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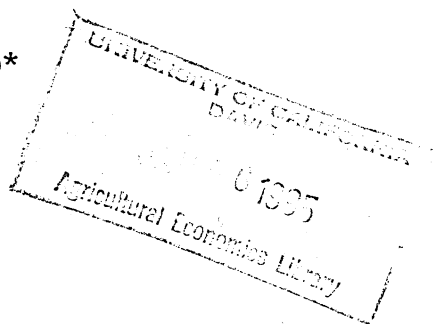
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Farm-Nonfarm Linkages in the West African Semi-Arid Tropics:  
New Evidence from Niger and Senegal

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281

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24236

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**Abstract**

Data from two recent household surveys in Africa are used to estimate growth multipliers. The paper provides evidence of larger multipliers and stronger nonfarm linkages than previously attributed to African smallholders. It indicates that broad-based agricultural growth will have large indirect benefits to the local economy.

**Farm-Nonfarm Linkages in the West African Semi-Arid Tropics:  
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There has been substantial debate in the growth linkages literature as to (1) the magnitude of growth linkage multipliers in Africa versus Asia, (2) the role of the poor in stimulating the regional growth linkage process, and (3) the differential benefits accruing to rich and poor segments of the rural population from technological change in agriculture (Haggblade and Hazell; Haggblade, Hazell and Brown; Hazell and Roëll; Hariss). This paper provides new evidence from Niger and Senegal on the first two issues and draws implications for the third.

Most farm-nonfarm linkage studies show that growth multipliers are about 60 percent lower in Africa than in Asia, 1.5 versus 1.8 (Haggblade, Hazell, and Brown). Although the empirical evidence for Africa is sketchy, multipliers are shown to be lowest among African smallholders -- 1.3 (Haggblade and Hazell).

Haggblade, Hazell, and Brown compare the results of expenditure studies in Northern Nigeria (Hazell and Roëll, 1983; Simmons, 1976) and Sierra Leone (King and Byerlee, 1977) to assess the strength of rural consumption linkages in Africa. They conclude that *"African spending patterns support far less rural nonfarm activity than do those in Asia"* (p. 1187). This conclusion is based on evidence that African consumers spend only 11-18 percent of incremental income on locally produced non-foods while Asian consumers spend 26-31 percent.

Empirical evidence related to the targeting of technological change is somewhat conflicting. Hazell and Roëll conclude that for the Gusau region of Northern Nigeria, *"Focusing agricultural growth on the larger farms would do more to stimulate the local economy ..."* (p. 54). After computing multipliers for Africa and Asia under a range of technological

assumptions, Haggblade and Hazell conclude that *"Middle sized farms appear to generate the greatest rural growth linkages because of greater demand diversification into nonfarm goods compared to small farms ..."* (p. 360). Bell, Hazell, and Slade conclude that in Asia *"... income increases in their hands [low income households] generate larger downstream benefits in the region than income increases received by the wealthy households"* (p. 252-53).

Few examples of regional growth multipliers exist for Africa, especially by income group. This paper uses data from two recent, very detailed, household surveys conducted in Niger and Senegal from 1988-90 to compute fixed-price growth multipliers for lower and upper expenditure terciles.

The purpose of this paper is to explore in greater detail the linkages between the farm and nonfarm sectors of the rural African economy, in particular the consumption linkages. It uses existing multiplier models and standard approaches to estimating marginal budget shares (Haggblade and Hazell; Hazell and Roëll). It presents evidence of larger multipliers and stronger nonfarm linkages than previously attributed to African smallholders. It maintains that the strength of growth linkages in Africa has been underestimated in previous studies, in part due to the use of a functional (food/non-food) characterization of commodities as opposed to the more relevant sectoral (farm/nonfarm) categorizations. The paper also provides evidence that widespread diffusion of income-increasing agricultural technology packages will stimulate rural growth more than targeting to the most productive (wealthy) households.

### Conceptual Approach

A four sector variant of the semi-input/output model developed by Haggblade and Hazell was used to describe the rural economy. The model specifies equations for farm tradable, farm non-tradable, nonfarm tradable, and nonfarm non-tradable sectors.<sup>1</sup> As will be argued below, adding a fourth sector for nonfarm tradables to the original three sector model allows us to get a better picture of rich and poor responses to an increase in value added in the tradable sector. This model yields the following multiplier for an exogenous increase in tradable farm sector income:

$$(1) \quad (1/v_{at})(\partial Y/\partial T_{at}) = 1 + (v_{an}/v_{at})(\partial A/\partial T_{at}) + (v_{mn}/v_{at})(\partial M/\partial T_{at})$$

where

- Y - total household income;
- $T_{at}$  - gross output of tradable agriculture;
- A - gross output of non-tradable agriculture;
- M - gross output of non-tradable non-agriculture;
- $v_j$  - value added/gross output where  $j=at, an, mt, mn$ .

The multiplier measures the increase in regional value added given a one unit increase in value added from tradable agricultural. It has two components:  $(v_{an}/v_{at})(\partial A/\partial T_{at})$  is the increase in value added in non-tradable agriculture from a one unit increase in value added in tradable agriculture while  $(v_{mn}/v_{at})(\partial M/\partial T_{at})$  is the increase in nonfarm non-tradable value added.

Parameters needed to estimate the model include the marginal budget shares for farm and nonfarm non-tradables, the marginal propensity to save, the share of value added to gross output in each sector, and the share of non-tradable intermediate deliveries to gross output in each

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<sup>1</sup> The Haggblade and Hazell model defines three sectors: tradable, non-tradable agriculture, and non-tradable non-food.

sector. Marginal budget shares were derived from the OLS estimation of modified Working-Leser Engel functions. The approach is described in Hazell and Roëll (1983) and will not be repeated here.

Value added and intermediate delivery shares were calculated using the detailed input/output data for both agricultural and non-agricultural activities which were collected in each of the above mentioned surveys for the purpose of computing net earning by income source.

Fixed price input-output models imply a perfectly elastic supply of non-tradables. By not allowing for an upward sloping supply curve (increasing wages due to increased demand for labor, for example), these models tend to overstate the actual magnitude of the multiplier since the second round of adjustments caused by increases in prices are not taken into account. For the purposes of this paper this is not a concern since the results will be compared with results of other fixed price multipliers.

#### **Data and Definitions**

This paper uses detailed household expenditure and income data from surveys conducted in Niger and Senegal between September 1989 and December 1990. Fortnightly and monthly interviews were conducted to enumerate crop and livestock transactions (purchases, sales, gifts), food and non-food consumption, crop production, and non-agricultural income. In Niger, the sample consisted of 135 randomly chosen households in fifteen villages in the Sudano-Sahelian and Sudano-Guinean zones of western Niger. The Senegal sample used in this analysis consist of 36 randomly chosen households in three villages in the southeastern Peanut Basin. Villages in both studies were chosen to

reflect the diversity of the region in terms of access to markets, infrastructure, size, etc. The survey methodology is described in more detail in Hopkins and Reardon and Kelly et. al.

#### Characterization of consumption goods

Results of expenditure and multiplier analysis rely heavily on the characterization of consumption goods. The detailed nature of the Senegal and Niger data and the authors' knowledge of the commodities, households, and regions where the data were collected permitted a very rigorous and accurate categorization of individual goods. For example, we were able to distinguish millet flour (as a nonfarm non-tradable) from unthreshed (with bran) millet (a farm tradable) from millet cakes (a nonfarm non-tradable). Likewise, traditionally processed peanut oil (nonfarm non-tradable) was distinguished from imported palm oil (nonfarm tradable). Likewise, locally crafted nonfarm tradables (e.g. palm-frond woven mats) were distinguished from locally crafted nonfarm non-tradables (e.g. calabasses).

Over 250 individual food items and 750 non-food items were classified: (1) by commodity category (at an aggregated 6 category level and a disaggregated 20 category level), (2) by sector (farm or nonfarm), and (3) by tradability. For the purposes of this paper only the sector and tradability definitions are important and will be summarized below.

Farm/nonfarm: Most multipliers reported for African economies are based on marginal budget shares derived from 'locational' classifications of food and non-food items -- locally produced versus imported foods or non-foods (King and Byerlee; Haggblade and Hazell). Locally produced food is usually equated with the farm sector in computing multipliers. In this analysis, a farm/nonfarm classification



system was used. The farm/nonfarm distinction may be the more relevant classification for multiplier analysis since it allows processed food items (e.g. processed cereals (flour, breads, cakes), processed vegetables, processed meat (e.g. butchered, dried, smoked, grilled, etc.) to be appropriately placed in the nonfarm sector.

Given that food processing is one nonfarm activity that is expected to grow most rapidly during a structural transformation (Haggblade, Hazell and Brown; Hazell and Haggblade), it seems particularly important to make this distinction.

Consumption durables (e.g. kitchen utensils, furniture, clothing), non-durables (e.g. fuelwood, kerosene, soap), and services are classified as nonfarm goods and services. In addition, food items which originate off-farm (while using farm sector inputs) are also classified in the nonfarm sector (e.g. flour, cakes, breads, tomato paste, canned milk, cooked tubers, spices, grilled meat, smoked fish). This is true regardless of whether they are imported or of local origin. Goods which originate on the farm (e.g. unprocessed cereals and pulses, fresh vegetables/fruits, by-products, live animals) are classified as farm sector goods.

Tradable/non-tradable: To derive multipliers which, by definition, quantify the additional income accruing to the nontradable sector from an exogenous shock in the tradable sector, goods were classified according to tradability. Determination of tradability rests on whether increased production of the good is supply constrained (tradable) or demand constrained (non-tradable). A good is supply constrained only in reference to a given market. The geographic breadth of the market ("catchment area") is a critical factor in classifying goods according

to their tradability. A given good may be supply constrained at the local level (tradable) but demand constrained (non-tradable) within a broader (national or regional) geographic area. A "local" definition (i.e. roughly a 100 km radius from the study villages) of tradability is used for the analysis presented here.

Thus, in addition to being classified into farm and nonfarm sectors all products were also classified as tradable or non-tradable at the local level based on the authors' knowledge of the study areas. For example, millet, sorghum, maize and rice are all tradable at the local level whereas the local cereal fonio is a non-tradable. Likewise, milk is a nontradable whereas live animals are a tradable. Within the nonfarm non-food category certain items such as woven palm-frond mats are tradable whereas other locally made items, such as calabasses, are non-tradables.

Most earlier work on linkages assumed that all 'locally produced' non-food goods were non-tradable. Our detailed classification of individual goods and knowledge of the study regions allows us to distinguish tradable and nontradable locally produced goods. This is particularly important in Niger where a number of locally produced nonfarm goods are exported to other regions and countries. The phenomenon is less common in the southeastern Peanut Basin of Senegal.

### **Empirical Results**

Multipliers for the overall sample and for households in the lower and upper income terciles are given in Table 1. Three points emerge. First, multipliers for Senegal and Niger are larger than previous African linkage studies have shown. Hazell and Haggblade report multipliers for Africa that cluster around 1.33. Our results yield

multipliers of 1.83 for Senegal and 1.77 for Niger. About 60 percent of the Senegalese multiplier is due to backward production linkages in the peanut sector while about 80 percent of the Niger multiplier is due to consumption linkages.

The greater importance of consumption linkages in Niger appears to be due to its more dynamic nonfarm economy which produces locally many of the nonfarm household goods that tend to be imported into the southeastern Peanut Basin of Senegal. The fact that Senegal has one of West Africa's largest ports and Niger is landlocked, with high transport costs, also influences the extent to which imports versus local goods are important in the respective economies. The production linkages are strong in Senegal because intermediate input demands for the tradable farm sector (peanuts) represent a large share of value added (37 percent versus only 9 percent in Niger) and they are almost all nontradable (peanut seed, animal traction services, and hired labor).

Second, the growth linkages with the nonfarm economy, particularly for Niger, appear stronger than previous studies suggest. Haggblade and Hazell report that a 1 dollar increase in the tradable farm sector in Asia, generates an additional 33 to 67 cents in nonfarm income. In Africa, they find that the same shock generates only 18 to 30 cents. They conclude that nonfarm activities account for a larger share of the total multiplier in Asia than in Africa.

For Niger, the additional income accruing to the non-tradable nonfarm sector from a 1 dollar shock to the farm tradable sector is 56 cents, while that to the non-tradable farm sector is only 21 cents. Thus, of the 77 cents of indirect gain, 73 percent is generated by the nonfarm economy. In Senegal, 38 cents accrues to the non-tradable

nonfarm sector and 45 cents to the non-tradable farm sector -- nearly half of the total indirect gain is generated by the nonfarm sector. The farm sector contributes slightly more than the nonfarm sector in Senegal because of the importance of intermediate input demands mentioned above.

It is important to note that the nonfarm sector contributes a much larger share to the total multiplier in Niger (.73) than was reported by Hazell and Roëll for the Gusau region of Nigeria (.34). This is due, at least in part, to our classification of processed foods as nonfarm. Because previous studies used the food/non-food distinction and non-food was taken to represent nonfarm this component of the total multiplier may have been underestimated and the farm component overestimated.

The conclusion that African spending patterns support far less rural nonfarm activity than do those in Asia is based on low marginal budget shares for nonfarm non-tradable goods reported in previous studies. Both Hazell and Roëll and King and Byerlee report marginal budget shares for 'local non-food' items (which were classified as non-tradables) of about 9 percent. In Niger, the marginal budget share for 'nonfarm non-tradable' goods is 26 percent, in Senegal it is 15 percent (Table 2).

Third, multipliers are larger for the poor than for the rich in both Niger (1.84 versus 1.74) and Senegal (2.01 versus 1.64). Farm-nonfarm links appear to be stronger for poorer households -- a 1 dollar shock to the farm tradable sector generates 65 cents of additional income in the nonfarm sector for lower income households in Niger (46 cents in Senegal) versus only 49 cents for upper income households in Niger (26 cents in Senegal). One could argue, based on these results,

that widespread diffusion of improved technology packages will stimulate rural growth more than targeting them to the most productive (wealthy) households.

Given that 79 percent of the multiplier in Niger is due to consumption linkages, the magnitude of the multiplier is driven largely by the spending patterns of rural households. The poor are spending 32 cents of each additional dollar on nonfarm non-tradable goods while the rich only spend 22 cents of every dollar on nonfarm non-tradable goods (Table 2). Instead, the rich are spending 38 cents of each additional dollar on nonfarm tradables which (whether imported or locally produced) represent a leak to the local economy. The poor only spend 20 cents of each additional dollar on nonfarm tradables. In Senegal, the marginal budget shares of the poor for nontradable farm and nonfarm goods are about 10 percentage points larger than those of the wealthy.

#### Summary and Conclusions

There are several conclusions to be drawn from this analysis. First, the results present strong evidence that Haggblade and Hazell's assertion -- *"Nonfarm linkages generated by technical change in agriculture can accentuate both the growth and the poverty-reducing impact of agricultural growth"* (p. 345) holds for Africa as well as Asia. These results are particularly relevant at a time when donors are decreasing their support for agriculture. They indicate that agriculture can, in fact, be a dynamic lead sector in rural growth strategies for Africa.

Second, generalizing about growth multipliers in Africa on the basis of a limited number of studies (drawn from data that are now more than a decade old) may be misleading. The Senegal and Niger studies

show that growth multipliers are much stronger than current West African thinking and development policies acknowledge.

In Senegal in particular, there has been a strong movement away from investment in rainfed agriculture. These results suggest that investments in agricultural research, infrastructure, and credit programs that successfully increase farm incomes will produce important growth linkages in the rural nonfarm economy. Efforts to revive a stagnating agricultural sector in a zone of relatively high potential, such as the southeastern Peanut Basin of Senegal, could have positive effects in both the farm and nonfarm sectors of the rural economy.

Third, the results provide evidence that focusing agricultural growth on the poor will generate the largest indirect benefits to the local economy. This suggests that policies can be developed to encourage both equity and growth at the same time. This is a refreshing finding, given that many previous results have suggested that growth will occur faster if programs are targeted to the rich.

The final point is a methodological one. Classifying goods into farm and nonfarm sectors rather than into food and non-food categories (which later tend to be interpreted as 'farm' and 'nonfarm' for policy analysis) provides a more accurate picture of the linkages between the farm and nonfarm sectors. By doing this, we can continue to focus on the growth multipliers in the nonfarm sector, but we have fully accounted for the very important set of food processing activities that provide end products accounting for a large share of marginal budget expenditures as incomes increase in the Sahel.

Table 1. Value-added multipliers for Niger and Senegal by income group

Sector	Niger			Senegal		
	Overall Sample	Lower Tercile	Upper Tercile	Overall Sample	Lower Tercile	Upper Tercile
Farm tradable	1.00	1.00	1.00	1.00	1.00	1.00
Farm non-tradable	0.21	0.19	0.25	0.45	0.55	0.38
Non-farm non-tradable	0.56	0.65	0.49	0.38	0.46	0.26
<b>Total</b>	<b>1.77</b>	<b>1.84</b>	<b>1.74</b>	<b>1.83</b>	<b>2.01</b>	<b>1.64</b>

Source: IFPRI/INRAN and IFPRI/ISRA survey data

Table 2. Expenditure patterns for rural households in Niger and Senegal by expenditure tercile

Country/Sector	Lower Expenditure Tercile			Upper Expenditure Tercile			Overall Sample		
	Average Budget Share	Marginal Budget Share	Expenditure Elasticity	Average Budget Share	Marginal Budget Share	Expenditure Elasticity	Average Budget Share	Marginal Budget Share	Expenditure Elasticity
<b>Niger</b>									
Farm tradables	55	37	0.67	46	24	0.52	51	32	0.63
Farm non-tradables	7	11	1.73	9	16	1.86	7	13	1.79
Non-farm tradables	22	20	0.92	26	38	1.46	24	29	1.20
Non-farm non-tradables	16	32	1.94	19	22	1.13	18	26	1.45
<b>Total</b>	<b>100</b>	<b>100</b>		<b>100</b>	<b>100</b>		<b>100</b>	<b>100</b>	
<b>Senegal</b>									
Farm tradables	51	23	0.45	40	10	0.25	45	13	0.28
Farm non-tradables	5	7	1.40	4	-2	-0.50	5	2	0.40
Non-farm tradables	39	52	1.33	49	84	1.70	44	70	1.60
Non-farm non-tradables	5	18	3.60	7	8	1.14	6	15	2.50
<b>Total</b>	<b>100</b>	<b>100</b>		<b>100</b>	<b>100</b>		<b>100</b>	<b>100</b>	

Source: IFPRI/INRAN and IFPRI/ISRA survey data

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