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177 The Rationality of Intercropping in Sahelian Africa: Evidence from Niger

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Introduction

Mixed cropping of various sorts is widely practiced by traditional farmers in Niger. The government estimated that in 1983, 73% of the cultivated area was planted in mixed crops (Ministere de Developpement Rural, 1984). Yet for more than two decades, government extension efforts had focused on pure cropping. The time has come to re-examine the rationale for intercropping from the perspective of a small farmer in a semiarid environment.

Constraints to Crop Production in Niger

The logic of mixed cropping depends on the objectives of a farm household and the environmental and socioeconomic constraints within which it operates. Nigerien subsistence farmers are primarily concerned with securing minimum cereal production to survive until the next harvest. Limited water availability is the primary and most limiting environmental constraint of semiarid regions. The agricultural zone of Niger lies in the Sahelo-Sudanian climatic zone with a mean annual rainfall of 350 to 600 mm. (World Bank, 1985). Virtually all rains fall between June and September, and only for two and a half months per year does mean precipitation exceed half the mean evapotranspiration (Koechlin, 1980). High temperatures, a second limiting factor, also limit crop options. Mean monthly temperatures range from 22 to 32° C (ICRISAT, 1986).

Soil fertility is a third limiting environmental factor. Most of the agricultural soils are sandy aeolian deposits which cover stony alluvial deposits from the Quaternary period. They are mildly acidic, and low in organic matter, nitrogen, phosphorus, and exchangeable bases (Ca, Mg, K) (Ouattara and Persaud, 1985).

Agricultural labor becomes constraining during planting and weeding operations (which must be executed immediately after significant rains) (Krause et al., 1987). Failure to plant and weed in a timely fashion reduces millet (*Pennisetum typhoides*) and cowpea (*Vigna unguiculata*) yields significantly (Berrada, 1987). Yet, even in the more favored agricultural regions such as southern Maradi, most farmers lack the animal traction equipment needed to hasten these operations (Swinton, 1985). However, the reluctance of farmers to adopt animal traction on subsistence crops in West Africa makes its promise as a time-saver debatable (Eicher and Baker, 1982).

Intercropping to Overcome Constraints

Agronomic research in Niger has demonstrated the potential of certain crop mixtures to relax some of these constraints. The most successful crop associations maximize the physical complementarities between component crops so as to make most efficient possible use of the available resources (Andrews, 1972; Fussell and Serafini, 1985; Ruthenberg, 1971). Millet and cowpeas appear to be particularly complementary. In association, they exhibit more efficient water use (Fussell and Serafini, 1985; Reddy et al., 1985; Reddy, 1987), and higher light reception (Fussell and Serafini, 1985) than either crop grown alone. There is no clear evidence, however, that cowpeas improve soil fertility by contributing to the soil nitrogen supply if allowed to mature (Andrews, 1972; Fussell and Serafini, 1985). From a farmer's standpoint, these technical advantages are only meaningful if they translate into improved yields or lower risk of crop failure. Research results from both on-station agronomic trials and farm surveys demonstrates that they do.

Mixed Cropping Gave Comparable or Higher Yields

Mean grain yields were equally high or higher for all mixed cropping systems but one in 1984 and 1985 in samples of 75 farms in Madarounfa and 117 in Maradi (Table 1). Yield variability in both years was so high that no crop had yields that were significantly different from zero at a 95% level (due to large numbers of crop failures).

On-station agronomic research in Niger has shown

Table 1. Mean grain yields for five principal cropping systems in Central Niger, 1984 and 1985.

Cropping system	Location and year		
	Madarounfa[a]		Maradi[b]
	1984	1985	1984
	kg/ha		
Monocrop systems			
Millet	145	376	371
Sorghum	145	274	182
Mixed crop systems			
Millet-sorghum	117	359	261
Millet-cowpea	158	413	256
Millet-sorghum-cowpea	179	556	262

[a] From Swinton, 1988; 75 farms.
[b] From Projet de Developpement Rural de Maradi, 1986 (adjusted to include fields with crop failures); 117 farms.

Table 2. Mean labor use and hourly wages for the five principal cropping systems on 75 Madarounfa farms, Niger, 1984 and 1985 (from Swinton, 1988).

Cropping system	Mean labor use		Mean hourly wage	
	1984	1985	1984	1985
	person-hours/ha		C.F.A. francs	
Monocrop systems				
Millet	155	189	70	122
Sorghum	183	163	30	99
Mixed crop systems				
Millet-sorghum	154	184	59	117
Millet-cowpea	190	199	68	127
Millet-sorghum-cowpea	200	209	70	163

that total biological yields tend to be higher for millet-cowpea intercrops because millet yields are not significantly reduced from yields in pure stands (Berrada, 1987; Fussell and Serafini, 1985). Hence, cowpea production becomes something of a bonus crop in association with millet.

Lower Yield Risk

Mixed cropping offers two advantages in managing yield risk. Clearly, a diversified portfolio is less likely to suffer a total loss than an unmixed one. Different planting dates and differences in crop life cycles make them susceptible to climatic stress at different times. An early end to the rainy season caused cowpea to fail almost totally in south-central Niger in 1984 and 1985. The few farmers who monocropped cowpeas suffered accordingly. Those who mixed their cowpeas with millet or sorghum at least harvested the cereal. In contrast, in a good rainfall year, such as 1986, cowpeas yielded well (Reddy, 1987), having made use of residual soil water after the millet matured in late August. Research in northern Nigeria indicates that the association of early millet with late-maturing sorghum is "potentially productive" (Fussell and Serafini, 1985), supporting a traditional practice in southern Niger.

The second yield risk management advantage is that farmers can add short-season crops to fields where early plantings of long-season crops have partially died off. Rather than suffer a partial crop loss on pure millet, farmers have been observed to add short-season cowpea to the bare spots left by dead millet plants (Swinton et al., 1985).

Better Price Risk Management

Some crops fetch more at market than others, and relative prices vary. Even subsistence farmers sell some of their production, and growing multiple crops offers one means to hedge against price risk. From 1984 to 1985, the ratio of cowpea to millet prices in Maradi (ranged from) 1.3 to 4.3 (Swinton, 1988). Yet, the poor cowpea yields and generally higher yield risk associated with leguminous crops in Niger have not made them a good pure crop in recent years.

Higher Returns to Labor

Phased planting can increase returns to peak-period labor, making labor use more efficient (Norman et al., 1979) and spreading the peak period of labor demand (Swinton et al., 1985). Table 2 shows that despite a higher mean labor input per field, the effective hourly wage (net field income divided by field hours worked) for cereal-cowpea systems was higher than for monocrop systems in both 1984 and 1985 in Madarounfa. Phased planting and harvesting increased labor input, but the opportunity to do several tasks without added trips to the field made work more efficient (e.g., planting cowpea and weeding millet at the same time).

Conclusion

Subsistence farmers in Niger practice forms of intercropping that exhibit high complementarity between component crops. In so doing, they combine subsistence "safety-first" objectives with yields, returns to labor, and risk of crop failure that are generally better than under pure cropping.

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