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Potential of and constraints on rainfed lowland rice farming in Mozambique

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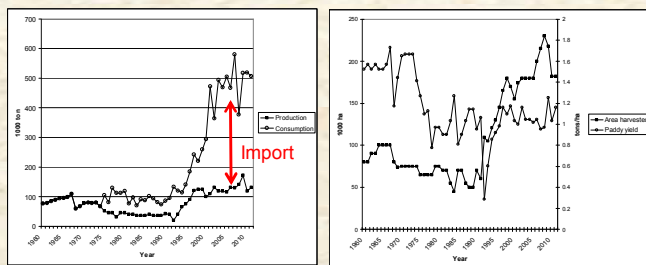
Potential of and constraints to rainfed lowland rice farming in Mozambique

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1. Background

- Rice consumption in Mozambique has been increasing but local rice production has stagnated. The stagnant yield resulted in a rapid increase in rice importation.
- A high priority has been given to the development of the domestic rice sector in the country.
- About 90 % of the rice area in Mozambique is classified under rainfed lowland ecology (Seck et al. 2010).



- Only 41 % of cultivable lowland is used for rice.

→ Potential for area expansion exists.

- Average paddy yield is 1.1 t/ha, but top 25% of farmers achieved 2.5 t/ha even under rainfed condition.

→ A great potential to increase productivity exists.

2. Research questions

- Production increase can be achieved through rice area expansion or land productivity (yield) improvement.

What are the determinants of these two processes?

- The 2nd point is important because some farmers have already achieved high yield even under rainfed conditions by modernizing their practices.

3. Study sites and data collection

- Zambézia and Sofala provinces
- Household survey during the 2007-08 agricultural season (IRRI & National Agricultural Survey of 2008 [Trabalho de Inquérito Agrícola 2008 (TIA08)])



4. Determinants of rice area expansion (Tobit regression results)

| | Dependent var.: rice cultivated area (ha) | | | |
|---------------------------------------|---|---------------------------|-------------------------------|---------------------------|
| | Tobit & District fixed effects | | Tobit & Village fixed effects | |
| | Linear | Quadratic | Linear | Quadratic |
| <i>Individual determinants</i> | | | | |
| Landholding (lowland) | 0.0730 (0.0502) | 0.0441 (0.1139) | 0.0324 (0.0513) | -0.0418 (0.117) |
| Lowland area size sq | | 0.00963 (0.0219) | | 0.0231 (0.0392) |
| No. of working members | 0.141*** (0.0487) | -0.122 (0.138) | 0.155*** (0.0504) | -0.151 (0.135) |
| No. of working members sq | | 0.0564* (0.0198) | | 0.0424** (0.0195) |
| Ave educ | 0.00668 (0.0224) | 0.0220 (0.0564) | 0.00131 (0.0228) | -0.0244 (0.0571) |
| Ave educ sq | | -0.00151 (0.00629) | | 0.00431 (0.00830) |
| Head age | 0.00237 (0.00314) | 0.00404*** (0.0154) | 0.00296 (0.00334) | 0.0524*** (0.0156) |
| Head age sq | | -0.000438** (0.000171) | | -0.000561** (0.000176) |
| Female head | -0.00771 (0.00916) | -0.0622 (0.0928) | 0.0175 (0.0970) | -0.0294 (0.0661) |
| Prop of ag. training participation | -0.157 (0.518) | 1.00529 (1.005) | -0.0643 (0.502) | -0.202 (1.843) |
| Prop of ag. training participation sq | | 0.476 (2.113) | | 0.0627 (2.045) |
| No. of draft animals | 0.00216 (0.0980) | -0.0151 (0.0960) | 0.0441 (0.0959) | 0.0264 (0.0929) |
| <i>Village-level determinants</i> | | | | |
| Rice price (village only) | -0.0124 (0.0135) | 0.0356 (0.149) | | -0.0244 (0.071) |
| Rice price sq | | -0.00146 (0.00358) | | 0.00431 (0.00830) |
| Av. proportion of non-ag workers | 0.0848 (0.163) | -0.653 (0.663) | | -0.187 (0.738) |
| Av. proportion of non-ag workers sq | | 0.738 (0.622) | | -0.187 (0.738) |
| Road access (paved) | -0.142 (0.189) | -0.119 (0.250) | | -0.159 (0.250) |
| Road access (non-seasonal) | -0.146 (0.146) | -0.159 (0.146) | | -0.159 (0.146) |
| Seed market access | 0.0460 (0.185) | 0.0580 (0.105) | | 0.0580 (0.105) |
| Fertilizer market access | 0.729** (0.241) | 0.0840 (0.640) | | 0.0840 (0.640) |
| Credit access (trader) | -0.244 (0.402) | -0.254 (0.402) | | -0.254 (0.402) |
| Animal rental mkt | 0.106 (0.233) | 0.134 (0.233) | | 0.134 (0.233) |
| Machine rental mkt | 0.177 (0.177) | 0.222 (0.222) | | 0.222 (0.222) |
| Constant | -0.146 (0.355) | -0.816 (0.896) | -0.100 (0.249) | -0.384 (0.384) |
| Pseudo R squared | 0.095 | 0.119 | 0.147 | 0.181 |
| Observations | 248 | 248 | 248 | 248 |

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; 51 left-censored obs. at 0.

Labor endowment is a constraint to rice area expansion.

Existence of animal rental markets contribute to area expansion.

Lack of power constrains rice area expansion.

5. Determinants of paddy yield (OLS & IV regression results)

| | Dependent var.: paddy yield (kg/ha) | | | |
|---|-------------------------------------|----------------------|----------------------|----------------------|
| | Village Fixed Effect | | IV | |
| | OLS | IV | OLS | IV |
| Proportion of rice area ^a | 312.4 (294.2) | 1.214 (1.057) | | |
| Full land utilization (dummy) ^a | | | 415.2* (264.0) | 1272* (763.5) |
| Cultivated area ^a | -643.2*** (196.1) | -1.392*** (433.4) | -643.2*** (190.5) | -1.022*** (304.8) |
| Landholding (lowland) | 84.43 (96.30) | 196.4 (144.0) | 79.37 (92.25) | 145.3 (97.87) |
| No. of working members/ha | 11.45** (5.258) | 3.590 (6.338) | 10.88** (5.257) | 5.897 (5.512) |
| Ave educ | 58.47 (41.10) | 47.04 (40.80) | 57.95 (40.85) | 48.64 (38.60) |
| Head age | 8.262 (6.104) | 11.16* (5.970) | 8.859 (6.098) | 11.61** (5.812) |
| Female head | -68.96 (181.3) | -83.11 (179.1) | -57.18 (180.8) | -24.80 (182.2) |
| Ag. training participation | 859.8 (855.9) | 944.7 (821.8) | 784.9 (830.9) | 709.9 (787.4) |
| No. of draft animals/ha | 125.5** (49.83) | 111.5** (48.00) | 137.8*** (49.93) | 155.1*** (49.69) |
| Constant | 414.3 (491.0) | 389.5 (594.3) | 531.8 (474.8) | 662.7 (471.2) |
| Endogeneity test (Durbin) | 2.86 (0.09) | | 4.42 (0.11) | |
| Endogeneity test (Wu-Hausman) | 1.95 (0.15) | | 1.77 (0.17) | |
| First stage F for prop rice area or full cult | | 3.09 (0.00) | | 2.33 (0.03) |
| First stage F for cultivated area | | 10.11 (0.00) | | 10.11 (0.00) |
| Overidentification test (Sargan) | | 6.64 (0.24) | | 5.61 (0.34) |
| Overidentification test (Basmann) | | 5.27 (0.38) | | 4.42 (0.50) |
| Observations | 197 | 197 | 197 | 197 |
| R-squared | 0.370 | 0.332 | 0.375 | 0.331 |

a) Possible endogenous variable. Identifying IVs are the explanatory variables in the quadratic village fixed effect model in Table 4. Standard errors in parentheses; p-values in brackets. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15.

Emergence of land intensification among the farmers who have reached the land frontier (*Boserupian process*)

They achieve high yield by adopting modern rice technologies (e.g. use of a high yielding variety (ITA312) and use of animals). (Regression results not shown here)

Animal power is also important for productivity improvement.

6. Take home messages

- The potential is not fully exploited as only 41% of cultivable lowland is used for rice.
- The lack of power is the predominant constraint to rice area expansion. (The existence of animal rental market relaxes the constraints.)
- High potential also exists in land intensification (the average yield of the top 25% of farmers is 2.5 t/ha).
- The *Boserupian process* (intensification through technology adoption and intensive crop care) seems to be emerging among farmers who have reached the rice land frontier.
- Adoption of high yielding varieties and animal use contribute to yield increase.