# Information Frictions and Bargaining: Experimental Evidence from Rural Guinea-Bissau

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Often **producers are not well informed** about international market conditions.

This paper studies **how market information and advice affects producers**:

1. How does it change producers' sales decisions?
2. Does it affect bargaining power and producer prices?
3. Does it make producers better off?

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- Collects data from national and international markets.
- Delivering **weekly** information via mobile phones (**voice and text**) to producers.
- Providing news, **prices**, and commercialization **advice** about raw cashew nuts

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→ estimating direct and spillover effects (both *within* and *across* clusters).

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+ transaction diaries; + administrative data on usage; + survey of traders.

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   *Why?* → Negotiate better deals.
   → Change buyers.

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   Treated producers invest more on their own production.

   Better terms of barter → Less likely to make direct rice purchases.
   (Noisy) increase in revenue relative to the control group (4× cost of intervention).

# Outline

Introduction

Context
- Market structure
- Motivating evidence

Intervention and experimental design

Results

Mechanisms

Discussion

# The cashew nut market structure

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# A context where timing matters

**Price fluctuations** are **exogenous**: Guinea-Bissau is a price-taker in the world market of raw cashew nuts, which make up 90% of its export revenue.

**Prices** across and within-seasons are **not well-communicated** to producers.

**Sales timing matters**: On average 2 offers received and one sale during the trading season (March to July). Difficult to store across seasons. Details

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- More than 80 percent of production goes into exports.
- Sector accounts ∼25 percent of GDP.

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Traders more frequently access price information than producers.

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Sales of raw **cashews are the main source of income for 80 percent** of producers. Median annual revenue from raw cashew sales was around 845 USD in 2019.

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**Spatial arbitrage matters less**: Nearly 98% of sales take place in the village.

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- Intervention
- Design

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# We rolled-out a new Market Information System: *n'kalô*

One of the **best sources of information** on the cashew market worldwide: N'kalô service

*N'kalô* is a MIS providing information on agricultural markets in 13 countries.

Combines information collected by different market analysts focusing on the main producing countries.

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# Content of the weekly messages

We communicate to producers one message per week, with:

- Synthesised and **simplified news** about the national cashew market.

  `Deliveries at the harbour delayed.`

- A **range of** the latest region-specific **farm-gate prices**.

- News about the international cashew market and **advice on whether it is a good time to sell**, based on a simple message describing the likely direction of prices.

▸ Accuracy ▸ Other examples

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  `Prices in Oio between 350-450 FCFA/kg, 375-450 FCFA/kg in Cacheu.`

- News about the international cashew market and **advice on whether it is a good time to sell**, based on a simple message describing the likely direction of prices.

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```
We advice to sell at least half of stocks if 400 FCFA /kg is offered,
all if 450 FCFA/kg is offered.
```

▸ Accuracy ▸ Other examples

# Study design and sample

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▸ Timeline ▸ Sampling ▸ Map of villages ▸ Randomisation ▸ Training ▸ Attrition and compliance

# Estimation

$$y_{iv} = \textit{treatment}_{iv} \cdot \beta + \textit{spillover}_{iv} \cdot \delta + y_{oiv} \cdot \gamma + \alpha_v + \epsilon_{iv} \tag{1}$$

- $i$ and $v$ index individuals, and villages, respectively,
- $y_{iv}$ denotes the outcome of interest measured in the follow-up,
- $y_{oiv}$ denotes the outcome of interest measured in the baseline,
- $\textit{treatment}_{iv}$ denotes individual-level assignment to the treatment group,
- $\textit{spillover}_{iv}$ denotes individual-level assignment to the spillover group in treated villages,
- $\alpha_v$ denotes the randomization triplet fixed effect,
- $\epsilon_{iv}$ is the unobserved variation in the outcome.
  Errors are clustered at the triplet-level (de Chaisemartin and Ramirez-Cuellar, 2024).

https://www.socialscienceregistry.org/trials/4740

# Outline

Introduction

Context

Intervention and experimental design

Results
- Engagement
- Timing
- Prices

Mechanisms

Discussion

# Treated producers engage more with the service

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# 1. Treated producers sell more frequently

# 2. Prices increase for treated producers in the second season

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# 2. Better terms of barter for rice

# Outline

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Mechanisms
- Prices
- Timing
- Alternatives

Discussion

# 1. Why did treated producers earn higher prices?

*Negotiated* higher prices in 2021.

Effect is driven by producers with *larger plots*.

Difference in prices *later* in the trading season.

They switched *buyers*, which may help negotiation.

They changed *sources of market information*.

What could explain the modest size of the price effects?

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# Testing for spillovers across villages

We identify between-village spillovers in the style of Miguel and Kremer (2004) and Egger et al. (2022):

$$y_{iv} = \textit{treatment}_{iv} \cdot \beta_1 + \textit{spillover}_{iv} \cdot \delta_1 + y_{oiv} \cdot \gamma_1 \sum_{d=1}^{D} \left( \mathrm{V}^d_{iv\neg v} \cdot \pi^d_1 + \mathrm{TP}^d_{iv\neg v} \cdot \pi^d_2 \right) + \alpha_v + \epsilon_{iv} \quad (2)$$

Controlling for the number of study villages within a radius ($V_{iv\neg v}$), the number of treated producers outside of your village ($\mathrm{TP}^d_{iv\neg v}$) is plausibly random.

Distance selected to be 0-5km after minimising the BIC across all models from 0-50km, varying inner radius from 1-5km.

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# Spatial distribution of treatment intensity

# Quasi-random exposure to exogenous treatment

Details

Control village (orange) center-left has no treated villages (blue) within 5km.

# Prices increased in some control villages too

# Mechanisms that we rule out

We rule out that treated producers:

- Changed the *location* of their sales.
- Kept better *records* of their sales or salience.
- Got different *attitudes* towards risk.

Qualitatively similar results from *buyer* surveys.

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# 3. Are producers better off?

Producers more likely to *make* agricultural investments.

By selling more *quantity*

*Income* goes up by 12-21%.

→ About four times the cost of the intervention at experiment's scale.

Willingness-to-pay for the service is equal to the subscription cost.

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   - Commercialization decisions influenced by...

     credit/liquidity (Burke et al., 2019; Fink et al., 2020; Albuquerque et al., 2022)
     storage (Aggarwal et al., 2018; Kadjo et al., 2018)
     market power (Casaburi and Reed, 2022; Chatterjee, 2022)

   - Market information, via mobile phones, can change *sales location* (Jensen, 2007; Aker, 2010; Aker and Mbiti, 2010; Casaburi et al., 2013; Allen, 2014; Wiseman, 2023)

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   - Previous price information on *domestically* traded commodities has...

     positive effects: (Svensson and Yanagizawa, 2009; Goyal, 2010; Nakasone et al., 2014; Soldani et al., 2023)

     no/mixed effects: (Fafchamps and Minten, 2012; Courtois and Subervie, 2015; Mitra et al., 2018; Camacho and Conover, 2019; Falcao Bergquist et al., 2024)

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   Consistent with information spreading through traders
   (Soldani et al., 2023; Falcao Bergquist et al., 2024)

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# Thank you !

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www.pep-net.org https://pedl.cepr.org/

# How reliable was the information?

Number of sales

Bearish message, advising to wait before selling

Bullish message, advising to sell

# Outline

Design details

Extra results

Discussion

# Margins vary *across* seasons

# Prices vary both *within* the same season and *across* seasons

By regions

# Prices vary both *within* the same season and *across* seasons

By regions

# Price variation *within* seasons and across regions

Interquartile range by geographic zones across years

# Price variation *within* seasons and across zones

Interquartile range by geographic zones

# Sampling

**Sampling Frame** 2009 national census, with geo-coded villages.

**Eligible villages:** with over 10 households in 2009.

**Village sampling** Randomly select 290 villages across 6 regions (out of 8).

We **maximized the minimum distance between any two villages**, covering as much area as possible within the regions.

**Eligible households:** every household that owns a cashew plantation and a working mobile phone.

**Household sampling:** Randomly select 7 producers from a list with all producers, obtained from the village chief.

# Villages by treatment status

Green points are treated villages, red points are control ones.

Zguinchor
Bissau
Bissorã
Farim
Mansoa
Bafatá
Gabú
Bambadinca
Xitole
Buba
Quebo
Catió
Bolama
Bubaque
Ilha de Bubaque
Ilha de Orango
Ilha de Canhabaque
Ilha de Caravela
Ilha de Uno
Ilha de Unhocomo
Ilha Galinhas
Ilha Bubaque
Ilha de Chanquinho
Parque Natural dos Lagos de Cufada
Dulombi-Boe National Park
Cantanhez National Park
Varela National Park
Cacheu
Canchungo
Bula
Pelundo
Tombali
Quebo
Buba
Catió
Cacine
Tombali
Bissau
Bissorã
Farim
Mansoa
Bafatá
Gabú
Bambadinca
Xitole

# Randomisation

For village-level stratification, we follow Fafchamps and Minten (2012):

We use an algorithm to distribute villages into **triplets of most similar villages** within regions: 2 randomly allocated to treatment and 1 to control.

For within-village randomisation:

**On-site lottery:** Once selected producers complete the baseline surveys, an on-the-spot within-village lottery (drawing two kinds of beads from a bag) among interviewed producers randomly determines 4 treated and 3 non-treated households in "treated villages".

# Face-to-face training after baseline with treated producers

# Example of SMS

```
Opening of the cashew season
postponed because of coronavirus.
Dry your nuts well to keep quality.
Advice is to wait to sell until
confusion is over.
```

# Example of push-call

This is André from n'kalô to give you the last news of the cashew market. The demand for cashew is increasing all over the country as factories in India and Vietnam have re-opened. Prices at farm-gate are between 300 and 375 FCFA/kg around Biombo and Bissora, between 250 and 325 FCFA/kg in Bafata and Gabu and reach 300 to 400 FCFA/kg in Bonco close to the border with Senegal. As demand is growing prices are expected to go up, so we advise not to sell before the price reaches 375 FCFA/kg. N'kalô wishes you a very good week.

# Number of sales recorded in diaries

# Timeline of the study

Nov-Dec 2019: Baseline (in-person) survey and training of treated producers.

Apr-Aug 2020: Information dissemination.

Apr-May 2021: Follow-up (in-person) survey.

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# Sample descriptives (*baseline*)

On average, respondents have 43 years and 4 years of formal education. 5% are women.

30% of respondents could read a sentence without difficulties.

Plot size is 3ha on average.

56% of respondents rely on family and friends for marketing advice. Only 6% of respondents belong to a producer cooperative.

Each village has around 30 producers per village (36 households/village) and 3 local buyers. 13 household members / household.

30% of respondents report difficulties with storage.

32% of respondents report having a fixed buyer.

Back

# Rice exchanges

14 percent of total production is exchanged for rice

35 percent of producers took up a loan before the start of the trading season in 2019, and 85 percent of these loans were in-kind (rice).

- 53 percent of cash loans were repaid using cashew nuts
- 80 percent of the in-kind loans were repaid with cashew nuts.

# Balance: Demographic characteristics

| | Control (1) Mean (SD) Total obs. | (2) Treatment | (3) Spillover | (4) Treat. vs. spillover | (5) Max pairwise st. diff. |
|---|---|---|---|---|---|
| 1 if female | 0.05 | 0.00 | -0.00 | 0.00 | 0.02 |
| | (0.23) | (0.01) | (0.01) | (0.01) | 1985 |
| | 1985 | [0.95] | [1.00] | [0.99] | |
| Age | 43.47 | -1.06 | -1.11 | 0.05 | 0.06 |
| | (14.96) | (0.79) | (0.77) | (0.75) | 1988 |
| | 1988 | [0.37] | [0.46] | [0.99] | |
| Household size | 13.40 | 0.57 | 1.02* | -0.45 | 0.08 |
| | (7.88) | (0.54) | (0.57) | (0.41) | 1988 |
| | 1988 | [0.44] | [0.34] | [0.85] | |
| Years of education | 3.89 | 0.01 | -0.10 | 0.11 | 0.04 |
| | (3.77) | (0.23) | (0.23) | (0.18) | 1988 |
| | 1988 | [0.95] | [1.00] | [0.97] | |
| 1 if Kriol is the most spoken language at home | 0.21 | -0.01 | -0.01 | 0.00 | 0.05 |
| | (0.41) | (0.02) | (0.02) | (0.02) | 1988 |
| | 1988 | [0.89] | [1.00] | [0.99] | |
| 1 if cashew is the main source of income | 0.79 | 0.02 | 0.00 | 0.02 | 0.06 |
| | (0.41) | (0.02) | (0.02) | (0.02) | 1988 |
| | 1988 | [0.44] | [1.00] | [0.85] | |
| 1 if faces storage limitations | 0.27 | 0.06** | 0.02 | 0.04* | 0.15 |
| | (0.45) | (0.03) | (0.02) | (0.02) | 1988 |
| | 1988 | [0.05]* | [0.89] | [0.85] | |
| Minimum age of trees | 3.32 | -0.06 | 0.08 | -0.14 | 0.06 |
| | (3.43) | (0.17) | (0.20) | (0.20) | 1966 |
| | 1966 | [0.89] | [1.00] | [0.97] | |
| Max age of trees | 17.23 | -0.20 | 0.04 | -0.25 | 0.04 |
| | (8.41) | (0.47) | (0.48) | (0.48) | 1868 |
| | 1868 | [0.89] | [1.00] | [0.99] | |
| 1 if trees were plagued | 0.69 | -0.03 | -0.01 | -0.03 | 0.08 |
| | (0.46) | (0.03) | (0.03) | (0.03) | 1980 |
| | 1980 | [0.37] | [1.00] | [0.85] | |
| 1 if sells other crops | 0.65 | 0.09*** | 0.10*** | -0.01 | 0.21 |
| | (0.48) | (0.02) | (0.02) | (0.02) | 1988 |
| | 1988 | [0.00]*** | [0.00]*** | [0.99] | |
| Index of trust (Anderson 2008) | -0.00 | 0.07 | 0.07 | -0.00 | 0.05 |
| | (1.00) | (0.05) | (0.05) | (0.06) | 1988 |
| | 1988 | [0.37] | [0.55] | [0.99] | |

*Notes:* Coefficient of treatment and spillover at baseline (columns 2–3). Column 3 tests for differences in parameters obtained in previous two columns. Column 4 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted $p$-values. $q$-values reported in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

# Balance: Producer characteristics

| | Control (1) Mean (SD) Total obs. | (2) Treatment | (3) Spillover | (4) Treat. vs. spillover | (5) Max pairwise st. diff. |
|---|---|---|---|---|---|
| Desired reference price | 1042.00 | -16.38 | 14.87 | -31.25 | 0.09 |
| | (297.53) | (16.78) | (22.31) | (23.25) | 1988 |
| | 1988 | [0.38] | [0.68] | [0.42] | |
| Minimum price at which sold most cashew in the last 3 years | 318.64 | -5.68 | -1.93 | -3.75 | 0.06 |
| | (88.85) | (4.22) | (4.70) | (4.40) | 1988 |
| | 1988 | [0.25] | [0.68] | [0.67] | |
| 1 if delayed sales because expected price to raise | 0.72 | 0.00 | -0.01 | 0.02 | 0.04 |
| | (0.45) | (0.02) | (0.02) | (0.03) | 1984 |
| | 1984 | [0.82] | [0.68] | [0.67] | |
| Number of potential buyers that made offers | 2.68 | 0.19* | 0.05 | 0.13 | 0.16 |
| | (1.71) | (0.10) | (0.10) | (0.10) | 1981 |
| | 1981 | [0.13] | [0.68] | [0.42] | |
| 1 if thinks that the reference price is important in marketing | 0.36 | 0.03 | 0.03 | 0.01 | 0.07 |
| | (0.48) | (0.02) | (0.03) | (0.03) | 1987 |
| | 1987 | [0.25] | [0.68] | [0.79] | |
| Number of producers that shared price offers with imputations | 4.91 | 0.60** | 0.74** | -0.13 | 0.11 |
| | (5.79) | (0.29) | (0.34) | (0.39) | 1863 |
| | 1863 | [0.13] | [0.11] | [0.79] | |
| Number of producers informed of an offer received with imputations | 5.95 | 0.81** | 1.72*** | -0.91* | 0.20 |
| | (6.86) | (0.35) | (0.48) | (0.53) | 1878 |
| | 1878 | [0.13] | [0.00]*** | [0.42] | |

*Notes*: Coefficient of treatment and spillover at baseline (columns 2-3). Column 3 tests for differences in parameters obtained in previous two columns. Column 4 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted *p*-values. *q*-values reported in brackets. * denotes significance at 10 pct., ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

# Balance: Village characteristics

| | Control (1) Mean (SD) Total obs. | (2) Treatment |
|---|---|---|
| Number of cashew producers in the village | 33.87 | -0.67 |
| | (23.49) | (2.83) |
| | 288 | [0.81] |
| Number of cashew buyers in the village | 2.90 | 1.14*** |
| | (2.58) | (0.41) |
| | 287 | [0.05]* |
| Road distance in km to nearest sector capital | 25.59 | 1.02 |
| | (23.70) | (2.65) |
| | 290 | [0.81] |
| Road distance in km to nearest region capital | 51.48 | -0.85 |
| | (33.51) | (2.96) |
| | 290 | [0.81] |
| Road distance in km to the capital | 162.30 | 4.15 |
| | (69.26) | (4.60) |
| | 290 | [0.59] |
| Distance in km to the nearest primary road | 20.16 | 2.35 |
| | (17.17) | (1.60) |
| | 290 | [0.38] |
| Distance in km to the nearest secondary road | 3.19 | 0.53 |
| | (2.85) | (0.32) |
| | 290 | [0.38] |
| Distance in km to the nearest road | 2.74 | 0.30 |
| | (2.40) | (0.28) |
| | 290 | [0.58] |

*Notes:* Coefficient of village-level treatment at baseline (columns 2). Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the village. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are robust. Stars on the coefficient estimates reflect unadjusted **p**-values. **q**-values reported in brackets. * denotes significance at 10 pct., ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

# Balance: Main outcomes

| | Control (1) Mean (SD) Total obs. | (2) Treatment | (3) Spillover | (4) Treat. vs. spillover | (5) Max pairwise st. diff. |
|---|---|---|---|---|---|
| Price per sale per kg | 395.89 | -3.66 | 1.35 | -5.01 | 0.05 |
| | (96.24) | (5.51) | (5.60) | (4.75) | 1968 |
| | 1968 | [0.73] | [0.81] | [0.56] | |
| Value of all sales and exchanges | 525563.79 | 35895.89 | 24851.78 | 11044.11 | 0.03 |
| | (921998.28) | (44423.03) | (43333.93) | (29750.44) | 1978 |
| | 1978 | [0.68] | [0.77] | [0.84] | |
| Value of all sales | 486696.38 | 14815.85 | 15806.13 | -990.28 | 0.01 |
| | (912168.16) | (43992.64) | (43245.56) | (28614.91) | 1984 |
| | 1984 | [0.80] | [0.77] | [0.97] | |
| Value of exchanges | 38130.25 | 22023.34*** | 10701.90* | 11321.43** | 0.22 |
| | (83549.96) | (6769.25) | (5951.64) | (5656.60) | 1982 |
| | 1982 | [0.02]** | [0.40] | [0.29] | |
| Total quantity sold | 1206.35 | 54.39 | 36.52 | 17.87 | 0.01 |
| | (1855.65) | (96.73) | (94.05) | (66.13) | 1984 |
| | 1984 | [0.75] | [0.77] | [0.85] | |
| Number of sales | 1.62 | 0.01 | 0.07 | -0.05 | 0.08 |
| | (0.81) | (0.04) | (0.05) | (0.04) | 1988 |
| | 1988 | [0.80] | [0.40] | [0.56] | |
| 1 if exchanged cashew for rice | 0.30 | 0.04 | 0.02 | 0.02 | 0.15 |
| | (0.46) | (0.03) | (0.03) | (0.02) | 1985 |
| | 1985 | [0.34] | [0.77] | [0.56] | |
| Total quantity exchanged | 113.66 | 57.26*** | 25.75 | 31.51** | 0.21 |
| | (247.43) | (19.08) | (17.06) | (15.94) | 1982 |
| | 1982 | [0.02]** | [0.40] | [0.29] | |
| Share of quantity sold over quantity exchanged and sold | 0.90 | -0.02 | -0.01 | -0.02 | 0.13 |
| | (0.20) | (0.01) | (0.01) | (0.01) | 1979 |
| | 1979 | [0.34] | [0.77] | [0.47] | |
| 1 if borrowed money or rice | 0.35 | -0.00 | 0.04 | -0.05* | 0.10 |
| | (0.48) | (0.03) | (0.03) | (0.03) | 1987 |
| | 1987 | [0.92] | [0.40] | [0.29] | |
| Implicit price of loans per kg of cashews | 356.61 | -11.98 | -19.76 | 7.77 | 0.18 |
| | (101.18) | (11.23) | (12.33) | (12.43) | 516 |
| | 516 | [0.62] | [0.40] | [0.76] | |
| Total quantity paid for loans | 45.23 | 17.69* | 8.85 | 8.85 | 0.10 |
| | (126.18) | (9.09) | (7.27) | (9.30) | 1987 |
| | 1987 | [0.23] | [0.42] | [0.56] | |
| Share of quantity sold over quantity exchanged and paid in loans | 0.94 | -0.01 | -0.01 | 0.00 | 0.03 |
| | (0.15) | (0.01) | (0.01) | (0.01) | 1983 |
| | 1983 | [0.68] | [0.40] | [0.76] | |

*Notes:* Coefficient of treatment and spillover at baseline (columns 2-3). Column 3 tests for differences in parameters obtained in previous two columns. Column 4 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted $p$-values. $q$-values reported in

# Balance: Secondary outcomes

| | Control (1) Mean (SD) Total obs. | (2) Treatment | (3) Spillover | (4) Treat. vs. spillover | (5) Max pairwise st. diff. |
|---|---|---|---|---|---|
| 1 if delayed sales because expected price to raise | 0.72 | 0.00 | -0.01 | 0.02 | 0.04 |
| | (0.45) | (0.02) | (0.02) | (0.03) | 1984 |
| | 1984 | [0.90] | [0.87] | [0.83] | |
| 1 if sped up sales because expected price to drop | 0.30 | -0.01 | -0.01 | -0.00 | 0.00 |
| | (0.46) | (0.03) | (0.03) | (0.03) | 1978 |
| | 1978 | [0.90] | [0.93] | [0.99] | |
| 1 if sold most to local buyer | 0.37 | 0.00 | 0.02 | -0.02 | 0.06 |
| | (0.48) | (0.03) | (0.03) | (0.03) | 1984 |
| | 1984 | [0.95] | [0.87] | [0.94] | |
| 1 if sold most to itinerant buyer | 0.55 | -0.00 | -0.02 | 0.02 | 0.04 |
| | (0.50) | (0.03) | (0.03) | (0.03) | 1984 |
| | 1984 | [0.99] | [0.87] | [0.83] | |
| 1 if sold most directly to a market | 0.06 | 0.00 | 0.01 | -0.00 | 0.03 |
| | (0.24) | (0.01) | (0.01) | (0.01) | 1984 |
| | 1984 | [0.90] | [0.87] | [0.97] | |
| 1 if sold to or close to Senegal | 0.00 | -0.00 | -0.00 | 0.00 | 0.05 |
| | (0.07) | (0.00) | (0.00) | (0.00) | 1988 |
| | 1988 | [0.90] | [0.87] | [0.97] | |
| 1 if sold cashews in April 2019 or before | 0.20 | -0.02 | -0.00 | -0.02 | 0.06 |
| | (0.40) | (0.02) | (0.02) | (0.02) | 1854 |
| | 1854 | [0.88] | [0.93] | [0.78] | |
| 1 if sold cashews in May 2019 | 0.50 | 0.01 | 0.07** | -0.06** | 0.14 |
| | (0.50) | (0.03) | (0.03) | (0.03) | 1854 |
| | 1854 | [0.90] | [0.28] | [0.42] | |
| 1 if sold cashews in June 2019 | 0.55 | 0.04* | 0.01 | 0.04 | 0.11 |
| | (0.50) | (0.02) | (0.03) | (0.03) | 1854 |
| | 1854 | [0.83] | [0.93] | [0.69] | |
| 1 if sold cashews in July 2019 or later | 0.19 | -0.01 | -0.00 | -0.00 | 0.06 |
| | (0.39) | (0.02) | (0.02) | (0.02) | 1854 |
| | 1854 | [0.90] | [0.93] | [0.98] | |
| Total quantity produced | 1477.87 | 147.53 | 58.96 | 88.57 | 0.07 |
| | (1997.03) | (108.25) | (102.99) | (77.61) | 1912 |
| | 1912 | [0.88] | [0.87] | [0.70] | |
| 1 if lost cashew post-harvest | 0.06 | -0.01 | 0.02 | -0.03** | 0.13 |
| | (0.24) | (0.01) | (0.01) | (0.02) | 1988 |
| | 1988 | [0.90] | [0.87] | [0.42] | |
| Quantity lost post-harvest | 2.46 | -0.85 | 1.10 | -1.94* | 0.13 |
| | (15.04) | (0.75) | (1.13) | (1.07) | 1986 |
| | 1986 | [0.88] | [0.87] | [0.51] | |

*Notes:* Coefficient of treatment and spillover at baseline (columns 2-3). Column 3 tests for differences in parameters obtained in previous two columns. Column 4 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted $p$-values, $q$-values reported in brackets. * denotes significance at 10 pct., ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

# Attrition and compliance

At follow-up response rate is 86%, balanced across treatment arms. Attrition

53% of treated producers received at least 8 SMS messages or robocalls Compliance

# Attrition

| | Control (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Mean (SD) | Treatment | Spillover | Treat. vs. spillover | Max pairwise st. diff. Total obs. |
| 1 if attrited at endline | 0.13 | 0.01 | 0.00 | 0.00 | 0.05 |
| | (0.33) | (0.02) | (0.02) | (0.02) | 1988 |
| | | [0.66] | [0.80] | [0.90] | |
| 1 if attrited at follow-up | 0.12 | 0.00 | -0.01 | 0.01 | 0.03 |
| | (0.33) | (0.02) | (0.02) | (0.02) | 1988 |
| | 1988 | [0.81] | [0.80] | [0.90] | |

*Notes:* Coefficient of treatment and spillover at baseline (Columns 2-3). Column 4 tests for differences in parameters obtained in previous two columns. Column 5 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for randomization triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Asterisks on the coefficient estimates reflect unadjusted p-values. p-values reported in brackets. Significance levels: *10%, **5%, and ***1%. Column 1 displays the control mean, standard deviation, and total number of observations.

# Compliance

| | Year 1 | | | | Year 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | Mean | | | | Mean | | | |
| | (SD) | Treatment | Spillover | Treatment-Spillover | (SD) | Treatment | Spillover | Treatment-Spillover |
| | Total obs. | | | | Total obs. | | | |
| *Self-reported data*: | | | | | | | | |
| 1 if heard of mobile MIS | 0.14 | 0.30*** | 0.10*** | 0.20*** | 0.68 | 0.12*** | 0.04 | 0.08*** |
| | (0.35) | (0.02) | (0.03) | (0.03) | (0.47) | (0.03) | (0.03) | (0.02) |
| | 1714 | [0.00]*** | [0.00]*** | [0.00]*** | 1724 | [0.00]*** | [0.13] | [0.00]*** |
| 1 if used mobile MIS | 0.02 | 0.25*** | 0.03 | 0.22*** | 0.43 | 0.18*** | 0.05* | 0.13*** |
| | (0.16) | (0.02) | (0.02) | (0.02) | (0.49) | (0.03) | (0.03) | (0.03) |
| | 1714 | [0.00]*** | [0.10] | [0.00]*** | 1724 | [0.00]*** | [0.13] | [0.00]*** |
| *Administrative data*: | | | | | | | | |
| Take-up rate | 0.00 | 0.53*** | 0.00 | 0.53*** | 0.08 | 0.28*** | 0.01 | 0.27*** |
| | (0.00) | (0.02) | (0.01) | (0.02) | (0.27) | (0.02) | (0.02) | (0.02) |
| | 1988 | [0.00]*** | [0.86] | [0.00]*** | 1988 | [0.00]*** | [0.52] | [0.00]*** |

*Notes:* Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 and 8 test for differences in parameters obtained in previous two columns. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted $p$-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

# Messages received

728 treated producers

# Producers negotiated a better price...

# 2. Producers more likely to sell at or above the median price

# Treated producers follow less the advice of intermediaries or other agents (in the first year)

# Treated producers tend to sell more to itinerant traders...

# Treated producers tend to receive higher prices later...

# Producers with larger production benefit more

# Producers sold more than once because they...

# Treated producers seek advice on the best time to sell

# ...and barter later, when the terms of trade are better

With spillover

# More realistic priors? Future expectations go down

# Outline

Design details

Extra results

Discussion

# More likely to make productive investments

# But by selling more...

# ..treated producers earn more income

# Difficult to fully account for extra quantity sold

# ..treated producers make slightly more revenue

# Between-village spillovers: discussion

SUTVA not holding despite sampling aimed to maximise minimum distance across any two villages.

Number of treated producers within a 0-5km is uncorrelated to other observable variables after controlling for the number of study villages within the same radius. Check

Instrumenting for demeaned number of treated producers after simulating the village-level random assignment marginally increases point estimates (Borusyak and Hull, 2023). Check

# Robustness to endogenous exposure to exogenous shock

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Year 1 | | Year 2 | |
| | Price per sale per kg | Total quantity sold | Price per sale per kg | Total quantity sold |
| Treated producers within 0–5km | 2.072 | -3.895 | 1.171 | 30.599 |
| | (1.209) | (15.361) | (1.027) | (15.625) |
| Treatment | 2.066 | 99.903 | 6.471 | 178.443** |
| | (3.373) | (53.527) | (3.355) | (59.254) |
| Spillover | 2.385 | 17.427 | 0.929 | 64.792 |
| | (3.267) | (54.190) | (3.296) | (58.395) |
| Observations | 1586 | 1621 | 1704 | 1709 |
| Randomization Inference $p$-value | 0.064 | 0.834 | 0.336 | 0.148 |

Standard errors in parentheses account for spatial correlation.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

# Heterogeneous effects consistent with between-village spillovers

Effects on **prices** are higher for producers living:

- *farther away from regional capitals* (relative to untreated producers in comparably remote villages),
- in *smaller villages* than for those living in larger ones.

We also pre-specified other dimensions of heterogeneity, but do not find consistent patterns.

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in *smaller villages* than for those living in larger ones.

We also pre-specified other dimensions of heterogeneity, but do not find consistent patterns.

# Exposure is uncorrelated to observables

| | Treated producers within 0-5km | Treated producers within 0-5km | Treated producers within 0-5km | Treated producers within 0-5km |
|---|---|---|---|---|
| Villages within 0-5km | 3.0868*** | 3.0790*** | 3.0868*** | 3.0790*** |
| | (0.1646) | (0.1680) | (0.1642) | (0.1670) |
| Number of cashew producers in the village | -0.0050 | -0.0052 | -0.0050 | -0.0052 |
| | (0.0044) | (0.0044) | (0.0043) | (0.0043) |
| Number of cashew buyers in the village | 0.0027 | 0.0015 | 0.0027 | 0.0015 |
| | (0.0264) | (0.0263) | (0.0261) | (0.0260) |
| Road distance in km to nearest sector capital | -0.0031 | -0.0024 | -0.0031 | -0.0024 |
| | (0.0074) | (0.0074) | (0.0069) | (0.0069) |
| Road distance in km to nearest region capital | 0.0006 | 0.0004 | 0.0006 | 0.0004 |
| | (0.0031) | (0.0032) | (0.0030) | (0.0031) |
| Road distance in km to the capital | 0.0012 | 0.0014 | 0.0012 | 0.0014 |
| | (0.0025) | (0.0026) | (0.0024) | (0.0025) |
| Distance in km to the nearest primary road | 0.0064 | 0.0068 | 0.0064 | 0.0068 |
| | (0.0069) | (0.0071) | (0.0063) | (0.0065) |
| Distance in km to the nearest secondary road | -0.0111 | -0.0149 | -0.0111 | -0.0149 |
| | (0.0290) | (0.0293) | (0.0282) | (0.0284) |
| 1 if female | | 0.1825 | | 0.1825 |
| | | (0.1356) | | (0.1341) |
| Age | | 0.0003 | | 0.0003 |
| | | (0.0024) | | (0.0024) |
| Household size | | -0.0034 | | -0.0034 |
| | | (0.0057) | | (0.0057) |
| Years of education | | 0.0045 | | 0.0045 |
| | | (0.0108) | | (0.0107) |
| 1 if Kriol is the most spoken language at home | | 0.0591 | | 0.0591 |
| | | (0.0767) | | (0.0733) |
| 1 if cashew is the main source of income | | 0.0218 | | 0.0218 |
| | | (0.0818) | | (0.0787) |
| 1 if faces storage limitations | | 0.0160 | | 0.0160 |
| | | (0.0716) | | (0.0704) |
| Minimum age of trees | | 0.0138* | | 0.0138* |
| | | (0.0073) | | (0.0072) |
| Max age of trees | | 0.0033 | | 0.0033 |
| | | (0.0037) | | (0.0036) |
| 1 if trees were plagued | | -0.0042 | | -0.0042 |
| | | (0.0780) | | (0.0756) |
| 1 if sells other crops | | 0.0043 | | 0.0043 |
| | | (0.0938) | | (0.0935) |
| Index of trust (Anderson 2008) | | -0.0053 | | -0.0053 |
| | | (0.0283) | | (0.0274) |
| Index of food security (Anderson 2008) | | 0.0649** | | 0.0649** |
| | | (0.0315) | | (0.0304) |
| Regression type | Cluster at village-level | Cluster at village-level | Conley | Conley |

# Effects from intermediary surveys

| | (1) Control | (2) Treatment | (3) p-value (1) - (2) | (4) N |
|---|---|---|---|---|
| 1 if intermediary was interviewed in 2021 | 0.42 | 0.47 | -0.05 | |
| | (0.50) | (0.50) | [0.39] | 304.00 |
| 1 if made any purchase | 0.85 | 0.83 | 0.02 | |
| | (0.36) | (0.38) | [0.71] | 136.00 |
| Number of producers with whom they exchanged | 4.23 | 6.32 | -2.09 | |
| | (6.47) | (10.21) | [0.16] | 131.00 |
| Purchase price (XOF/kg) | 314.63 | 316.10 | -1.46 | |
| | (51.53) | (39.39) | [0.88] | 114.00 |
| Resale price (XOF/kg) | 395.00 | 382.71 | 12.29 | |
| | (71.06) | (81.00) | [0.57] | 53.00 |
| Margin (XOF/kg) | 74.17 | 65.57 | 8.60 | |
| | (67.37) | (78.32) | [0.68] | 53.00 |

*Notes:* Column 1 reports the mean in control villages for outcomes related to the 2020 trading season. Column 3 reports the mean in treatment villages. Outcome variables are listed on the left. The data comes from a survey of village-based intermediaries. Due to logistical issues it was not possible to interview an intermediary in every village. Standard deviations are reported in parentheses. Columns 3 reports the difference between columns 1 and 2 and the $p$-value from a $t$-test of equality between the means of intermediaries in treatment and control villages in brackets.

# Effects from village surveys

| | (1) Control | (2) Treatment | (3) p-value (1) - (2) | (4) N |
|---|---|---|---|---|
| **Number of itinerant traders that visited the village** | **10.13** | **6.75** | **3.38** | |
| | (14.01) | (9.29) | [0.03] | 284.00 |
| Number of seasonal traders that stayed in the village | 2.81 | 2.16 | 0.65 | |
| | (4.54) | (3.32) | [0.20] | 284.00 |
| Number of traders based in the village | 4.42 | 4.03 | 0.39 | |
| | (5.00) | (4.71) | [0.52] | 282.00 |
| 1 if itinerant traders visited in March | 0.07 | 0.09 | -0.02 | |
| | (0.25) | (0.29) | [0.46] | 284.00 |
| 1 if itinerant traders visited in April | 0.62 | 0.51 | 0.11 | |
| | (0.49) | (0.50) | [0.07] | 284.00 |
| 1 if itinerant traders visited in May | 0.78 | 0.68 | 0.11 | |
| | (0.41) | (0.47) | [0.04] | 284.00 |
| 1 if itinerant traders visited in June | 0.72 | 0.57 | 0.15 | |
| | (0.45) | (0.50) | [0.01] | 284.00 |
| 1 if itinerant traders visited in July | 0.10 | 0.08 | 0.02 | |
| | (0.30) | (0.28) | [0.66] | 284.00 |

*Notes*: Column 1 reports the mean in control villages for outcomes related to the 2020 trading season. Column 3 reports the mean in treatment villages. Outcome variables are listed on the left. The data comes from a survey of village leaders. Standard deviations are reported in parentheses. Columns 3 reports the difference between columns 1 and 2 and the p-value from a t-test of equality between the means between treatment and control villages in brackets.

# Price information shared

# Effects from transaction diaries

| | Control (1) Mean (SD) Total obs. | (2) Treatment | (3) Spillover | (4) Treat. vs. spillover |
|---|---|---|---|---|
| Average price from the diary | 310.96 | 3.92 | -8.94 | 12.85** |
| | (59.06) | (6.14) | (5.97) | (5.81) |
| | 448 | [0.52] | [0.54] | [0.11] |
| Number of sales from the diary | 3.00 | -0.26 | -0.16 | -0.10 |
| | (2.45) | (0.27) | (0.26) | (0.20) |
| | 523 | [0.44] | [0.67] | [0.62] |
| Timing: | | | | |
| 1 if sold cashews within two days of a message | 0.46 | -0.02 | -0.00 | -0.02 |
| | (0.50) | (0.05) | (0.06) | (0.06) |
| | 514 | [0.87] | [1.00] | [0.89] |
| 1 if sold cashews in April 2020 or before | 0.27 | -0.03 | 0.01 | -0.04 |
| | (0.44) | (0.05) | (0.05) | (0.05) |
| | 514 | [0.87] | [1.00] | [0.89] |
| 1 if sold cashews in May 2020 | 0.58 | 0.01 | -0.01 | 0.02 |
| | (0.50) | (0.06) | (0.06) | (0.06) |
| | 514 | [0.87] | [1.00] | [0.89] |
| 1 if sold cashews in June 2020 | 0.54 | 0.10* | 0.04 | 0.06 |
| | (0.50) | (0.06) | (0.06) | (0.05) |
| | 514 | [0.47] | [1.00] | [0.89] |
| 1 if sold cashews in July 2020 or later | 0.15 | 0.01 | 0.02 | -0.01 |
| | (0.35) | (0.04) | (0.04) | (0.05) |
| | 514 | [0.87] | [1.00] | [0.89] |

*Notes:* producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3. Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models

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