



# Counting Down to Change

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## Time Till Adoption of Cashew Agroforestry in Senegal



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# Outline

- **Background**
- **Problems and Proposed Solutions**
- **Methods**
- **Results**
- **Conclusions and Implications**



# Background: Physical

- Geography
  - Size of South Dakota
  - 8.5 million people (similar to New Jersey)
- Climate
- Seasons



# Background: Me

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## **First trip**

- June 2003 – March 2004
- Peace Corps volunteer: agroforestry extension
  - Mango grafting
  - Cashew nursery
  - Background information
- 'Adopted' by family of village Imam in Simong

# Background: Me

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- Family
- Work
- Location



# Background: Culture

- ❑ Religion
- ❑ Family
- ❑ Village



# Background: Agriculture

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- Cultivation
- Crops
  - Cash
  - Subsistence
- Labor
- Tenure
- Gender



# The Problem

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- Soil fertility
  - Long-term drought
  - Population pressure
  - Mechanization and animal traction
    - More land in production
    - Reduced fallow time
  - Clearing and burning
- Peanut prices



# The Solution

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## Cashew Agroforestry

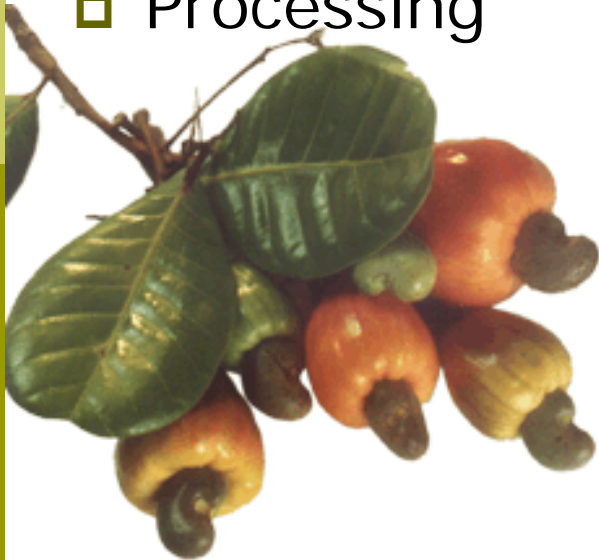
- ❑ Restores soil
- ❑ Provides cash income
- ❑ Has multiple uses



# The Solution

## Cashew (*Anacardium occidentale*)

- ❑ Natural History
- ❑ Apple
- ❑ Nut
- ❑ Processing



From *Flore d'Amérique dessinée d'après nature...*, 1843–1846, by Etienne Denisse. The fruit of the cashew.

# The Solution: Drawbacks

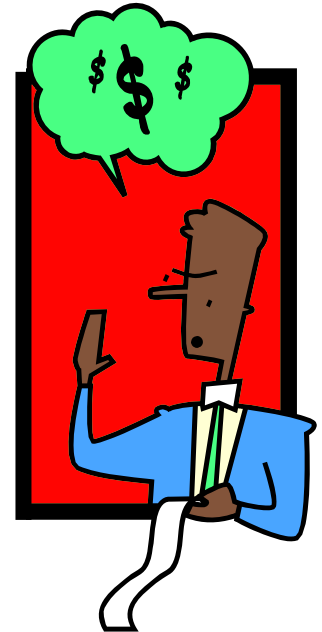
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## □ Drawbacks

- Labor intensive startup
- Some capital required for high survival rate/large scale production

If replacing subsistence crops...

- Increased dependence on markets
- Potential for taxation



# The Solution: Benefits

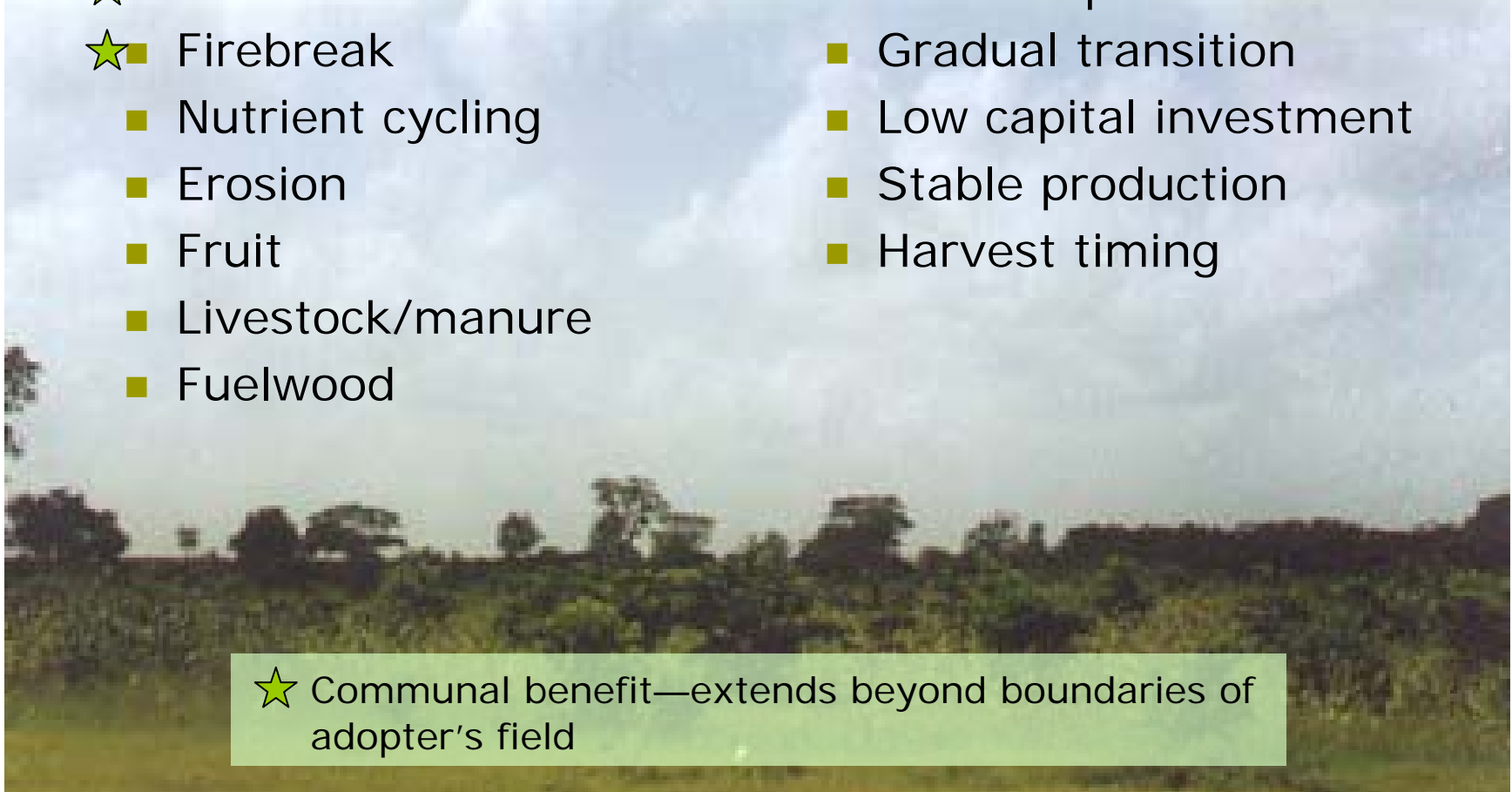
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## □ Physical benefits

- ★ ■ Windbreak
- ★ ■ Firebreak
  - Nutrient cycling
  - Erosion
  - Fruit
  - Livestock/manure
  - Fuelwood

## □ Operational benefits

- Inter-crops
- Gradual transition
- Low capital investment
- Stable production
- Harvest timing



★ Communal benefit—extends beyond boundaries of adopter's field

# The Problem

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- Even though...
  - 500 years ago: Cashews first introduced
  - 50 years ago: Government organized planting
  - 25 years ago: PASA subsidized planting
- Today...
  - Many farmers just beginning to harvest first cashews

# Research Questions

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## **Who Adopts First?**

- ❑ This research identifies traits of early adopters
- ❑ Early adopters require less information and are more likely to trial new technology on advice from outside source (Rogers 1995)
- ❑ These traits are compared to the characteristics of adopters as defined by adopt/reject literature (Pattanayak et al. 2003)

# Research Questions

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- Pattanayak et al. meta-analysis categories
  - Farmer preferences
  - Resource endowments
  - Market incentives
  - Bio-physical factors
  - Risk and uncertainty
- Experiential categories
  - Social proximity
  - Spatial proximity

# Research Questions

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## **Who will get others to adopt?**

- ❑ Early adopters may not be best *extension multipliers*
- ❑ Extension agents use traits to identify and target potential early adopters
- ❑ Trials are effective way to prove benefits to other farmers

# Methods

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## **Study conducted...**

- ❑ On two small farming villages, Mamouda and Simong
- ❑ Over 9 months of experiential observation;  
June 2003 – March 2004
- ❑ Over 3 months of interviews and GPS;  
February - May 2005
- ❑ With qualitative, quantitative, and spatial data and analyses

0 500 1,000 Meters

## Cashew adoption in Mamouda and Simong, Senegal

### Legend

#### Fields

years since cashew planting

0 (non-adopt)

1

2

3 - 5

6 - 50

protected forest

roads

Mamouda village center

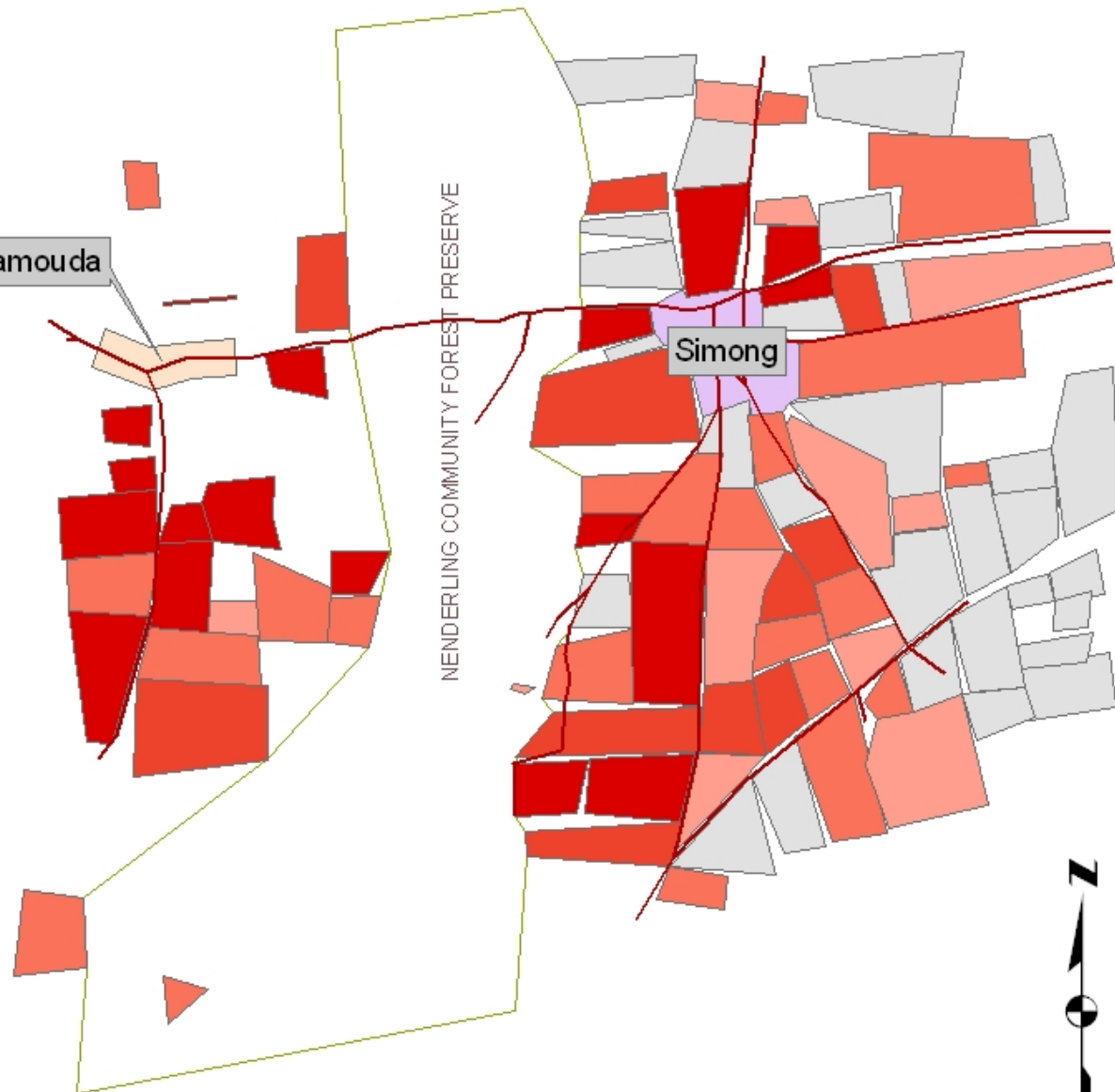
Simong village center

Note: Mamouda non-cashew fields are not shown

Mamouda

NENDERLING COMMUNITY FOREST PRESERVE

Simong



# Methods: Data

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- Spatial

- Survey

- Household

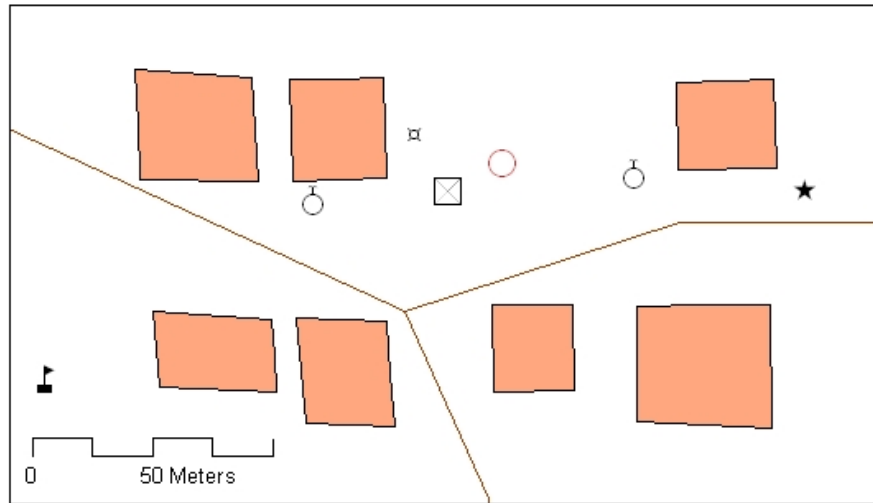
- Farmer

- Field

*Farmer is unit of analysis*

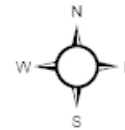
## Survey distribution

	Simong	Mamouda	<i>Total</i>
# households	23	10	33
# household surveys	23	9	32
# farmers	42	19	61
# fields	71	21	92
# cashew fields	40	21	61
# non-cashew fields	31	0	31






Mamouda

# Village Maps










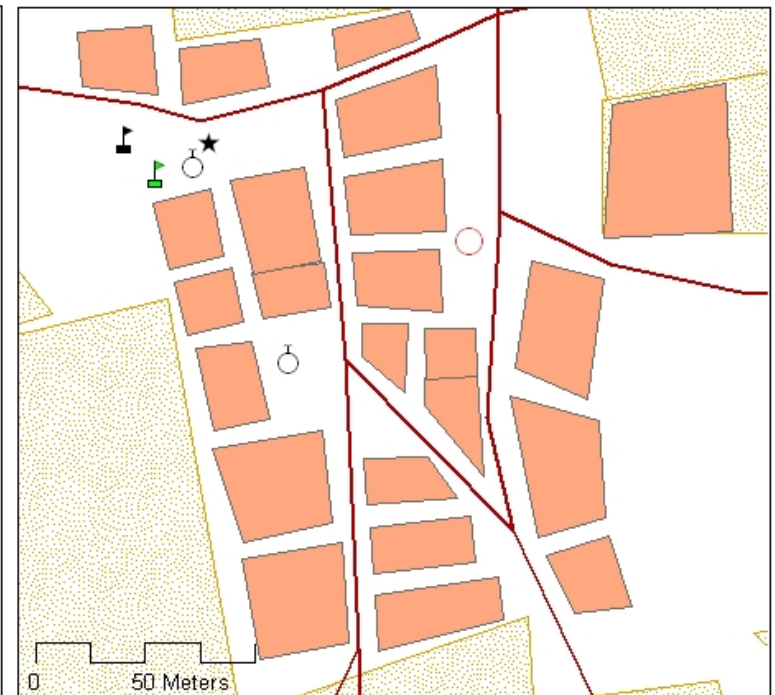
Simong

**Legend**

-  Farm plots
-  compounds
-  roads

**Landmarks**

-  mosque
-  old school
-  old well
-  school
-  storage hut
-  water tap
-  well



Nevin Dawson  
12/05  
Note: compounds and  
landmarks not drawn to scale

# Methods: Spatial

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## □ Collection

- Handheld rover unit: Magellan GPS 315
- Toured field corners with farmers
- Used average of 100 points

## □ Analysis

- Uploaded to ArcGIS
- Snapped field polygons to corner points
- Joined survey data to fields
- Symbolized by cashew age, slope, and soil

# Methods: Household

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## □ Collection

### ■ 32 household surveys

- Household head
- Opinions about cashews and their place in current farming system to check for areas not covered by meta-analysis
- Assets, household roster, tree work and extension experience

### ■ 11 women/children surveys

- Checking for differing opinions

# Methods: Household

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## □ Analysis

- Categorical coding and summary of qualitative responses
- Household-wide responses (e.g. assets) expanded to farmer level



# Methods: Farmer

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## □ Collection

- Social network: “If your crops had a problem, who would you go to for advice?”
- Responded with list of names

## □ Analysis

- Number of advisees counted
- Linked to year of cashew adoption by advisor

# Methods: Fields

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## □ Collection

- Age and extent of cashews
- Subjective soil and slope condition

## □ Analysis

- Joined to spatial data
- Condensed to farmer level
- Linked to social data

# Methods: Survival Model

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- Parametric survival regression model for farmer unit of analysis
- Dependent variable: log of time till adoption, 50 yr start point
- Independent variables
  - Variable reduction
    - Small sample size allows for limited number of variables in model specification
    - Variables measuring same factor were combined through principal components procedure

# Methods: Survival Model

## Variables (4 categories from Pattanayak et al. 2003)

<u>Dependent Variable</u>		<u>Bio-physical Factors</u>	
LOG50YR	Log of years till adoption, beginning 50 years ago	AVGAREA (ha)	Average plot area
<u>Preference Proxies</u>		WGTFERT (index)	Weighted subjective fertility
HHARABED (years)	Most years of Arabic education	WGTSLP (index)	Weighted subjective slope
HHFRCHED (years)	Most years of French education	<u>Risk and Uncertainty</u>	
AGEYR (years)	Farmer age class converted to years	TENURAVG (years)	Years since ownership transferred to farmer on his oldest plot (w/ added averages)
HHMALENO, HHMALEP	Household # male, household % male	ExtnPC1, ExtnPC2	Principal components for extension & experience group
ADVSEENO	Number of respondents that listed farmer as advisor	EXPTOTL	Experience and extension weighted index
<u>Resource Endowments</u>		<u>Social connectivity/proximity</u>	
AsetPC1, AsetPC2	Principal components of asset group	ADCSHOLD (0/1)	Presence of advisors with older cashews
HHWAGE (people)	Number of wage earners	CNTCTCS4 (years)	Median age of advisors' cashews
HHLABORN (people), HHLABORP (%)	Number of HH members age 9-60, (HH members age 9-60)/(HH pop)	<u>Physical connectivity/proximity</u>	
LBRDPND	Dependents/laborers in HH	DISTCC, DISTAC (m)	Distance from nearest cashew plot
TTLAREAH (ha)	Farmer's total combined field area	CSHADJ (%)	Percent of adjacent fields that are planted in cashews
CredPC1, CredPC2	Principal components of credit group	MXADJAGE (years)	Age of oldest adjacent cashews

# Results

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- Household
- Farmer
- Field
- Model
- Advisor



# Results: Household

## “Why Adopt?”

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### Uses

- When asked “Why did you plant cashews? What uses do they have?”, household heads emphasized the commodity aspects more than the environmental
  - Living near subsistence threshold does not allow for long-term perspective

Cashew uses. Household heads gave multiple answers, such that sum is greater than 100%. n=32

Response category	# of Respondents	% of Respondents
<b>Sell</b>	21	0.66
<b>Other</b>	17	0.53
<b>Consume</b>	16	0.50
<b>Environmental</b>	6	0.19

“Your kids will steal other peoples' cashews if you don't have your own.”

# Results: Household

## “Why Adopt?”

### Friends v. Fields

	n	Friends (%)	Fields (%)	Both (%)
Q1: Do you plant cashews because your friends and other owners talked about it and that caused you to reach for it, or because you saw that people are planting cashews everywhere in their fields, so you did it too?	31	48	39	13
Q2: Do other people plant because their friends and other owners talked about it and that caused them to reach for it, or because they saw that people are planting cashews everywhere in their fields, so they did it too?	32	44	41	16

- Slight preference for hearing about cashews from friends rather than seeing cashew cultivation in the fields
- Suggests that farmers chosen to multiply extension with trial plots should be well-placed socially *and* spatially

# Results: Household

## “Adopt When?”

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### **Awareness v. Knowledge**

- ❑ PASA created awareness in 1980
- ❑ Many farmers claimed late adoption because they “didn’t see the benefits” (47%)
- ❑ Awareness alone was not sufficient information for adoption

“I didn’t know the benefits at the time [after the PASA training]. I ate them and they were tasty. I sold them in Banjul and got money. Then I planted.” -Mamouda farmer

# Results: Household

## “Adopt When?”

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### **Awareness v. Knowledge**

- Knowledge came from travels
  - Must be seen first hand
- Early planters are cosmopolitan (Rogers 1995)
- Extension efforts must provide a first-hand experience or information equivalent to one

“The people who traveled a lot planted early. The Gambia, Guinea Bissau, Casamance have more trees than here—you can see their benefit there.” -Mamouda farmer

# Results: Household

## “Adopt When?”

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### **Mistrust**

- ❑ Land scam rumors confounded PASA's extension efforts
  - Bribes were not enough
- ❑ Extension agents must build trust for successful adoption

“People didn't dare participate in PASA because they knew of people that came to villages and had villagers make an agreement to do work. The company would come back later when work was done and take the land from them.” –Simong farmer

# Results: Women and Children

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## Similar responses to men

- Emphasis on firewood
- Cashews increase total workload by small amount
- Women have tenure issues
  - Girls optimistic

“No, I’m a woman and my husband won’t agree to give me a field because I’ll get too much benefit from it” -Mamouda woman

# Results: Farmer

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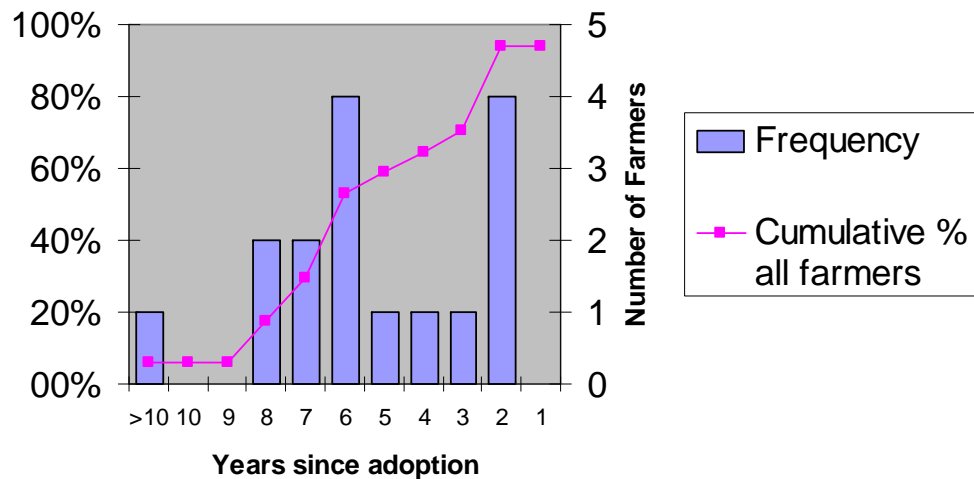
Farmers were asked “Who do you go to for advice?”, but some said that they have no advisors

- Median age class of this group is “>60 years”
- Bivariate correlation between number of advisees and age (0.39)
- Elders do not seek/admit to seeking advice from youth
  - Elders are social nodes; target for trials

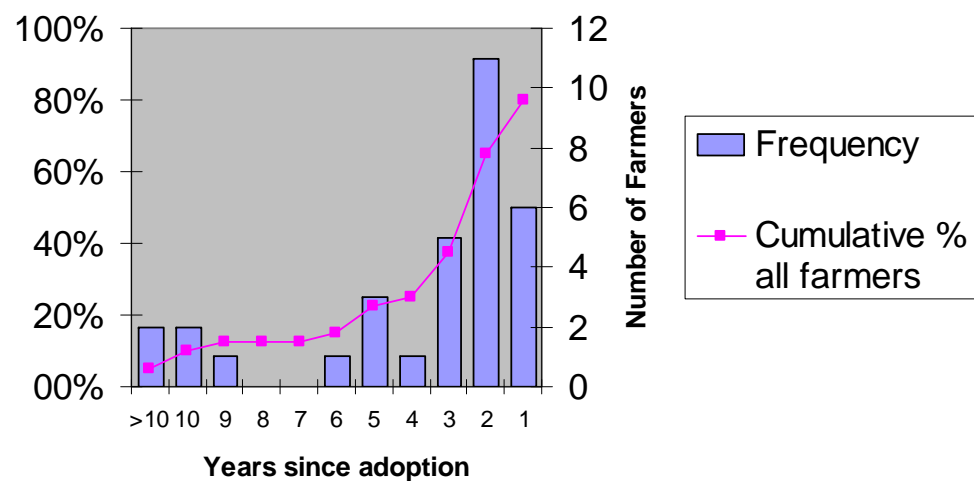
# Results

## Fields

Cashew adoption frequency by Mamouda landed farmers (n=17)



Cashew adoption frequency by Simong landed farmers (n=40)



# Results: Fields

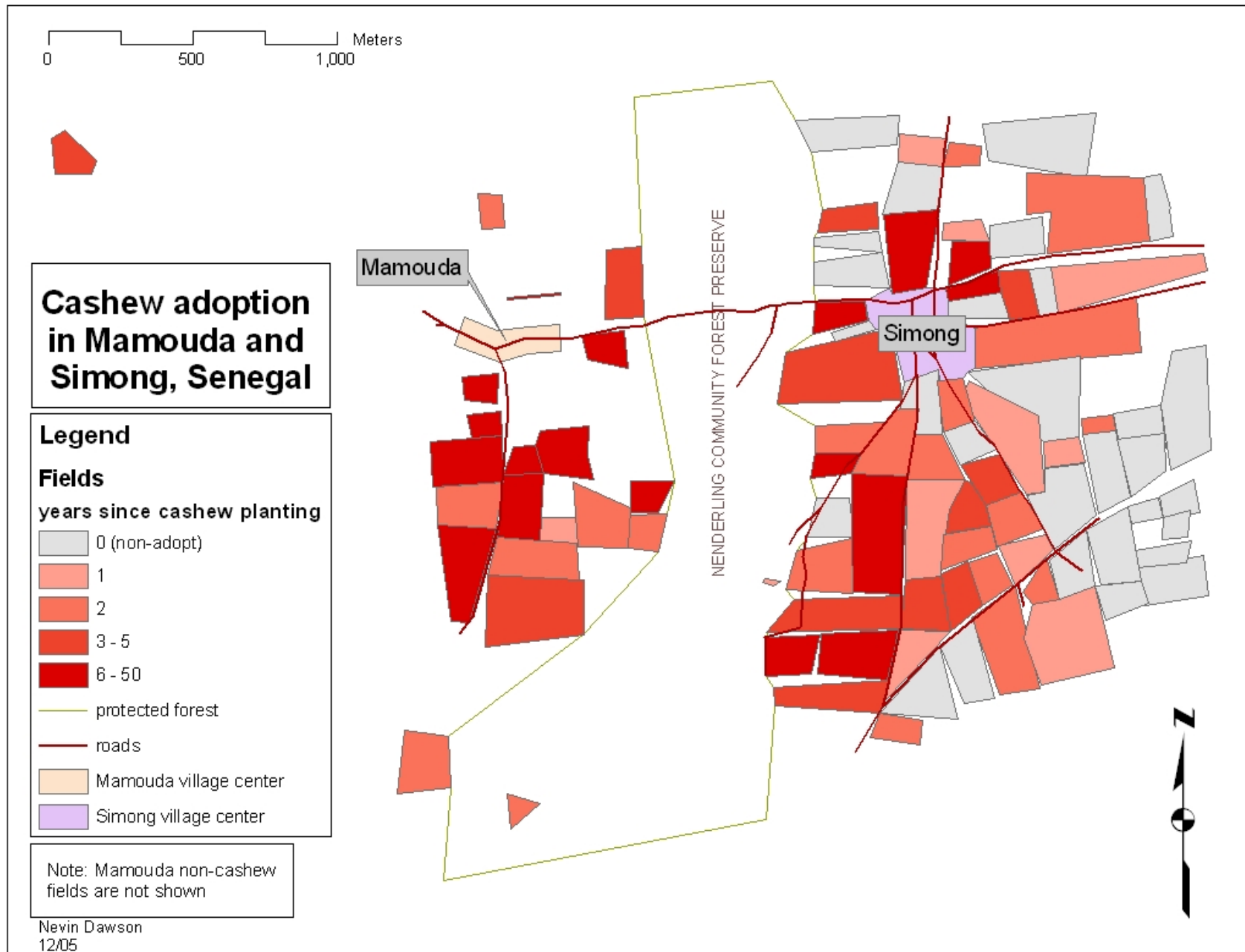
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## Average cashew age

- Overall: 3.8 years (n=63)
- Mamouda: 5.2 years (n=21)
- Simong: 3.1 years (n=42)



# □ Cashew



# Results: Survival Model

## Cashew fields: parametric log-logistic

	Cashew fields w/o social var. n=55	Cashew fields w/ social var. n=45
Wald test chi-squared; sig. level	36.2; 0.000	22.5; 0.001
Non-labor/labor	-	n/a
Labor/HH population	n/a	+
No. of advisees	_*_*	_*_*
Wealth	_*	-
Extension/Experience PC	+	+
Max. adjacent cashew age	+	+
Median age of advisors' cashews (N/R filled w/ average value)	n/a	+_*_*

\* Significant at 0.15 level; \*\* highly significant at 0.05 level; PC = principal component

# Results: Survival Model

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- Number of advisees highly significant in both specifications
  - Opinion leaders should make excellent extension multipliers—willing to adopt early and are source of information for others
- Assets Principal Component
  - Assets comprise: tv, bike, cart, cow, sheep, goat, tin roofs, cement floors, cement walls.
  - Suggests that farmers with more resources available are more willing to adopt with less information (take more risk)
  - Correlates with larger land holdings/early adoption in Mamouda
- Advisor cashew age offers no ready explanation

# Results: Advisors

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Advisor OLS model results. Dependent variable = total advisee cashew years; n=21; \* Significant ( $p < 0.15$ ); \*\* highly significant ( $p < 0.05$ )

	Using total field area	Using road frontage
R-squared	0.213	0.309
Total field area	+*	Not included
Farmer age	+	+
Number of fields on main road	Not included	+**

# Conclusions

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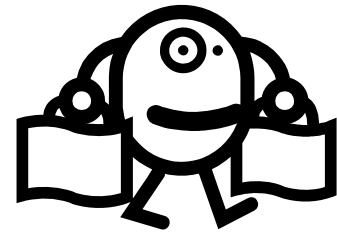
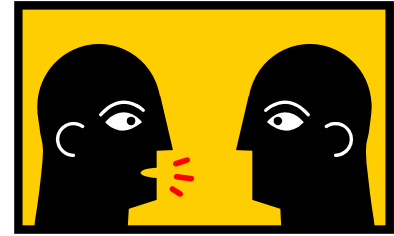
- Who adopts early?
- Who will get others to adopt?
- Village choice
- Recommendations



# Who will adopt early?

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- Well-connected opinion leaders
  - Model (+/-)
- Farmers in wealthy households
  - Model
- Travelers
  - Household



# Who will get others to adopt?

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## □ Socially central

- Household
- Farmer
- Model

**Elder opinion leaders at  
hubs of  
social network**

## □ Spatially central

- Spatial
- Household

**Farmers with highly-visible  
plot in area with high  
adoption potential**

# Conclusions: Village Choice

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- Characteristics of a good extension multiplier should apply both to people and to villages as a whole
  - Survey area for wealthy, highly-visible villages
  - Successful trial should serve as seed and spread to other villages

# Conclusions: Recommendations

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- Point out environmental benefits, but emphasize financial gains
- Provide risk management for poorest farmers (e.g. cashew crop insurance)
  - Avoid “the rich get richer while the poor get poorer”
- Provide *Knowledge* rather than *Awareness*
  - On-site trial (time)
  - Off-site field trip (money)
- Build trust with farmers

# Conclusions

“Given budget and personnel constraints on extension programs, broadcasting information widely is unlikely to be intensive enough, that is, the seeds will be too small, to provide the amount of information necessary for sufficient risk reduction and adoption. Planting only a few seeds and taking careful care of them, however, should produce a successful stand, which will upon reaching maturity reproduce and flourish into a healthy forest through self-sustaining social and spatial interactions.”

Questions?

