Analysis of the Sustainability of Selected Targeted NGO Interventions for a Representative Small-Scale Farm Family in Ecuador

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Abstract: Linear programming techniques are used to illustrate the potential effects of targeted agricultural development interventions by non-governmental organizations. The results demonstrate the interconnection of nutrition, agricultural production, and economics in determining optimum decisions for farm families in the study area in northern Ecuador. The findings suggest that planned interventions for small-scale farmers should first consider a range of nutritional, agricultural, and economic factors before an intervention is implemented. Otherwise, planned interventions that focus on only one aspect of the family's well-being have a high probability of being unsustainable.

Keywords: International development, NGOs, small-scale agriculture.

The number and role of non-governmental organizations (NGOs) conducting international development programs have steadily expanded since 1970 with over 20,000 such NGOs now in operation (Werker and Ahmed 2008; Edwards and Hulme 1995; Lewis and Kanji 2009).[1] NGO activities and programs are usually designed to provide assistance to poor people in developing countries and are referred to as "interventions" because they attempt to change either the conditions or behavior of recipients as a means to improve their well-being. Because NGOs rely on public and/or private donations for their existence, these interventions essentially reflect donors' beliefs regarding the types of interventions that should be implemented (Bebbington *et al*. 2007; Kech and Sikkink 1998).

NGO interventions serve many different needs and target populations. For example, interventions may be directed at urban or rural residents. They may be highly sophisticated and simultaneously address a spectrum of needs for the target population such as agricultural development, nutrition, and education. Other interventions may be highly specific or targeted such as providing vaccinations against a single disease or promoting particular cropping methods (e.g., TISRA 2013). Interventions may be implemented at the individual, community, district, or national levels.

Given the resources expended on international development efforts by rich nations and private donors, there is surprisingly little research evaluating[2] the quality, effectiveness, and sustainability of NGO interventions (Werker and Ahmed; Erickson 2012). Werker and Ahmed suggest NGOs' incentives are to manage donor expectations and satisfaction rather than to closely monitor recipient satisfaction with the interventions they receive. Also, many private sector NGO donors make relatively small donations and do not necessarily expect detailed follow-up and analysis regarding the effectiveness of how these resources are spent. As a result some NGOs tend to manage donors more from a public relations rather than a "bottom-line" perspective of the effectiveness of interventions (Werker and Ahmed).

Well-intended interventions may improve one aspect of the recipient's life in the short-term, but ignore broader impacts such as reduced income or other lost opportunities resulting from participation in an intervention. In economic terms, NGOs may ignore recipients' opportunity costs of participation. Ignoring these implicit costs may result in the intervention being unsustainable. For example, providing subsidized or free agricultural inputs to small-scale farmers may

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[1]From this point forward the term NGO refers to NGOs engaging in international development activities.

[2]While we do not gather data to evaluate long-run adoption rates and impacts on household level income and health (nutrition), we are indirectly assessing the likelihood of long-run adoption by using an *ex ante* rather than an *ex post* evaluation of the interventions considered in this study.

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make labor-intensive crops such as garden vegetables profitable for the farmers to grow in the short-run.[3] However, when the intervention concludes and the input(s) is (are) no longer free or subsidized, farmers may find that other activities, such as working off the farm or growing cash crops, provide a higher income and, consequently, a better living standard for their families than growing vegetables. As a result, they will cease growing vegetables when the subsidy provided by the NGO concludes.

For recipients to continue deploying an intervention after the NGO program ends, they must consider the intervention to be of long-term value. The long-term value of the intervention may depend heavily on opportunity costs, the family's nutritional needs, and the suitability of the farm family's resource endowment[4] to the intervention. This makes long-run adoption of an intervention a more complex decision than simply whether or not to accept a free or subsidized service or product from an NGO in the short-run. The analysis presented here attempts to integrate a few of the factors influencing a farm family's choice to adopt an intervention or not based on the likelihood the family would implement selected NGO interventions if subsidies are not provided.

The objective of this paper is to determine if selected targeted interventions aimed at changing recipient behaviors are sustainable. An analysis is presented which focuses on three factors[5] affecting a farm family's well-being, namely agricultural production decisions, economics, and nutrition. The results report expected net household income assuming optimum decisions under different potential NGO interventions and given a representative farm family's initial resource endowment. The findings illustrate that these factors (agricultural production decisions, economics, and nutrition) cannot be considered in isolation when implementing NGO interventions because doing will likely result in interventions that are unsustainable. The specific interventions considered in the analysis are 1) encouraging the representative farm family to be self-sufficient (growing garden vegetables while minimizing purchases of food at local markets) and 2) encouraging the representative farm family to achieve specific nutritional targets. Each of these interventions represents interventions that can or are being pursued by NGOs in the study area. The analysis also considers the impact of specific opportunity costs associated with these interventions by either allowing or restricting off-farm employment and the hiring of on-farm labor. The likelihood of long-run adoption of these interventions (sustainability) is determined based on whether or not the projected result of the intervention is consistent with economic incentives to continue the intervention if no NGO funding (subsidization) is available.

The study area is a poor, rural community in northern Ecuador and the unit of study is a representative family living on a farm consisting of one hectare of land. Data include detailed estimates for costs and returns (enterprise budgets) for the study area for 26 crops and livestock enterprises the farm family could produce as well as prices for food products produced by these crops and livestock enterprises. Prices for food products available at local markets, wage rates for off-farm employment and hired on-farm labor, nutritional requirements for the representative family, and non-food household expenditures are also used in the analysis.

The results of the analysis illustrate the connections among farm production decisions (including decisions about off-farm employment), family nutrition, and family income. They demonstrate, at least for the study area, that when off-farm employment opportunities are available, the representative farm family will tend to produce cash field crops rather than relatively labor-intensive garden vegetables, especially when fruits and vegetables are relatively inexpensive to purchase at local markets. The analysis indicates that encouraging self-sufficiency or some nutritional targets (i.e., My Plate) are not likely to be sustainable over time because alternatives other than these targeted interventions can meet the basic nutritional needs of the family while generating higher household incomes.

NUTRITION, AGRICULTURAL PRODUCTIVITY, AND POVERTY

International aid and development activities are as varied as the needs of the people they are intended to serve. These activities include 1) agricultural development; 2) economic development; 3)

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[3]Some interventions are intended to occur at only one point in time without necessarily changing recipient behavior. An example would be human vaccination programs.

[4]For example, do land and water resources match the intervention well? Are markets accessible? Are market transaction costs reasonable? Does the family have enough labor available to continue the intervention or will labor need to be hired?

[5]Many factors could potentially be considered when evaluating a potential intervention such as education and health. However, the results presented here are sufficient to demonstrate that targeted interventions potentially adversely affect other aspects of the small-scale farm family's lives resulting in unsustainability.

international relief (including food aid and emergency relief); 4) education development; 5) health development; 6) science and technology development; 7) fostering democracy and civil society development; 8) environment, population and sustainability issues; and 9) human rights, migration, and refugee issues (Reid and Kerlin 2006). Each of these activities is important in terms of real needs existing in the developing world. Also, each of these activities has significant funding from public and private sources to implement development programs, many of which are delivered by NGOs.[6]

Seventy-five percent of the world's poor live in rural areas and most are involved in agriculture. According to the World Bank (2012), agriculture remains fundamental to economic growth, poverty alleviation, and environmental sustainability. Rural industrialization in the developing world is very limited so smallholder agriculture continues to be the primary source available for economic growth and improving the lives of the rural poor (Berdegué and Fuentealba 2011). In this study, we consider interventions at the level of a representative individual small-scale farm family. Consequently, the focus of this paper is on interventions that relate to decisions about agricultural production, family nutrition, and off-farm employment because these are factors within the relative immediate control of the farm family.[7]

The importance of nutrition and its connection to chronic hunger is clear (Engle *et al*. 2007; WHO 2008; Schoendorfer *et al*. 2010; Benton 2010; Paus 2010; UNICEF 2012); Deboer *et al*. 2012). A common theme in international development is that solving world hunger requires increasing agricultural productivity in the developing world (Keulen and Breman 1990; Claessens and Feyen 2006; Place 2009; USAID 2013a). While increasing agricultural productivity is important to reducing hunger in the developing world, the relationship between poverty and hunger is often overlooked. Economics can help explain this connection by describing the factors that keep people poor and, consequently, hungry. This is especially true in rural areas and economics should be a fundamental part of analyses of small-scale agriculture and development interventions. For example, providing food aid may actually be destructive to the agricultural economy of the recipient nation resulting in more hunger and poverty in the long-run because it undercuts local farmers who cannot compete with free food or food subsidized below market prices (Oxfam 2005; Barrett 2006; Mourmouras and Rangazas 2007; Brautigam 2009). Market imperfections may also lead small-scale farmers to pay more for inputs, receive less than full farm-gate price when they sell their crops, and have difficulty in obtaining needed capital (WHO 2012; Sharma 2009; Banderjee and Duflo 2006; Mousseau 2005).

Choosing to focus in this analysis on the impact of selected NGO interventions on economics, agricultural production, and nutrition is consistent with the Millennium Development Goals (MDG) established by the United Nations (UN). The first goal (MDG 1) calls for the eradication of extreme poverty and hunger. The UN indicates the achievement of this goal is crucial for national progress and development (UN 2010).[8] Because donor support will likely take into account MDG 1, it will lead many NGOs to gear their fundraising activities and programs toward a message of reducing poverty (economics) and hunger (nutrition). NGO programs in rural Ecuador will likely echo these themes given that almost a quarter of children under age five in Ecuador are malnourished (Wuaya 2011) and many if not most Ecuadorian farmers are small and poor.[9]

STUDY AREA AND SURVEY

The community of Cochas La Merced is located within the province of Imbabura Ecuador near the Columbian border and is situated at about 2,800 meters above sea level. The community was a part of a large plantation in the past that was divided[10] into sections called "huasipungos," which is a Quichua word for a small portion of land, and given to the former workers and their families. Each family received an average of between 1-2 hectares of land. The study area was selected because it is similar to many such communities in the northwest part of South America

[6]The role of NGOs in international development efforts has expanded as governments increasingly outsource services, the non-profit sector has expanded through "not-for-profit entrepreneurship," and as NGOs have become more sophisticated and better managed (Werker and Ahmed). Not-for-profit entrepreneurship refers to the expanding development and financing of not-for-profit entities (including NGOs) based on new ideas and innovations to address development and other humanitarian aid issues.

[7]For example, the impact of education or health care decisions by the family could also be candidates for inclusion in the analysis. The family's decisions about farm production, economics and nutrition are sufficient to illustrate the important and complex interactions among these factors and how targeted interventions may be unsustainable as a result.

[8]One method to assess progress toward achieving MDG 1 is measuring the prevalence of underweight children under the age of five (UNICEF 2012).

[9]For example, OFIAGRO (2009) reports that half of potato farmers in Ecuador (a crop frequently grown in the study area) farm on less than two hectares.

[10]Likely occurred as part of the Agrarian Reform in Ecuador.

and because of existing contacts with people and NGOs operating programs in this part of Ecuador.

A survey was conducted during August 2012 to determine typical characteristics of the farms and farm families in the study area. Each of the surveys was completed by only one student enumerator (fluent in Spanish). Eighteen formal face-to-face surveys were completed with small-farm families while casual conversations with approximately 80 other individuals provided other types of information on an informal basis such as information about the local market and market prices, the community, and local farming practices.[11] The surveys provide data describing typical agronomic, family, and economic characteristics used to develop the enterprise budgets and supporting tables.[12] The population of Cochas is approximately 2,000. Given a representative family size of six, the survey represented over 5% of the entire population of the community. The survey was not conducted as a probability sample, but rather based on existing relationships made through NGO contacts. The face-to-face survey generated basic information about a representative family, cropping patterns, types of crops, and costs and returns. It also provided information on wage rates and household expenses such as utilities, education, and health care.

Families participating in the survey range in size from single individuals to families of 12 or more. A representative family size for this study is six with the typical family composed of three children, two parents, and a grandparent. The household head typically works in the town of Ibarra traveling each day to and from work by bus from home.[13]

Family farms in the study area typically focus on producing field crops for cash market sale and daily consumption. The typical farmer engages in harvesting potatoes, corn, wheat, quinoa, and barley. The daily diet of the farm family consists primarily of these same food stuffs with sporadic consumption of vegetables purchased at local markets. But, vegetables are not staple parts of the average diet and are not routinely grown by farm families in the study area.

[11]The surveys and procedures were approved by the Internal Review Board of the University.
[12]The intention of the survey was not to provide statistically defensible numbers in the LP model, but rather to develop representative information similar to the concept of representative farms used in policy simulation models (e.g., FLIPSIM (Agricultural & Food Policy Center 2013)).
[13]Often though, heads of households and older household members work for extended periods of time in Quito (performing manual labor) and returning home every eight to 22 days to help with harvest or to bring money home.

DATA AND METHODOLOGY

Data developed through the surveys allows for the estimation of costs and returns (enterprise budgets) for 26 separate crop and livestock enterprises for the study area. To our knowledge, this is the first time such an extensive set of cost and return information has been developed for the study area. Although garden vegetable crops are not routinely grown by farmers in the study area, the crops used in the analysis are representative of vegetable crops grown by at least a few farmers in the area. Estimated costs and returns for different potential enterprises are essential because the analysis allows the farm family to “choose” the activities (produce crops, produce livestock, work off-farm, hire on-farm labor, buy food at the local market, grow food on the farm) it pursues based on maximizing household income under the restrictions imposed by the NGO interventions considered. Table **1** presents one of the enterprise budgets for a field/cash crop (barley) while Table **2** is a representative enterprise budget for one of the garden[14] crops (beets).

Table **3** lists summary information for all of the different crop and livestock enterprises developed for the study. Yields for the garden crops are estimated based on representative yields in the United States (Drost 2012).[15] Communications with input suppliers, coupled with the survey participants’ best estimates for time and other input requirements to grow these crops are used to develop estimated costs and returns.

Costs and returns for garden crops (Tables **2** and **3**) are estimated using a square meter (m^2) as the land unit. This assumes the farm family grows these crops on small plots primarily for home consumption to achieve self-sufficiency. Also, growing a full hectare of these crops is impractical given the size of the local market. Prices used to calculate revenues for garden crops are 50% of the price of the same varieties sold in local markets. This is adjusts for waste, spoilage, and labor costs incurred if the family took these crops to the local market to sell.[16]

[14]“Garden” is used here to designate vegetables grown primarily for home consumption. Other vegetables, such as maize and potatoes, are considered “field” or “cash” crops grown primarily for sale off of the farm.
[15]National or regional estimates of yields for garden vegetable are not available and reported yields by the few farmers growing garden vegetables are considered unreliable. Yields under U.S conditions are expected to be optimistic estimates of yields for small plots of vegetables in the study area.
[16]Linear programming scenarios were also completed, but are not reported here, under the assumption of full price for the garden crops. However, they yielded essentially the same results (family will work off the farm and produce cash crops rather than produce vegetables for home consumption). The 50% adjustment to prices is a conservative estimate of costs given that marketing costs are not estimated in this study.

Table 1: Estimated Costs & Returns for One Hectare of Quinoa in Cochas, Ecuador

			Unit	Quantity	Price	Amount	% of Total
Revenue							
Quinoa[a]			Kg	782	$0.88	$688.16	96.2%
Seed[b]			Kg	18	$1.50	$27.00	3.8%
Total Revenue						$715.16	100%
Operating Expenses							
Seed			Kg	18	$1.50	$27.00	3.8%
Tractor[c]			Hour	6	$20.00	$120.00	16.8%
Tools[d]	# / Hectare	Life (Yrs.)					
Machete	3	2	#/yr/m^2	1.50	$5.00	$7.50	1.1%
Rake	4	3	#/yr/m^2	1.33	$5.00	$6.67	0.9%
Hoe	4	5	#/yr/m^2	0.80	$5.00	$4.00	0. 6%
Shovel	2	8	#/yr/m^2	0.25	$30.00	$7.50	1.1%
Oxen[e]			Hour	2.00	$2.50	$5.00	0.7%
Feed[f]			Flat Rate	1.00	$0.50	$0.50	0.1%
Interest[g]				$70.00	18%	$12.60	1.8%
Total Non-Labor Operating Expenses						$190.77	26.7%
Returns to Land, Labor & Management						$524.39	73.3%
Return Per Hour of Labor						$3.86	0.54%
Return Per Day of Labor						$30.85	4.31%
Labor							
	Land Prep/Planting[h]		Hours	16	$0.63	$10.00	1.4%
	Maintenance[i]		Hours	40	$0.63	$25.00	3.5%
	Harvest[j]		Hours	80	$0.63	$50.00	7%
Total Labor Expense						$85.00	11.9%
Returns to Land & Management						$439.39	61.4%

[a]The farm gate price is used to calculate revenue. Average production/hectare 800 kg (782 sold and 18 held for seed). Revenue and expenses calculated assuming a minimum of double cropping.
[b]Seed quantity deducted from yield and saved for next crop.
[c]Rented tractor and tractor operator utilized in land preparation.
[d]Number of tools utilized on a full hectare divided by useful life to calculate per year straight-line depreciation, then divided by 10,000 to arrive at quantity used per year per m^2.
[e]Oxen team used to cover seed behind tractor.
[f]Estimated value of feed for oxen allocated by time spent in activities related to this crop.
[g]Fee charged by 3rd party for tractor time financed through local bank at an annual interest rate and calculated for time crop is in ground.
[h]Two people for an entire day to prepare and plant. Includes labor expended supervising tractor operations, creating rows, covering seed.
[i]Mostly weeding, average two hours/hectare per week.
[j]Five workers needed for two days.

Table 2: Estimated Costs & Returns for One Square Meter of Beets in Cochas, Ecuador

				Unit	Quantity	Price	Amount	% of Total
Revenue								
	Beets[a]			Kg	6.73	$0.30	$2.02	100%
	Seed[b]			Gram	0	$0.04	$ --	0%
	Total Revenue						$2.02	100%
Operating Expenses								
	Seed			Gram	1.68	$0.04	$0.07	4%
	Water			Days	100.00	$0.001	$0.10	5%
Tools[c]		# / Hectare	Life (Yrs.)					
	Machete	3	2	#/yr/m^2	0.00015	$5.00	$0.00075	0%
	Rake	4	3	#/yr/m^2	0.00013	$5.00	$0.00067	0%
	Hoe	4	5	#/yr/m^2	0.00008	$5.00	$0.00040	0%
	Shovel	2	8	#/yr/m^2	0.00003	$30.00	$0.00075	0%
	Drip System[d]	1	5	price/yr/ha	1	$0.03	$0.03	2%
	Repairs[e]			per m^2	1	$0.02	$0.02	1%
	Garden Enclosure[f]		5	meters/area/yr	0.06	$2.10	$0.13**	6%
	Interest				$0.19	18%	$0.03	2%
	Total Non-Labor Operating Expenses						$0.39	19%
Returns to Land, Labor & Management							$1.63	81%
	Return Per Hour of Labor						$0.08	4%
	Return Per Day of Labor						$0.68	33%
	Labor							
	Land Prep/Planting			Hours	1.65	$0.63	$1.03	51%
	Maintenance[i]			Hours	5.89	$0.63	$3.68	182%
	Harvest[j]			Hours	0.25	$0.63	$0.16	8%
	Total Labor Expense						$4.87	241%
Returns to Land & Management							$(3.24)	-160%

[a]Revenue and expenses assume a minimum of double cropping. Garden crop varietiesare assumed to be planted in rows 60cm on center with a 33cm wide bed.Beet yield is measured per 33cm^2.Garden variety crop prices are derived using half of market price.
[b]Assume no saving of seed but rather purchase seed each season.
[c]Number of tools utilized on a full hectare divided by useful life to calculate per year straight-line depreciation, then divided by 10,000 to arrive at quantity used per year per m^2.
[d]Drip irrigation kit for a hectare is $65 for valves/diverters, $1500 for tubing. Five-year straight-line depreciation. Same style of kit is $43 for garden crop area of 20x10 meters or 200m^2.
[e]Repairs begin in year 2 at $4/yr. through year 5 for 200 m^2.Scaled to a hectare.
[f]Garden enclosure amount should be calculated by linear meters needed divided by area encompassed and then divided by useful life which is multiplied by netting price per linear meter. Netting not used for small gardens. Utilization of wind break and security netting at larger scales will depend on geography and size of plot.
[g]Interest calculated on direct expenses, i.e. seed, water, drip system repair.
[h]Worker can prepare and plant a row that has 33cm bed, spaced 60cm on center, and 8m long; total area 4.8m^2.
[i]Maintenance costs calculated by water days divided by seven for weeks. Each row requires four hours every other week for weeding/maintenance.
[j]Harvest as crop becomes ripe. Common practice is to leave the crop in field for storage until needed.

Table 3: Summary Information from Enterprise Budgets Developed for Crop and Livestock Enterprises in Cochas, Ecuador, August 2012

Enterprise	Unit	Total Revenue	Non-labor Operating Expenses	Return to Land, Labor, and Management	Labor Expense	Return to Land and Management
Barley	Hectare	$200.00	$107.52	$92.48	$130.00	-$37.57
Beets	Meter^2	$2.02	$0.30	$1.63	$4.87	-$3.24
Broccoli	Meter^2	$0.92	$0.27	$0.66	$3.40	-$2.74
Carrots	Meter^2	$1.96	$0.33	$1.63	$5.24	-$3.61
Cauliflower	Meter^2	$1.08	$0.27	$0.81	$3.40	-$2.59
Celery	Meter^2	$1.17	$0.32	$0.85	$4.50	-$3.65
Chard	Meter^2	$0.63	$0.43	$0.20	$6.71	-$6.51
Choco	Hectare	$236.40	$83.27	$153.13	$43.13	$110.01
Maize (Corn)	Hectare	$1,002.92	$76.61	$926.31	$346.15	$580.16
Green Cabbage	Meter^2	$1.22	$0.31	$0.91	$4.87	-$3.96
Green Onion	Meter^2	$0.35	$0.36	-$0.01	$4.87	-$4.88
Lettuce	Meter^2	$0.61	$0.31	$0.29	$4.50	-$4.21
Oats	Hectare	$227.00	$92.47	$134.53	$175.00	-$40.47
Potatoes	Hectare	$3,217.00	$769.42	$2,447.58	$1,225.00	$1,222.58
Quinoa	Hectare	$715.16	$190.77	$524.39	$85.00	$439.39
Radish	Meter^2	$0.80	$0.29	$0.50	$2.29	-$1.79
Red Cabbage	Meter^2	$1.26	$0.31	$0.05	$4.87	-$3.92
Spinach	Meter^2	$0.35	$0.36	-$0.01	$4.50	-$4.51
Tomatoes	Meter^2	$1.81	$0.35	$1.47	$5.61	-$4.14
Chinese Turnip	Meter^2	$1.02	$0.30	$0.72	$4.50	-$3.78
Wheat	Hectare	$660.89	$77.26	$583.63	$370.71	$212.91
White Onion	Meter^2	$0.87	$0.36	$0.51	$5.61	-$5.10
Zucchini	Meter^2	$0.34	$0.40	-$0.06	$3.95	-$4.01
Chickens	Eggs/Culls	$199.08	$74.55	$124.53	$57.49	$67.04
Milk Cows	Milk/Culls	$488.33	$127.57	$360.76	$122.85	$237.91
Guinea Pigs (Cuy)	2 Pigs/12 Pups	$62.00	$19.40	$42.60	$38.33	$4.27

On-farm wages are calculated at $0.63/hour; the "going rate" for hired field labor in the study area. Both family and hired farm labor are valued at this rate to calculate costs and returns for the different crop and livestock enterprises. The household head typically works off the farm and nets[17] approximately $0.96/hour. A crop calendar is established by dividing each month into two periods (24 total periods). This is used to establish the timing of labor requirements for each crop so that the analytical model is forced to ration available family labor across different activities when the different enterprises are competing for labor to plant, maintain crops, or harvest. The household head is assumed to have 100 hours of labor available during each of these periods. Other family labor is assumed to be devoted solely to farm activities and total available farm family labor is assumed to be 240 hours per half-month period.[18]

Nutritional characteristics for the different foods (grown or purchased) are determined based on 100

[17]Costs associated with working off of the farm included bus fare and eating expenses while away from home.

[18]Besides the household head's labor, the spouse is assumed to have 60 hours each week to devote to the farm, the grandparent 40 hours, and the oldest child 40 hours.

Table 4: Summary of Nutrients Considered in the Analysis (Measured in the Analysis Based on 100 gram (g) Servings)

Nutrient	Measure	
Calories	kcal	43.10
Calories from Fat	kcal	1.71
Calories from Saturated Fat	kcal	0.28
Protein	g	1.04
Carbohydrates	g	10.10
Dietary Fiber	g	3.00
Total Sugars	g	6.60
Fat	g	0.19
Saturated Fat	g	0.03
Mono Fat	g	0.01
Poly Fat	g	0.08
Trans Fatty Acid	g	0.00
Cholesterol	mg	0.00
Water	g	87.70
Vitamin A - IU	IU	25359.00
Beta-Carotene	mcg	12320.00
Vitamin B1	mg	0.09
Vitamin B2	mg	0.06
Vitamin B6	mg	0.14
Vitamin B12	mcg	0.00
Vitamin C	mg	6.99
Vitamin D	mcg	0.00
Vitamin E	mg	0.42
Folate	mcg	13.30
Calcium	mg	27.00
Iron	mg	0.50
Potassium	mg	323.00
Sodium	mg	35.00
Zinc	mg	0.20
Omega 3 Fatty Acid	g	0.01
Omega 6 Fatty Acid	g	0.07

gram servings using the Genesis software program (ESHA.com 2012). Genesis provides 33 nutrient measures for each food (Table **4**). Almost 60 separate food sources are considered in the analysis for their nutritional content and cost (Table **5**).[19]

The family has other expenses besides those incurred raising crops or buying food. For example, the typical family in the survey has at least one child attending school. While school expenses can vary widely depending on whether the school is public or private, the survey suggests a typical cost for school is $532.50per year[20] for an older child and $162.50 per year for a younger household expenses for utilities are estimated to be $9.50[21] or $114/year.[22] The family's

[19]Costs for pantry items include salt, pepper, cooking oil, brown sugar, and at least 12 eggs per month.

[20]Ecuador's currency is the U.S. dollar.

[21]Includes $3.50 for bottled gas; $3.00 for electricity; and $4.00 for water.

[22]Typical expenses for an older student are the following: school supplies = $20/year; uniforms = $75/year; lunch = $2.50/month; breakfast = $5.00/month; books = $100; and bus fare = $1.50/day. There is a nine-month school year. A younger child could go to a local school and would not have a cost for books or bus fare.

Table 5: Foods Considered in the Nutritional Analysis (Nutrient Content Calculated Based on Measures Presented in Table 4)

Food Types
Barley flour; Barley-hulled-dry; Cooked Beets; Fresh beets; Cooked broccoli; Fresh broccoli; Cooked carrots; Fresh carrots; Cooked cauliflower; Fresh cauliflower; Cooked celery; Fresh celery; Cooked Chinese turnip; Fresh Chinese turnip; Cooked corn; Fresh corn; Cooked green cabbage; Fresh green cabbage; Fresh green onion; Fresh lettuce; Oats; Cooked potato; Cooked quinoa; Fresh radishes; Cooked red cabbage; Fresh red cabbage; Cooked spinach; Fresh spinach; Fresh tomato; Wheat flour; Wheat-whole-grain; Fresh white onion; Cooked zucchini; Fresh zucchini; Chocho; Rice; Oil; Brown sugar; Cow milk; Goat milk; Chicken; Pork; Lamb; Cuy; Beef cuts; Beef ground; Eggs; Pineapple; Apple; Peach; Banana; Salt; Pepper; Water; Corn flour; Chard; Tostada; Cooked White onion; Dry quinoa; Bread.

medical expenses are estimated to be approximately \$350/year.[23]

Linear Programming Model

A linear program (LP) is used as the analytical basis for this study. LP analysis is a comparatively simple methodology, but it is a powerful tool that identifies the impacts of a farm family's decisions on multiple facets of their well-being.[24] LP is mathematical programming using constrained optimization where an objective function is described (in this case the maximization of household income) together with the constraints underlying the objective function. LP results should be understood in the context that they describe the optimum combination of decisions that are feasible, in this case for the representative farm family, rather than the actual impact of those decisions. In terms of an evaluation of the NGO interventions considered in this study, the LP results represent an *ex ante* rather than an *expost* evaluation of the interventions. The LP used in this analysis is described as follows:

(1) Maximize Income = $-\sum_i \sum_j A_i X1_{ij} + \sum_j \sum_k B_k X2_{jk} + \sum_j \sum_k C_k X3_{jk} - \sum_m \$0.625 X6_m + \sum_m \$0.96 X7_m - \sum_n D_n X8_n - UTILITIES - MEDICAL - SCHOOL$

Subject to:

(2) $\sum_i E_{ir} F_i X1_{ij} + \sum_k E_{kr} F_k X4_{kj} + \sum_n (E_{nr} F_n G_n X8_n) / 12 \geq NUT_{jr} \ \forall j \text{ and } r$

(3) $\sum_k X3_{km} \leq 10{,}000 \ \forall m$

(4) $X8_n \leq 10 \ \forall n$

(5) $X8_2 \leq 2$

(6) $H_k X3_{jk} + (1 - I_k) X5 j_k - X5_{j-1,k} - X2_{jk} - X4_{jk} \geq 0 \ \forall j \text{ and } k$

(7) $\sum_k J_{km} X3_{km} + \sum_n K_n X8_n + X7_m - X6_m \leq 240 \ \forall m$

where:

$X1_{ij}$ = the amount of thei^{th} food purchased during the j^{th} month

$X2_{jk}$ = the amount of thek^{th} raised crop sold during the j^{th} month

$X3_{jk}$ = the amount of the k^{th} crop raised on the farm during the j^{th} month

$X4_{jk}$ = the amount of the k^{th}raised crop consumed on the farm during the j^{th} month

$X5_{jk}$ = the amount of the k^{th}crop stored on the farm during the j^{th} month

$X6_m$ = the number of hours of non-family labor hired during the m^{th} half-month period

$X7_m$ = the number of hours worked off the farm by the household head during the m^{th} half-month period

$X8_n$ = the number of the n^{th} livestock type owned by the family

A_i = the per unit price paid for i^{th} purchased food

B_k = the per unit price for the k^{th} crop

C_k = the variable costs of production for the k^{th} crop (does not include a charge for family labor)

D_n = the variable costs of production for the n^{th} livestock type (does not include a charge for family labor)

UTILITIES = average annual utility charge for the family

MEDICAL = average medical expenses for the family

[23]This was based on a \$50 charge per visit to a physician.
[24]LP is a commonly-used methodology. See Kuyiah *et al*. (2006) for another example related to international, small-scale agriculture.

SCHOOL = average annual school expenses for the family

E_{ir},E_{kr}, E_{nr} = the amount of the r^{th} nutrient in one kilogram of the i^{th}, k^{th}, and n^{th} purchased food, respectively

F_i, F_k, and F_n = the cooked yield in percentage for the i^{th} and k^{th} vegetable purchased or grown on the farm, respectively, and the n^{th} livestock product

G_n = the number of units of the livestock product produced by each n^{th} livestock type each year

H_k = yield for the k^{th} crop

I_k = percent storage loss for the k^{th} crop each month

J_{km} = the hours of labor used by the k^{th} crop each m^{th} period

NUT_{jr} = the minimum nutrient requirement of the r^{th} nutrient during the j^{th} month for the farm family of six

i = each different food source (see list in Table **5**)

j = January, February, March, April, May, June, July, August, September, October, November, December

k = each crop that could be grown (see list of crops in Table **3**)

m = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24

n = guinea pig (cuy), milk cows, and chickens (See livestock enterprises listed in Table **3**)

r = calories, fat, cholesterol, sodium, carbohydrates, fiber, sugar, protein, vitamin A, vitamin C, vitamin B12, vitamin B6, calcium, iron, riboflavin, niacin, thiamin, folate

The objective function (equation (1)) indicates that the farm family's objective is to maximize income. The family's income is determined by subtracting the costs of food purchased, wages paid to hired labor, expenses for growing crops and household expenses (utilities, medical, and school expenses) from income obtained by the sale of crops and working off of the farm.The constraints described in equations (2) through (7) require that the family's nutritional needs be met each month (equation (2)) either through purchased food or food raised on the farm. Equation (3) limits the land available to the farm family to be no more than one hectare (the actual size of the farm)during any one-half month period. Equation (4) limits the number of animals to be no more than ten units[25]of each species and is based on maximum livestock numbers observed on farms in the study area. Equation (5) limits the farm family to having no more than two milk cows.[26] Equation (6) indicates that the amount of crops sold, eaten or stored during a half-month period may not exceed the amount of crops available (raised or previously stored) for that period. Equation (7) indicates that family labor is limited to 240 hours for all activities on and off the farm for each half-month period.

Scenarios

The LP is not used here to describe the actual activities the farm family is currently pursuing. Rather, the LP can be adjusted to simulate "scenarios" of various decisions and conditions under which the farm family could operate. The scenarios facilitate observation of changes in the household's objective function as different scenarios are considered. In this case, scenarios are developed to reflect two potential NGO interventions. One seeking to encourage farm families to be self-sufficient (limit food purchases)[27] and the other encouraging the farm family to meet established nutritional targets.[28]The nutrient targets selected for analysis include the Recommended Daily Allowance (RDA) and MyPlate. RDA requirements consist of meeting the minimum RDA for each member of the family for calories, protein, riboflavin, sodium, sugars, thiamin, vitamin A, vitamin B12, vitamin B6, and vitamin C. The RDA target represents a basic, healthy diet and is a well-established and reasonable goal for NGO interventions emphasizing nutrition. MyPlate is an "ideal" approach to nutrition and is geared primarily to people in the developed world who often face different nutritional challenges than people in

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[25]"Units" refers to how small livestock are brought into the model. For example, one unit of chickens represents seven hens so 10 units are 70 hens. This is done because of the difficulty in estimating costs and returns for single hens rather than for the typical small flocks found in the study area. A cuy unit is one male and one female.

[26]A family having two milk-cows is very representative for these farm families. Land and labor constraints will tend to limit the number of milk cows. Also, because the self-sufficiency interventions emphasize garden vegetable crop production, we purposely limit the amount of time spent on this livestock activity.

[27]The argument some NGOs use to promote self–sufficiency is that it removes much of the price risk small-scale farmers face selling cash crops, ensures adequate nutrition for the family, and results in ensuring healthy people who are more able to compete and succeed in society. NGOs pursuing this intervention argue that poor people are more able to perform well in school and in society in general compared to people who may not have their nutritional needs met when crop prices are low and household income is completely dependent on cash crop sales.

[28]Many NGOs implement interventions, often using educational programs, which are designed to ensure minimum nutritional requirements are met for rural families, especially for children. In this analysis, different nutritional targets as defined by the U.S. Department of Agriculture (Recommended Daily Allowance and MyPlate) are used as the basis for analysis.

Table 6: Description of Scenarios Used In the Analysis

Scenario Number	Description			
	Nutrient[a] Target (RDA or MyPlate)	Farm Family[b] Self-Sufficient (Yes or No)	HH Head Works[c] Off of the Farm (Yes or No)	Family Allowed[d] to Hire Farm Labor (Yes or No)
1	RDA	No	Yes	No
2	RDA	No	No	No
3	RDA	Yes	No	No
4	RDA	Yes	Yes	No
5	RDA	No	Yes	Yes
6	MyPlate	No	Yes	No
7	MyPlate	No	No	No
8	MyPlate	Yes	No	No

[a]RDA= Recommended Daily Allowance, RDA is sufficient to meet the nutrient requirements of nearly all healthy individuals. RDAs used in the analysis are calculated for infants, children, adult males, and adult females. RDA requirements are required to be met for protein, riboflavin, sodium, sugars, thiamin, vitamin A, vitamin B12, vitamin B6, and vitamin C. MyPlate is an "ideal" approach to nutrition and is geared primarily to people in the developed world who often face different nutritional challenges than people in the developing world. MyPlate is designed to promote a balanced diet based on the number of servings per day from five different food groups (fruits, vegetables, grains, protein foods, and dairy).
[b]The farm family is considered to be self-sufficient if they eat only food products produced on the farm (no food purchased off of the farm unless self-sufficiency is infeasible). Conversely, if the farm family is not forced to be self-sufficient, they can purchase food from off of the farm.
[c]If the household head is allowed to work off the farm in the scenario, this is indicated to be "Yes."
[d]If the scenario allowed the farm family to hire farm labor, this is indicated to be "Yes."

the developing world.[29] MyPlate is designed to promote a balanced diet based on the number of servings per day from five different food groups (fruits, vegetables, grains, protein foods, and dairy). It emphasizes choosing nutrient-dense foods and minimizing high-calorie fats and sugars.

These interventions (self-sufficiency and nutrient targets) are considered in the context of the household head being allowed or restricted from working off the farm as well as the farm family being allowed or restricted from hiring on-farm labor. The different combinations of nutritional targets, self-sufficiency, and employment options result in eight separate scenarios being considered in the analysis. A brief summary of the main characteristics of each scenario is provided in Table **6**. The scenarios differ based on four main criteria namely nutritional targets (RDA Scenarios 1-5 and MyPlate Scenarios 6-8), whether or not the farm family is encouraged to be self-sufficient (Scenarios 3, 4, and 8), whether or not the household head works off of the farm (Scenarios 1, 4, 5, and 6), and whether or not the farm family hires farm labor (Scenario 5).

Self-sufficiency discourages the farm family from buying food products at the local market to either wholly or partially meet the family's nutritional requirements. For scenarios assuming self-sufficiency, the price of purchasing food is increased by a factor of 90 making food purchases prohibitively expensive for scenarios where self-sufficiency is encouraged. This is done to allow the model to buy food if there is no ability to satisfy a nutritional requirement of the family with on-farm food production. However to allow comparison, the value of the objective function and cost of food purchases is reported for the scenarios encouraging self-sufficiency using the original food price. This method forces the family to be self-sufficient unless it is infeasible to do so. If the household head is allowed to work off of the farm, he/she is assumed to bring home $0.96/hour for their labor after transportation and other expenses are netted out of his/her pay. If the family hires farm labor, it is allowed to do so at a rate of $0.63/hour or $5/day.

RESULTS

The LP is run under each of the different scenarios described in Table **6**. Table **7** displays summary information for the results for each of the scenarios. The results in Table **7** suggest that the farm family's income tends to be significantly enhanced by off-farm income when working off the farm is allowed (Scenarios 1, 4, 5, and 6). This suggests that self-sufficiency is not a preferred option for the farm family and NGO interventions emphasizing self-sufficiency will require subsidization to recruit participants and will

[29]In the developed world, obesity is a common nutritional challenge while in much of the developing world it is not.

Table 7: Summary of Expenses and Revenues for Each Scenario

Measure	Scenario							
	1	2	3	4	5	6	7	8
Off-Farm Income	$1,924			$1,994	$2,304	$1,918		
Income from Crops	$2,550	$2,714	$2,228	$1,872	$3,797	$2,323	$2,498	$1,788
Net Income from Animals	$351	$351	$175	$175	$351	-$36	-$36	-$36
Gross Income	$4,825	$3,065	$2,403	$4,043	$6,452	$4,205	$2,462	$1,752
Crop Expenses	-$621	-$685	-$622	-$525	-$1,056	-$555	-$620	-$576
Food Purchases	-$262	-$258	-$83	-$83	-$257	-$275	-$275	-$93
Family and Household Expenses	-$1,159	-$1,159	-$1,159	-$1,159	-$1,159	-$1,159	-$1.159	-1,159
Hired Labor Expense					-$732			
Total Expenses	-$2,042	-$2,102	-$1,904	-$1,767	-$3,203	-$1,989	-$2,054	-1,828
Net Family Income (Objective Function)	$2,783	$964	$499	$2,275	$3,249	$2,216	$408	-$75

likely not be sustainable once this subsidization ends (the intervention ceases). The scenario generating the highest income for the family is Scenario 5. Scenario 5 allows the household head to work off the farm and also allows the family to hire farm labor. Under Scenario 5 the farm family focuses on producing potatoes for sale in local markets (Table **8**). This illustrates that if the off-farm labor rate is higher than the cost of hiring farm labor, the farm family will expand production of the most profitable cash crop (potatoes) while expanding the number of hours the household head works off of the farm.

In general, the farm family chooses not to grow garden vegetables unless it is forced to do so (Table **9**). Again, confirming the unsustainability, at least in this study area, of NGO interventions emphasizing self-sufficiency. Consuming vegetables is important in terms of meeting the family's nutritional requirements. However, vegetable crops are labor intensive and the opportunity cost of using family labor, especially the household head's labor in this case, is such that it makes more sense for the family to have the household head work off the farm and to buy garden vegetables at the local market than to use the household head's time to grow vegetables for the family's on-farm consumption. This is best illustrated by Scenario 2 where no off-farm income is generated, but the family can buy food in the local market (not forced to be self-sufficient). In this case (Scenario 2 in Table **7**), the family still focuses on growing cash crops (maize and potatoes) and buys other needed foods in the local market rather than focusing on growing vegetables for home consumption (Tables **9** and **10**). This is not surprising given the profitability of potatoes and the low profits/negative profits associated with garden vegetable crops (Table **3**).

Although not reported here, scenarios are examined with labor constraints removed. When this is done the family still does not produce very many vegetables unless forced to pursue self-sufficiency. Instead the family focuses on producing additional potatoes. In this situation (labor constraint removed), land becomes the constraining resource[30] rather than family labor and the most productive use of land is to grow potatoes to sell rather than producing more vegetables for a self-sufficient diet.

[30]This means that the family's choices to increase income become constrained or limited by the fact that they have only one hectare of land. This is in contrast to when only 240 hours of family labor are available during each one-half month period. In which case, the family's choices to increase income are limited by the amount of family labor available.

Table 8: Total Crops Produced on the Farm and Sold During the Year Reported in Kilograms for Each Scenario

Crop	Scenario							
	1	2	3	4	5	6	7	8
Corn (Maize)	1,402	1,130	1,444	1,976		1,582	1,318	779
Potatoes	5,965	6,690	5,004	3,486	10,849	5,145	5,894	4,374

With all of the self-sufficient scenarios (Scenarios 3, 4, and 8), basic pantry items (salt, pepper, oil, and sugar) cannot be produced on the farm and are purchased (Scenarios 3 and 4 in Table **9**). When nutritional requirements for the self-sufficient scenarios could not be satisfied with on-farm production in February, some spinach is purchased that month. The reason for this is two-fold. First, spinach is highly nutrient dense. It contains vitamins commonly associated with vegetables (vitamins A and C), though not at the same level as carrots, tomatoes, broccoli, and red cabbage. However, spinach isa superior source of folate (essential for proper fetal development), calcium (essential for bone development and muscle function), and iron (essential for proper immune function and oxygen transport to muscles). This allows spinach to meet nutritional requirements typically associated with more expensive animal protein (iron) and dairy (calcium). The purchase price of spinach ($0.018/100 grams) is also lower than any other vegetable (cabbage was the next lowest at $0.035/100 grams), and is dramatically lower than dairy (milk $0.125/100 grams) or animal protein (chicken $0.440/100 grams).

When the family is forced to grow vegetables for home consumption (Scenarios 3, 4, and 8), they still must grow cash crops to meet the family's cash expenses (school, medical, and utilities). In each of the self-sufficient scenarios (Scenarios 3, 4, and 8), the family grows a wide variety of vegetables, especially for Scenario 8, the MyPlate self-sufficient scenario. Scenario 8 is the only case in which the farm family is unable to cover annual expenses (i.e., has a negative net income) (see Table **7**). The results for Scenarios 3 and 4 illustrate that it is possible for the farm family to be economically viable (have a positive net income (Table **7**)) if the farm family focuses on basic nutritional needs (RDA) and grows most of the food they need on the farm.

The results for interventions using nutritional targets suggest that pursuing a MyPlate diet rather than basic nutrient needs (RDA) reduces the farm family's income in each case (Scenario 1 compared to Scenario 6 and Scenario 2 compared to Scenario 7 (Table **7**)). This suggests that the nutritional programs NGOs try to implement in the developing world need to account for the basic economics (costs) of those programs to recipients and, consequently, the sustainability of the programs. These results suggest that for poor rural families, meeting basic nutritional needs first, rather than achieving more sophisticated and balanced diets, will be a priority given the need to produce cash

Table 9: Consumption of Crops Produced on the Farm During the Year Reported in 100 Gram Portions for Each Scenario

Food Type	Scenario							
	1	2	3	4	5	6	7	8
Wheat Flour	439	439	336	338	440	414	414	414
Corn Flour	46	46	58	58	46	46	46	46
Cooked Cauliflower								190
Fresh Carrots			110	68				94
Fresh Spinach			29	29				92
Fresh Tomatoes			31	31				94
Fresh Celery								97
Fresh Red Cabbage		14	204	204				188
Cooked Broccoli			11	11	11			
Cooked Corn								767
Cooked Potatoes			801	844		95	95	95

Table 10: Totals for Food Purchased During the Year Reported in 100 Gram Portions for Each Scenario

Food Type	Scenario							
	1	2	3	4	5	6	7	8
Fresh Spinach	3,281	3,011	366	366	3,011	11,040	11,040	920
Wheat Flour	975	982			975			
Cooking Oil	108	108	108	108	108	108	108	108
Brown Sugar	240	240	240	240	240	240	240	240
Salt	5	5	5	5	5	5	5	5
Pepper	1	1	1	1	1	1	1	1

income for other family and household expenses. Any intervention emphasizing MyPlate as a nutritional target would likely not be sustainable based on these findings.

The ability to hire farm labor leads to more intensive land use and higher income for the farm family if the off-farm labor rate is higher than the rate to hire farm labor (Scenario 5 in Tables **7** and **11**). Scenario 5 illustrates a fairly sophisticated knowledge of the economics the family faces. That is, the family would need to fully understand the opportunity costs associated with not working off the farm as well as understand that potatoes offer the largest return to family and hired farm labor to pursue the strategy described by Scenario 5. While many men in the study area work off the farm, maize is commonly grown on farms rather than specializing only in potatoes. This may be related to culture the study area because maize and potatoes are common components of the local diet. There may also be crop rotation limitations over time that are not included in this model but which would limit the amount of potatoes that could be grown. In any case, Scenario 5 would be considered an atypical strategy.

Off-farm employment will improve the family's standard of living regardless of which scenario is considered. For example, Scenarios 1 and 2 are the same except for the ability to work off the farm. A comparison of outcomes for Scenarios 1 and 2 shows that household income increases when the household head is allowed to focus on working off the farm and the family focuses on cash cropping (Scenario 1) rather than focusing on meeting the family's nutritional needs by growing vegetables (Scenario 2) (Net Income for Scenario 1 was $2,783 while Net income for Scenario 2 was $964 (Table **7**)). This suggests that any NGO interventions in the study area that are on-farm labor intensive, such as growing more vegetables, are unsustainable given current economic conditions. However, it is possible that highly risk-averse farm families may choose to grown vegetables if cash crops have extreme price risks. However, few farm families in

Table 11: Land Used for Each Crop Produced on the Farm During the Year Reported in Square Meters for Each Scenario[a]

Food Type	Scenario							
	1	2	3	4	5	6	7	8
Corn (Maize)	4,812	3,908	4,993	6,762	151	5,413	4,534	5,600
Potatoes	7,457	8,363	7,303	5,459	13,561	6,553	7,490	5,589
Wheat	1,283	1,283	980	988	1,286	1.210	1.210	1,210
Carrots			75	46				64
Cauliflower								30
Broccoli			3	3	3			
Spinach			7	7				23
Celery								21
Red Cabbage		2	33	33				30
Tomatoes			6	6				19

[a]Total planted area exceeds 10,000 meter^2 for each scenario due to double or triple cropping.

the study area concentrate on growing vegetables primarily for on-farm consumption. This suggests that, at least in this study area, farm families do not perceive that the risk trade-offs between cash crops and growing food for family consumption are large enough to warrant focusing on vegetable production. Even if off-farm employment is not available (say the local economy softened), these farm families would likely continue to focus on cash crops rather than vegetable production (Scenarios 2, 3, and 7 (Table **7**)).

The results appear to favor market-related interventions (i.e., reducing marketing costs, reducing storage losses, more effective marketing (i.e., pooling)) while focusing on meeting the basic nutritional requirements of the farm family. This finding supports the decisions by major funders such as USAID to focus on market interventions in their international agricultural development efforts (USAID, 2013b). The results also suggest that educational opportunities leading to better opportunities for off-farm employment would generate sustainable outcomes for farm families in the study area. Any intervention tending to reduce family income will tend to be unsustainable over time. This is illustrated by how important off-farm income is to these families and the unlikelihood that interventions reducing off-farm income possibilities will be adopted in the long-run by farm families in the study area.

CONCLUSIONS

The results demonstrate how interconnected nutrition, agricultural production, and economic decisions are for farm families in the study area. Encouraging families to grow primarily for family consumption could have potentially devastating effects on the economic conditions of representative families; especially if it is coupled with non-basic nutritional targets such as MyPlate (Scenario 8 (Table **7**)). This suggests that targeted or single-faceted NGO interventions that do not account for these connections could easily result in the unsustainability of the intervention. This demonstrates the importance of initial assessments using local data to account for a broad range of factors, such as nutritional needs, agricultural productivity, opportunity costs, and other economic considerations before an intervention is launched. This approach may be difficult given the public relations bent NGOs often require to generate funding (Werker and Ahmed). It also suggests that efforts to educate donors and the public in general regarding how to measure the effectiveness of interventions in international development may be warranted.

Opportunity cost plays a huge role in farm family decisions, especially if off-farm employment opportunities are present. This suggests that farm families living within relatively easy commuting distances from cities will tend to focus their efforts on growing cash crops while working off of the farm if they are able to. This implies that donor and, consequently, NGO strategies for interventions are likely best developed on a location-specific basis because they need to account for opportunity costs. Essentially, "one size does not fit all" in the case of agricultural development interventions. Developing location-specific strategies requires significant initial background work covering a range of nutritional, agricultural, and economic factors to be able to develop appropriate interventions that have the best chance of being sustainable.

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