



Migration and LCLU in the Ecuadorian Amazon

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Research Questions

- 1) How can *population redistribution* be associated with increasing *deforestation and urbanization* in the Ecuadorian Amazon?
- 2) What *factors affect*, in what intensity and direction, out-migration from rural areas in the Ecuadorian Amazon?
- 3) How such factors affect differently (or not) out-migration to *rural or urban destinations*?

Study Area in the Northern Ecuadorian Amazon (NEA)





Study Area in the NEA

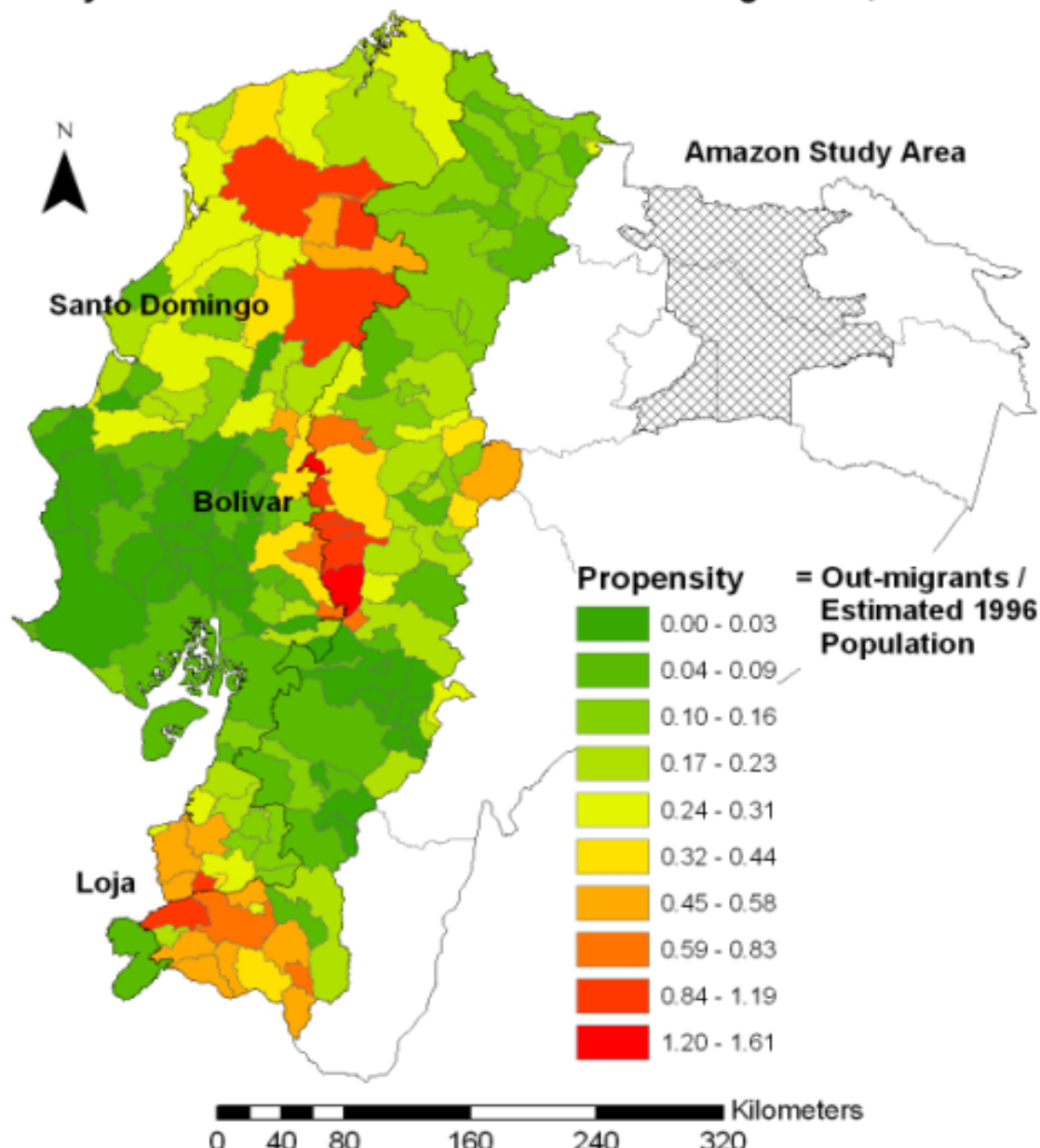


Study Area in the NEA





Propensities of Out-migration to the Northern Ecuadorian Amazon Study Area from the Ecuadorian Coast and Highlands, 1996-2001



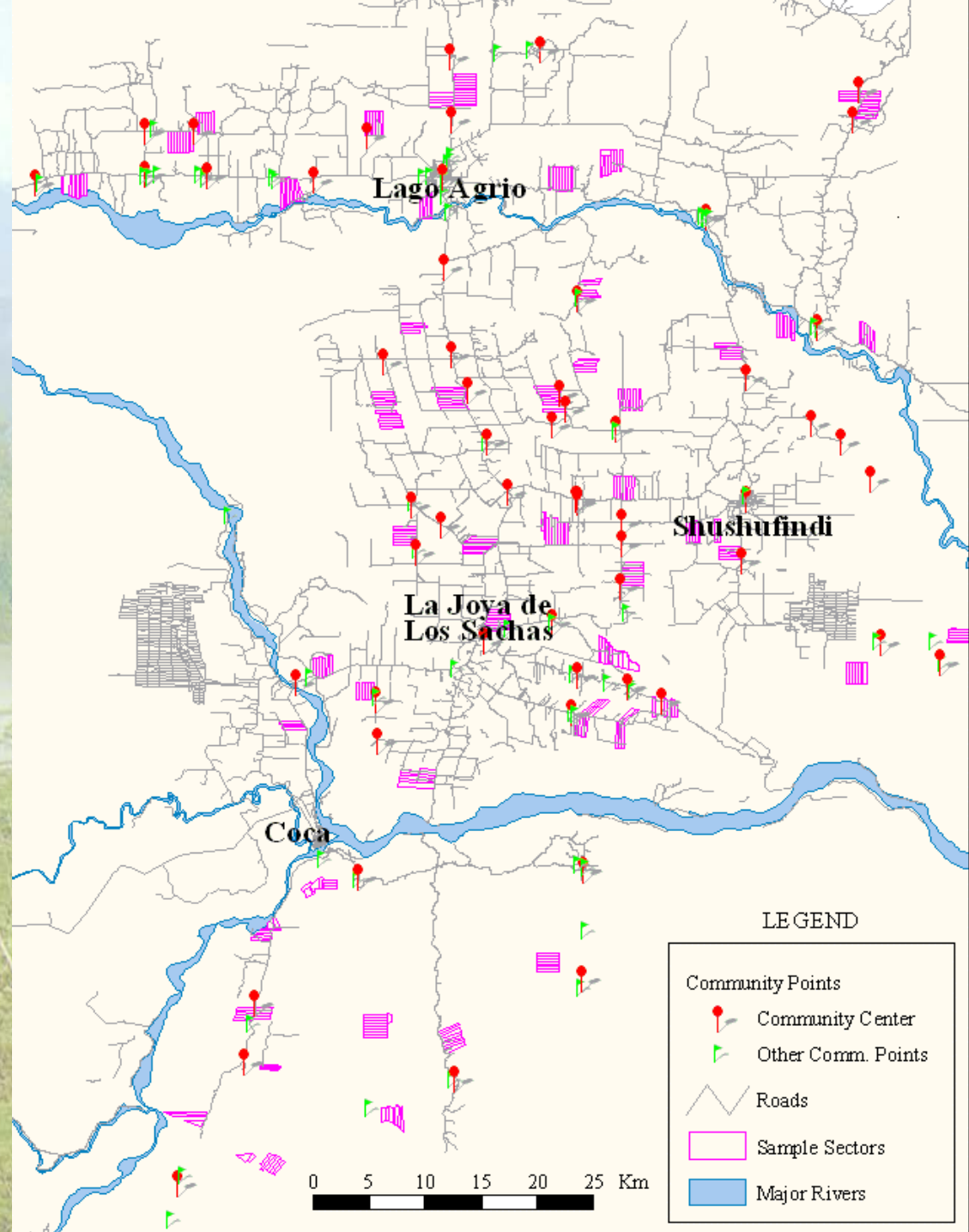


Conceptual framework: relevance of various factors to migration decisions

1. Personal attributes: age (Ravenstein, 1889; Lee, 1966; Castro and Rogers, 1993); gender (Guest, 1993)
2. Human capital factors—education, work experience (Sjaastad, 1962; Becker, 1964; Vanderkamp 1971)
3. Risk diversification, etc.: New Economics of Labor Migration (NELM) (Stark and Bloom, 1985; Stark and Taylor, 1989, 1991)
4. Household composition and farm household life-cycle factors: household size and composition; size of farm (land), forms of agricultural land use, (Thorner *et al* 1986, on Chayanov; Ellis 1988, etc; Walker and Homma, 1996; Perz, 2001; McCracken *et al.*, 2002).
5. Migration networks (Lee, 1966; Da Vanzo, 1981; Taylor, 1986; Massey *et al*, 1987; Massey *et al*, 1993)
6. Community characteristics (roads, infrastructure) (Bilsborrow *et al*, 1984, 1987; Findley, 1987).

Sample Sectors and Farms

- Same farm plots visited in 1990 and 1999; PPS sample
- This study based on same households interviewed in both years
- 246 farm households (1,787 people in 1990 and 1,324 people in 1999)
- Linked to 43 communities



Method

Discrete-time multinomial hazard model (1990, ..., 1999)

$$\log\left(\frac{\pi_{rit}}{\pi_{sit}}\right) = \alpha_{rt} + \beta_{rA}X_{ri} + \beta_{rB}X_{rit}$$

($r = 1$ representing out-migration to a rural area, $r = 2$ out-migration to an urban area); s ($s = r = 0$, the decision of not moving); for persons in the ages 12-59

$\log\left(\frac{\pi_{rit}}{\pi_{sit}}\right)$ represents the log-odds of having an event of type r compared to an event of type s ;

Estimation of robust standard deviations



Results (1): Out-migration

Number of out-migrants from the study area in the Ecuadorian Amazon between 1990 and 1999, according to place of destination and type of household*

	Total		Rural		Urban	
	Out-migrants N	% of Total Population*	Out-migrants N	Out-migrants % of Total	Out-migrants N	Out-migrants % of Total
All persons	466	26.3	316	67.8	150	32.2
12-59 years	398	27.3	266	66.8	132	33.2

* Considering total population (migrants over the decade plus non-migrants in 1999): 1,458 individuals aged 12-59, and 1,771 individuals of all ages

Results and discussion: personal attributes and human capital variables

Table 4 – Estimates from the discrete-time hazard models for the probability of an individual to out-migrate from the study area in the Ecuadorian Amazon between 1990 and 1999 (standard errors in parenthesis)

Variable	Model 1 out-migration vs. no out-migration	Model 2a rural-rural migration vs. no out-migration	Model 2b rural-urban migration vs. no out-migration	Model 2c rural-rural migration vs. rural-urban migration
<i>Personal attributes</i>				
Gender (ref.=female)+	-	-	-	+
Age group 12-19 (reference group: 35+)	+	+	+	-
Age group 20-34 (reference group: 35+)	+	+	+	-
<i>Human capital</i>				
Engagement in farm work (ref.=not engaged)+	+	+	-	+
Household's head education (ref.=less than secondary)+	-	+	-	+
Intercept	-	-	-	-
Log-likelihood	-1515.79	-1105.15	-619.15	-212.22

+ time-invariant independent variables

Significance levels: yellow : $p < 0.05$, green : $p < 0.01$ (two-tailed test)

Results and discussion: household composition and farm life cycle variables

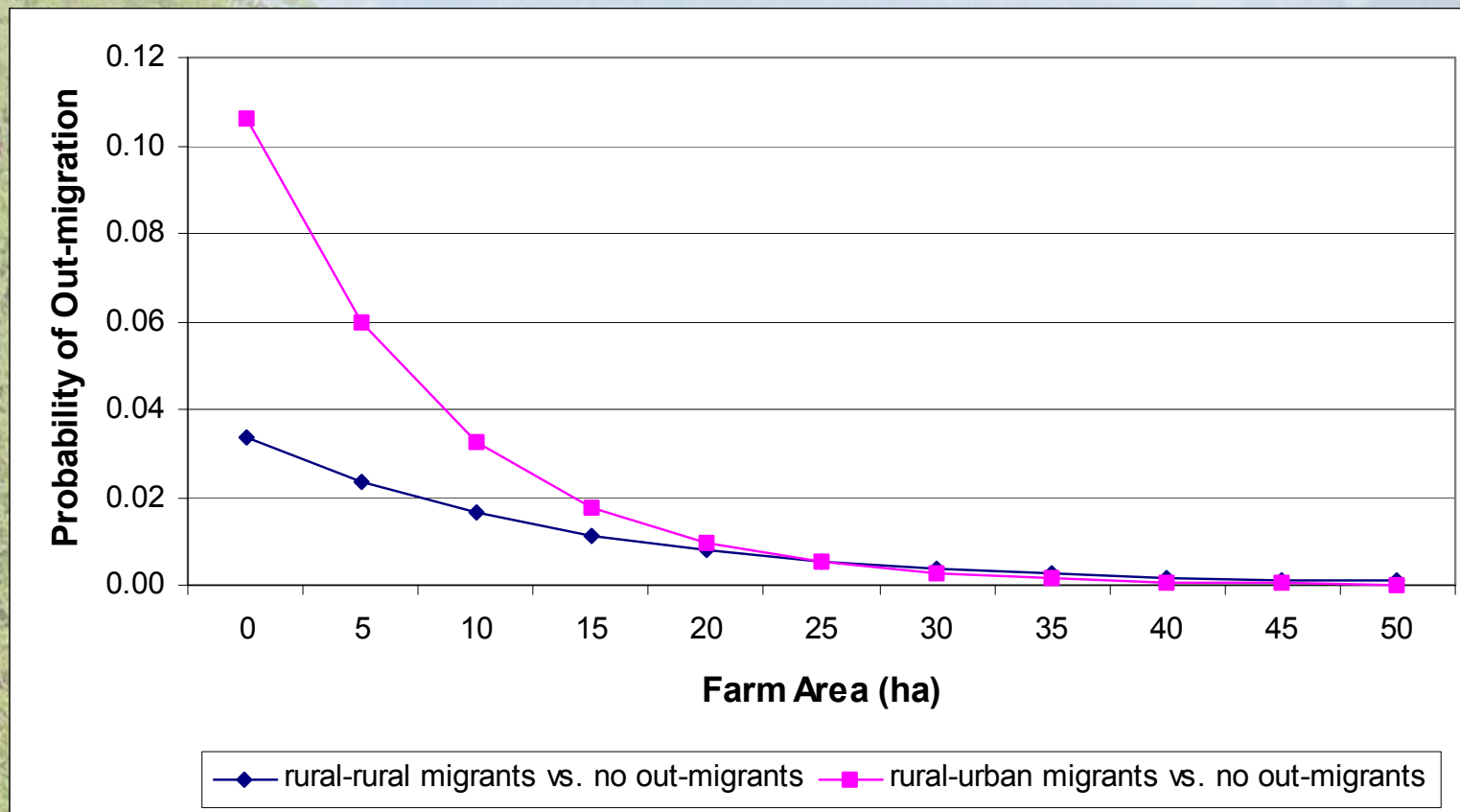
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<i>Farm area</i>				
Farm area (ha)	-	-	-	-
Logarithm of farm area	+	+		+
Squared farm area (ha)			+	
Cubic farm area (ha)			-	
<i>Farm household life cycle</i>				
Number of adults in the farm household	+	+	-	+
Number of children in the farm household	-	-	-	+
Farmland in crops and perennials in 1990 (ha)+	-	-	-	-
Farmland in pasture in 1990 (ha)	+	-	+	-

+ time-invariant independent variables

Significance levels: yellow : $p < 0.05$, green : $*p < 0.01$ (two-tailed test)

Results and discussion: Effects of farm land size



Results: migration network and community variables

Table 4 – Estimates from the discrete-time hazard models for the probability of an individual to out-migrate from the study area in the Ecuadorian Amazon between 1990 and 1999 (standard errors in parenthesis)

Variable	Model 1 out-migration vs. no out-migration	Model 2a rural-rural migration vs. no out-migration	Model 2b rural-urban migration vs. no out-migration	Model 2c rural-rural migration vs. rural-urban migration
<i>Migration Networks</i>				
Number of previous out-migrants from the household	+	+	+	-
<i>Community factors</i>				
Distance from community to nearest town/market (km)+	+	+	+	-
Health facility in the community (ref.=no health facility)	-	-	+	-
Secondary school (ref.=no secondary school)	+	+	-	+

+ time-invariant independent variables

Significance levels: yellow : $p < 0.05$, green : $*p < 0.01$ (two-tailed test)



Conclusions

- Contribution to the *empirical literature* on determinants of population mobility in frontier areas
- Investigating (some) *key determinants* of rural out-migration in the frontier; disentangling migrants' *choice of destination*
- Prospects of increasing *deforestation and urbanization* due to large future stock of potential migrants; closed frontier
- Need for *multi-scalar (or multi-level)* empirical studies – linking individuals, households, communities



Acknowledgements

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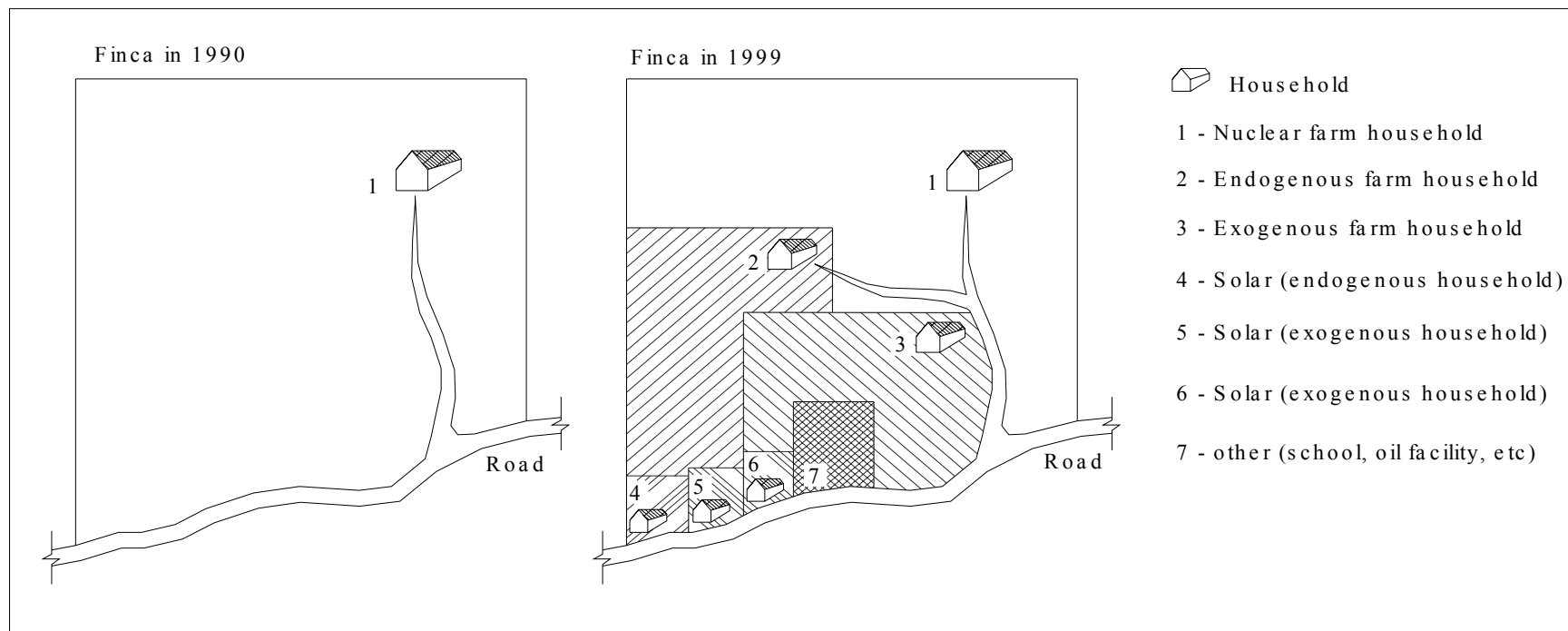
Funding to Alisson Barbieri:

- a) CAPES Scholarship Program (Brazilian government)
- b) Compton Population Fellowship





Linking land fragmentation and migration



Results and discussion: personal attributes and human capital variables

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Variable	Model 1 out-migration vs. no out-migration	Model 2a rural-rural migration vs. no out-migration	Model 2b rural-urban migration vs. no out-migration	Model 2c rural-rural migration vs. rural-urban migration
<i>Personal attributes</i>				
Gender (ref.=female)+	-0.3225*** (0.1141)	-0.1923 (0.1342)	-0.5988*** (0.1998)	0.1755 (0.2786)
Age group 12-19 (reference group: 35+)	1.2566*** (0.2037)	0.9990*** (0.2256)	2.1251*** (0.4831)	-0.7439 (0.5540)
Age group 20-34 (reference group: 35+)	2.0494*** (0.1967)	1.8187*** (0.2137)	2.8726*** (0.4706)	-0.8035 (0.5229)
<i>Human capital</i>				
Engagement in farm work (ref.=not engaged)+	0.1878 (0.1321)	0.4160** (0.1655)	-0.2070 (0.2176)	0.9205*** (0.2925)
Household's head education (ref.=less than secondary)+	-0.0140 (0.1226)	0.0566 (0.1475)	-0.1584 (0.2033)	0.4557* (0.2708)
Intercept	-6.9289*** (0.5971)	-9.0330*** (1.0315)	-6.7566*** (0.8071)	-2.9212** (1.4682)
Log-likelihood	-1515.79	-1105.15	-619.15	-212.22

+ time-invariant independent variables

Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (two-tailed test)

Results and discussion: household composition and farm life cycle variables

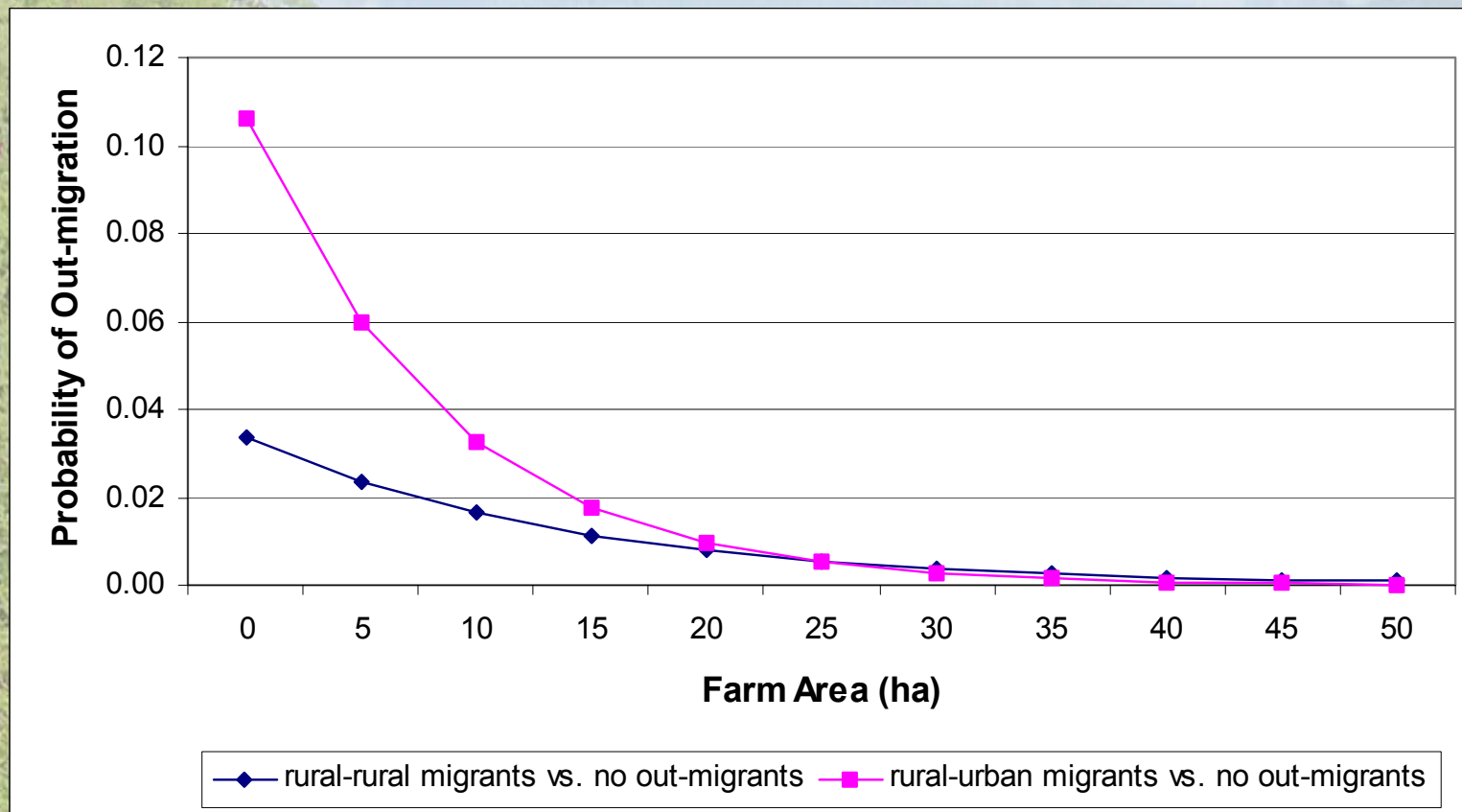
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<i>Farm area</i>				
Farm area (ha)	-0.0095** (0.0050)	-0.0359*** (0.0113)	-0.0336 (0.0223)	-0.0505*** (0.0165)
Logarithm of farm area	0.2494 (0.1757)	1.0338*** (0.3294)	- -	1.4625*** (0.4613)
Squared farm area (ha)	- -	- -	0.00066* (0.0004)	- -
Cubic farm area (ha)	- -	- -	-0.000003* (0.0000)	- -
<i>Farm household life cycle</i>				
Number of adults in the farm household	0.0319** (0.0169)	0.0365** (0.0189)	-0.0023 (0.0281)	0.069500 (0.0567)
Number of children in the farm household	-0.0539** (0.0296)	-0.0263 (0.0325)	-0.1713*** (0.0590)	0.2154** (0.0850)
Farmland in crops and perennials in 1990 (ha)+	-0.0237** (0.0100)	-0.0222* (0.0120)	-0.0228 (0.0154)	-0.0099 (0.0228)
Farmland in pasture in 1990 (ha)	-0.0026*** (0.0010)	-0.0044 (0.0046)	0.0062*** (0.0013)	-0.0084*** (0.0028)

+ time-invariant independent variables

Significance levels: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Results and discussion: Effects of farm land size



Results: migration network and community variables

Table 4 – Estimates from the discrete-time hazard models for the probability of an individual to out-migrate from the study area in the Ecuadorian Amazon between 1990 and 1999 (standard errors in parenthesis)

Variable	Model 1 out-migration vs. no out-migration	Model 2a rural-rural migration vs. no out-migration	Model 2b rural-urban migration vs. no out-migration	Model 2c rural-rural migration vs. rural-urban migration
<i>Migration Networks</i>				
Number of previous out-migrants from the household	0.1888*** (0.0199)	0.1839*** (0.0214)	0.1807*** (0.0296)	-0.0612 (0.0469)
<i>Community factors</i>				
Distance from community to nearest town/market (km)+	0.0078** (0.0033)	0.0017 (0.0039)	0.0153*** (0.0053)	-0.0203*** (0.0069)
Health facility in the community (ref.=no health facility)	-0.3122 (0.2374)	-0.5912** (0.2741)	0.5087 (0.4589)	-1.1642** (0.5641)
Secondary school (ref.=no secondary school)	0.2516 (0.2242)	0.3783 (0.2534)	-0.2542 (0.4462)	0.6067 (0.5422)

+ time-invariant independent variables

Significance levels: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)



Study Area in the NEA





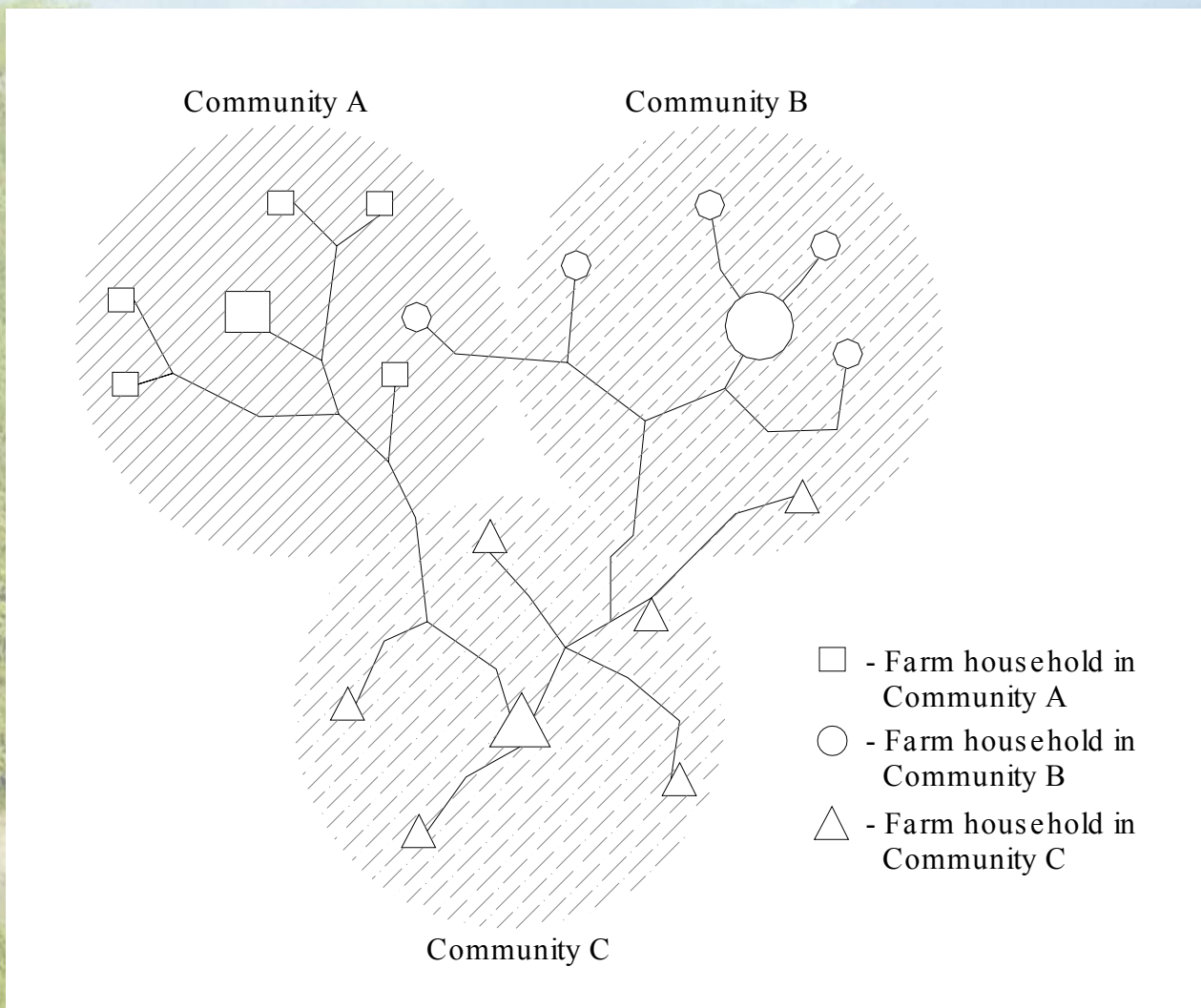
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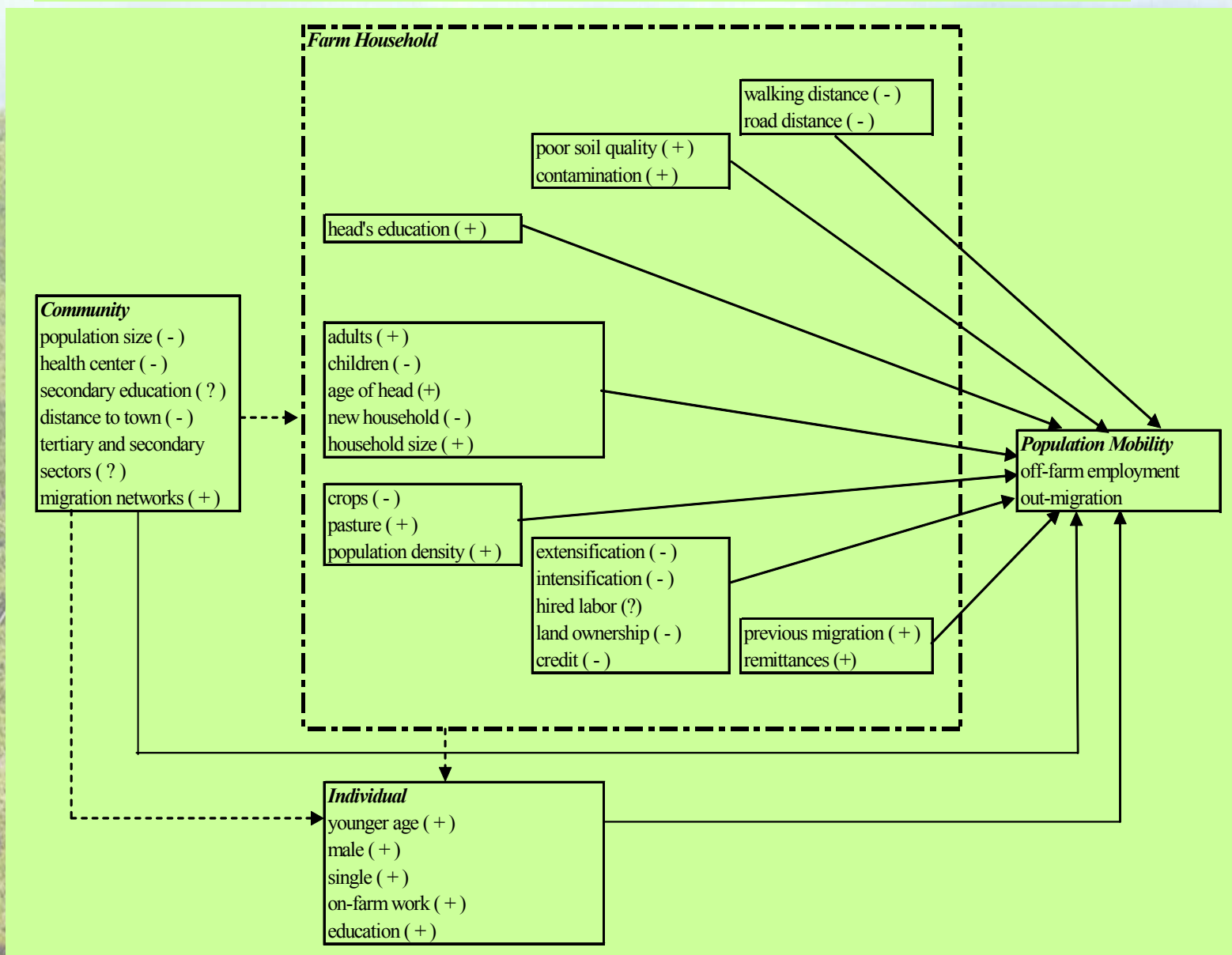
What do we learn from the previous literature on population mobility?

1. Personal attributes: age (Ravenstein, 1889; Lee, 1966; Castro and Rogers, 1993); gender (Guest, 1993); marital status (Brown *et al.*, 1988)
2. Neoclassical economics, Human capital theory—education, work experience (Sjaastad, 1962; Becker, 1964; Vanderkamp, 1974; Taylor, 1986)
3. Risk diversification, etc.: New Economics of Labor Migration (NELM) (Stark and Bloom, 1985; Stark and Taylor, 1989, 1991);
4. Household composition and farm household life-cycle factors: household size and composition; size of farm (land), forms of agricultural land use, (Thorner *et al.* 1986, on Chayanov; Ellis 1988; Perz, 2001, etc.)
5. Migration networks (Lee, 1966; Da Vanzo, 1981; Taylor, 1986; Massey *et al.*, 1987; Massey *et al.*, 1993)
6. Theory of the Multiphasic Responses (Davis, 1964; Bilsborrow, 1987)
7. Migration selectivity
8. Community characteristics (roads, infrastructure) (Bilsborrow *et al.*, 1984, 1987; Findley, 1987; Massey, 1990).
9. Macroeconomics; dual sector (Lewis, 1954; Ranis and Fei, 1961)
10. Structural approaches (Wallerstein, 1974; Piore, 1979; Balán, 1981)
11. Mediating factors (socioeconomic, cultural, institutional, the environment)

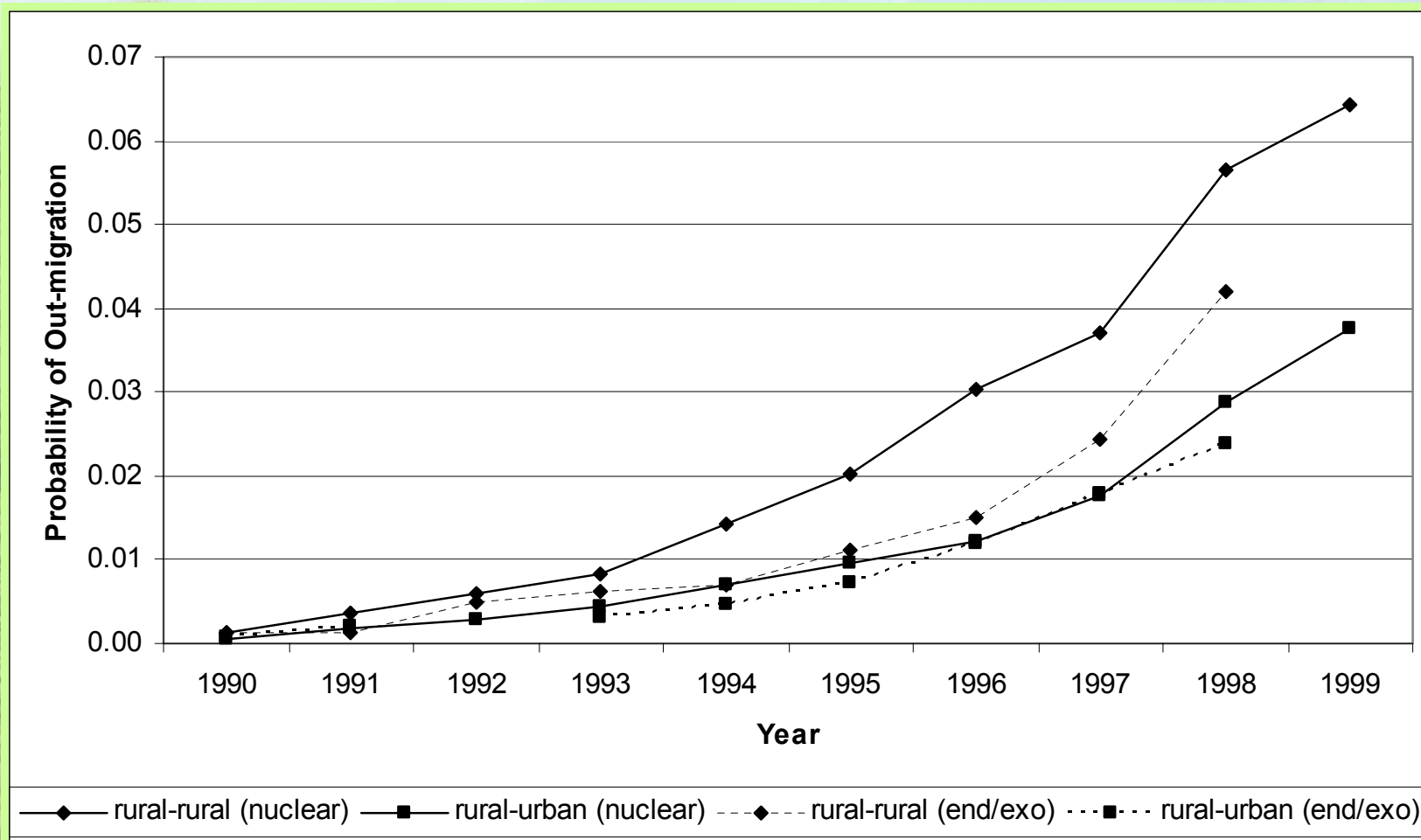
Linking Farm Households and Communities



Conceptual framework (3): A Multi-scale approach



Results (1): Discrete-time Hazard Model of Out-migration



Probability of Out-migration from a Farm Household in the Study Area in the Northern Ecuadorian Amazon between 1990 and 1999, According to Destination and Type of Farm Household

Results (1): Out-migration

Reasons to out-migrate to rural and urban areas, according to type of household and age group – Northern Ecuadorian Amazon, 1990-1999

<i>Reason to Out-migrate (%)</i>	Nuclear farm households (N=398)									
	Rural Destinations (N=266)					Urban Destinations (N=132)				
	age 12-17	age 18-24	age 25-34	age 35-59	% in total of reason	age 12-17	age 18-24	age 25-34	age 35-59	% in total of reason
Accompany spouse or relative	1.9	11.3	20.3	9.8	43.2	1.5	10.6	19.7	10.6	42.4
Looking for employment	6.4	2.3	15.4	14.3	38.3	0.8	2.3	15.9	13.6	32.6
Education	0.0	0.0	2.6	0.8	3.4	0.8	4.5	6.8	1.5	13.6
Other reasons*	2.3	3.8	4.5	4.5	15.0	0.8	2.3	6.8	1.5	11.4
<i>Reason to Out-migrate (%)</i>	Endogenous/Exogenous farm households (N=100)									
	Rural Destinations (N=62)					Urban Destinations (N=38)				
	age 12-17	age 18-24	age 25-34	age 35-59	% in total of reason	age 12-17	age 18-24	age 25-34	age 35-59	% in total of reason
Accompany spouse or relative	1.6	4.8	35.5	6.5	48.4	0.0	13.2	15.8	13.2	42.1
Looking for employment	1.6	0.0	9.7	14.5	25.8	2.6	2.6	13.2	10.5	28.9
Education	0.0	6.5	1.6	0.0	8.1	0.0	2.6	7.9	0.0	10.5
Other reasons*	4.8	1.6	4.8	6.5	17.7	0.0	2.6	7.9	7.9	18.4

* Include, for example, answers like "health reasons", "military service", "didn't like the place".



Results (1): Discrete-time Hazard Model of Out-migration

Means of independent variables at the individual level - study area in the Northern Ecuadorian Amazon, 1990 to 1999, according to out-migration status and type of farm household

Variables	Nuclear Farm Households						Endogenous and Exogenous Farm Households					
	Rural-rural migrants		Rural-urban migrants		Non-migrants		Rural-rural migrants		Rural-urban migrants		Non-migrants	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
<i>Personal attributes</i>												
Age group 12-17	0.32	0.47	0.41	0.49	0.27	0.44	0.28	0.45	0.35	0.48	0.24	0.43
Age group 18-24	0.38	0.49	0.39	0.49	0.18	0.38	0.37	0.48	0.44	0.50	0.22	0.41
Age group 25-34	0.21	0.41	0.16	0.37	0.17	0.36	0.30	0.46	0.17	0.38	0.26	0.44
Age group 35+	0.09	0.28	0.03	0.18	0.38	0.49	0.05	0.21	0.03	0.18	0.28	0.45
Gender (0=female, 1=male)+	0.62	0.49	0.49	0.50	0.57	0.50	0.62	0.49	0.50	0.50	0.56	0.50
<i>Human capital</i>												
Engagement in farm work (0=no, 1=engaged)+	0.80	0.40	0.66	0.47	0.70	0.46	0.80	0.80	0.82	0.39	0.86	0.35

+ time-invariant independent variables

Results (1): Discrete-time Hazard Model of Out-migration

Means and standard deviations of independent variables at the farm household level - study area in the Northern Ecuadorian Amazon, 1990 to 1999, according to out-migration status and type of farm household

Variables	Nuclear Farm Households						Endogenous and Exogenous Farm Households					
	Rural-rural migrants		Rural-urban migrants		Non-migrants		Rural-rural migrants		Rural-urban migrants		Non-migrants	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
<i>Human capital</i>												
Household head's education (1=at least secondary)+	0.34	0.47	0.33	0.47	0.41	0.49	0.67	0.47	0.73	0.45	0.61	0.49
<i>Migration networks</i>												
Number of previous out-migrants from the household	1.95	2.43	2.18	2.50	1.68	2.38	0.87	1.20	0.71	0.96	0.29	0.76
<i>Household life cycle</i>												
Age of household head	42.36	12.00	44.05	13.41	44.72	13.19	37.44	10.62	45.29	9.81	38.57	11.74
Number of adults in the farm household	7.15	3.21	6.11	1.91	6.09	3.22	5.22	1.85	5.64	2.01	3.93	1.99
Number of children in the farm household	2.33	2.49	1.82	1.58	1.79	1.98	2.34	1.93	2.21	1.56	2.36	1.78
<i>Land management</i>												
Farm area (ha)	42.19	15.74	42.42	23.31	43.74	27.09	25.00	18.90	24.39	19.55	18.57	19.51
Land title (0=no, 1=yes)	0.42	0.49	0.46	0.50	0.53	0.50	0.37	0.48	0.40	0.49	0.24	0.43
<i>Land Use</i>												
Farmland in crops and perennials (ha)+	7.27	5.73	7.47	6.11	8.76	6.41	3.27	3.63	2.75	2.88	3.00	2.98
Farmland in pasture (ha)	19.33	65.78	7.63	9.28	9.28	15.41	4.71	6.50	3.52	6.50	3.47	6.37
<i>Environmental conditions</i>												
Soil quality (0=poor, 1=good)+	0.42	0.49	0.45	0.50	0.37	0.48	0.44	0.50	0.44	0.50	0.46	0.50
<i>Transportation accessibility</i>												
Walking distance (Km)+	0.85	1.51	0.70	1.38	0.84	1.44	1.19	1.55	1.11	1.80	1.25	1.79
Road distance (Km)+	19.67	15.51	21.39	18.32	20.31	15.68	14.50	10.50	15.89	12.45	15.18	9.86

+ time-invariant independent variables

* Means and standard deviations are weighted by person-weights, that is, the number of individuals exposed to the risk of out-migration in the farm household in a given year. For example, if in 1992 five individuals were exposed to the risk of out-migration (were in the ages 12-59), the number of adults in this household is multiplied by 5. If one individual out-migrated from this farm household in 1993, the number of adults in this year is multiplied by four (weight=4). Weighting by person-weights allows distinguishing farm household variables according to the household's internal composition between out-migrants and non migrants.



Results (1): Discrete-time Hazard Model of Out-migration

Means and standard deviations of independent variables at the community level - study area in the Northern Ecuadorian Amazon, 1990 to 1999, according to out-migration status and type of farm household*

Variable	Nuclear Farm Households						Endogenous/Exogenous Farm Households					
	Rural-rural migrants		Rural-urban migrants		Non-migrants		Rural-rural migrants		Rural-urban migrants		Non-migrants	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
<i>Community services</i>												
Secondary school (0=no, 1=yes)	0.24	0.43	0.38	0.49	0.33	0.47	0.08	0.28	0.38	0.49	0.26	0.26
Health facility in the community (0=no, 1=yes)	0.19	0.39	0.35	0.48	0.27	0.44	0.08	0.28	0.36	0.48	0.24	0.43
<i>Labor market</i>												
Proportion of labor force in secondary sector+	0.05	0.07	0.07	0.08	0.05	0.06	0.09	0.09	0.10	0.08	0.08	0.08
Proportion of labor force in tertiary sector+	0.33	0.27	0.33	0.28	0.31	0.27	0.40	0.26	0.35	0.29	0.35	0.27

+ time-invariant independent variables

* Means and standard deviations are weighted by person-weights, that is, the number of individuals exposed to the risk of out-migration in the community in a given year.

Results (1): Discrete-time Hazard Model of Out-migration

Table 1 – Estimates from the discrete-time hazard models of the probability that an individual living in a nuclear farm household will out-migrate from the Northern Ecuadorian Amazon between 1990 and 1999 – individual-level variables

Variables	Model 1		Model 2a		Model 2b		Model 2c	
	Out-migration vs. non-migration		Rural-rural migration vs. non-migration		Rural-urban migration vs. non-migration		Rural-rural migration vs. rural-urban migration	
	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]
<i>Personal attributes</i>								
Age group 12-17 (ref.: 35+)	0.965	0.218***	0.719	0.247***	1.816	0.507***	-0.716	0.578
Age group 18-24 (ref.: 35+)	2.144	0.201***	1.838	0.221***	3.021	0.480***	-0.825	0.518
Age group 25-34 (ref.: 35+)	1.954	0.214***	1.776	0.235***	2.650	0.496***	-0.578	0.537
Gender (ref.: 0=female)+	-0.319	0.116***	-0.184	0.137	-0.606	0.204***	0.360	0.284
<i>Human capital</i>								
Engagement in farm work (ref.: 0=not engaged)+	0.132	0.137	0.407	0.166**	-0.292	0.220	0.887	0.309***

+ time-invariant independent variable

[‡] Significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Table 2 – Estimates from the discrete-time hazard models of the probability that an individual living in an endogenous/exogenous farm household will out-migrate from the Northern Ecuadorian Amazon between 1990 and 1999 – individual-level variables

Variables	Model 1		Model 2a		Model 2b		Model 2c	
	Out-migration vs. non-migration		Rural-rural migration vs. non-migration		Rural-urban migration vs. non-migration		Rural-rural migration vs. rural-urban migration	
	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]
<i>Personal attributes</i>								
Age group 12-17 (ref.: 35+)	0.927	0.501*	0.383	0.595	2.245	1.119**	-1.583	1.854
Age group 18-24 (ref.: 35+)	2.389	0.459***	2.053	0.515***	3.462	1.108***	-0.613	1.773
Age group 25-34 (ref.: 35+)	2.262	0.499***	1.753	0.563***	3.605	1.152***	-0.339	1.899
Gender (ref.: 0=female)+	-0.316	0.223	-0.030	0.293	-0.890	0.351**	1.242	0.713*
<i>Human capital</i>								
Engagement in farm work (ref.: 0=not engaged)+	0.046	0.279	-0.093	0.331	0.472	0.445	-1.055	0.644*

+ time-invariant independent variable

[‡] Significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Results (1): Discrete-time Hazard Model of Out-migration

Table 1 – Estimates from the discrete-time hazard models of the probability that an individual living in a nuclear farm household will out-migrate from the Northern Ecuadorian Amazon between 1990 and 1999 – individual-level variables

Variables	Model 1		Model 2a		Model 2b		Model 2c	
	Out-migration vs. non-migration		Rural-rural migration vs. non-migration		Rural-urban migration vs. non-migration		Rural-rural migration vs. rural-urban migration	
	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]
<i>Migration networks</i>								
Number of previous out-migrants from household	0.187	0.020***	0.171	0.021***	0.178	0.030***	-0.068	0.049
<i>Household life cycle</i>								
Age of household head	0.003	0.005	-0.002	0.005	0.012	0.007*	-0.025	0.011*
Number of adults in farm household	0.018	0.017	0.014	0.019	-0.005	0.031	0.059	0.053
Number of children in farm household	-0.028	0.031	0.025	0.035	-0.124	0.061**	0.206	0.089**
<i>Land management</i>								
Farm area (ha)	-0.007	0.004**	-0.028	0.011***	-0.040	0.021*	-0.046	0.015***
Logarithm of farm area	0.2719	0.164*	0.8575	0.316***			1.141	0.475**
Squared farm area	-	-	-	-	0.00085	0.0003**	-	-
Cubic farm area	-	-	-	-	0.000004	0.0000**	-	-
<i>Land Use</i>								
Farmland in crops and perennials (ha)+	-0.021	0.010**	-0.130	0.067**	-0.023	0.016	0.064	0.022*
Logarithm of farmland in crops and perennials+	-	-	-	-	-	-	-0.557	.197**
Squared farmland in crops and perennials+	-	-	0.009	0.006	-	-	-	-
Cubic farmland in crops and perennials+	-	-	-0.0002	0.0001	-	-	-	-
Farmland in pasture (ha)	0.002	0.001*	-0.008	0.006	0.005	0.002***	-0.016	0.004***
Logarithm of farmland in pasture	-	-	-	-	-	-	0.131	0.087
<i>Transportation accessibility</i>								
Walking distance (Km)+	-0.051	0.043	-0.380	0.158**	-0.014	0.075	0.171	0.111
Squared walking distance	-	-	0.050	0.028*	-	-	-	-
Road distance (Km)+	-0.020	0.011**	-0.003	0.005	-0.079	0.045*	0.142	0.063**
Squared road distance	0.0003	0.0002**	-	-	0.00287	0.0017*	-0.00580	0.0024**
Cubic road distance	-	-	-	-	-0.00002	0.00000	0.00010	0.0000**

+ time-invariant independent variable

[‡] Significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Results (1): Discrete-time Hazard Model of Out-migration

Table 1 – Estimates from the discrete-time hazard models of the probability that an individual living in an endogenous/exogenous farm household will out-migrate from the Northern Ecuadorian Amazon between 1990 and 1999 – individual-level variables

Variables	Model 1		Model 2a		Model 2b		Model 2c	
	Out-migration vs. non-migration		Rural-rural migration vs. non-migration		Rural-urban migration vs. non-migration		Rural-rural migration vs. rural-urban migration	
	Coefficient	St. error [†]	Coefficient	St. error [†]	Coefficient	St. error [†]	Coefficient	St. error [†]
<i>Human capital</i>								
Household's head education (ref.: less than secondary)+	0.176	0.260	-0.430	0.305	1.208	0.558**	-2.392	0.753***
<i>Migration networks</i>								
Number of previous out-migrants from household	0.216	0.085**	0.397	0.106***	-0.020	0.171	1.419	0.529***
<i>Household life cycle</i>								
Age of household head	0.025	0.011**	-0.012	0.014	0.070	0.022***	-0.112	0.036***
Number of adults in farm household	0.344	0.060***	0.429	0.073***	0.387	0.115***	0.274	0.216
Number of children in farm household	-0.230	0.080***	-0.124	0.102	-0.391	0.114***	0.552	0.234**
<i>Land management</i>								
Farm area (ha)	0.015	0.007**	0.008	0.009	0.036	0.011***	-0.062	0.027**
Land title (ref.: 0 = no title)	0.687	0.259***	0.867	0.331***	0.787	0.492*	1.399	1.430
<i>Land Use</i>								
Farmland in crops and perennials (ha)+	-0.073	0.033**	-0.083	0.045*	-0.259	0.143*	0.118	0.140
Logarithm of farmland in crops and perennials+	-	-	-	-	0.551	0.251**	-	-
Farmland in pasture (ha)+	-0.006	0.017	0.025	0.021	-0.452	0.163***	0.163	0.057***
Squared farmland in pasture+	-	-	-	-	0.042	0.018**	-	-
Cubic farmland in pasture+	-	-	-	-	-0.001	0.0005**	-	-
<i>Environmental conditions</i>								
Soil quality (ref.: 0 = poor soil)	0.453	0.251*	0.284	0.342	0.406	0.423	-1.449	0.889*
<i>Transportation accessibility</i>								
Walking distance (Km)+	-0.048	0.078	0.599	0.422	-0.041	0.115	3.953	1.072***
Squared walking distance	-	-	-0.315	0.178*	-	-	-1.508	0.352***
Cubic walking distance	-	-	0.031	0.018*	-	-	0.126	0.029***
Road distance (Km)+	-0.066	0.027**	-0.084	0.041**	-0.085	0.033***	0.019	0.003
Squared road distance	0.00155	0.0005***	0.00210	0.0007***	0.00200	0.0007***	-	-

+ time-invariant independent variable

[†] Significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Results (1): Discrete-time Hazard Model of Out-migration

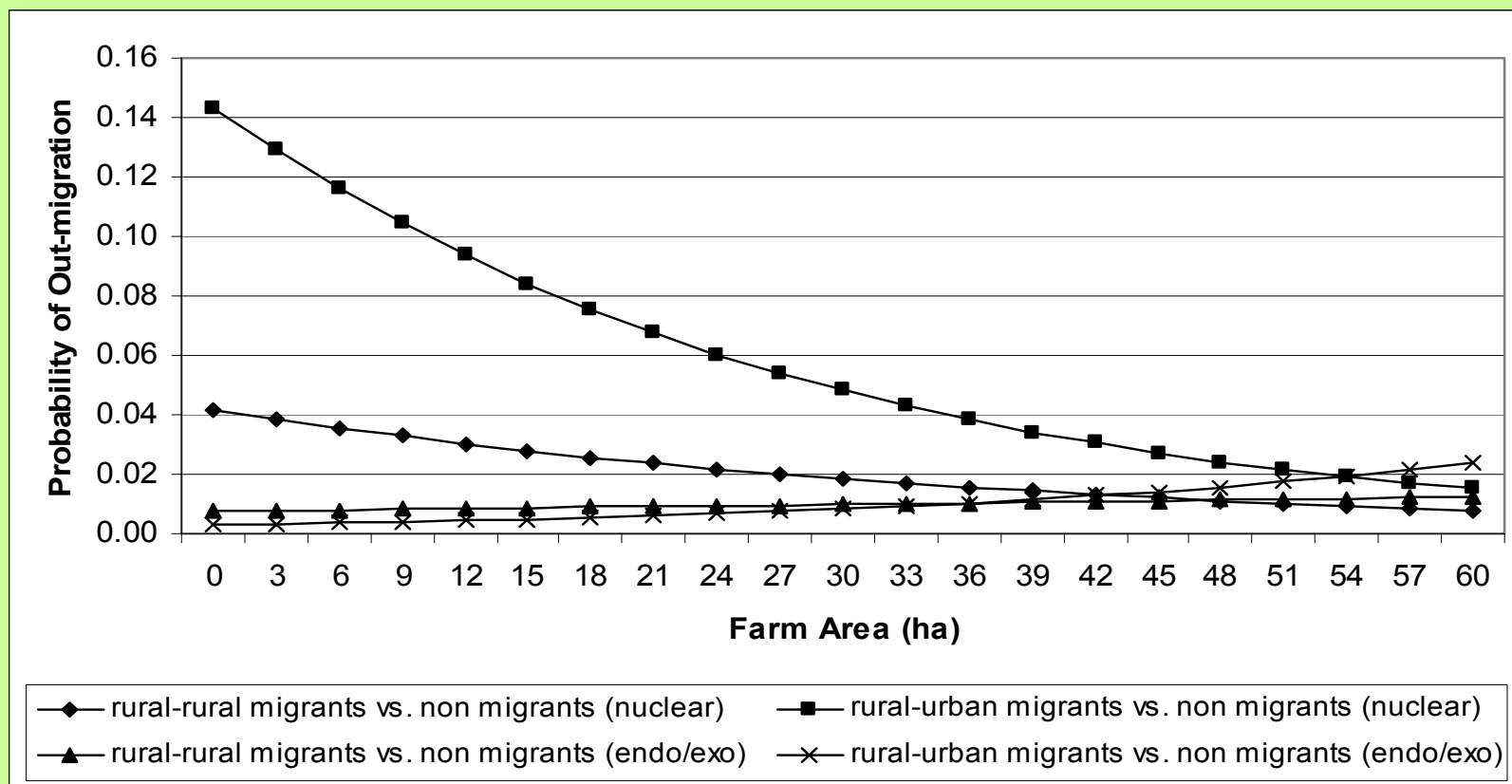


Figure 1 – Predicted probability of out-migration from a farm household in the Ecuadorian Amazon between 1990 and 1999, according to farm area (ha)

Results (1): Discrete-time Hazard Model of Out-migration

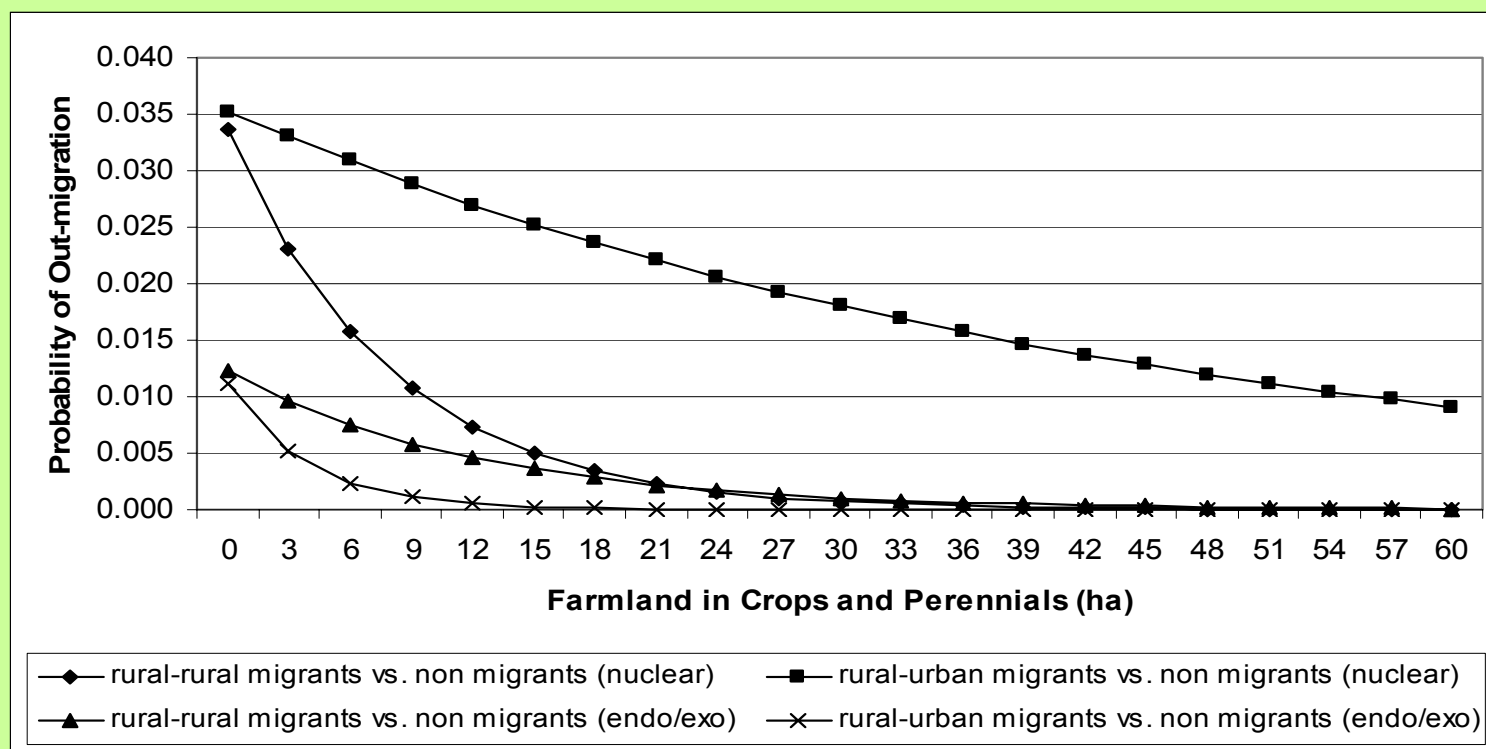


Figure 1 – Predicted probability of out-migration from a farm household in the Ecuadorian Amazon between 1990 and 1999, according to farmland in crops/perennials (ha)



Results (1): Discrete-time Hazard Model of Out-migration

Table 1 – Estimates from the discrete-time hazard models of the probability that an individual living in a nuclear farm household will out-migrate from the Northern Ecuadorian Amazon between 1990 and 1999 – community-level variables

Variables	Model 1		Model 2a		Model 2b		Model 2c	
	Out-migration vs. non-migration		Rural-rural migration vs. non-migration		Rural-urban migration vs. non-migration		Rural-rural migration vs. rural-urban migration	
	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]
<i>Community services</i>								
Secondary school (ref.: 0 = no school)	-0.015	0.2431	-0.468	0.179***	-0.251	0.475	1.278	0.626**
Health facility in the community (ref.: 0 = no health facility)	-0.261	0.148*	-	-	0.479	0.455	-1.645	0.619***
<i>Labor market</i>								
Proportion of labor force in secondary sector+	-2.7655	1.415**	-2.8190	3.9950	1.6420	1.5930	-1.0620	2.3870
Logarith of the proportion of labor force in secondary sector+	0.1897	0.096**	-	-	-	-	-	-
Squared proportion of labor force in secondary sector+	-	-	110.276	27.15***	-	-	-	-
Cubic proportion of labor force in secondary sector+	-	-	-402.74	106.04***	-	-	-	-
Proportion of labor force in tertiary sector+	-2.546	2.533	2.276	1.373*	-0.460	0.425	0.365	0.581
Squared proportion of labor force in tertiary sector+	10.6169	6.9322	-2.662	1.428*	-	-	-	-
Cubic proportion of labor force in tertiary sector+	-9.691	5.321*	-	-	-	-	-	-
Intercept	-5.655	0.687***	-8.264	1.031***	-6.545	0.911***	-1.757	1.605
Likelihood-ratio Index (LRI)	0.11		0.11		0.13		0.17	

+ time-invariant independent variable

[‡] Significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Results (1): Discrete-time Hazard Model of Out-migration

Table 1 – Estimates from the discrete-time hazard models of the probability that an individual living in an endogenous/exogenous farm household will out-migrate from the Northern Ecuadorian Amazon between 1990 and 1999 – community-level variables

Variables	Model 1		Model 2a		Model 2b		Model 2c	
	Out-migration vs. non-migration		Rural-rural migration vs. non-migration		Rural-urban migration vs. non-migration		Rural-rural migration vs. rural-urban migration	
	Coefficient	St. error [†]	Coefficient	St. error [†]	Coefficient	St. error [†]	Coefficient	St. error [†]
<i>Community services</i>								
Secondary school (ref.: 0 = no school)	-0.229	0.226	-0.679	0.396*	0.252	0.442	-1.894	1.209
<i>Labor market</i>								
Proportion of the labor force in the secondary sector ⁺	-2.876	1.300**	-2.371	1.493	-4.355	2.581*	-53.447	21.80**
Squared proportion of the labor force in the secondary sector ⁺	-	-	-	-	-	-	176.862	77.721**
Proportion of the labor force in the tertiary sector ⁺	0.342	0.436	6.403	2.263***	0.549	0.785	-0.087	1.395
Squared proportion of the labor force in the tertiary sector ⁺	-	-	-6.835	2.274***	-	-	-	-
Intercept	-9.056	0.959***	-8.585	1.234***	-12.372	1.576***	7.995	2.769***
Likelihood-ratio Index (LRI)	0.18		0.18		0.23		0.28	

⁺ time-invariant independent variable

[†] Significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)



Results (2): Off-farm Employment (OFE)

Table 1 – Number and Distribution of Persons Engaged in Off-farm Employment, by Place of Work and Type of Farm Household, and Existence of Previous Out-migration from the Farm Household - Northern Ecuadorian Amazon, 1999*

Place of off-farm employment	Nuclear farm households					Endogenous/exogenous farm households				
	Total	Without out-migrant		With out-migrant		Total	Without out-migrant		With out-migrant	
		N	%	N	%		N	%	N	%
Local Community	91	23	25.3	68	74.7	185	140	75.7	45	24.3
Other Rural	58	21	36.2	37	63.8	74	63	85.1	11	14.9
Other Urban	39	8	20.5	31	79.5	60	48	80.0	12	20.0
Not engaged in off-farm employment	819	269	32.8	550	67.2	890	685	77.0	205	23.0
Total	1007	321	31.9	686	68.1	1209	936	77.4	273	22.6

* For 12-59 years of age



Results (2): Multilevel Model of Off-farm Employment (OFE)

Table 1 – Means and standard deviations of independent variables, according to off-farm employment status and individual-level independent variables – Northern Ecuadorian Amazon, 1999*

Independent variable	Place of Off-farm Employment						Not in off-farm employment	
	Local Community		Other Rural		Other Urban		employment	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
<i>Personal attributes</i>								
Age group 12-17	0.11	0.31	0.05	0.21	0.07	0.26	0.32	0.47
Age group 18-24	0.28	0.45	0.23	0.42	0.28	0.45	0.21	0.40
Age group 25-34	0.26	0.44	0.43	0.50	0.33	0.47	0.17	0.37
Age group 35-59	0.35	0.48	0.30	0.46	0.31	0.47	0.30	0.46
Gender (0=female, 1=male)+	0.88	0.32	0.92	0.27	0.62	0.49	0.48	0.50
Marital status (0=married/in union, 1=single/not in union)	0.39	0.49	0.39	0.49	0.37	0.49	0.50	0.50
<i>Human capital</i>								
Education (1=at least some secondary)	0.49	0.50	0.58	0.49	0.74	0.44	0.52	0.50
Engagement in farm work (1=yes, 0=no)+	0.90	0.30	0.84	0.37	0.68	0.47	0.84	0.37

* For persons in the ages 12-59



Results (2): Multilevel Model of Off-farm Employment (OFE)

Table 1 – Means and standard deviations of independent variables according to off-farm employment status and farm household-level independent variables – Northern Ecuadorian Amazon, 1999*

Independent variable	Place of Off-farm Employment						Not engaged in off-farm employment	
	Community		Rural		Urban		mean	st. dev.
	mean	st. dev.	mean	st. dev.	mean	st. dev.		
<i>Household life cycle</i>								
Number of adults	4.57	2.97	4.92	2.61	4.09	2.07	4.68	2.48
Number of children	2.63	2.14	2.70	2.03	2.14	1.54	2.72	2.13
Age of the household's head	43.21	13.50	43.83	13.43	42.02	12.78	45.99	12.14
<i>Land use</i>								
Land in crops/perennials (ha)	2.87	2.52	3.12	3.51	2.56	3.18	4.00	3.67
Land in pasture (ha)	4.13	6.82	4.54	8.28	6.23	9.84	6.66	9.56
<i>Environmental conditions</i>								
Environmental contamination (0=no, 1=yes)	0.42	0.50	0.51	0.50	0.43	0.50	0.43	0.49
<i>Land management</i>								
Farm area (ha)	21.32	18.22	28.45	25.64	24.44	20.56	30.47	26.07
Land title (1=has title)	0.33	0.47	0.41	0.49	0.41	0.50	0.44	0.50
Use of inputs (0=no, 1=yes)	0.29	0.45	0.37	0.48	0.28	0.45	0.34	0.47
Hired farm labor (0=no, 1=yes)	0.35	0.48	0.55	0.50	0.57	0.50	0.44	0.50
Credit or technical assistance (0=no, 1=yes)	0.23	0.42	0.25	0.43	0.20	0.40	0.26	0.44
<i>Transportation accessibility</i>								
Walking distance to the nearest road (Km)	1.03	1.58	1.18	1.76	0.55	1.06	1.12	1.75
Road distance to the nearest town (Km)	17.47	12.51	18.66	15.38	14.77	12.84	17.89	13.47

* For persons in the ages 12-59.



Results (2): Multilevel Model of Off-farm Employment (OFE)

Table 1 – Means and standard deviations of independent variables according to off-farm employment status and community-level independent variables – Northern Ecuadorian Amazon, 1999*

Independent variable	Place of Off-farm Employment						Not in off-farm employment	
	Local Community		Other Rural		Other Urban		employment	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
<i>Transportation accessibility</i>								
Distance to nearest town (Km)	18.55	16.00	21.02	18.01	18.54	15.82	20.60	16.14
<i>Community size</i>								
Population size	2064.11	4950.77	2816.02	5933.34	4578.59	85.14	2692.00	5506.35
<i>Labor market</i>								
Proportion of labor force in secondary sector	0.08	0.08	0.07	0.07	0.08	0.07	0.08	0.07
Proportion of labor force in tertiary sector	0.29	0.26	0.35	0.28	0.42	0.31	0.34	0.27

* For persons aged 12-59.

Means and standard deviations are weighted by person-weights, that is, the number of individuals exposed to the risk of off-farm employment in a community in 1999.

Results (2): Multilevel Model of Off-farm Employment (OFE)

Table 1 - Coefficient estimates of independent variables at the individual level, multilevel model of off-farm employment – Northern Ecuadorian Amazon, 1999

Independent variable	Model 1: Engaged in off-farm employment vs. not in off-farm employment		Place of Off-farm Employment (versus not in off-farm employment)					
			Model 2a: Local Community		Model 2b: Other Rural		Model 2c: Other Urban	
	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]	Coefficient	St. error [‡]
<i>Personal attributes</i>								
Age group 18-24 (ref.:age group 12-17)	-0.303	0.176**	-3.834	0.351***	-3.511	0.460***	-3.727	0.481***
Age group 25-34 (ref.:age group 12-17)	-2.410	0.256***	-0.632	0.254**	-0.272	0.297	-1.147	0.351***
Age group above 35 (ref.:age group 12-17)	-0.393	0.190**	0.218	0.232	1.25	0.278***	0.186	0.323
Gender (ref.: 0 = female)	2.316	0.158***	2.417	0.211	2.522	0.332***	0.799	0.252***
Marital status (ref.: 0 = married/in union)	0.075	0.188	-0.449	0.239*	-	-	-	-
<i>Human capital</i>								
Education (ref.: 0 = less than secondary education)	0.256	0.165	-0.513	0.232**	-	-	1.381	0.288***
Engagement in farm work (ref.: 0 = not engaged)	-0.450	0.196**	0.531	0.284*	-	-	-1.093	0.301***

[‡] significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Results (2): Multilevel Model of Off-farm Employment (OFE)

Table 1 - Coefficient estimates of independent variables at the farm household level, multilevel model of off-farm employment – Northern Ecuadorian Amazon, 1999

Independent variable	Model 1: Engaged in off-farm employment vs. not in off-farm employment		Place of Off-farm Employment (versus not in off-farm employment)					
			Model 2a: Local Community		Model 2b: Other Rural		Model 2c: Other Urban	
	Coefficient	St. error [†]	Coefficient	St. error [†]	Coefficient	St. error [†]	Coefficient	St. error [†]
<i>Household life cycle</i>								
Age of household head	-0.018	0.008**	-0.061	0.012***	-0.024	0.012**	-0.060	0.013***
Number of adults	0.078	0.042*	0.389	0.066***	-	-	-	-
Number of children	-0.027	0.040	0.246	0.060***	0.325	0.074***	0.165	0.081**
<i>Land use</i>								
Land in crops/perennials (ha)	-0.124	0.027***	-	-	-0.172	0.050***	-0.149	0.055***
Land in pasture (ha)	-0.026	0.011**	-0.081	0.019***	-	-	-	-
<i>Environmental conditions</i>								
Environmental contamination (ref.: 0 = no contamination)	0.274	0.155*	1.002	0.235***	1.057	0.293***	-	-
<i>Land management</i>								
Farm area (ha)	-0.007	0.004*	-0.045	0.007***	-	-	-0.020	0.009*
Land title (ref.: 0 = no title)	-0.155	0.187	-	-	-	-	0.591	0.351*
Use of inputs (ref.: 0 = no use)	-0.160	0.165	-0.740	0.245***	-	-	-0.703	0.324**
Hired farm labor (ref.: 0 = did not hire)	0.223	0.162	-	-	-	-	0.861	0.312***
Credit or technical assistance (ref.: 0 = no credit or assistance)	0.019	0.191	0.927	0.281***	0.851	0.345**	-	-
<i>Transportation accessibility</i>								
Walking distance to nearest road (Km)	-0.087	0.048*	-0.144	0.072**	-	-	-0.379	0.133***

[†] significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Results (2): Multilevel Model of Off-farm Employment (OFE)

Table 1 - Coefficient estimates of independent variables at the community level, multilevel model of off-farm employment – Northern Ecuadorian Amazon, 1999

Independent variable	Model 1: Engaged in off-farm employment vs. not in off-farm employment		Place of Off-farm Employment (versus not in off-farm employment)					
			Model 2a: Community		Model 2b: Rural		Model 2c: Urban	
	coefficient	st. error [†]	coefficient	st. error [†]	coefficient	st. error [†]	coefficient	st. error [†]
<i>Transportation accessibility</i>								
Distance to nearest town (Km)	-0.028	0.017*	-0.048	0.023**	-0.043	0.026**	-	-
Squared distance to nearest town	0.000	0.000*	0.001	0.000*	0.001	0.000*	-	-
<i>Community size</i>								
Population size	-0.018	0.011*	-0.006	0.003**	-0.007	0.003**	-0.004	0.002*
Squared population size	0.000	0.000	-	-	-	-	-	-
Cubic population size	0.000	0.000	-	-	-	-	-	-
<i>Labor market</i>								
Proportion of labor force in secondary sector	-0.365	1.073	-	-	-3.585	2.134*	-2.483	2.062
Proportion of labor force in tertiary sector	0.077	0.418	-	-	1.013	0.615*	1.832	0.582***

[†] significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)



Results (2): Multilevel Model of Off-farm Employment (OFE)

Table 1 - Coefficient estimates and standard deviations for the constant term, and household and community random effects for the full model of off-farm employment, including individual, household and community level variables - Northern Ecuadorian Amazon, 1999

Independent variable	Model 1: Engaged in off-farm employment vs. not in off-farm employment		Place of Off-farm Employment (versus not in off-farm employment)					
			Model 2a: Community		Model 2b: Rural		Model 2c: Urban	
	coefficient	st. error [‡]	coefficient	st. error [‡]	coefficient	st. error [‡]	coefficient	st. error [‡]
Constant	-1.416	0.407**	-1.286	0.641	-3.147	0.749***	0.708	0.804
Farm household-level random effect	0.770	0.169***	3.360	2.000*	5.469	2.000**	3.000	3.464
Community-level random effect	0.000	0.000	0.117	4.472	0.000	0.000	0.000	0.000

[‡] significance level: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)



Issues for Future Research

- 1) Gender differences
- 2) Remittances
- 3) Family migration
- 4) Spatial autocorrelation
- 5) Endogeneity
- 6) Survey design and implementation



Study Area in the NEA

