could not learn the new location; in a few cases they just did not want to participate again in the survey. We did not find systematic reasons to consider attrition a problem.

Moreover, the characteristics of the original sample of 619 observations did not differ from the final sample with 578 observations (excluding the 41 households with incomplete data) (Sherman, 2000). Table D 4 shows the descriptive statistics for several household and village characteristics in 2009 for the original and the final sample of households[9]. The p-values for t-tests for equal means suggest that the two samples are not statistically different. We can conclude that there is not a problem of attrition.

[9] We were not able to estimate the probability of abandoning the sample, since the number of observations with positive outcome was only 41 in comparison with 578 negative outcomes.

Table D 4. Comparison between households in the original sample and households in the reduced final sample due to attrition, 2009.

	Original sample n=619		Final sample n=578			
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Difference**	**p-value***
Household Head characteristics:						
Female=1	0.14	0.34	0.14	0.34	0.00	0.96
Age (years)	48.48	15.07	48.52	14.94	-0.04	0.97
Education (years)	2.95	2.76	2.93	2.65	0.02	0.89
Household Characteristics:						
Farm gross margins C$	6,641	33,319	6,646	34,105	-4.35	1.00
Experienced hunger=1	0.36	0.48	0.35	0.48	0.01	0.79
Experienced crop losses=1	0.82	0.38	0.82	0.38	0.00	0.98
Experienced stored grain losses=1	0.34	0.47	0.33	0.47	0.01	0.84
Household size (persons)	5.23	2.30	5.28	2.27	-0.05	0.72
Inadequate housing=1	0.85	0.35	0.86	0.34	-0.01	0.67
Overcrowding=1	0.51	0.50	0.52	0.50	-0.01	0.86
Inadequate services=1	0.73	0.44	0.73	0.45	0.01	0.74
Dependency ratio	0.74	0.71	0.74	0.71	0.00	0.91
Farm Characteristics:						
Cultivated land (Mz)	3.39	3.54	3.40	3.41	0.00	0.99
Steep slope=1	0.32	0.47	0.32	0.47	0.00	1.00
Value of productive assets:						
Infrastructure (C$/1000)	1.22	7.24	1.19	7.38	0.03	0.94
Equipment (C$/1000)	3.35	8.77	3.39	8.93	-0.04	0.94
Livestock (C$/1000)	9.52	18.11	9.31	16.00	0.21	0.83
Village Characteristics:						
Distance to market (Km/10)	1.51	0.85	1.52	0.84	-0.01	0.80
Distance to paved road (Km/10)	0.92	0.91	0.92	0.92	-0.01	0.89
Population 2009	640	561	639	562	0.91	0.98
Public school=1	0.97	0.16	0.98	0.15	0.00	0.72
Health facility=1	0.25	0.43	0.25	0.43	0.00	0.87
Farms producing basic grains 2003 (percentage)	0.56	0.22	0.55	0.22	0.00	0.83
Landholdings less than 10Mz 2003 (percentage)	0.86	0.18	0.87	0.17	-0.01	0.56

*Corresponds to p-value for a t-test for equal means.
Source: Agriculture for Basic Needs Survey, 2010.

The final distribution of the sample of 578 households, 282 households in 30 treatment villages and 294 households in 30 control villages can be found in Table D 5.

Table D 5. Number of observations collected by village and municipality.

	Treatment		Comparison	
Municipality	**Village**	**Freq**	**Village**	**Freq**
Jinotega	Chaguite Grande	9	Corral de Piedra	10
	El Mojón	10	El Cacao	13
	Hermita de Saraguasca	10	El Yankee	13
	San Antonio de Sisle	9	Las Lomas	9
	San Gregorio	10	Mancotal	11
	Saraguasca	10	Tomatoya	12
	Sasle	10		
	Sisle 1	9		
	Sisle 2	9		
	Total	86	Total	68
San Rafael del Norte	Los Horcones	10	Los Encuentros de San Gabriel	8
			Los Potrerillo	10
			Sacaclí	11
			Santa Barbara	10
	Total	10	Total	39
San Isidro	El Llano Boqueron	9	Wiston Castillo	9
	San Ramon de las Uvas	9	El Carrizal	8
	Total	18	Total	17
Esquipulas	Coscuilo	10	El Castillo	9
	El Barro	10	El Zapotal	14
	La Enea	9	La Sirena	9
	Pita Abajo	10		
	Pita Arriba	9		
	Total	48	Total	32
Terrabona	San José	9	El Arado	7
	Total	9	Total	7

Table D 5. (cont'd)

	Treatment		Comparison	
Municipality	**Village**	**Freq**	**Village**	**Freq**
Estelí	El Espinal	12	El Quebracho	10
	Las Cuevas	10	Isiquí	7
	San Antonio	10	Llano Redondo	14
			Llanos de Colon	10
	Total	32	Total	41
La Trinidad	El Hornillo	10	Cebadilla	10
	La Concepcion	9	La Laguna	4
	Las Cañadas	7	Las Lajas	14
	Las Tablas	9	Las Pencas	14
	Mechapa	10	Llano Largo	8
	Pacaya	6	Mesa de los Espejos	6
	Rosario Abajo	8	San Jose de Guasimal	7
	Tomabú	10	San Lorenzo	12
	Total	69	Total	75
San Nicolas	Quebrada De Agua	10	Cuajiniquil	8
			Las Puertas	7
	Total	10	Total	15
	Grand total	282		294

Source: A4N Household Survey 2010 and 2012.

Appendix E. List of data collected with the household and village survey instruments.

Household survey:

Information was collected on:

At the household level

- Housing characteristics
- Off farm income sources: remittances, off farm labor, small business.
- Food scarcity
- Non-farm assets
- Farm equipment
- Farm infrastructures
- Livestock inventory
- Livestock products, sales and costs
- Production from disperse trees
- Land use
- Crop losses
- Post-harvest management practices
- Total costs of agricultural production: agricultural inputs including hired labor.
- Credit and saving
- Participation in rural development projects

Individual level

- Household member characteristics: age, gender, education, main economic activity, participation in groups.

Plot level:

- Land ownership
- Sharecrop arrangements
- Plot characteristics
- Use of agricultural conservation practices, agricultural conservation structures
- Access to irrigation
- Agricultural production per season
- Farm garden
- Plantations
- Planting materials use in the plot

Village level survey:

- Population
- Infrastructure: transportation, distance to paved road and market
- Access to water, sanitation, electricity, education and health
- Main agricultural products prices
- Livestock prices
- Rural development projects

Appendix F. Household survey instrument for the A4N impact evaluation panel.

Statement of Consent

Program Participation, Economic Impact, and Agricultural Practices among Nicaraguan Smallholder Farmers

We are conducting a research study to understand how agricultural practices and projects affect farm incomes in western Nicaragua. The study is conducted by Michigan State University and Nitlapan at the Universidad Centroamericana with funding from Catholic Relief Services. I would like to ask you questions about your farm activities as well as your participation in agricultural projects. I would also like to look at your house, crop fields and your farm, both today and again after two years.

Your participation in the survey is voluntary, so you are free not to participate at all and you may terminate the interview at any time with no penalty. However, I want to encourage you to participate. By learning about how agricultural practices on farms like yours contribute to your income and welfare, our study aims to inform the design of future agricultural development projects. This survey will take two hours and I will be taking note of your answers.

Although you will not directly benefit from your participation in this study, however, the lessons from it may help in designing better agricultural projects and we know of no risks associated with this study. Your privacy will be protected to the maximum extent allowable by law. All the information you provide us will be kept confidential, with the questionnaire identification sheets locked in a cabinet at Michigan State University for three years after the research is completed. This means that no one except the researchers and the MSU Human Research Protection Program will have access to your answers. We will not identify you or your household in any publication from this study.

If you have any questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact Professor Scott Swinton by email (swintons@msu.edu), by telephone at (1) 517-353-7218, or by postal mail at Michigan State University, East Lansing, MI 48824-1039, USA. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 207 Olds Hall, Michigan State University, East Lansing, MI 48824.

You indicate your voluntary agreement to participate by beginning this interview. Thank you again for your help with this important research about agricultural welfare.

Questionnaire:

Program Participation, Economic Impact, and Agricultural Practices among Nicaraguan Smallholder Farmers -2011

No.

Cover page to be removed.

Stratum: **( ) 1. Participant** **( ) 0. Non -participant**

Cover page

Name of household head: _____

Name of respondent: _____

Address: _____

Phone number: _____

Date: _____

Department: _____

Municipality: _____

Community: _____

Read consent script before begin.

Write questionnaire number again:

No.

Questionnaire:

Program Participation, Economic Impact, and Agricultural Practices among Nicaraguan Smallholder Farmers -2011

Stratum: ( ) 1. Participant ( ) 0. Non-participant

1. General information

1.1 Enumerator name: _____
1.2 Supervisor name: _____

1.8 Relationship of respondent with household head (mark with an X):

[ ] 1 Head
[ ] 2 Spouse
[ ] 3 Son/daughter
[ ] 4 Father/mother
[ ] 5 Brother/sister
[ ] 6 Grandson/granddaughter
[ ] 8 Son in law/daughter in law
[ ] 9 Brother in law/sister in law
[ ] 10 Non relative
[ ] 99 Other, specify: _____

2. Household and housing characteristics:

Answer questions from 2.1 to 2.3 by observation; please mark the answer with an X

2.1 House predominant walls material:

[ ] 1 Adobe
[ ] 2 Wood
[ ] 3 “Minifalda”
[ ] 4 Concrete
[ ] 5 “Playcem”
[ ] 6 Plastic
[ ] 7 Bricks
[ ] 8 Carrizo
[ ] 9 Blocks
[ ] 10 Stones and dirt
[ ] 11 Stone, dirt and bamboo
[ ] 12 Zinc
[ ] 13 Bamboo
[ ] 99 Other, specify _____

2.2 House predominant roof material:

[ ] 1 Thatch
[ ] 2 Zinc
[ ] 3 Tile
[ ] 4 Plastic
[ ] 5 “Nicalit”
[ ] 99 Other, specify _____

2.3 House predominant floor material:

[ ] 1 Dirt
[ ] 2 Wood
[ ] 3 Concrete
[ ] 4 Bricks
[ ] 99 Other, specify _____

3. Household members characteristics:

Now we are going to talk about your household members at January 1st of 2012:
A household if formed by people who share food from the same pot or who share food expenses.

Family i.d.	First name	Relationship with household head	Gender	Age	Years of education (Maximum level attained)	What did the person do most of the time in 2011?	Group or association the person was part of in 2011(multiple answers)		
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C9**	**C10**	**C11**	**C12** (99)
1									
2									
3									
4									
5									
6									

The codes for each variable are in the next page.

Family i.d.	First name	Relationship with household head	Gender	Age	Years of education (Maximum level attained)	What did the person do most of the time in 2011?	Group or association the person was part of in 2011(multiple answers)
HH (This i.d. will be used throughout this questionnaire to identify the household member)	(Without last name) Identify household members according to their closeness to the household head, like this: head, spouse, son or daughter, other relatives of household head, non relatives	Write code 1 Head 2 Spouse 3 Son/daughter 4 Father/mother 5 Brother/sister 6 Grandson/ Granddaughter 8 Son /daughter in law 9 Brother /sister in law 11 Step son/daughter 18 Non relative 99 Other, specify	Write code: 0 Male 1Female	(In years) (Use 0 if it is someone younger than 1 year old)	0 Pre-school 1-6 Elementary 7-11 Secondary 12-16 University 17 Professional 20 Adult education 21 Literate 22 Illiterate 99 Other, specify 999 Does not apply	Write code: 1 Work in own farm 2 Agricultural worker 3 Non agricultural worker 4 Professional 5 Own business 6 Study/attending school 7 Housewife 99 Other, specify 999 Does not apply	Write code: 0 None 1 Producers group 2 Marketing group 3 Savings group 4 Women group 5 Youth group 6 Church group 7 Watershed committee) 8 Community council 9 Health brigade 11 Sports or team 12 Political organization 13 School committee 99 Other, specify 999 Does not apply

4 Migration

4.1 In 2011 did you or any of your household members *migrate temporarily* to other region of Nicaragua or overseas for work? [ ] 1 Yes [ ] 0 No If the answer is No, continue with 4.2.

CF	First name (Without last name)	Where did the person go? Write code 1.Managua 2. Inside the department 3. Outside the department 4. Costa Rica. 5. Mexico 6. Other Central American country 7. USA 99. Other, specify	How long was the person there?	What did the person do?	During 2011 how much was the person contribution to the household? Write code: 1. US$ 0-100 2. US$ 101-200 4. US$ 201-300 5. US$ 301-400 6. US$ 401 – 500 7. US$ 501-1000 8. US$ 1001 or more 9. Did not contribute
C1	C2	C3	C4	C5	C6

4.2 Did any relatives or others who are not members of your household send money to you or any member of your household during 2011?

[ ] 1 Yes [ ] 0 No If the answer is No, continue with 5.1

Name of person who sends money (First name without last name)	Where is […] now? Write code: 1.Managua 2. Inside the department 3.Outside the department 4.Costa Rica. 5. Mexico 6. Other Central American country 7. USA 99. Other, specify	How much did you receive from this person in 2011? Write code: 1. US$ 0-100 2. US$ 101-200 4. US$ 201-300 5. US$ 301-400 6. US$ 401 – 500 7. US$ 501-1000 8. US$ 1001 or more
C1	C2	C3

5 Other income

5.1 During 2011, did you or any of your household members have a ***permanent job*** outside the household farm?

[ ] 1 Yes [ ] 0 No If the answer is No, continue with 5.2

CF	**First name (without last name)**	Activity	How many days did the person work on average a month?	During which months did the person work in 2011	Whole year 1 Yes	How much did the person make per month on average? C$
C1	C2	C3	C4	C5	C6	C7
				1 2 3 4 5 6 7 8 9 10 11 12		
				1 2 3 4 5 6 7 8 9 10 11 12		
				1 2 3 4 5 6 7 8 9 10 11 12		
				1 2 3 4 5 6 7 8 9 10 11 12		
				1 2 3 4 5 6 7 8 9 10 11 12		

5.2 During 2011, did you or any of your household members have a ***temporary job*** outside the household farm?

[ ] 1 Yes [ ] 0 No If the answer is No, continue with 5.3

CF	**First name (Without last name)**	Activity	How many days per month did the person work in 2011, on average?													How much did the person make per day, on average **C$**
C1	C2	C3	C4	C5												C6
			Month	1	2	3	4	5	6	7	8	9	10	11	12	
			#Days													
			Month	1	2	3	4	5	6	7	8	9	10	11	12	
			#Days													
			Month	1	2	3	4	5	6	7	8	9	10	11	12	
			#Days													
			Month	1	2	3	4	5	6	7	8	9	10	11	12	
			#Days													

Own business

5.3 In 2011, did you or any of your household members work self-employed or in their own business ***individually***?

[ ] 1 Yes [ ] 0 No If the answer is No, continue with 5.3a

CF	**First name (Without last name)**	Type of Business/ activity See code	Name of Business/ activity	How many days a month did you run this Business?	During which months of 2011 did you run this Business?	On average, when you run this Business/activity; what are your:	
						Gross revenue *C$*	Global costs *C$*
C1	C2	C3	C4	C5	C6	C7	C8
					1 2 3 4 5 6 7 8 9 10 11 12		
					1 2 3 4 5 6 7 8 9 10 11 12		
					1 2 3 4 5 6 7 8 9 10 11 12		
					1 2 3 4 5 6 7 8 9 10 11 12		

Write code:

1. **TRADE**: Activities that imply the resale of products of any kind. The person does not transform inputs to get the products, just buys and sells a finished product. For example: miscellaneous store, food stores, clothes stores, hardware, etc.
2. **SERVICES**: Activities that imply offering services within the community, such as miscellaneous repair services, transportation, beauty, sewing, gardening, laundry and ironing, etc.
3. **FOOD PROCESSING**: Activity where food, as an input, is transformed to be sold, for example, making *tamales* for sale, bread and other baked products, cheese, marmalade, pickles, packaging of different products, etc.
4. **SMALL INDUSTRY**: Activities where the person transforms non-food inputs, for producing outputs such as soap, bricks, blocks, etc.
5. **HANDYCRAFT**: Activity where inputs are transformed by hand in a using traditional technologies, such as making hammocks, baskets, hats, wood products, clay products, etc.
6. **OTHER ACTIVITIES**: Other, not defined previously.

NOTE: If you are not sure on the classification of the activity, please write the name of the activity and a short description, and ask you field supervisor for help on classifying the activity.

5.3.a. In 2011, did you or any of your household members work self-employed or in their own business ***with others***? ***Only report what corresponded to the individual, not to the entire group.***

[ ] 1 Yes **[ ] 0 No** **If the answer is No, continue with 6**

CF	**First name (Without last name)**	Type of Business/ activity See code	Name of Business/ activity	How many days a month did you run this Business?	During which months of 2011 did you run this Business?	On average, when you run this Business/activity; what are your:	
						Revenue *C$*	Costs *C$*
C1	C2	C3	C4	C5	C6	C7	C8
					1 2 3 4 5 6 7 8 9 10 11 12		
					1 2 3 4 5 6 7 8 9 10 11 12		
					1 2 3 4 5 6 7 8 9 10 11 12		
					1 2 3 4 5 6 7 8 9 10 11 12		
					1 2 3 4 5 6 7 8 9 10 11 12		

Write code:

1. **TRADE**: Activities that imply the resale of products of any kind. The person does not transform inputs to get the products, just buys and sells a finished product. For example: miscellaneous store, food stores, clothes stores, hardware, etc.
2. **SERVICES**: Activities that imply offering services within the community, such as miscellaneous repair services, transportation, beauty, sewing, gardening, laundry and ironing, etc.
3. **FOOD PROCESSING**: Activity where food, as an input, is transformed to be sold, for example, making *tamales* for sale, bread and other baked products, cheese, marmalade, pickles, packaging of different products, etc.
4. **SMALL INDUSTRY**: Activities where the person transforms non-food inputs, for producing outputs such as soap, bricks, blocks, etc.
5. **HANDYCRAFT**: Activity where inputs are transformed by hand in a using traditional technologies, such as making hammocks, baskets, hats, wood products, clay products, etc.
6. **OTHER ACTIVITIES**: Other, not defined previously.

NOTE: If you are not sure on the classification of the activity, please write the name of the activity and a short description, and ask you field supervisor for help on classifying the activity.

6. Food scarcity

6.1.During 2011, was there a period of time when you could not cook one of the daily meals?

[ ] 1 Yes [ ] 0 No If the answer is No, continue with 7.

If the answer is Yes, in total, for how long did you experience this situation where you could not cook one of the daily meals?

[ ] 1 One week or more
[ ] 2 Between 1 and 4 weeks
[ ] 3 Between 1 and 2 months
[ ] 4 More than 2 months
[ ] 0 Does not know, does not remember

6.1a. During 2011, How did you do to cope with this situation (could not cook one of the daily meals)?

Mark with an X, multiple answers.

[ ] 1 Sell livestock
[ ] 2 Sell small animals
[ ] 3 Sell farm tools and/or farm equipment
[ ] 4 Migrate overseas
[ ] 5 Migrate to other region in the country
[ ] 6 Ask for a loan to relatives or friends to buy food
[ ] 7 Received food from relatives or friends
[ ] 8 Received food from World Food Program (WFP) or from the local municipality
[ ] 9 Withdraw money from savings
[ ] 10 Requested a consumption loan
[ ] 99 Other, specify _____

Ask the following questions with reference to January 1st of 2012

7. Access to public services and housing characteristics.

7.1 How many rooms are there in your house? (Note: consider only the ones made of durable materials) _____

7.1a How many of these rooms are used as bedrooms?_____

7.2 In January 1st 2012, the house where you and your household members were living was:

[ ] 1 Rented (*7.2.1)
[ ] 2 Owned with documentation (**7.2.2)
[ ] 3 Owned without documentation (**7.2.2)
[ ] 4 Loaned
[ ] 5 Shared
[ ] 99 Other, specify _____

7.2.1 *If rented, how much did you pay for the rent? C$_____
7.2.2 ** If owned, for how much would you sell the house? C$_____

Ask questions with respect to January 1st 2012

7.3 How did you get water for your house?

[ ] 1 River or spring
[ ] 2 Pipe inside the house
[ ] 3 Pipe outside the house
[ ] 4 Public well
[ ] 5 Private well
[ ] 6 Water harvesting
[ ] 7 Brings water from neighbors/relatives houses
[ ] 99 Other, specify _____

7.4 Which kind of toilet service did you have in your house?

[ ] 1 None
[ ] 2 Latrine outside the house (with of without treatment)
[ ] 3 Flushing toilet
[ ] 99 Other, specify _____

7.5 Which type of lighting energy did you have in your house?

[ ] 1 Candle
[ ] 2 Electric power
[ ] 3 Electric plant/motor
[ ] 4 Solar panels
[ ] 99 Other, specify _____

7.6 Which kind of cooking fuel did you use?

[ ] 1 Wood
[ ] 2 Coal
[ ] 30 Gas
[ ] 31 Biogas produced at the farm
[ ] 5 Electric power
[ ] 99 Other, specify _____

7.7 ¿ How many of the following articles did you have at your house? ***Please consider the ones that worked at January 1st 2012***.

Articles	Quantity on **1-1-2012** (write 0 if did not have)	For how much could you have sold it on **1-1-2012**? (Total value in C$)
C1	C2	C3
Television		
Refrigerator		
Bicycle		
Motorcycle		
Car		
Sewing machine		
Blender		
Electric iron		
Cellphone		
Radio		
Tape recorder		
Stereo		

8 **Livestock inventory <u>Big and Small animals.</u>**
NOTE: C1=(C2+C3+C5+C6)-(C7+C9+C10)

Animals	How many animals January 1st 2012?	How many animals January 1st 2011?	**In 2011**				**Out 2011**			
			Quantity purchase	Price per animal C$	Births	Gifts	Quantity sale	Price per animal C$	Household consumpt	Deaths, gifts
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
1. Oxen										
2. Horses										
3. Donkeys/mules										
4. Bulls										
5. Cows										
6. Heifers (all ages)										
7. Steers (all ages)										
8. Calves (0 to 1 year old)										
9. Local hogs										
10. Improved hogs										
11. Local goats										
12. Improved goats										

Livestock inventory continued

Animals	How many animals January 1st 2012?	How many animals January 1st 2011?	**In 2011**				**Out 2011**			
			Quantity purchase	Price per animal C$	Births	Gifts	Quantity sale	Price per animal C$	Household consumpt	Deaths, gifts
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
13. Local sheep										
14. Improved sheep										
15. Local poultry										
16. Improved poultry										
17. Local rabbits										
18. Improved rabbits										
19. Local ducks										
20. Improved ducks										
21. Local turkey										
22. Improved turkey										
99. Other, specify										

8.2 Did you produce or process livestock/small animals' products? [ ] 1 Yes [ ] 0 No

Product	Unit of measure	January-April 2011				May-October 2011			
		Quantity produced	Quantity consumed	Quantity sold	Unit price C$	Quantity produced	Quantity consumed	Quantity sold	Unit price C$
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
1. Milk	Lts x day								
2. Cream	Lb x week								
3. Salty cheese	Lb x week								
4. Cheese	Lb x week								
5. Butter	Lb x week								
6. Soft Cheese	Lb x week								
7. Eggs	units x week								
8. Manure/organic fertilizer	qq x year								
9. Beef (uncooked)									
10. Pork (uncooked)									
99. Other, specify									

Produce or process livestock/small animals' products continued

Product	**Unit of measure**	**November-December 2011**			
		Quantity produced	Quantity consumed	Quantity sold	Unit price C$
C1	C2	C11	C12	C13	C14
1. Milk	Lts x day				
2. Cream	Lb x week				
3. Salty cheese	Lb x week				
4. Cheese	Lb x week				
5. Butter	Lb x week				
6. Soft Cheese	Lb x week				
7. Eggs	units x week				
8. Manure/organic fertilizer	qq x year				
9. Beef (uncooked)					
10. Pork (uncooked)					
99. Other, specify					

8.3 Livestock production costs 2011.

Cost	Did you do this?	Did you incur in any costs?	Livestock	Small animals	Observations (If the activity took place, but did not incur in costs)
	1 Yes 0 No	1 Yes 0 No	Total value C$	Total value C$	
C1	C2	C3	C4	C5	C6
1. Hired labor					
2. Feed/forages purchased (e.g. concentrate, manure, molasses)					
3. Medicines, vaccines, veterinary					
4. Insemination					
5. Infrastructure management					
99. Other services (e.g. transportation, processing.)					

8.4 Other species

Did you do aquaculture or apiculture activities **individually** during 2011?

[ ] 1 Yes [ ] 0 No, If the answer is No, continue with 8.3.a

Species	Quantity	Quantity	Unit of measure	During 2011								
	January 1st 2011?	**January 1st 2012**?	UM	Purchase	Purchase price	Gifts deaths stolen other	Product	Consump	Sales	UM	Sale price UM	Total annual manag cost 2011
					C$						C$	C$
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Fish in ponds												
Beehives												
Honey												

UM: unit of measure

8.3.a Did you do aquaculture or apiculture activities **with other farmers** during 2011?

[ ] 1 Yes [ ] 0 No If the answer is No, continue with 9.

If the answer is yes, fill the following table, with the information on what corresponded to the individual farmer, and not to the entire group.

Species	Quantity **January 1st 2012**?	Unit of measure UM	Income 2011 C$	Costs 2011 C$
C1	C2	C3	C4	C5
Fish in ponds				
Beehives				
Honey				

9 Did you have the following equipment/infrastructure on **January 1st 2012**?

Equipment	Number **1-1-2012** (write 0 if did not have it)	For how much could you sell it at **1-1-2012**? Total value C$	Observations
C1	C2	C3	C4
Oxen plough (without oxen value)			
Tractor			
Manual knapsack sprayer			
Motor pump sprayer			
Plastic containers			
Metallic containers			
Metallic silos			
Barrels			
Irrigation pump (without accessories)			
Irrigation motor			
Sprinkler irrigation accessories			
Drip irrigation accessories			
Cart			
Bio-digesters			
Grain grinder			
Manual sheller			
Mechanic sheller			
Apiculture equipment			
Apiculture protection equipment			
Other, specify			

Infrastructure	Did you have it? 1 Si 0 No	Value of infrastructure at **1-1-2012**? C$	Observations
C1	C2	C3	C4
Water harvesting ponds			
Fish ponds			
Poultry house			
Pig sty			
Forage silos			
Feeders			
Drinkers			
Barnyard			
Granary (wood)			
Greenhouse			
Other, specify			

Now let's talk about agricultural production at your farm.

10 Did you have dispersed fruit trees on **January 1st 2012**?

[ ] 1 Yes [ ] 0 No If the answer is No, continue with 11.

NOTE: C3=(C5+C6+C7)

Dispersed fruit trees (list by order if importance, write the tree species)	Number of trees at **1-1-2012**	Production **2011**	Unit of measurement UM	Quantity consumed **2011**	Gifts **2011**	Sales **2011**	Price per UM C$
C1	C2	C3	C4	C5	C6	C7	C8

11 For managing your farm, in 2011 did you implement any of the following?

[ ] 0 None
[ ] 1 Farm plan
[ ] 2 Keep books of revenues and costs
[ ] 99 Other, specify _____

12 Farm sketch, ***include all the plots under the management of the farmer during 2011*** identify each plot with a number and a name, if the farmer has a name for it.

Please draw the sketch in the attached blank sheet

With the help of the sketch, fill the table about land uses.

12.2 Land uses 2011, include all the plots under the farmer's management.

NOTE: C3=C4+C5+C6+C7+C8

Plot number	Plot name	Total area in Mz	Area in Manzanas (Mz)				
			Annual crops	Plantations	Grasses/ forages	Forests	Uncultivated land
C1	C2	C3	C4	C5	C6	C7	C8
0	House*						

PLEASE START THE PLOT INFORMATION SHEET (FILL ONE PER PLOT)

Plot information sheet

13.1.Plot name: _____ No.:_____

13.2.Area in Mz: _____

13.3.Ownership:

[ ] 1 Owned*
[ ] 2 Owned and sharecropped*, ***
[ ] 3 Rented (owner is someone else) **
[ ] 4 Sharecropped (owner is someone else) ***
[ ] 5 Own and rented*, **
[ ] 99 Other, specify _____

13.4a *If owned, what is the legal ownership situation of the plot?

[ ] 0 None
[ ] 1 Ownership document
[ ] 2 Agrarian reform title
[ ] 3 Bill of sale
[ ] 99 Other, specify_____

13.4aa *If owned, for how much could you have sold it on January 1st 2012? C$ _____

13.4b **If rented,

Rent 1. Paid 2. Received	Period 1.Apante 2.Primera 3.Postrera 4. All year	Payment 1.In kind 2.Cash 99. Other, specify	Area Mz	How much was the rent? (total)* C$	Quantity paid in kind	In kind payment unit of measurement	Form of in-kind payment
C1	C2	C3	C4	C5	C6	C7	C8

*If payment was in labor, please estimate the value in C$..

13.4c ***If sharecropped, what was the agreement (%)?

Item	Percentage assumed in the sharecropping agreement	Season 1 Apante 2 Primera 3 Postrera
C1	C2	C3
Inputs		
Production		
Labor		
Other, specify		

13.4.Distance to closest road: _____Km

13.5.Distance to the homestead: _____Km

13.6.Slope: [ ] 1 Flat [ ] 2 Not to steep [ ] 3 Steep

13.7.Soil texture: [ ] 1 Clay [ ] 2 Silt [ ] 3 Sandy [ ] 4 Loam

13.8.Presence of rocks: [ ] 1 None [ ] 2 Few [ ] 3 Many

13.9.Did you have access to irrigation in this plot on January 1st 2012? [ ] 1 Yes [ ] 0 No.

If the answer is Yes, continue with 13.9a y 13.9b, otherwise go to 13.10

13.9a If yes, from where did you get the water for irrigation?

[ ] 1 Well [ ] 3 Water harvesting pond
[ ] 2 River or spring [ ] 4 Waterhole
[ ] 99 Other, specify _____

13.9b. Type of irrigation system:

[ ] 1 Gravity irrigation [ ] 3 Sprinkler irrigation
[ ] 2 Drip irrigation with pipe [ ] 4 Drip irrigation with bottle
[ ] 99 Other specify_____

13.10 Soil and water conservation structures

Structure	Did you have this soil/water conservation structure on January 1st 2012? 1 Yes 0 No	Did you build any of these structures between January 1st 2010 and January 1st 2012? 1 Yes 0 No	Area of length built between January 1st 2010 and January 1st 2012	Unit of measurement of the area/length built
C1	C2	C3	C4	C5
1 Stone barriers/terraces				
2 Crop residue barriers				
3 Live barriers (perennial crops planted in contours)				
10 Trees planted to protect waterways and canals.				
11 Infiltration trenches				
12 Dams				
13 Ditches				
99. Other, specify				

13.11 Did you implement any of the following soil and water conservation practices during 2011?

Soil and water conservation practices	Did you implement any of these practices during 2011? 1 Yes 0 No
C1	C2
1 Minimum tillage	
2 No tillage	
3 No burning	
11 Manure	
12 Compost	
13 Vermicompost	
21 Green manure	
22 Cover crops	
23 Mulch	
31 Contour planting	
99 Other, specify	

13.12 Cultivos anuales durante 2011. Si es a medias reportar solamente lo que le correspondió.

Season	Crop 1.Maize 2.Beans 3.Maize and beans intercropped 4.Other intercropped 99.Other, specify	Cultivated area Mz	Production	Unit of measure UM	Consumption	Gift	Quantity of grain stored **1-1-2012**	Sales	Price per UM C$	Did you sell to: 1 Intermediary 2 Consumer 3 Coop 4 Supermarket/ Enterprise 99 Other, specify
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Apante 2010-2011										
Primera 2011										
Postrera 2011										

Annual crops 2010-2011 continued

Season	Crop 1.Maize 2.Beans 3.Maize and beans intercropped 4.Other intercropped 99.Other, specify	How did you take products to the market? 0 On farm 1 Horse 2 Mule 3 Bus 4 Bicycle 5 Motorcycle 6 Truck 99 Other, specify	Transportation costs	
			Cost C$/UM	Cost per trip/number of trips
C1	C2	C12	C13	C14
Apante 2010-2011				
Primera 2011				
Postrera 2011				

13.13 During 2011 did you have family garden?

[ ] 1 Yes [ ] 0 No

If the answer is No, continue with 13.13a

Total area of family garden in Mz: _____

Crop	Quantity produced in 2011	Unit of measure UM	Quantity used for consumption 2011	Quantity sold	Price per UM C$	Observation
C1	C2	C3	C4	C5	C6	C7

13.13a. Did you participate in a group garden with other farmers during 2011?

[ ] 1 Yes [ ] 0 No

If the answer is No, continue with 13.14

Only report what corresponded to the individual farmer. DO NOT report the total for the group.

Total garden area in Mz: _____

Crop	Quantity for consumption 2011	Quantity sold 2011	Price per UM C$
C1	C2	C3	C4

13.14 Plantations 2011

Type Write code: 1. Coffee 2. Fruits 3. Musaceae 4. Cocoa 5. Forest 99 Other, specify	Area in Mz	Year when planted	Quantity produced 2011	Unit of measurement	Quantity sold 2011	Price per UM C$
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**

13.15 Grasses and forages **2011**

	Area
[ ] 1 Natural grass	_____Mz
[ ] 2 Improved pasture	_____Mz
[ ] 3 Improved forage crop	_____Mz

13.16 Planting materials 2011 **(for all the crops planted in the Plot in 2011)**

Variety Specify	Season when used Write code: 1 apante 2 primera 3 postrera 4 whole year	How did you get it? Write code 1 Previous harvest 2 Community 3 NGO, ***write name*** 4 Government 5 Bought at inputs store 6 Bought at cooperative 7 Produced yourself 99 Other, specify	Quantity	Unit of measure UM	Equivalence UM	Price per UM **(Only if the person bought it)**
C1	C2	C3	C4	C5	C6	C7
Bean						
Maize						
Sweet potato						
Other						

NOTE: MAKE SURE YOU FILLED ALL THE PLOT SHEETS, ONE PER PLOT UNDER THE FARMER'S MANAGEMENT, BEFORE CONTINUING.

Production and storage losses

14 During **2011**, did you experience any production losses on any of your crops?
[ ] 1 Yes [ ] 0 No, if the answer is No, continue with 15, if the answer is yes, fill this table:

Crop	Percentage of losses (with respect to what was expected)	Season 1 Apante 2 Primera 3 Postrera	Plot (use the number already defined)
C1	C2	C3	C4

The crop losses experienced were a result of:

14.1a Natural phenomena? [ ] 1 Yes [ ] 0 No, if the answer is No, continue with 14.1b,
if yes please mark the cause with an X:

[ ] 1 Drought
[ ] 2 Winds
[ ] 3 Flood/landslides
[ ] 99 Other,specify_____

14.1b Pests and diseases? [ ] 1 Yes [ ] 0 No. If the answer is no No, continue with 15 if yes, indicate on which crops?_____

15 During 2011, did you use any biological or organic pest and disease control on your crops?
[ ] 1 Yes [ ] 0 No, If the answer is No, continue with 16,
if the answer is Yes, fill the table

Crop	Type of control used?
C1	C2

16 ¿Did you store grains produced during **2011**? [ ] 1 Yes [ ] 0 No, if the answer is No, continue with 17, if Yes, fill 16.1

16.1.How did you store grains during **2011**? Mark with an X

[ ] 10 Sacks
[ ] 11 Barrels
[ ] 12 Metallic silos
[ ] 13 Granary (made of wood)
[ ] 19 Other storage facilities at the household, specify_____
[ ] 20 Storage community center
[ ] 29 Other community storage facilities specify_____

17 Did you experience any grain storage losses during **2011**? [ ] 1 Yes [ ] 0 No
If the answer is No, continue with 17.1, if yes answer 17.a.

17.a Which were the causes of grain storage losses during 2011?

[ ] 1 Humidity and fungi
[ ] 2 Insects
[ ]3 Rodents
[ ]4 Birds
[ ] 99 Other, specify_____

17.1. Do you think that the percentage or stored grain losses has changed between **2009 and 2011**?
[ ] 1 Yes [ ] 0 No
If the answer is No, continue with 18.

Crop	Change in grain storage loss percentage **2009 to 2011** % (if the percentage of losses has increased right +, if it has decreased, right -)
C1	C2

18 Total costs of agricultural inputs 2011. (all crops, including the ones grown in the family garden, and non synthetic inputs)

Inputs used (Specify type)	How much did your purchase 2011?											
	Apante 2011				Primera 2011				Postrera 2011			
	Quant	Unit	Equiv	Price per unit	Quant	Unit	Equiv	Price per unit	Quant	Unit	Equiv	Price per unit
C1	C2	C3	C4	C5	C6	C7	C8	C7	C8	C9	C10	C11
Fertilizers												
Pesticides												
Herbicides												
Fungicides												
Cost intercrop												
Cost Group garden												
Plantations costs (total for 2011)												

18.1 Total costs of agricultural inputs 2011. (all crops, including the ones grown in the family garden, and non-synthetic inputs)

Inputs used (Specify type)	How much did you purchase in 2011?											
	Apante 2011				Primera 2011				Postrera 2011			
	Quant	Unit	Equiv	Price per unit	Quant	Unit	Equiv	Price per unit	Quant	Unit	Equiv	Price per unit
C1	C2	C3	C4	C5	C6	C7	C8	C7	C8	C9	C10	C11
Other, specify												
Other annual costs												

19. Labor hired 2011

Did you hire workers during 2011? [ ] 1 Yes [ ] 0 No

19.1 Daily payment

Activity	Apante				Primera				Postrera			
	Wages paid 2011 C$				Wages paid 2011 C$				Wages paid 2011 C$			
	No. of days paid	With food	Without food	Other	No. of days paid	With food	Without food	Other	No. of days paid	With food	Without food	Other
C1	C2	C3	C4	C5	C6	C7	C7	C8	C9	C10	C11	C12
Soil preparation												
Planting												
Applying fertilizer												
Weeding												
Harvest												
Other												

19.2 Other activities independently of how long it takes).

Payment by productivity (per volume, area, or other unit of measure

Activity 2011	Total paid 2011 C$		
	Apante	Primera	Postrera
C1	C2	C3	C4
Oxen plough			
Tractor			
Other			

Activity 2011	Quantity	Unit of measure	Payment per unit C$	Observations
C1	C2	C3	C4	C5

Credit and savings

20. On January 1st 2012, did you or any of your household members hold any loans?
[ ] 1 Yes [ ] 0 No If the answer is No, continue with 21. Otherwise fill the table:

CF	First name (Without last name)	Use of loan Write code 1 Agricultural inputs 2 Food 3 School supplies 4 Health expenses 5 Migrate to work 6 Non agricultural business 7 Buy clothes 8 Housing improvements 99 Other, specify	Source Write code: 1 Bank 2 Intermediary 3 Microfinance institution 4 Cooperative 5 Community lender 6 Savings group 7 Relative/friend 30 FDL(*Fondo de Desarrollo Local*) 99 Other, specify	Year of approval	Total amount C$	Duration of loan	Pending amount 1-1-2012 C$
C1	C2	C3	C4	C5	C6	C7	C8

21. On January 1st 2012, did you or any of your household members have savings?
[ ] 1 Yes [ ] 0 No If the answer is No, continue with 22. Otherwise fill the table:

CF	First name (Without last name)	Amount Write code 1 C$ 0 – 500 2 C$ 501 – 1000 3 C$ 1001 – 1500 4 C$ 1501 – 2000 5 C$ 2001 – 2500 6 C$ 2501 – 3000 7 C$ 3001 or more	Where did you have your savings? Write code 1 Bank 2 Microfinance institution 3 Cooperative 4 Saving groups 5 House 99 Other specify
C1	C2	C3	C4

Participation in rural development projects

22. From **2009 to the end of 2011**, did you or any of your household members participate in rural development project activities?

Themes	**1 Yes** **0 No**	Activity and/or benefit (multiple answers) write code 1 Attendance to workshops and talks 2 Technical assistance in the field 3 Agricultural inputs 4 Experimental plots 5 Pest management 6 Credit 7 Animals 8 Food 9 Medicines 10 School supplies 99 Other, specify	**I**nstitution Write code 1 MAGFOR 2 INTA 3 Caritas 4 CRS 5 CARE 6 FIDER 7 Visión Mundial 8 Plan International 9 PROMIPAC 10 TECNOSERVE 11 RAMAC 12 CIAT 13 UNA 14 UCA 99 Other, specify
C1	**C2**	**C3**	**C4**
1 Seeds production			
2 Seedlings production			
3 Integrated pest management			
4 Organic management			
5 Good agricultural practices			
6 Product transformation			
7 Forage/grasses improvement			
8 Trade and marketing			
9 Posthervest management			
10 Conservation agriculture			

From **2009 to the end of 2011**, did you or any of your household members participate in rural development project activities? Continued

Themes	1 Yes 0 No	Activity and/or benefit (multiple answers) write code 1 Attendance to workshops and talks 2 Technical assistance in the field 3 Agricultural inputs 4 Experimental plots 5 Pest management 6 Credit 7 Animals 8 Food 9 Medicines 10 School supplies 99 Other, specify	**I**nstitution Write code 1 MAGFOR 2 INTA 3 Caritas 4 CRS 5 CARE 6 FIDER 7 Visión Mundial 8 Plan International 9 PROMIPAC 10 TECNOSERVE 11 RAMAC 12 CIAT 13 UNA 14 UCA 99 Other, specify
C1	**C2**	**C3**	**C4**
11 Small animals management			
12 Farmer field schools			
13 Local agricultural research committee (CIAL)			
14 Bee keeping			
15. Fish farming			
16 Reforestation and watershed conservation			
18 Savings			
20 Health			
21 Nutrition			
99 Other, specify			

Appendix G. Village survey instrument for the A4N impact evaluation panel.

Community Survey:

Program Participation, Economic Impact, and Agricultural Practices among Nicaraguan Smallholder Farmers -2011Información General

Read statement of consent before begin

Name: _____

Supervisor: _____

Department: _____

Municipality: _____

Community: _____

Total population: _____

Number of houses: _____

Number of families: _____

Sale price for land: _____C$/Mz

Date: _____/_____/_____

1. Infrastructure

   1.1 Name of closest market _____

   1.2 Distance to closest market _____Km.

   1.3 Distance to closest paved road_____Km.

   1.4 Bus trip time to closest municipality _____min

   Walking time to bus stop_____min

   1.5 Where do you buy agricultural inputs? (name of closest place)

   _____

2. Access to education and services

2.1 Public School? [ ] 1 Yes [ ] 0 No

2.1.a Schooling age for children _____years

2.2 Health facility? [ ] 1 Yes [ ] 0 No

2.3 Electricity? [ ] 1 Yes [ ] 0 No

2.4 Aqueduct/Piped water? [ ] 1 Yes [ ] 0 No

2.5 Sewage system? [ ] 1 Yes [ ] 0 No

3. Agricultural and livestock production 2011

Product	Price C$			Unit of measure	Average yield
	Apante	Primera	Postrera		
Basic grains					
Maize					
Bean					
Wheat					
Millet					
Sorghum					
Horticultural crops/tubers					
Tomato					
Cabbage					
Chiltoma					
Lettuce					
Pipían					
Onion					
Potato					
Quequisque					
Cassava					
Ayote					
Malanga					
Carrots					
Beets					
Cucumber					
Chilla					
Sweet potato					
Radish					
Chayote					
Garlic					

3. Agricultural and livestock production 2011 Continued

Product	Price C$			Unit of measure	Average yield
	Apante	Primera	Postrera		
Fruits/ bananas					
Mango					
Avocado					
Orange					
Sour lemon					
Sweet lemon					
Passion fruit					
Water melon					
Cantelope					
Mamon					
Plums					
Nancite					
Pitahaya					
Tamarind					
Zapote					
Banana					
Other					
Coffee					
Other livestock					
Eggs					
Beef					
Cheese					
Pork					
Poultry					
Cow milk					
Goat milk					

4. Labor prices 2011

Activity	Apante		Primera		Postrera		Adjustment /Unit
	With meals	Without meals	With meals	Without meals	With meals	Without meals	
Workday							
Plowing with oxen							
Tractor plow							
Coffee harvest							
Cane sugar cutting							
Tomato harvest							
Harvest							
Seeding							
Soil preparation							
Chapia							

5. Livestock prices en 2011

Animal	Average price C$	Observations
1. Oxen		
2. Horses		
3. Mules / Asses		
4. Bulls		
5. Cows		
6. Heifers (all ages)		
7. Steers (all ages)		
8. Calves (0 to 1 year old)		
9. Local hogs		
10. Improved hogs		
11. Local goats		
12. Improved goats		
13. Local sheep		
14. Improved sheep		
15. Local poultry		
16. Improved poultry		
17. Local rabbits		
18. Improved rabbits		
99. Other, specify		

6. Institutions that implemented projects in the community 2009 y 2011

Institution	Project
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

7. Extreme weather events.

Where there extreme weather events during 2009-2011 (rains, drought, winds, others) that affected the community agricultural and livestock production?

[ ] 1 Yes [ ] 0 No

If the answer is yes, please answer the following:

Weather event	Year
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Appendix H. Algorithm for estimating the propensity score.

We apply Dehejia and Wahba's (2002) suggested algorithm for estimating the propensity score to determine whether higher order terms and/or interaction terms need to be included in the model:

1. Start with a parsimonious logit specification to estimate the score.
2. Sort the data according to estimated propensity score (ranking from lowest to highest).
3. Stratify all observations such that estimated propensity scores within a stratum for treated and comparison units are close (no significant differences); for example, start by dividing observations intro strata if equal range (0-0.2, 0.2-0.4, …, 0.8-1)
4. Statistical test: for all covariates, differences in means across treated and comparison units within each stratum are not statistically different from zero.
    a. If covariates are balanced between treated and comparison observations for all strata, stop.
    b. If covariates are not balance for some stratum, divide the stratum into finer strata and reevaluate.
    c. If a covariate is not balanced for many strata, modify the logit by adding interaction terms and/or higher-order terms of the covariates and reevaluate.

Appendix I. Pretreatment characteristics of treatment and comparison households.

Looking into the pretreatment (2009) characteristics for both A4N and non-A4N households, for the eligibility criteria, the average area of cultivated land among the participants is 3.3 Mz (Table I 1), which is greater than the 2.5 Mz maximum area of land proposed as a formal eligibility criterion for participation. In practice, this type of eligibility criterion is difficult to enforce, and since the project was also allowing non-eligible households to participate as part of its strategy, it is not surprising that we find that not all the eligibility criteria are met. Also, more than 60% of the A4N households live in inadequate housing, and 88% lacked access to piped water and sewage (inadequate services) (Table I 1), indicating that most of these households were poor as measure by these two components of the index of unsatisfied basic needs (UBN).

Based on comparison of individual sample means for pretreatment characteristics using a t-test for samples with unequal variance (Table I 1), the A4N and the non-A4N household characteristics and asset endowments do not differ significantly for most cases. A4N households had less access to adequate services (piped water and flushing toilet), higher incidence of hunger, a higher proportion of households with female head, and infrastructure and livestock with lower value in comparison with non-A4N households. The A4N households were also located in villages farther from markets and the proportion of these villages with access to a health facility was lower.

Both A4N and non-A4N villages, and A4N and non-A4N households (see Table I 1) are similar in terms of the characteristics used by the project to select villages and households. We can say with confidence that we successfully constructed a valid counterfactual for impact assessment.

Table I 1. Pretreatment characteristics of A4N and non-A4N households, 2009.

Variable	A4N n=282 Mean	Std. Dev.	Non-A4N n=294 Mean	Std. Dev.	Difference	p-value
Farm Characteristics						
Cultivated land Mz	3.29	(3.42)	3.50	(3.41)	-0.20	0.47
Steep slope=1	0.32	(0.47)	0.32	(0.47)	0.01	0.87
Housing Characteristics						
Inadequate services=1	0.66	(0.47)	0.79	(0.41)	-0.12	0.00
Inadequate housing=1	0.88	(0.33)	0.85	(0.36)	0.03	0.26
Electricity access=1	0.61	(0.49)	0.63	(0.48)	-0.02	0.69
Household Characteristics						
Hunger experienced=1	0.39	(0.49)	0.32	(0.47)	0.07	0.09
Head female=1	0.20	(0.40)	0.07	(0.26)	0.13	0.00
Children under 5 years old (number)	0.51	(0.73)	0.51	(0.71)	0.00	0.95
Head age (years)	49.41	(15.29)	47.67	(14.57)	1.74	0.16
Head education (years)	2.83	(2.70)	3.04	(2.59)	-0.22	0.32
Household size (persons)	5.20	(2.32)	5.36	(2.23)	-0.16	0.39
Persons per room	3.82	(2.03)	3.86	(2.09)	-0.04	0.84
Asset values						
Infrastructure (C$/1000)	0.52	(1.49)	1.48	(8.64)	-0.96	0.06
Livestock (C$/1000)	6.71	(9.94)	9.07	(16.30)	-2.35	0.04
Equipment (C$/1000)	1.76	(4.39)	2.08	(4.85)	-0.32	0.40
Village characteristics						
Population 2009	637	(488)	640	(626)	-2.95	0.95
Dist. to marrket (Km/10)	14.09	(6.86)	16.29	(9.59)	-2.21	0.00
Dist. to paved road (Km/10)	9.53	(9.65)	8.95	(8.72)	0.58	0.45
Health facility=1	0.21	(0.40)	0.28	(0.45)	-0.08	0.03

Source: A4N Household Survey 2010 and Village Survey 2010.

Appendix J. Description of outcomes to be evaluated by the project.

This impact evaluation focuses on the population of farmers with access to land and expected to benefit from interventions related to agricultural activities. With respect to project outcomes, Table J 1 reports the sample averages for both A4N and non-A4N households before and after treatment, it also presents the definition of the outcomes, and the units of measure. These outcomes correspond to: agricultural conservation structures, agricultural conservation practices, storage practices, kitchen garden, small livestock, saving and credit, food scarcity and agricultural income and household wealth related outcomes. Most of these outcomes were not statistically different in 2009. There were some differences between the two groups in terms of the use of cover crops in at least one of the plots under the management of the household, the proportion of households experiencing stored grain losses and the value of production of main crops (Table J 1). On the whole, the great similarities between the groups confirms that we successfully built a valid counterfactual for comparison

The self-reported participation in different A4N interventions by project beneficiaries, was obtained from a survey question asking if the household received benefits from development projects between 2009 and 2011. The results are shown in Table J 2 for A4N project beneficiaries. About 40% of project beneficiaries participated in A4N agricultural conservation, good agricultural practices and organic management, and group formation related interventions. Between 23% and 35% participated in seed and seedling production, savings, integrated pest management and farmer field school CIALes, while 15% reported participation on postharvest management activities (Table J 2). Most of these interventions involved training and workshops on the different technologies and practices promoted by the project.

Table J 1. Outcome and explanatory variables for impact evaluation analysis.

Outcome Variables			2009				
			A4N n=282		non-A4N n=294		Dif
Variables	**Unit**	**Definition**	Mean	sd.	Mean	sd.	Mean
Agricultural Conservation Structures (Length built in meters between 2009 and 2011)							
All structures	m/Mz	Length built in agricultural conservation structures 2011-2009.					
Stone barriers/terraces	m/Mz	Length built in stone barriers and terraces 2011-2009					
Live barriers	m/Mz	Length built in live barriers 2011-2009					
Ditches	m/Mz	Length built in ditches 2011-2009					
Agricultural Conservation Practices							
All practices	1=yes, 0=no	hh has implemented at least one cons ag practice in one of the plots under its management	0.71	(0.45)	0.68	(0.47)	0.03
Minimum tillage	1=yes, 0=no	hh has implemented minimum tillage at least in one plot	0.18	(0.39)	0.13	(0.34)	0.05
Zero tillage	1=yes, 0=no	hh has implemented zero tillage at least in one of its plots	0.15	(0.36)	0.16	(0.36)	0.00
Vermiculture	1=yes, 0=no	hh has implemented vermiculture at least in one of its plots	0.01	(0.10)	0.01	(0.10)	0.00
Cover crops	1=yes, 0=no	hh has implemented cover crops at least in one of its plots	0.00	(0.00)	0.01	(0.12)	-0.01**

Levels of significance ***1%, **5%, *10%. sd refers to standard deviation. hh refers to household. 1 Mz=1.73 Acres

Table J 1. (cont'd).

Outcome Variables			2011				
			A4N n=282		non-A4N n=294		Dif
Variables	**Unit**	**Definition**	Mean	sd.	Mean	sd.	Mean
Agricultural Conservation Structures (Length built in meters between 2009 and 2011)							
All structures	m/Mz	Length built in agricultural conservation structures 2011-2009	116	(387)	41	(116)	75***
Stone barriers/terraces	m/Mz	Length built in stone barriers and terraces 2011-2009	43	(7)	21	(119)	23***
Live barriers	m/Mz	Length built in live barriers 2011-2009	23	(76)	8	(49)	15***
Ditches	m/Mz	Length built in ditches 2011-2009	9	(41)	2	(27)	7***
Agricultural Conservation Practices							
All practices	1=yes, 0=no	hh has implemented at least one cons ag practice in one of the plots under its management	0.90	(0.30)	0.84	(0.37)	0.06
Minimum tillage	1=yes, 0=no	hh has implemented minimum tillage at least in one plot	0.27	(0.44)	0.36	(0.48)	-0.09**
Zero tillage	1=yes, 0=no	hh has implemented zero tillage at least in one of its plots	0.45	(0.50)	0.26	(0.44)	0.19***
Vermiculture	1=yes, 0=no	hh has implemented vermiculture at least in one of its plots	0.06	(0.23)	0.01	(0.08)	0.05***
Cover crops	1=yes, 0=no	hh has implemented cover crops at least in one of its plots	0.02	(0.13)	0.00	(0.06)	0.01***

Levels of significance ***1%, **5%, *10%. sd refers to standard deviation. hh refers to household.1 Mz=1.73 Acres

Table J 1. (cont'd).

Outcome Variables			2009				
			A4N n=282		non-A4N n=294		Dif
Variables	**Unit**	**Definition**	Mean	sd	Mean	sd.	Mean
Storage Practices							
hh experienced stored grain losses	1=yes, 0=no	hh has experienced stored grain losses. Only for households that stored grain.	0.41	(0.49)	0.26	(0.44)	0.15***
hh stored grain in metallic silos	1=yes, 0=no	hh uses metallic silos for grain storage. Only for households that stored grain	0.16	(0.36)	0.19	(0.39)	-0.04
Number of metallic silos	number	Number of metallic silos owned by the household	0.26	(0.56)	0.27	(0.54)	-0.01
Kitchen Garden							
hh had a kitchen garden	1=yes, 0=no	hh has a kitchen garden	0.06	(0.24)	0.04	(0.21)	0.02
Small Livestock							
Pigs owned	number	Pigs in livestock inventory on January 1st	0.40	(0.89)	0.36	(0.88)	0.04
Goats owned	number	Goats in livestock inventory on January 1st	0.02	(0.25)	0.14	(1.84)	-0.12
Poultry owned	number	Poultry in livestock inventory, on January 1st	9.17	(8.50)	8.22	(8.71)	0.94
Savings and Credit							
hh has savings	1=yes, 0=no	hh had savings on January 1st	0.14	(0.35)	0.11	(0.31)	0.04
hh has credit	1=yes, 0=no	hh had credit on January 1st	0.20	(0.40)	0.21	(0.41)	-0.01

Levels of significance ***1%, **5%, *10%. sd refers to standard deviation. hh refers to household.

Table J 1. (cont'd).

Outcome Variables			2011				
			A4N n=282		non-A4N n=294		Dif
Variables	**Unit**	**Definition**	Mean	sd	Mean	sd	Mean
Storage Practices							
hh experienced stored grain losses	1=yes, 0=no	hh has experienced stored grain losses. Only for households that stored grain.	0.22	(0.41)	0.25	(0.43)	-0.03
hh stored grain in metallic silos	1=yes, 0=no	hh uses metallic silos for grain storage. Only for households that stored grain	0.28	(0.45)	0.23	(0.42)	0.05
Number of metallic silos	number	Number of metallic silos owned by the household	0.46	(0.66)	0.33	(0.57)	0.13**
Kitchen Garden							
hh had a kitchen garden	1=yes, 0=no	hh has a kitchen garden	0.10	(0.31)	0.05	(0.21)	0.06***
Small Livestock							
Pigs owned	number	Pigs in livestock inventory on January 1st	0.68	(1.18)	0.46	(0.87)	0.23***
Goats owned	number	Goats in livestock inventory on January 1st	0.05	(0.34)	0.01	(0.17)	0.04*
Poultry owned	number	Poultry in livestock inventory, on January 1st	12.59	(12.01)	11.84	(10.56)	0.75
Savings and Credit							
hh has savings	1=yes, 0=no	hh had savings on January 1st	0.29	(0.45)	0.12	(0.32)	0.17***
hh has credit	1=yes, 0=no	hh had credit on January 1st	0.26	(0.44)	0.28	(0.45)	8.00

Levels of significance ***1%, **5%, *10%/ sd refers to standard deviation. hh refers to household.

Table J 1. (cont'd).

Outcome Variables			2009 A4N n=282		2009 non-A4N n=294		Dif
Variables	**Unit**	**Definition**	Mean	sd.	Mean	sd.	Mean
Food Scarcity							
hh experience food scarcity	1=yes, 0=no	hh experienced a period of the year when they could not cook one of the daily meals	0.39	(0.49)	0.32	(0.47)	0.07
Agricultural income and households wealth							
Bean production	QQ=100 Kg	Total bean production in quintals	13.32	(16.35)	12.08	(14.27)	1.23
Maize production	QQ=100 Kg	Total maize production in quintals	17.44	(17.30)	17.03	(19.67)	0.41
Tropical livestock units	TLU	Conversion factors are: horses 0.8; cattle and mule 0.7; asses 0.5; pigs 0.2; goat, sheep 0.1; poultry 0.01 [1]	1.96	(2.03)	2.14	(2.66)	-0.18
Farm gross margins	C$ 2011	Total revenues minus total costs of all the agricultural and livestock activities	4,938	(32,729)	6,902	(34,873)	-1,964
Total agricultural sales	C$ 2011	Total revenues: quantity sold X prices per unit sold for all crops and livestock products	12,746	(35,056)	13,416	(40,608)	-670
Value main crops	C$ 2011	Total production of maize, beans, sorghum and millet X unit prices at village level	12,495	(15,292)	10,437	(10,912)	2,058*
Value of livestock and poultry products	C$ 2011	Total production from livestock X self-reported sale prices	1,371	(2,573)	1,500	(3,333)	-128

[1] source:http://www.ilri.cgiar.org/InfoServ/Webpub/fulldocs/X5443E/X5443E04.HTM

Levels of significance ***1%, **5%, *10%. sd refers to standard deviation. hh refers to household. U$1=C$22.42 in 2011

Table J 1. (cont'd).

Outcome Variables			2011				
			A4N n=282		non-A4N n=294		Dif
Variables	**Unit**	**Definition**	Mean	sd	Mean	sd	Mean
Food Scarcity							
hh experience food scarcity	1=yes, 0=no	hh experienced a period of the year when they could not cook one of the daily meals	0.21	(0.41)	0.21	(0.41)	0.00
Agricultural income and households wealth							
Bean production	QQ=100 Kg	Total bean production in quintals	13.99	(15.30)	16.50	(19.05)	-2.52*
Maize production	QQ=100 Kg	Total maize production in quintals	16.44	(16.64)	18.25	(18.66)	-1.81
Tropical livestock units	TLU	Conversion factors are: horses 0.8; cattle and mule 0.7; asses 0.5; pigs 0.2; goat, sheep 0.1; poultry 0.01 [1]	2.56	(2.29)	2.71	(3.15)	-0.14
Farm gross margins	C$ 2011	Total revenues minus total costs of all the agricultural and livestock activities	5,682	(42,150)	7,025	(61,161)	-1343
Total agricultural sales	C$ 2011	Total revenues: quantity sold X prices per unit sold for all crops and livestock products	19,939	(58,820)	23,531	(67,516)	-3592
Value main crops	C$ 2011	Total production of maize, beans, sorghum and millet X unit prices at village level	16,659	(16,221)	18,505	(18,702)	-1845
Value of livestock and poultry products	C$ 2011	Total production from livestock X self-reported sale prices	6,869	(11,652)	7,027	(7,675)	-157

[1] source:http://www.ilri.cgiar.org/InfoServ/Webpub/fulldocs/X5443E/X5443E04.HTM

Levels of significance ***1%, **5%, *10%. sd refers to standard deviation. hh refers to household. U$1=C$22.42 in 2011

Table J 2. Participation of A4N household in different project interventions 2009-2011.

Variable	Number	% of total
Agricultural conservation	115	41%
Good agricultural practices and organic management	113	40%
Group formation	109	39%
Seed and seedling production	98	35%
Savings	93	33%
Integrated pest management (IPM)	72	26%
Farmer field schools and local research committees (CIAL)	64	23%
Postharvest management	42	15%
Marketing and product transformation	32	11%
Small livestock management	30	11%

Note: Total of participant households 282
Source: A4N Household Survey 2012

The evaluation of certain outcomes, such as use of biofortified seeds of maize and beans, was not conducted due to small sample size or data gaps. Only 15 sampled households reported that they grew biofortified beans in 2011 and zero households reported that they grew biofortified maize in the same year. In addition to this, the information on the variables planted by farmers does not allow for analysis, since names of varieties reported by farmers do not coincide with technical names available. Some group level interventions also had a very low take up. Only 12 households reported activities related with beekeeping in 2011, only 13 households reported having a group garden and only five households reported that they participated on seed producer groups.

The project impact evaluation will focus on the household-level interventions that promoted improved agricultural technologies and practices, and savings; they do not analyze village level interventions.

Appendix K. Difference in difference estimation of project outcomes

Table K 1. Project impacts on building of agricultural conservation structures.

	Conserv ag structures m/Mz	Stone barriers m/Mz	Live barriers m/Mz	Ditches m/Mz
A4N=1	77.41***	24.32***	15.53***	7.44***
	(25.17)	(9.85)	(5.43)	(3.00)
Household size	1.95	0.95	-0.67	1.28*
	(5.71)	(4.42)	(1.21)	(0.76)
Average education hh members years	-0.80	-2.96	-0.33	0.29
	(4.00)	(2.78)	(1.24)	(0.73)
Area of cultivated land Mz	3.44*	2.27	0.68	0.01
	(2.14)	(1.48)	(0.45)	(0.07)
Constant	36.48***	16.16**	7.04*	2.36
	(9.00)	(6.07)	(2.73)	(2.03)
R-squared	0.01	0.02	0.01	0.01
N	567	567	567	567

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table K 2. Project impact on agricultural conservation practices

	Cons ag practices	Minimum tillage	Zero tillage	Vermiculture	Cover crops
A4N participant	0.04	-0.14***	0.19***	0.05***	0.03***
	(0.05)	(0.05)	(0.05)	(0.02)	(0.01)
Household size	-0.01	-0.01	-0.00	0.00	-0.00
	(0.01)	(0.02)	(0.02)	(0.00)	(0.00)
Average education hh members years	0.01	-0.01	-0.01	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Area of cultivated land Mz	0.01	0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.15***	0.22***	0.10***	-0.00	-0.01*
	(0.04)	(0.04)	(0.03)	(0.01)	(0.01)
R-squared	0.01	0.02	0.03	0.02	0.02
N	567	567	567	567	567

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table K 3. Impacts on postharvest storage

	Stored grain losses	Stored in metallic silos	Number of metallic silos owned
A4N participant	-0.16***	0.11***	0.14***
	(0.06)	(0.04)	(0.05)
Household size	-0.03*	-0.00	0.01
	(0.02)	(0.01)	(0.01)
Average education hh members years	0.02	0.00	0.03**
	(0.02)	(0.01)	(0.01)
Area of cultivated land Mz	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Constant	-0.03	0.05**	0.08***
	(0.04)	(0.03)	(0.03)
R-squared	0.02	0.02	0.03
N	476	476	575

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table K 4. Project impacts on the number of small livestock

	Number pigs	Number goats	Number poultry
A4N participant	0.18*	0.15	-0.10
	(0.10)	(0.11)	(0.99)
Household size	0.06*	-0.00	0.41
	(0.03)	(0.01)	(0.31)
Average education hh members years	0.03	-0.01	-0.34
	(0.03)	(0.02)	(0.33)
Area of cultivated land Mz	-0.02	-0.01	0.20
	(0.04)	(0.01)	(0.11)
Constant	0.15**	-0.12	3.24***
	(0.07)	(0.10)	(0.69)
R-squared	0.02	0.01	0.02
N	575	575	575

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table K 5. Project impacts on savings, credit, hunger, crop losses and kitchen garden.

	Saving	Credit	Experienced period of hunger	Experienced crop losses	Kitchen garden
A4N participant	0.14***	-0.01	-0.06	0.04	0.04
	(0.04)	(0.04)	(0.05)	(0.04)	(0.03)
Household size	0.02*	0.01	0.02	0.00	0.00
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Average education hh members years	0.03*	-0.01	-0.02	0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Area of cultivated land Mz	0.00	0.00	0.01	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.04	0.06*	-0.13***	0.02**	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
R-squared	0.04	0.01	0.02	0.00	0.01
N	575	575	575	575	571

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Appendix L. Difference in difference treatment effects by area of cultivated land in 2009.

Table L 1. DID treatment effect on agricultural conservation structures, for households with cultivated land >= 1.5 Mz

	Conserv ag structures m/Mz	Stone barriers m/Mz	Live barriers m/Mz	Ditches m/Mz
A4N=1	110.68	2.69	16.29	11.37**
	(73.34)	(27.10)	(15.00)	(5.33)
Household size	-9.58	-9.45*	-2.81	0.39
	(10.55)	(5.18)	(3.29)	(0.60)
Average education hh member years	1.34	-8.63	3.45	-0.97
	(14.19)	(10.33)	(4.22)	(1.39)
Area of cultivated land Mz	10.84	9.86	1.86	-0.49
	(10.20)	(7.93)	(1.95)	(0.33)
Constant	60.67***	28.71*	13.88*	0.40
	(24.00)	(15.14)	(7.73)	(0.63)
R-squared	0.00	0.04	-0.01	0.01
N	186	186	186	186

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 2. DID treatment effect on agricultural conservation structures, for households with 1.5Mz<Cultivated land<=3Mz

	Conserv ag structures m/Mz	Stone barriers m/Mz	Live barriers m/Mz	Diches m/Mz
A4N=1	42.02***	27.63**	13.26***	4.21**
	(16.65)	(12.12)	(4.59)	(2.09)
Household size	14.79	12.67	-1.27	1.33
	(14.14)	(12.22)	(1.97)	(1.92)
Average education hh member years	-2.42	-3.36	-0.58	-0.37
	(3.60)	(2.67)	(0.90)	(0.35)
Area of cultivated land Mz	7.40	6.49	1.19	0.43
	(5.81)	(4.95)	(0.78)	(0.67)
Constant	20.44*	3.52	0.94	-0.33
	(10.67)	(5.71)	(2.19)	(0.61)
R-squared	0.08	0.09	0.03	0.02
N	199	199	199	199

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 3. DID treatment effect on agricultural conservation structures, for households with Cultivated land>3Mz

	Conserv ag structures m/Mz	Stone barriers m/Mz	Live barriers m/Mz	Ditches m/Mz
A4N=1	74.39***	31.49***	17.83***	7.72
	(26.68)	(11.17)	(7.16)	(7.63)
Household size	0.43	-0.16	0.96	2.12*
	(4.74)	(1.55)	(1.31)	(1.30)
Average education hh member years	0.33	1.70	-2.29	2.41
	(5.06)	(1.53)	(2.28)	(2.15)
Area of cultivated land Mz	0.91	0.25	0.33	0.07
	(0.84)	(0.27)	(0.32)	(0.16)
Constant	17.30**	3.85**	4.24**	8.04
	(8.44)	(1.57)	(1.98)	(6.50)
R-squared	0.03	0.04	0.03	-0.00
N	185	185	185	185

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 4. DID treatment effect on agricultural conservation practices, for households with Cultivated land<=1.5Mz

	Cons ag practices	Minimum tillage	Zero tillage	Vermiculture	Cover crops
A4N participant	0.20**	-0.08	0.20**	0.05**	0.03
	(0.09)	(0.09)	(0.08)	(0.03)	(0.02)
Household size	-0.03	0.01	-0.01	0.00	0.00
	(0.03)	(0.03)	(0.03)	(0.00)	(0.00)
Average education hh member years	-0.00	-0.03	-0.06**	-0.01	-0.03*
	(0.03)	(0.04)	(0.03)	(0.02)	(0.01)
Area of cultivated land Mz	0.01	-0.01	0.01	-0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)
Constant	0.18**	0.25***	0.03	0.01	0.00
	(0.07)	(0.07)	(0.06)	(0.02)	(0.01)
R-squared	0.04	0.01	0.06	0.03	0.05
N	186	186	186	186	186

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 5. DID treatment effect on agricultural conservation practices, for households with 1.5Mz<Cultivated land<=3Mz

	Cons ag practices	Minimum tillage	Zero tillage	Vermiculture	Cover crops
A4N participant	-0.03	-0.05	0.15	0.02	0.02
	(0.08)	(0.09)	(0.08)	(0.02)	(0.02)
Household size	0.01	-0.04	-0.00	0.00	-0.01
	(0.03)	(0.03)	(0.03)	(0.00)	(0.01)
Average education hh member years	0.01	-0.01	-0.02	-0.00	0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.00)
Area of cultivated land Mz	0.00	0.02	-0.01	0.00	0.01
	(0.02)	(0.01)	(0.01)	(0.00)	(0.01)
Constant	0.17**	0.14*	0.15*	-0.01	-0.02
	(0.06)	(0.07)	(0.06)	(0.01)	(0.01)
R-squared	0.003	0.02	0.02	0.01	0.05
N	199	199	199	199.00	199

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 6. DID treatment effect on agricultural conservation practices, for households with Cultivated land>3Mz

	Cons ag practices	Minimum tillage	Zero tillage	Vermiculture	Cover crops
A4N participant	-0.06	-0.30**	0.19*	0.08*	0.03
	(0.06)	(0.09)	(0.08)	(0.04)	(0.02)
Household size	-0.00	-0.01	0.01	0.00	-0.00
	(0.02)	(0.02)	(0.03)	(0.01)	(0.00)
Average education hh member years	0.01	0.01	0.02	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
Area of cultivated land Mz	0.00	0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.11*	0.26***	0.11*	0.00	-0.02
	(0.05)	(0.07)	(0.05)	(0.02)	(0.01)
R-squared	0.01	0.06	0.04	0.04	0.05
N	185	185	185	185	185

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 7. DID treatment effect on postharvest management, for households with Cultivated land<=1.5Mz

	Stored grain losses	Stored in metallic silos	Number of metallic silos owned
A4N participant	-0.06	0.06	0.07
	(0.12)	(0.06)	(0.07)
Household size	-0.01	-0.01	-0.01
	(0.04)	(0.02)	(0.02)
Average education hh member years	-0.00	-0.03	0.04*
	(0.05)	(0.02)	(0.02)
Area of cultivated land Mz	0.01	0.01	-0.01
	(0.02)	(0.01)	(0.01)
Constant	-0.10	0.01	0.13**
	(0.08)	(0.04)	(0.06)
R-squared	0.003	0.02	0.02
N	147	147	191

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 8. DID treatment effect on postharvest management, for households with 1.5Mz<Cultivated land<=3Mz

	Stored grain losses	Stored in metallic silos	Number of metallic silos owned
A4N participant	-0.28***	0.15**	0.16**
	(0.09)	(0.06)	(0.07)
Household size	-0.05	-0.03*	-0.03
	(0.03)	(0.02)	(0.02)
Average education hh member years	-0.01	-0.00	0.03*
	(0.02)	(0.01)	(0.02)
Area of cultivated land Mz	-0.02	0.01	0.02
	(0.02)	(0.01)	(0.02)
Constant	-0.01	-0.01	0.04
	(0.07)	(0.05)	(0.05)
R-squared	0.07	0.05	0.05
N	169	169	199

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 9. DID treatment effect on postharvest storage, for households with Cultivated land>3Mz

	Stored grain losses	Stored in metallic silos	Number of metallic silos owned
A4N participantA4N participant	-0.12	0.10	0.21*
	(0.09)	(0.08)	(0.10)
Household size	-0.03	0.02	0.05
	(0.02)	(0.02)	(0.03)
Average education hh member years	0.07*	0.03	0.03
	(0.03)	(0.02)	(0.03)
Area of cultivated land Mz	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Constant	0.03	0.14**	0.06
	(0.06)	(0.05)	(0.05)
R-squared	0.05	0.04	0.06
N	160	160	185

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 10. DID treatment effect on small livestock, for households with Cultivated land<=1.5Mz

	Number pigs	Number goats	Number poultry
A4N participant	0.06	0.40	0.60
	(0.11)	(0.34)	(1.77)
Household size	-0.01	0.00	0.53
	(0.04)	(0.02)	(0.64)
Average education hh member years	0.03	-0.01	-1.21
	(0.03)	(0.08)	(0.98)
Area of cultivated land Mz	0.10	-0.08*	0.17
	(0.07)	(0.04)	(0.20)
Constant	-0.03	-0.18	1.93
	(0.13)	(0.24)	(1.35)
R-squared	0.19	0.03	0.02
N	191	191	191

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 11. DID treatment effect on small livestock, for households with 1.5Mz<Cultivated land<=3Mz

	Number pigs	Number goats	Number poultry
A4N participantA4N participant	0.10	0.12	-1.22
	(0.15)	(0.11)	(1.60)
Household size	0.07	-0.01	-0.93**
	(0.06)	(0.01)	(0.40)
Average education hh member years	-0.01	-0.03	0.20
	(0.04)	(0.02)	(0.38)
Area of cultivated land Mz	0.01	0.02	0.86***
	(0.03)	(0.01)	(0.27)
Constant	0.11	-0.14	3.75***
	(0.09)	(0.14)	(1.07)
R-squared	0.01	0.01	0.06
N	199	199	199

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 12. DID treatment effect on small livestock, for households with Cultivated land>3Mz

	Number pigs	Number goats	Number poultry
A4N participant	0.26	-0.01	0.19
	(0.20)	(0.04)	(1.77)
Household size	0.11*	0.00	1.34**
	(0.06)	(0.00)	(0.45)
Average education hh member years	0.12*	0.01	-0.42
	(0.05)	(0.01)	(0.47)
Area of cultivated land Mz	-0.04**	-0.00	0.13
	(0.03)	(0.00)	(0.11)
Constant	0.24	0.03	3.23**
	(0.16)	(0.04)	(1.14)
R-squared	0.09	0.003	0.06
N	185	185	185

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 13. DID treatment effect on saving, credit, hunger, losses and kitchen garden, for households with Cultivated land<=1.5Mz

	Saving	Credit	Experienced period of hunger	Experienced crop losses	Kitchen garden
A4N participantA4N participant	0.22***	0.10	-0.03	0.14*	0.12**
	(0.07)	(0.07)	(0.08)	(0.08)	(0.05)
Household size	0.01	-0.02	0.05	0.03	0.01
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Average education hh member years	0.02	0.03	-0.02	0.01	-0.03
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)
Area of cultivated land Mz	0.01	0.01	-0.01	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-0.02	0.03	-0.17**	-0.07	0.02
	(0.05)	(0.05)	(0.06)	(0.06)	(0.03)
R-squared	0.06	0.03	0.02	0.03	0.04
N	191	191	191	191	189

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 14. DID treatment effect on saving, credit, hunger, losses and kitchen garden, for households with 1.5<Cultivated land<=3Mz

	Saving	Credit	Experienced period of hunger	Experienced crop losses	Kitchen garden
A4N participant	0.08	-0.03	-0.06	0.03	-0.02
	(0.06)	(0.07)	(0.08)	(0.07)	(0.04)
Household size	0.01	0.00	0.00	-0.04*	0.01
	(0.02)	(0.02)	(0.04)	(0.02)	(0.02)
Average education hh member years	0.04*	-0.01	-0.05***	-0.01	0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
Area of cultivated land Mz	-0.01	0.01	0.01	0.01	0.02***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Constant	0.12**	0.08	-0.17**	0.00	-0.01
	(0.05)	(0.06)	(0.06)	(0.06)	(0.03)
R-squared	0.03	0.004	0.03	0.02	0.06
N	199	199	199	199	198

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Table L 15. DID treatment effect on saving, credit, hunger, losses and kitchen garden, for households with Cultivated land>3Mz

	Saving	Credit	Experienced period of hunger	Experienced crop losses	Kitchen garden
A4N participantA4N participant	0.09	-0.13	-0.08	-0.05	0.02
	(0.08)	(0.09)	(0.08)	(0.07)	(0.05)
Household size	0.05**	0.04*	0.01	0.02	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Average education hh member years	0.04	-0.02	0.02	0.05**	-0.02*
	(0.03)	(0.02)	(0.03)	(0.02)	(0.01)
Area of cultivated land Mz	-0.00	-0.00	0.01***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.03	0.08	-0.06	0.14*	-0.06
	(0.05)	(0.06)	(0.05)	(0.05)	(0.03)
R-squared	0.06	0.03	0.00	0.03	0.02
N	185	185	185	185	184

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%

Appendix M. Impacts on long-term outcomes related with agricultural income and household wealth.

The analysis of overall project impacts aims to determine the impact of the adoption of the different practices promoted by the project on outcomes such as production, gross margins and revenues from agricultural activities. The long-term goal of the project is to increase agricultural income and household wealth. Several proxy variables were available to measure these project impacts. For agricultural income, they include: bean yields, maize yields, farm gross margins, total value of production of main crops (maize, bean, sorghum and millet), total value of production of livestock products (meat, eggs, dairy). Another long-term outcome of interest is increases in household wealth. An indicator of agricultural assets is the number of tropical livestock units (TLU). Impacts were measure using the same methods used in Chapter 2, FD, PSM-DID and PSW.

The FD estimates suggest no impacts on bean and maize yields (Table M 1). Since the project was on its earlier stages when this impact evaluation was conducted, is possible that farmers are still learning and experimenting with new practices that are not yet translated into increases in yields for the main crops they produced. In general the estimates using FD, PSM-DID and PSW suggest that the project did not have an impact in agricultural income and household wealth related outcomes. The estimates for the monetary measures of agricultural income are not

statistically significant and very imprecise, as shown by its very high standard errors (Table M 1)[10].

Table M 1. Project impact on agricultural income and household wealth related outcomes.

		PSM-DID			
Difference outcome variables	**DID untrimmed**	**kernel (epan)**	**NN(5)**	**llr (tricube)**	**PSW**
Bean yields qq/Mz [1]	-0.76	-0.85	-0.72	-0.86	-2.05
	(0.89)	(1.32)	(1.50)	(1.68)	(2.57)
Maize yields qq/Mz [2]	-1.23	-1.98	-2.23	-1.42	-0.36
	(1.86)	(2.82)	(2.95)	(3.25)	(1.14)
TLU [3]	0.09	-0.03	-0.02	-0.05	-0.04
	(0.17)	(0.20)	(0.22)	(0.22)	(0.21)
Farm gross margins C$2011	735	3006	2650	2611	3259
	(3869)	(3142)	(3651)	(3298)	(2690)
Value main crops [4] C$2011	-2755*	-760	-601	-780	-1547
	(1507)	(1814)	(2015)	(1963)	(1752)
Value of livestock and poultry products [5] C$2011	59	684	835	837	720
	(804)	(800)	(935)	(848)	(902)

Standard errors (se) in parenthesis, DID robust se, PSM-DID and weighed PS se bootstrap with 1000 repetitions
Levels of significance ***1%, **5%, *10%
U$1=C$22.42 in 2011, qq=100Kg
NN refers to nearest neighbor, LLR to local linear regression
Untrimmed sample n=575, trimmed sample for PSW-DID and PSW n=554
A total of 265 pairs formed with PSM-DID

[1] Excludes intercropping, non-trimmed sample n=335, trimmed sample n=323

[2] Excludes intercropping, non-trimmed sample n=246, trimmed sample n=234

[3] TLU refers to tropical livestock units, conversion factors are: horses 0.8; cattle and mule 0.7; asses 0.5; pigs 0.2; goat, sheep 0.1; poultry 0.01 source: http://www.ilri.cgiar.org/InfoServ/Webpub/fulldocs/X5443E/X5443E04.HTM

[4] Estimated at village level prices, only for households that produced maize, beans and sorghum. Non trimmed sample n=541, trimmed sample n=521

[5] Estimated at self-reported prices

[10] Due to this issue, we conducted quantile regression to estimate average treatment effects in the median (not presented here) instead of the mean, but the results were also not statistically significant.

The descriptive statistics for project outcomes appear in Table M 2. Farm gross margins, value of main crops and value of livestock products were measured with high variability. Standard errors are high for both 2009 and 2011, which is explained by the effects of extreme weather events on those years in crop production and yields. The variability due to weather shocks incorporates noise into the estimates, making it difficult to draw conclusions from the analysis. Moreover, it is not surprising that we do not find impacts in income and wealth just after two years of the project.

Looking at the analysis of outcomes by area of cultivated land, results suggest that households with small area decreased their production of beans and maize (Table M 2). Therefore the overall decrease in bean production that we found (Table M 2) comes from the decreases for this group. During 2009-2011 the percentage of households in this group that experienced crop losses of at least 25% increased 14%, and crop losses for farmers included in the sample were severely felt during the heavy rains in 2011. However, thanks to the project, counting with savings might have helped these groups of farmers to cope with this situation.

Table M 2. Heterogeneity of program impacts in outcomes related to agricultural income and household wealth.

	Terciles of Cultivated land					
	<=1.5Mz n=191		1.5<land<=3Mz n=199		>3Mz n=186	
Outcomes	**Coef**	**se**	**Coef**	**se**	**Coef**	**se**
Bean yields qq/Mz	-1.90	(1.99)	0.01	(1.11)	-1.05	(1.61)
Maize yields qq/Mz	-3.43	(4.01)	-2.31	(2.76)	1.47	(3.62)
TLU [1]	0.18	(0.23)	-0.01	(0.24)	0.13	(0.37)
Farm gross Margins C$2011	-4770	(3089)	-960	(4009)	9543	(10668)
Value main crops C$2011	-5523*	(2482)	-2566	(2285)	-2385	(3052)
Value of livestock products C$2011	532	(1156)	-358	(946)	277	(1996)

Robust standard errors (se) in parenthesis
Levels of significance ***1%, **5%, *10%
1 Mz = 1.73 acres, 1 qq = 100 Kg
U$1=C$22.42 in 2011
[1] TLU refers to tropical livestock units, conversion factors are: horses 0.8; cattle and mule 0.7; asses 0.5; pigs 0.2; goat, sheep 0.1; poultry 0.01 source: http://www.ilri.cgiar.org/InfoServ/Webpub/fulldocs/X5443E/X5443E04.HTM

Appendix N. Pretreatment characteristics of villages considered for the trust game.

Table N 1. Village pretreatment characteristics.

	Village	Population 2005	Households 2005	% inadequate housing 2005	% houses no electricity 2005	% houses no piped water 2005	% households produce basic grains 2003	% farms with landholding >10 Mz 2003
non-A4N	Llano Redondo	168	38	46%	44%	59%	94%	59%
	El Quebracho	125	25	93%	53%	17%	94%	58%
	Licoroy	216	49	57%	67%	90%	78%	22%
	San Lorenzo	296	58	34%	41%	87%	73%	23%
	Cebadilla	157	33	73%	84%	46%	100%	13%
	La Laguna	131	25	17%	41%	79%	50%	50%
	Llano Largo	377	78	19%	30%	30%	82%	44%
	Las Lajas	-	-	-	-	-	73%	40%
	Cuajiniquil	-	-	-	-	-	94%	47%
	Las Puertas	200	38	67%	86%	84%	100%	38%
A4N	San Antonio	160	31	57%	76%	81%	100%	30%
	El Espinal	655	142	54%	84%	85%	100%	40%
	Las Cuevas	699	114	60%	18%	95%	91%	52%
	Las Cañadas	307	67	26%	6%	2%	42%	67%
	Tomabu	585	128	74%	30%	96%	100%	78%
	Las Tablas	322	75	45%	3%	80%	92%	48%
	Rosario (Arriba+ Abajo)	613	126	74%	88%	53%	8%	45%
	La Pacaya	289	53	63%	85%	85%	2%	100%
	Concepción	348	79	25%	17%	22%	100%	9%
	Mechapa	641	135	27%	32%	83%	75%	61%
	El Hornillo	251	51	49%	65%	57%	75%	25%
	Las Gavetas	156	39	41%	5%	86%	100%	25%
	Quebrada de Agua	203	38	60%	84%	88%	83%	83%
	Average non A4N	209	43	51%	56%	61%	84%	39%
	Average A4N	402	83	50%	46%	70%	75%	51%
	P values	0.02	0.02	0.95	0.47	0.50	0.45	0.23

Source: Instituto Nacional de Estadisticas y Censos (INIDE) Nicaragua
Ministerio Agropecuario y Forestal (MAGFOR) Nicaragua

Appendix O. Number of groups per village, number of group members in 2011, population and households 2005, considered for the trust game.

Table O 1. Number of groups per A4N village, number of members in 2011, pretreatment population and households in each village 2005.

Village	A4N groups	No. Group members	Population 2005	Households 2005
Cañada	2	33	307	67
Espinal	2	23	655	142
Hornillo	2	34	251	51
La Concepcion	1	7	348	79
La Laguna	1	8	131	25
La Pacaya	1	7	289	53
Las Animas	1	16	129	25
Las Cuevas	2	33	699	114
Las Gavetas	4	61	156	39
Las Lomas	1	14	95	22
Las Tablas	2	63	322	75
Mechapa	2	27	641	135
Monte Verde	1	13	144	30
Potrerillo	2	21	122	24
Rosario Abajo	3	37	613	126
San Antonio	1	17	160	31
Tablas	1	25	322	75
Tomabu	4	87	585	128
coefficient of correlation between number of groups and population 2005		0.41		

Source: Fundación para la Investigación y el Desarrollo Rural (FIDER)
Instituto Nacional de Estadisticas y Censos (INIDE) Nicaragua

Appendix P. Consent script for the trust game.

Statement of Consent

Program Participation, Economic Impact, and Agricultural Practices among Nicaraguan Smallholder Farmers

We are conducting a research study to understand trust attitudes among farmers in villages of western Nicaragua. The study is conducted by Michigan State University and Nitlapan at the Universidad Centroamericana. From this study, researchers hope to gain methodological insight in experimental economics. You will participate in an economic experiment with us today, consistent in determining monetary amounts you are willing to share with others. At the end of this activity you will be presented with a short survey. The survey will first ask you to identify several demographic features about your household, your farm activities and your participation in agricultural projects.

To participate in this activity you must be 18 years old or older. Your participation in this experiment and the subsequent survey is voluntary, so you are free not to participate at all and you may terminate your participation at any time with no penalty. However, I want to encourage you to participate, since this activity will allow us to better design rural development projects. This session will take one hour. At the end of the agenda for the day you will receive the earnings from the experiment.

Although you will not directly benefit from your participation in this study, however, the lessons from it may help in designing better agricultural projects and we know of no risks associated with this study. Your privacy will be protected to the maximum extent allowable by law. All the information you provide us will be kept confidential, with the questionnaire locked in a cabinet at Michigan State University for three years after the research is completed. This means that no one except the researchers and the MSU Human Research Protection Program will have access to your answers. We will not identify you or your household in any publication from this study.

If you have any questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact Professor Scott Swinton by email (swintons@msu.edu), by telephone at (1) 517-353-7218, or by postal mail at Michigan State University, East Lansing, MI 48824-1039, USA. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 207 Olds Hall, Michigan State University, East Lansing, MI 48824.

You indicate your voluntary agreement to participate by beginning with the experiment. Thank you again for your help with this important research about trust among farmers in villages in western Nicaragua.

Appendix Q. Game procedures in the field

- Contact local leaders to conduct recruitment. In our case since we wanted to have 20 subjects per session, we recruited 30 subjects.

- Everyday night before each activity, we have to make sure that we have all the lists of recruited subjects, templates (Cardenas & Ramos, 2006), surveys, fake bills and money required for the activities is ready.

- For the different sessions, find either schools, community centers, churches or big houses, where is possible to use two separate spaces for conducting the sessions.

- When recruited subjects arrive at the experiment venue, take down their name (either write it down on a participant sheet, or check them off a list you already have), assign them to a role (sender or returner) and give them a participant number. In a piece of paper, or computer spreadsheet, we will have available the code of each player and the codes for each couple, in such a way that when recording time comes up, we will just need to know the participant's code. Couples will be already be formed, by randomly assigned number in excel spreadsheet, and nobody but the PI will have this information. Participants' code will be handed to each participant in big pieces of paper that can be seen by the researchers conducting the experiments.

- After a number of subjects of at least 14 and after waiting for reasonable time for subjects to arrive, the session will start. Once the session has started a person will be at the door indicating to subjects arriving late that the session has already started and no more people is allowed. This is done with the aim of having all subjects participating in the sessions have the same information from the very beginning, and for not having disrupt the explanation of the dynamic of the game to subjects who arrived on time.

- We will introduce ourselves (PI and helpers) read the consent script aloud and provide copies of it to subjects. Then the instructions for the game will be given orally to all subjects. Then explain the dynamic of the game, we will do this adapting Cardenas & Ramos (2006) (see Peralta and Shupp, 2013) manual for economic games with the helpers we will also act the game in front of all the participants in the activity, and provide examples of possible outcomes of the game, to ensure understanding of the activity by everybody attending the sessions.

Here in some of the examples to be provided during the explanation of the game:

Initial S	Initial R	Sent S to R	Kept S	Received R	Total R	Returned R to S	Total earning S	Total earning R
100	100	50	50	150	250	50	100	200
100	100	0	100	0	100	0	100	100
100	100	100	0	300	400	200	200	200
100	100	80	20	240	340	160	180	180
100	100	20	80	60	160	20	100	140
100	100	60	40	180	280	120	160	160
100	100	30	70	90	190	50	120	140

S: sender, R: receiver.

- Separate the two groups in different rooms or spaces and ask them not to talk to each other, having a facilitator in the room or space with each group.

- Senders will be called one by one to a separate area, away from both the rest of the senders and receivers, to make their decision on how much they will send. While this process is taking place, the helper in the room with the receivers will be asking them a set of trust attitudinal questions, in our case the GSS questions and a set of questions written by our own.

- Have a desk with a cover area (maybe using cardboard box for that) where we ask the participants to come over, first start with the senders, one of the facilitators will be there with them to repeat the instructions. They will be given two envelopes with a set of blank fake bills, and one color envelope with a set of fake bills with denominations of C$10 each, for a total of C$100, the amount that we will be giving to each participant as endowment. Using two different colors to indicate what is sent and what is received.
  The senders will be told that:
  "Here you have a *color* envelope with 10 fake bills of C$10, and a *blank* envelope with blank fake bills. You will make a decision on how much from those fake bills to send to a receiver, the identity of the receiver will not be reveal to you. Please remember that the amount that you will be sending to the receiver will be tripled. For example, if you send C$10, the receiver will get C$30, of you send C$50, the receiver will get C$150, if you send C$100, the receiver will get C$300. Please let me know if you have any questions"
  "Later on this activity you will receive some money back from the receiver, or the other person that will send money to you. Please let us know writing down on this piece of paper, how much money are you expecting to receive back. You can write the amount down in private and fold this piece of paper when returning it to me".

- After all the senders have made their decisions, and these decisions have been recorded and the amounts sent tripled, we will start with the process with the receivers. Receivers are called one by one to make their decisions on the space designated for that.
  Give the receiver the following instructions:
  "Here you have a *color* envelope with the amount of money you have been sent by the sender, that has been tripled, as explain previously to you. For example, if you were sent C$10, you are receiving C$30, if you were sent C$50, you will received C$150, if you were sent C$100, you will receive C$300, you will receive this amount plus a C$100 endowment. All this money will be given to you in bills of C$10".
  "Before you make this decision, and open this envelope, please write down on a piece of paper, how much you are expecting to receive from the sender. Please let us know writing down on this piece of paper. You can write the amount down in private and fold this piece of paper when returning it to me".

- While receivers are being called to learn how much they were sent and to make their decision on how much to return, the helper in the senders room will be asking them the attitudinal trust questions mentioned before, the GSS questions and the attitudinal questions we wrote.

- A separate area will be set for data recording. We put the participants code in a piece of paper inside the envelope allowing recording the amount sent once we receive the envelope, this amount will be tripled, we will take out the number of the sender and introduce the number of the receiver in the envelope. After all the senders make their decisions, and all the envelopes for the receivers have been organized, they are put in a bag, where they will be drop randomly by the helper, who will start calling the receivers to make their decisions. We collect all the data and ask for the participants to return their envelopes. Then while we collect the data and organize the payments, the subjects will be filling a survey.

- Subjects who complete filling the survey, can come to a separate area to receive their earning from the game in cash, they will be asked to leave quietly and to not to talk about their decisions and the game.

Some additional notes:

- If there are 20 players, 10 will be "senders" and 10 will be "returners". The 10 senders could have participant numbers 1, 2 , 3,…10 while the 10 returners could have participant numbers 11, 12, 13,…20. We could then do a reverse match where 1 is matched with 20, 2 is matched with 19, etc. This would keep people who arrive together from being matched with each other since we should assign roles by alternating as people arrive to make sure we have as close to an equal number of senders and returners as possible. We could just assign people participant numbers randomly by handing packets and thus participant numbers out in a quasi-random way as they arrive – the only thing you need to be careful with here is keeping track of which numbers you have assigned in case not everybody comes (say 17 of the 20). Then you can adjust your matching scheme to take that into account. We will also probably want to over prepare…that is, have enough stuff and participant packets etc. for more than 20 in case extra people come and are eligible to participate.

- What do you do when there are an odd number of participants? Well, if you have been handing out packets/assigning roles such that the odd participant (i.e, the 3rd, 5th, 7th, etc arrival) is always assigned the role of "returner" then, while you are opening the "sender" envelopes, recording the amount sent, adding the investment return, and putting that into a separate "returner" envelope (with the returner's participant number NOT the sender's participant number – there needs to be this switch so neither participant can figure out who they were paired with by asking later "so, what participant number were you?") you can "create", by duplicating a random sender's choice, an extra "returner" envelope for the "returner" participant who doesn't have a "sender" partner. Essentially, you are using one random "sender's" decision twice. The extra returner gets to make a decision, but the returned money doesn't go to anyone, you intercept it in the process of collecting and recording the "returner" envelopes and decisions. The random sender only gets the "returner" envelope from their assigned partner. Remember, we need to switch the money back into the "sender's" envelope so the sender can't tell the number of the participant they were matched with.

Appendix R. Trust game instruments

Trust game

Fake bills:

Template per couple of players

Decisions and results format

Couple number: _____

(Fulfill a format per each couple that has been formed)

Place:_____ Date (day/month/year): ___/___/___ Inicial time: ___:____ (am/pm)

A	B	C	D	E	F	G	H	I
Initial amount P1	Initial amount P2	Sent by P1 to P2	Kept P1	Received P2 (Cx3)	Total P2 (B+E)	Returned P2	Earnings P1 (D+G)	Earnings P2 (F-G)

Total payment P1: _____

Total payment P2: _____

Register of players decisions

Trust game

Place: _____ Date (day/month/year): ___/___/___ Time: ___:____ (am/pm)
Enumerator:_____

Couple	Code P1	Code P2	Sent P1 to P2	Kept P1	Received P2	Total P2	Returned P2	Earnings P1	Earnings P2

Templates from Cardenas and Ramos, 2006.

Appendix S. Survey instrument, for participants in the trust game.

Read consent script before start.

[ ] 1 Beneficiary [ ] 0 Non beneficiary

Participant ID number: _____ Date: ____(dd)/____(mm)/_____(yyyy)

Player type (mark with an X): [ ] 1 [ ] 2

1. General information:

1.1 Department: _____

1.2 Municipality: _____

1.3 Village: _____

Questions asked to type 1 players ONLY:

2 During the activity, did you think that your decisions affected the decisions made by the person you were partnered with? [ ] 1 Yes [ ] 0 No

Explain why (briefly) _____

_____

3 For this kind of activity, do you think most people would think:

[ ] 1 The more money people send the more they will get back

[ ] 2 People will not send much money, because they are not going to get much money back, regardless of how much money they send.

Questions asked to type 2 players ONLY

4 During the activity, did you think that the decision made by the person you were partnered with considered what you would be deciding next?
[ ] 1 Yes [ ] 0 No

Explain why (briefly) _____

_____

5 For this kind of activity, do you think most people would think:

[ ] 1 The more money people receive, the more money people will send back.

[ ] 2 The more money people receive, the less money people will send back.

6 Demographic characteristics:

6.1 Age? (in years): _____

6.2 Gender? [ ] 1 Male [ ] 0 Female

6.3 Relationship with household head:

[ ] 1 Head
[ ] 2 Spouse
[ ] 3 Son/daughter
[ ] 4 Father/mother
[ ] 5 Brother/sister
[ ] 6 Grandson/granddaughter
[ ] 7 Non relative
[ ] 99 Other, specify _____

6.4 Number of people in the household? _____

6.5 Level of education in years (maximum level approved):_____

6.6 For how long have you been living in your village? _____(years/months)

6.7 What do you do most of your time (mark with an X):

[ ] 1 Works in own farm
[ ] 2 Agricultural worker
[ ] 3 Non agricultural worker
[ ] 4 Professional
[ ] 5 Self employed
[ ] 6 Student/attending school
[ ] 7 Housewife
[ ] 8 Unemployed
[ ] 99 Other, specify _____

6.8 Participation in groups or associations.

[ ] 0 None
[ ] 1 Producers group
[ ] 2 Marketing group
[ ] 3 Savings group
[ ] 4 Women's group
[ ] 5 Youth group
[ ] 6 Church group
[ ] 7 Watershed committee
[ ] 8 Village Council
[ ] 11 Sports group or team
[ ] 12 Political organization
[ ] 13 School Committee
[ ] 99 Other, specify _____

6.9 If participate in a group or association, please complete question 6.9, otherwise continue to question 7.

In the group the person is part of, the person is:

[ ] 1 President
[ ] 2 Vice-president
[ ] 3 Secretary
[ ] 4 Treasurer
[ ] 5 Member
[ ] 99 Other, specify_____

7 Housing characteristics

7.1 Is your house [ ] 1 Owned [ ] 2 Rented

[ ] 99 Other, specify_____

7.1 How do you obtain water for your house?

[ ] 1 River, spring
[ ] 2 Pipe inside the house
[ ] 3 Pipe outside the house
[ ] 4 Well
[ ] 99 Other, specify_____

7.2 What type of hygienic service do you have in your house?

[ ] 1 None
[ ] 2 Latrine outside the house
[ ] 3 Toilet connected to sewage system
[ ] 99 Other specify_____

7.3 What type of lighting do you have in your house?

[ ] 1 Electric power
[ ] 2 Candle
[ ] 3 Solar panel
[ ] 99 Other specify_____

8 Land uses

8.1 Distribution of cultivated land in the last cropping season where you grew crops, according the following land uses.

Area in Mz						
Maize	Beans	Maize and beans intercropped	Other annual crops	Plantations	Forages	Other land uses

8.2 Land property, please specify the ownership of the plots you grew in the lastcropping season.

Plot	Area in Mz	Ownership 1. Owned 2. Rented 3. Share crop 4. Borrowed 5. Rented 99. Other, specify
1		
2		
3		
4		
5		

9 Agricultural production 2011-2012. Please start with the main crops grown in the farm.

Crops 1 Maize 2 Beans 99 Other, specify	Season Write code 1 Apante 2 Primera 3 Postrera 4 All year	Production	Unit of measurement	Sales	Household consumption

10 Livestock inventory:

Please provide livestock inventory at May 1st 2012

Animal	How many do you have? No.	Observations
Chicken		
Turkey		
Hugs		
Horses		
Donkey		
Mule		
Cow		
Bull		
Steers		
Calves		
Goats		
Sheep		
Lamb		
Rabbits		
Bee hives		

11 Agricultural income

11.1 On average, what is the amount of your annual revenues from agricultural activities (annual, perennial crop product sales and livestock, including livestock products)?

[ ] 1 C$0-C$500
[ ] 2 C$501-C$1000
[ ] 3 C$1001-C$2000
[ ] 4 C$2001-C$3000
[ ] 5 C$3001-C$4000
[ ] 6 C$4001-C$5000
[ ] 7 C$5001-C$6000
[ ] 8 C$6001-C$7000
[ ] 9 C$7001-C$8000
[ ] 10 C$8001-C$9000
[ ] 11 C$9001-C$10000
[ ] 12 C$10001-C$15000
[ ] 13 15001 and more

12 Did you work outside of your farm in other activities during the last 12 months?

[ ] Yes [ ] No

12.1 If yes, what did you do? _____

12.2 How much did you make on this activity, on average, per week?_____

12.3 How many weeks? _____

13 Did you migrate over the past 12 months to work in other part of Nicaragua, or overseas for work?

[ ] Yes [ ] No

13.1 If yes, what did you do? _____

13.2 Where did you go? _____

13.3 How much money did you earn in total? _____USD/C$

14 Did you receive any contributions from household members/other people leaving in other parts of Nicaragua or overseas during the last 12 months?

[ ] Yes [ ] No

14.1 How much did you receive in total? _____USD/C$

15 Between 2009 and 2012, did you participate in activities with any organization in rural development projects? [ ] Yes [ ] No

If yes please mention the activity and the institution, if not continue with question 16.

Activity you developed with the Project	Institution
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

The following questions will be asked during the time experiment participants are making their individual decisions. Questions will be asked by helpers and participants will be distributed the answer sheet formats.

16 Generally speaking, do you consider that most people can be trusted, or that you cannot be too careful in dealing with people?

[ ] 1 You cannot be too careful in dealing with people
[ ] 2 Most people can be trusted
[ ] 88 Do not know

17 Do you think most people would try to take advantage of you if they got the chance, or would they try to be fair?

[ ] 1 Would take advantage of you
[ ] 2 Would try to be fair
[ ] 88 Do not know

18 Would you say that most time people try to be helpful, or that they are just looking out for themselves?

[ ] 1 Just look out for themselves
[ ] 2 Try to be helpful
[ ] 88 Do not know

19 In general, do you think that people in your village are interested in getting together to work with a common goal?

[ ] 1 Very interested
[ ] 2 Not very interested
[ ] 3 Not interested
[ ] 88 Do not know

20 Do you agree with the following statement:

People in your community are interested in getting together to work for a common goal.

[ ] 1 Strongly agree
[ ] 2 Agree
[ ] 3 Neutral (not agree, not disagree)
[ ] 4 Disagree
[ ] 5 Strongly disagree

21 Do you agree with the following statement:

In general, most people in your village trust people in your village.

[ ] 1 Strongly agree
[ ] 2 Agree
[ ] 3 Neutral (not agree, not disagree)
[ ] 4 Disagree
[ ] 5 Strongly disagree

22 Do you agree with the following statement:

In general, people in your village only cares about themselves most of the time

[ ] 1 Strongly agree
[ ] 2 Agree
[ ] 3 Neutral (not agree, not disagree)
[ ] 4 Disagree
[ ] 5 Strongly disagree

Thank you for your help.

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