Livestock Transfers and Food Security: Evidence from a Randomized Phased-in Program in Nicaragua

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Objective

- This paper explores the impact of a **livestock transfer program on food security.**

- For this purpose, we asses the three dimensions of food security:

  ➢**Food availability:** Supply of food at the national or local level

  ➢**Food access:** Ability of households to obtain food (i.e. financial resources, income)

  ➢**Food use:** Level of nutrients obtained from food

Motivation

- 50% of the poorest people rely on livestock production (FAO; Robinson, 2011).

- Importance of livestock production in rural areas has been **understudied** (Zezza et. al, 2016).

- Few studies have analyzed its **link with food security,** mostly focused on Africa (Carletto et al., 2016; Hoddinot, 2014; Azzari et al., 2014).

Motivation

- Livestock production has an important **potential to increase food security** (Zezza et al., 2016):

  ➤**Food availability:** Supply of food for the household

  ➤**Food access:** Stable source of income

  ➤**Food use:** Source of dietary diversity and vital nutrients

- **Livestock production is more stable than crop production**, reducing vulnerability to shocks (Fafchamps and Gavian, 1997; Randolph et al., 2007)

- Livestock assets are often considered a **form of savings and insurance** (FAO, 2009)

- **Other benefits:** improves soil fertility, contributes to crop production, agricultural waste recycling, employment.

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Value Added

- Assess **food security in its three dimensions** (i.e. access, availability and food use).

- **Exposure to treatment**—number of years in the program

- **Women's empowerment**—targeted female farmers

- Reduce the knowledge gap: lack of evidence in LAC

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The Program - Description

- The "Apoyos Productivos Agroalimentarios"(APAGRO) is a **livestock transfer program** implemented in Nicaragua between 2011 and 2014.

- It aimed at **boosting food security of small-scale female farmers**, by increasing income and productivity.

- The program financed **livestock assets and technical assistance**, through the provision of vouchers.

The Program - Intervention

- Beneficiary farmers could select among three livestock packages:

➢**One cow, one pig and chickens**
➢**One pig, goats and chickens**
➢**One cow, sheep and chickens**

The Program - Intervention

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  ➢ **One cow, one pig and chickens**
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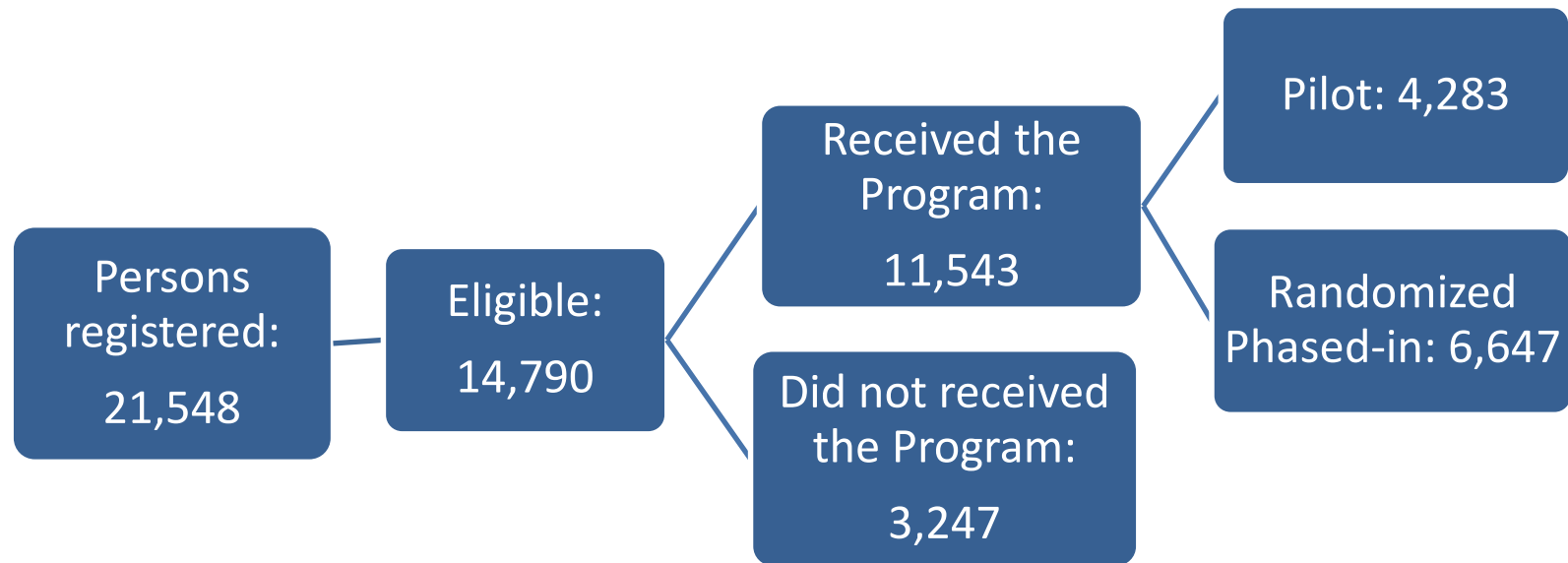 ➢ **One cow, sheep and chickens**

- **The technical assistance:** extension workers who visited individual households and held group sessions once a month

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The Program - Implementation

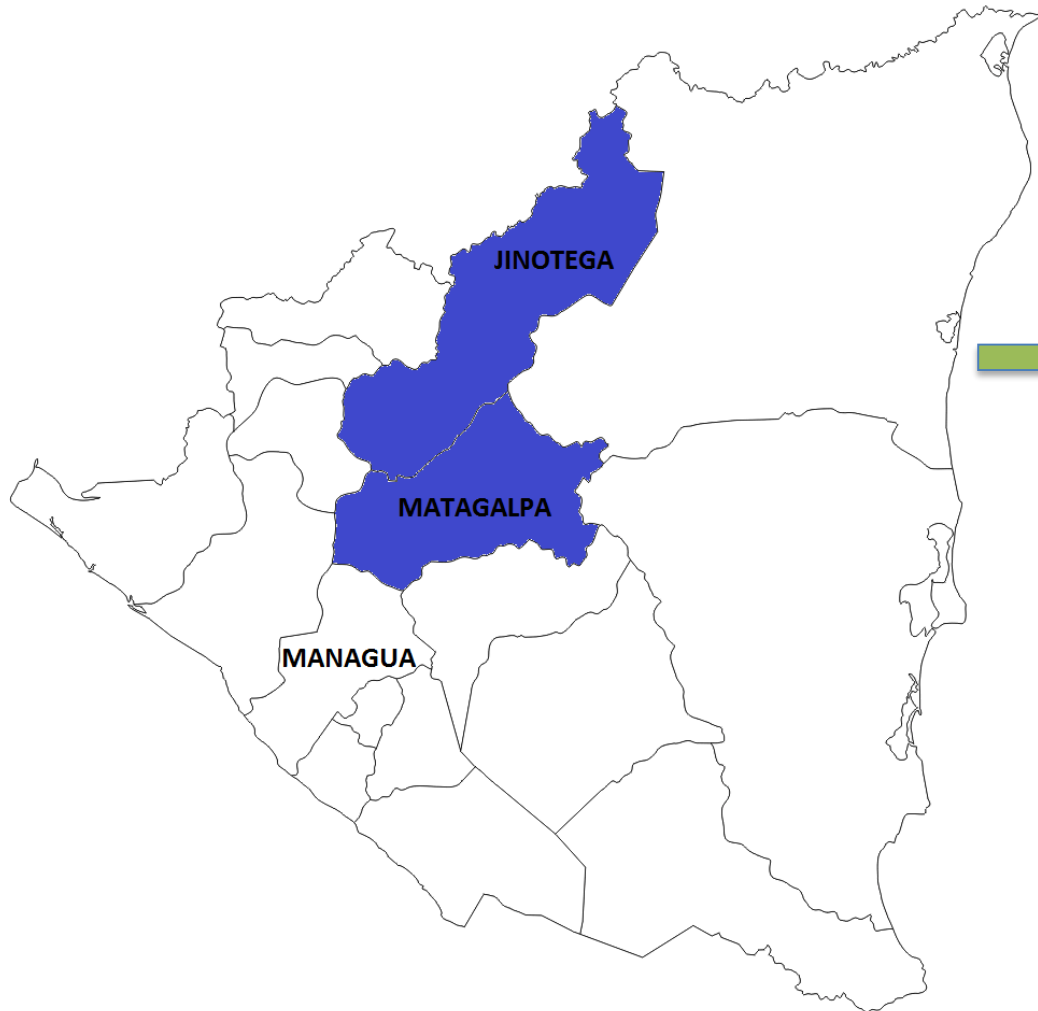**Eligibility Criteria**

- Access to at least 0.7 and max 7 Has of land
- Not beneficiaries of the Zero Hunger program
- To be a female producer

Persons registered: 21,548 → Eligible: 14,790

Eligible: 14,790 → Received the Program: 11,543

Eligible: 14,790 → Did not received the Program: 3,247

Received the Program: 11,543 → Pilot: 4,283

Received the Program: 11,543 → Randomized Phased-in: 6,647

The Program - Implementation

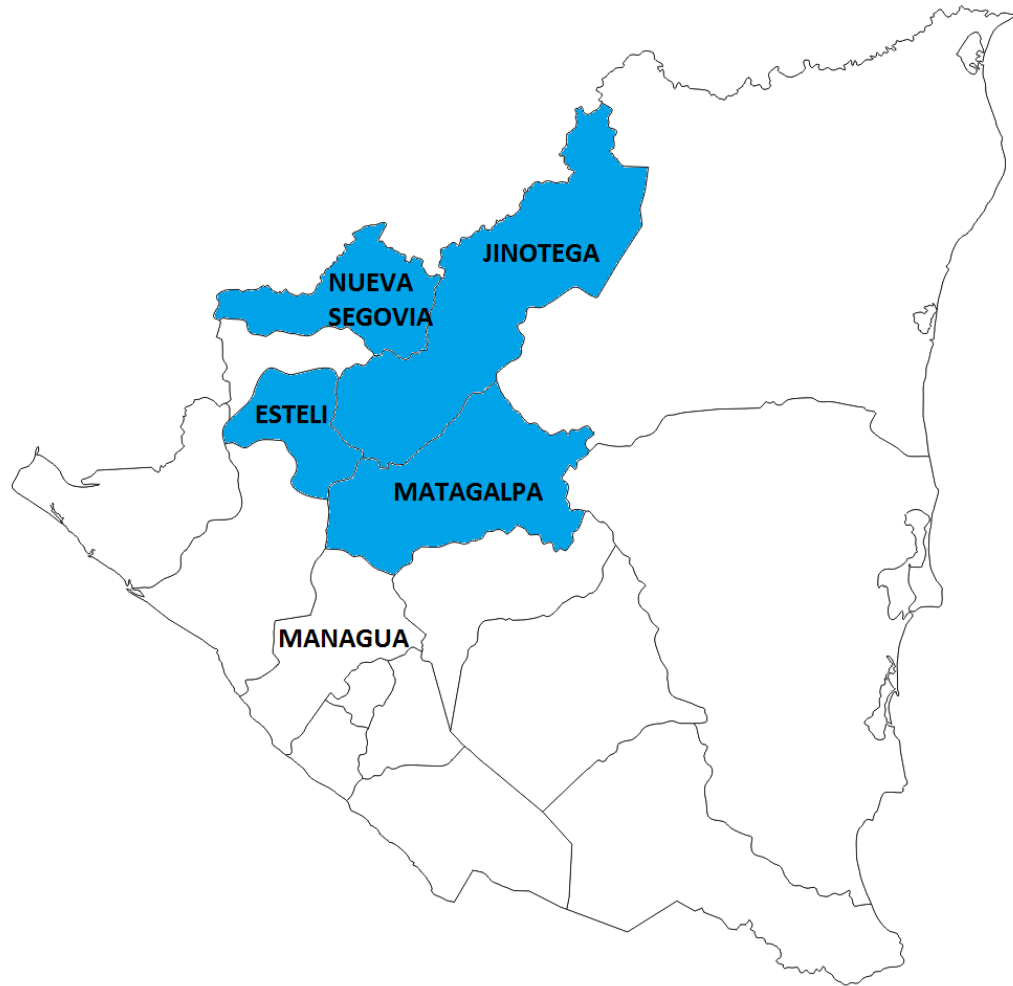JINOTEGA

MATAGALPA

MANAGUA

Pilot Group:
Nov 2010 – March 2011
Selection:
Logistical Convenience

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The Program - Implementation

Randomized Phased-in Group:
April 2011 – 2014
Selection:
Random Phased-in

Selection Process:
1. Organized Clusters
2. Randomly assigned numbers to each cluster
3. Program execution following random order

Data – Sample Selection

- **Panel Data:** Baseline 2011 - Follow Up 2014

- **Sample size:** 1200 (300 pilot beneficiaries, 300 RPI beneficiaries; 300 pilot controls; 300 RPI controls)—final obs: 1,081.

- **Control households were selected using PSM**, from the eligible households that did not receive the program.

- The PSM considered **relevant observable characteristics** as household size, education and age of head of household, agroecological zone, among others.
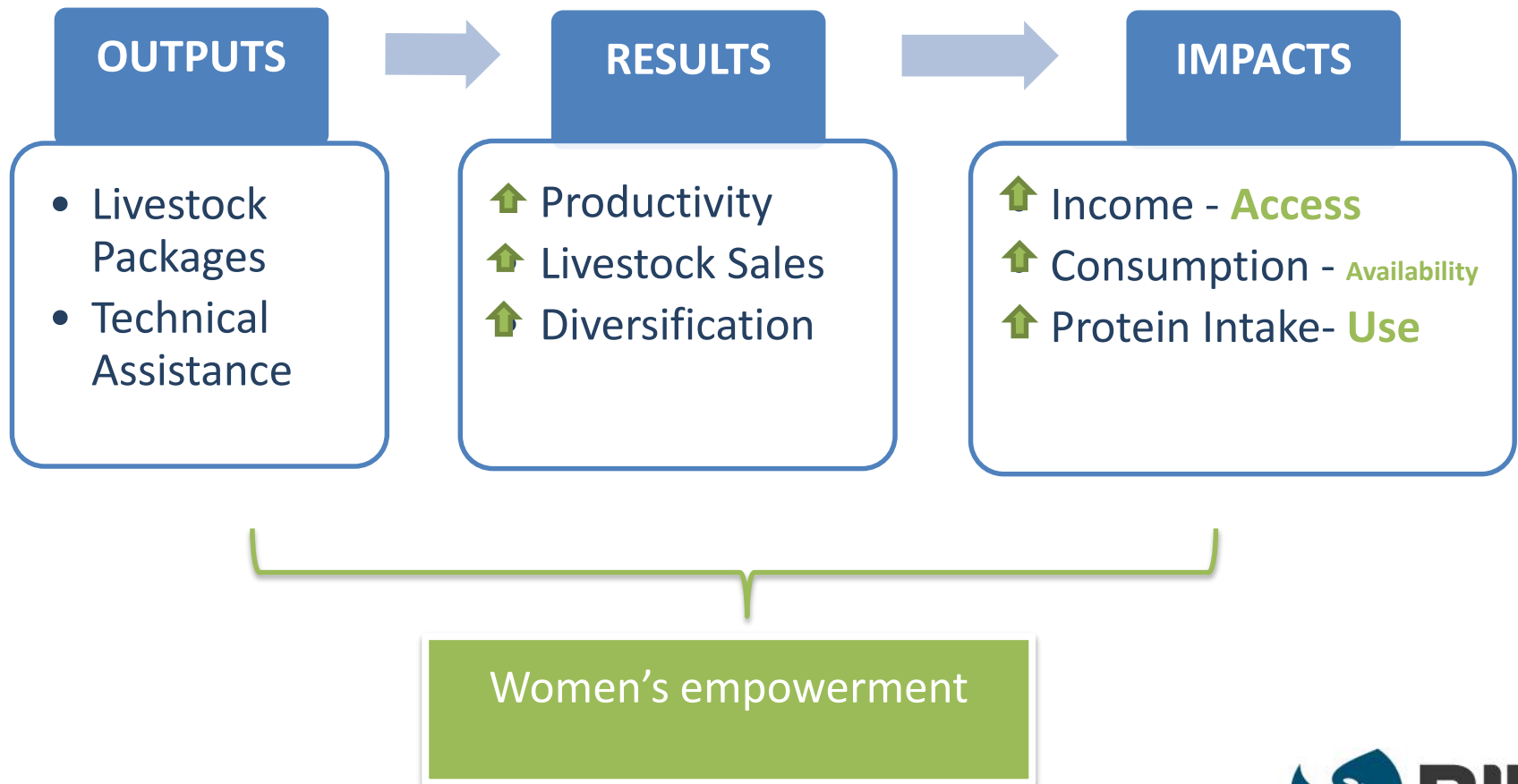
Data – Description

	Variables (unit)	Total	Treated	Control	Diff in Mean
Household	Household Size (members)	5.35	5.42	5.27	0.151
	Dirt floor (0,1)	0.75	0.78	0.72	0.057
	Distance to head city (km)	18.03	17.93	18.15	-0.222
	Participation in local group (0,1)	0.28	0.28	0.28	0.007
Head of Household	Woman (0,1)	0.83	0.86	0.8	0.057*
	Education (years)	6.39	6.47	6.3	0.167
	Age (years)	41.64	40.97	42.39	-1.414
Agricultural Practice	Land owned by HH (mz)	3.92	4.32	3.49	0.827*
	Cultivated land area (mz)	4.46	4.68	4.22	0.465
	Total Livestock Unit	0.54	0.48	0.6	-0.118
	Livestock ratio (liv prod/tot prod)	0.15	0.13	0.17	-0.037*
Income	Total income (cord)	34423.07	37827.88	30625.14	7202.7*
	Income from livestock sales (cord)	670.84	522.54	836.26	-313.714
	Value productivity (cord/mz)	9112.13	8834.02	9422.34	-588.312
Food Security	Food consumption (cord)	2974.8	3056.53	2883.64	172.898
	Food shortage intensity (weeks)	8.49	8.28	8.73	-0.451
N		1081	570	511	

Difference in means is significant at the *** 1%, ** 5%, * 10%, level

Data – Description

- The head of households are primarily woman (83%) around 41 years old, with low levels of education (6 years). The average household have 5 members and 75% have dirt floor.

- Households own 2.7 Has, the TLU is 0.54 on average and the livestock ratio (livestock prod./ total production) is 15%.

- Total household income per year is US$1,564, the income from livestock sales is US$30, and the value of production per mz. Is US$410.

- Food consumption is US$ 135 per month, and experienced food shortages have lasted for 8.5 weeks.

Theory of Change

OUTPUTS	→	RESULTS	→	IMPACTS

OUTPUTS
- Livestock Packages
- Technical Assistance

RESULTS
- ⬆ Productivity
- ⬆ Livestock Sales
- ⬆ Diversification

IMPACTS
- ⬆ Income - **Access**
- ⬆ Consumption - **Availability**
- ⬆ Protein Intake- **Use**

Women's empowerment

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Methodology: Difference in Difference (Pooled Sample)

$$Y_i = \alpha_i + \beta_1\, t + \beta_2 D_i + \beta_3(t * D_i) + \delta_{ij} X_{ij} + \varepsilon_i$$

Where:

Y_i = outcome variable of interest for household i;

t = dummy variable equals to 0 if year 2011 (baseline) and 1 if year 2014 (follow-up);

D_i = dummy variable equals to 1 if household i is treated;

β_3 --Impact

X_{ij} = a vector of observable characteristics for household i, measured at baseline;

ε_i = error term;

α, β, δ are unknown parameters.

Controls include: land ownership, dirt floor, assets, female head of household, age, education, distance to different locations, participation in social groups, access to credit,

Methodology: Difference in Difference (Exposure-Pooled Sample)

$$Y_i = \pi_i + \sigma_1\, t + \rho_1 D_1 + \rho_2 D_2 + \rho_3 D_3 + \rho_4 D_4 + \delta_1\,(t * D_1) +$$
$$\delta_2(t * D_2) + \delta_3(t * D_3) + \delta_4(t * D_4) + \vartheta_{ij} X_{ij} + \mu_i$$

Where:

- Y_i, t, D, X_{ij} = are the same as defined in equation (1);

- $D_j =$ is a dummy variable that takes the value of 1 if the household has received the program for j years;

- $\pi, \rho, \sigma, \vartheta$ are unknown parameters;

- The parameters of interest are $\delta_1, \delta_2\ \delta_3\ \delta_4$, that capture exposure to treatment for one year (or less), two years, three years and four years, respectively.

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Methodology: Randomized Phased-in

$$Y_i = \theta_i + \sigma_1 t + \pi_1 Y_1 + \pi_2 Y_2 + \pi_3 Y_3 + \pi_4 Y_4 + \vartheta_{ij} X_{ij} + \mu_i$$

- Drop beneficiaries from the pilot sample
- Data on number of years with technical assistance was collected in 2014
- For this sample, the timing of entry to program participation was randomly assigned. Therefore, $\pi_1, \pi_2, \pi_3,$ and π_4 will capture the impact of program exposure overtime

DD-Pooled Sample-Income

Variable	Total income (C$)		Income from livestock sales (C$)		Income from crop sales (C$)	
	Basic	**Exposure**	**Basic**	**Exposure**	**Basic**	**Exposure**
Time (1 if 2014)	-7,647***	-8,016***	-182.2	-161.7	-3,357	-3,752
	(2,755)	(2,813)	(192.1)	(189.1)	(2,708)	(2,775)
Treatment	1,925		-318.5*		1,297	
	(2,834)		(179.8)		(2,732)	
Period*Treatment	2,732		1,114***		785.9	
	(3,853)		(244.7)		(3,759)	
1 year or less exposure		3,514		-361.4**		3,151
		(3,825)		(164.4)		(3,747)
2 years of exposure		3,733		-316.9*		2,255
		(5,390)		(187.0)		(5,110)
3 years of exposure		-4,810		-173.1		-4,257
		(3,392)		(285.5)		(3,153)
4 years of exposure		412.4		-116.6		-3,407
		(4,745)		(603.0)		(4,110)
Time* 1 year or less		111.9		932.6***		83.94
		(4,924)		(276.6)		(4,835)
Time* 2 years		-3,957		1,096***		-6,288
		(6,530)		(329.8)		(6,221)
Time* 3 years		14,725***		1,445***		9,029*
		(5,343)		(492.2)		(5,147)
Time* 4 years		14,238		969.4		14,937
		(17,793)		(779.9)		(17,503)
Controls	yes	yes	yes	yes	yes	yes
Obs in Baseline	1073	1073	1073	1073	1073	1073
Obs in Follow Up	1073	1073	1073	1073	1073	1073

Income from livestock ↑133%

Peak: Year 3

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DD-Pooled Sample-Food Security

Variable	Home consumption (C$)		Food consumption (C$)		Protein consumption (C$)	
	Basic	Exposure	Basic	Exposure	Basic	Exposure
Time (1 if 2014)	-342.4***	-341.9***	-934.0***	-936.2***	-290.5***	-285.5***
	(44.23)	(43.97)	(74.44)	(73.91)	(31.37)	(30.98)
Treatment	78.91		140.2*		58.80*	
	(53.12)		(82.17)		(35.39)	
Time*Treatment	69.40		13.49		39.93	
	(62.31)		(101.3)		(42.66)	
1 year of exposure		60.34		96.65		67.15
		(67.85)		(110.1)		(45.00)
2 years of exposure		149.6*		191.7		12.99
		(86.02)		(116.8)		(48.74)
3 years of exposure		-31.66		99.65		176.3***
		(90.25)		(132.5)		(63.49)
4 years of exposure		328.0*		303.3		-10.50
		(181.6)		(247.3)		(80.37)
Time* 1 year or less		-75.39		-54.09		-28.68
		(79.94)		(132.2)		(54.72)
Time* 2 years		102.9		-52.26		113.8*
		(105.5)		(145.6)		(63.34)
Time* 3 years		354.2***		305.6*		27.27
		(108.6)		(166.5)		(75.88)
Time* 4 years		-139.0		-164.2		85.06
		(207.7)		(289.5)		(96.98)
Controls	yes	yes	yes	yes	yes	yes
Obs in Baseline	1073	1073	1073	1073	1073	1073
Obs in Follow Up	1073	1073	1073	1073	1073	1073

Food Consumption ↑10%

Home consumption ↑34%

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DD-Pooled Sample-Livestock Production

Variable	Total Livestock Unit		Livestock Ratio	
	Basic	**Exposure**	**Basic**	**Exposure**
Follow-up (1 if 2014)	0.0837	0.0947	-0.0440***	-0.0447***
	(0.138)	(0.137)	(0.0159)	(0.0157)
Treatment	-0.156*		-0.0133	
	(0.0803)		(0.0143)	
Time*Treatment	1.143***		0.170***	
	(0.153)		(0.0214)	
1 year of exposure		-0.220**		-0.0203
		(0.0945)		(0.0177)
2 years of exposure		-0.131		-0.0206
		(0.0939)		(0.0200)
3 years of exposure		-0.0839		0.0203
		(0.119)		(0.0238)
4 years of exposure		0.0467		-0.0693**
		(0.275)		(0.0273)
Time* 1 year or less		1.002***		0.116***
		(0.173)		(0.0269)
Time* 2 years		1.286***		0.215***
		(0.183)		(0.0309)
Time* 3 years		1.102***		0.193***
		(0.184)		(0.0349)
Time* 4 years		1.458***		0.301***
		(0.529)		(0.0549)
Controls	yes	yes	yes	yes
Obs in Baseline	1073	1073	1073	1073

TLU ↑1.14

Livestock Ratio ↑17%-30%

Randomized Phased-In (Only Treated)

	Income			Food Security		
Variable	**Total income (C$)**	**Income from livestock sales (C$)**	**Income from crop sales (C$)**	**Home consumption (C$)**	**Food consumption (C$)**	**Protein Intake (C$)**
Follow-up (1 if 2014)	-11,508***	508.6**	-6,069	-495.7***	-929.5***	-349.5***
	(4,358)	(231.0)	(4,404)	(100.6)	(144.5)	(62.31)
1 year of exposure	-887.4	1,533*	-4,627	183.9	119.1	161.0*
	(5,348)	(843.7)	(4,772)	(127.2)	(192.5)	(87.70)
2 years of exposure	-1,316	916.0***	-5,465	269.5**	86.24	186.3***
	(4,692)	(342.2)	(4,495)	(116.6)	(154.8)	(68.28)
3 years of exposure	2,405	1,632*	-4,803	464.6***	413.5	205.6*
	(7,410)	(935.6)	(6,529)	(179.5)	(282.7)	(111.8)
4 years of exposure	1,229	1,446*	-2,676	204.9	-22.76	29.59
	(7,749)	(788.9)	(7,440)	(225.8)	(270.8)	(94.01)
Controls	yes	yes	yes	yes	yes	yes
Obs in Baseline	294	294	294	294	294	294
Obs in Follow Up	294	294	294	294	294	294

Income from livestock sales ↑262%

Home consumption ↑38%

Protein intake ↑24%

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Randomized Phased-In (Only Treated)

Variable	Total Livestock Unit	Livestock Ratio	Livestock Costs (C$)	Ag. Production (C$/mz)	Food Shortage (weeks)
Follow-up	1.335***	0.0556*	1,021***	-925.8	3.222*
	(0.142)	(0.0334)	(236.8)	(895.0)	(1.752)
1 year of exposure	0.0152	0.0425	-547.4	-1,038	-5.277**
	(0.245)	(0.0498)	(360.1)	(1,216)	(2.067)
2 years of exposure	0.269	0.139***	763.8**	920.8	-6.671***
	(0.200)	(0.0381)	(324.2)	(1,234)	(1.741)
3 tears of exposure	0.353	0.103*	834.5*	770.9	-7.340***
	(0.243)	(0.0567)	(466.2)	(1,837)	(2.061)
4 years of exposure	1.808	0.146**	447.6	463.8	-9.887***
	(1.259)	(0.0739)	(436.3)	(1,498)	(2.224)
Controls	yes	yes	yes	yes	yes
Obs in Baseline	294	294	294	294	294
Obs in Follow Up	294	294	294	294	294

Livestock Costs ↑157%

Livestock Pn/ Total Pn ↑14%

Food Shortage ↓9 weeks

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Randomized Phased-In (Only Treated)

Variable	Woman receives income	Woman receives more income	Woman decides over income
Period	-0.0646	-0.0289	-0.113**
	(0.0689)	(0.0634)	(0.0525)
1 year of exposure	0.203**	0.139	0.207***
	(0.0997)	(0.110)	(0.0535)
2 years of exposure	0.0681	-0.0827	0.126**
	(0.0763)	(0.0675)	(0.0533)
3 tears of exposure	-0.0392	-0.131	0.0721
	(0.105)	(0.0855)	(0.0671)
4 years of exposure	0.0532	-0.0162	0.199***
	(0.137)	(0.117)	(0.0576)
Controls	yes	yes	yes
Obs in Baseline	251	249	249
Obs in Follow Up	251	249	249

Women's decision making ↑20%

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Conclusions

- Program participation **boosted income from livestock sales and food consumption from own production** (food access and availability)

- Also, the randomized phased-in approach suggests a **reduction of food shortages of approximately 9 weeks** for treated farmers and **improvements on protein intakes** (food use).

- Increased on-farm diversification by increasing ag production from livestock—**reduced vulnerability to shocks.**

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Conclusions

- Livestock management is **complex and costly**—Technical assistance (disentangle effects?)

- **Targeting women can generate greater empowerment and reduce asset inequalities**.

- There might be some **unintended consequences** (i.e. increase work burden)

- **Sustainability** needs to be assessed– some effects are lost in the 4th year

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Thank you

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