PN-ABL-548
77795

179 Credit Intervention to Promote High-Yielding Crop Technology in Niger: An Economic Analysis

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Introduction

Increasing food production is a high political priority in Niger, where agriculture is constrained by low rainfall and poor soils (Ouattara and Persaud, 1985). Research agronomists in Niger have developed a high-yielding technology for intercropped millet (*Pennisetum americanum*) and cowpea (*Vigna unguiculata*), the principal crops on sandy soils. This technology (T4), which combines improved crop varieties, increased planting density, and N and P fertilizer applications, also has shown higher net cash revenue per hectare than traditional technology (T1), improved varieties with traditional practices (T2), and improved varieties with increased density (T3). However, family labor constraints appear to limit the adoption of the T4 technology (Krause et al., 1987). The T4 technology could be adopted on a larger area if farmers had sufficient cash to hire laborers. This paper examines the effect of interest rates on the quantity of labor hired and the extent of adoption for this high-yielding, but labor and capital-intensive crop technology.

Family labor constraints are particularly important in Niger because late planting and late weeding reduce the amount of water available to the growing crops. Labor is often hired during planting and weeding periods to overcome these constraints and accounts for most of the cash expenses in crop production. Surveys in northern Nigeria by Norman et al. (1979) showed that an average of 57% of crop production cash costs were for labor. Raynaut (1976) found in south-central Niger that hiring laborers accounted for 60% of total household cash expenses in April-June and 92% in July-September (26% for the entire year).

Capital constraints are particularly important to Nigerien farmers because cash incomes are generally low, interest rates for informal credit are often very high, and access to institutional credit is limited. In a 1969 to 1970 survey of 72 households in south-central Niger, Raynaut found that average agricultural cash revenues per household were equivalent to just $33 (Raynaut, 1976). Interest rates for informal credit vary widely according to the relationship between creditor and debtor and type of loan, but nominal interest rates for cash loans to non-relatives appear to range between 20 and 70% in Niger (Hill, 1972), and 50 and 90% in northern Nigeria (Norman, 1973). The usual nominal interest rate for loans of food or seed repaid in kind (*dauke*) is 100% among the Hausa people of northern Nigeria and south-central Niger (Hill, 1972). Most informal credit loans are only for a few months, so the annual rates of interest are much higher than these nominal rates (throughout this paper, interest rates are expressed as nominal, not annual rates). Finally, a 1985 rural credit survey in Niger indicated that 15% or less of rural households had access to "meaningful" (excluding loans of negligible cash value) institutional loans (Ohio State University, 1987).

Methodology

A linear programming model of millet and cowpea intercrop technologies is used to evaluate the effect of family labor constraints, hired labor, and credit costs on the adoption of the technology combining improved varieties, increased density, and N and P fertilizer applications. Two versions of the model are constructed for representative farms in two villages in south-central Niger Maiguero and Rigial Oubandawaki. Both villages have predominantly sandy soils, but household and farm sizes are smaller for Maiguero. The average cultivated farm area for Maiguero is 3.84 ha and the average for Rigial Oubandawaki is 8.06 ha. Maiguero has an average of 0.84 active family laborers per ha and Rigial Oubandawaki has an average of 0.65 active family laborers per ha (Krause et al., 1987). Forty hours per week are assumed to be available for fieldwork.

The representation in the model of the four technologies for intercropped millet and cowpea is based on data from on-farm trials conducted by the Institut National de Recherches Agronomiques du Niger (INRAN) in 1986. Crop operations in the model begin during the periods they were performed in the trials and continue in later periods, when labor constraints cause delays. Crop yields in the model are reduced for delayed planting and

first weeding, using coefficients calculated from a linear regression analysis of the 1986 on-farm trial yields (Krause et al., 1987). The base crop yields are the average crop yields observed in the 1986 on-farm trials in each village (Table 1).

Crop prices in the model are 1986 harvest-time prices in the neighboring Gabi village market. Input prices are those observed in the on-farm trials (hired labor), those observed in village markets (local seed), or government prices (improved seed and fertilizers) in 1986. Nominal interest rates of 0, 20, 50, and 70% (0, 40, 100, and 140 in annual terms) are added to the prices for improved seed, fertilizers, and hired labor. The mix of crop technologies which maximizes net cash revenue is selected for each of the various nominal interest rates.

Results and Discussion

The linear programming analyses show that family labor constraints will limit the adoption of the technology combining improved varieties, increased density, and fertilizer applications (T4) unless labor can be hired using cash obtained at moderate interest rates. In the case of a 70% nominal interest rate, no labor is hired and only 30% of the fields are planted using the T4 technology at Maiguero (Table 2). With the same interest rate, only 1.2 man-days of labor are hired and none of the fields are planted using the T4 technology at Rigial Oubandawaki. However, a 20% nominal interest rate for purchased inputs increases the proportion of fields planted to the T4 technology to 100% at Maiguero and 78% at Rigial Oubandawaki (Table 2). Every reduction in the nominal interest rate between 70% and 20% dramatically increases the number of laborers hired and the proportion of fields planted to the T4 technology in both villages. Reducing the nominal interest rate from 50% to 20% also raises net farm revenue from 23,234 to 36,036 CFA francs at Maiguero and from 45,752 to 71,658 CFA francs at Rigial Oubandawaki (Table 2).

The problem posed by family labor constraints for the adoption of the T4 technology is indicated by the number of laborers hired with 0 to 20% nominal interest rates. Even with a 20% nominal interest rate, the number of man-days of labor hired is three times the number of family man-day equivalents available per planting period (6.5 at Maiguero and 11.4 at Rigial Oubandawaki). The importance of labor constraints is further indicated by results of the model with no hired labor and no interest rate, in which the T4 technology is adopted on only 39% of the fields at Maiguero and 5% of the fields at Rigial Oubandawaki.

Table 1. Average yields for millet and cowpea grain by treatment and by village, 1986 on-farm trials (from Krause et al., 1987).

Village and crop	Treatment T1	T2	T3	T4
	kg/ha			
Maiguero:				
Millet grain	279 bc[a]	310 b	238 c	627 a
Cowpea grain	67 c	84 c	150 b	245 a
Rigial Oubandawaki:				
Millet grain	200 b	184 b	162 b	325 a
Cowpea grain	113 c	140 bc	196 b	348 a

[a]Yields with different letters within the same row are significantly different ($P < 0.05$), based on the Duncan multiple range test.

Conclusion

The potential to raise food production in Niger through the adoption of higher yielding crop technologies appears to be linked to farmers' ability to find credit at moderate interest rates. The nominal interest rates most often offered in the informal credit market (50-70%) discourage farmers from hiring the labor needed to profitably adopt a millet and cowpea intercrop technology which combines improved varieties, increased density, and fertilizer applications. Offering credit at a 20% nominal interest rate would dramatically increase the adoption of this technology and raise net farm revenues. A 20% nominal interest rate also would require little or no government subsidy and could support interest rates for savings deposits that are high enough to attract local savings (Donald, 1976). It, therefore, appears that the government of Niger could increase food production by establishing a viable small farmer credit program charging nominal interest rates of about 20%.

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Table 2. Man-days of labor hired, net farm revenue, and proportion of total farm area planted to each treatment, for various interest rates, by village, based on the 1986 INRAN on-farm trials.

Village and interest rate	Hired labor	Net farm revenue	Total Farm Area T2	T3	T4
	Man-days	(CFA francs)	%		
Maiguero:					
0 interest	34.1	47,224	—	—	100.0
20% interest	20.5	36,036	—	—	100.0
50% interest	1.9	23,234	58.7	—	41.3
70% interest	—	19,730	60.8	9.5	29.6
Rigial Oubandawaki:					
0 interest	90.0	97,582	—	—	100.0
20% interest	58.0	71,658	—	21.6	78.4
50% interest	21.1	45,752	56.0	12.9	31.1
70% interest	1.2	41,907	87.2	12.8	—

Source: Results of the linear programming model analyse

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