

AGRICULTURE-LED INCOME DIVERSIFICATION IN THE WEST AFRICAN SEMI-ARID TROPICS: NATURE, DISTRIBUTION, AND IMPORTANCE OF PRODUCTION-LINKAGE ACTIVITIES

by

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1. Introduction

Rural households diversify their incomes when they supplement cropping income with nonfarm income. This diversification has been under-studied in the West African Semi-Arid Tropics (WASAT) (Norman, Newman, and Ouedraogo; Eicher and Baker).¹ We redress this gap by reviewing past (published and unpublished) evidence, and presenting new evidence on the following questions: (i) how extensive is rural household income diversification in the WASAT? how does this differ between poorer and richer households, and over agroecological zones? (ii) what determines nonfarm sector participation? (iii) what are diversification's food security effects? (iv) what share of nonfarm income exhibits production linkages with WASAT cropping and livestock husbandry (how 'agriculture-led' is it)?

The first three questions are important for policymakers as the answers direct attention to the importance of nonfarm activities for the short- and long-term food security of rural WASAT households, and point to promotional policies that would have the greatest equity and efficiency impacts. The fourth question is important because, if diversification activities are closely linked to local agriculture, then their development cannot be promoted independently of a firm commitment to agricultural development.

We see growing signs in international donor and research circles of a decline in support for 'agriculture-led' development strategies in the WASAT; the decline has been fueled by concern for the dim prospects for coarse grain agriculture, and by recent revelations (see below) of the empirical importance of nonfarm earnings to Sahel farmers. The latter has apparently been interpreted by some to mean that agriculture can be by-passed as the primary "growth motor" in the medium run, and that the rural nonfarm sector can flourish regardless of the condition of agriculture. Instead, we find that income diversification is extensive, and important to food security, but that the great bulk of WASAT incomes are based directly on or in production linkages with local agriculture.

The paper draws mainly on evidence from three recent field surveys, two in the 'interior WASAT' (Burkina Faso and Niger) and one in the 'coastal WASAT' (Senegal). Senegal is more urbanized, more densely populated, more endowed with transport infrastructure; rural income was 199 dollars per adult equivalent (AE), averaged over two study years, 1988-1990, in three agroecological zones. Rural income in Burkina Faso was only 92 dollars per AE, averaged over four study years, 1981-85, for three

¹. Various studies in the latter had focused on particular aspects of, for example, employment, migration, and land use in the WASAT, and performed in-depth, single-year surveys of one or several villages (e.g. Ancy in Burkina Faso; Hill in Northern Nigeria).

agroecological zones; in Niger it was 132 dollars per AE, for 1989/90, for two agroecological zones.²

We distinguish three major agroecological zones: (a) the Sahelian zone (poor agroclimatically; 200-500 mm. annual rainfall, the northern isohyet of the WASAT); (b) the Sudanian zone (moderately-poor agroclimatically; 500-700 mm. annual rainfall, the intermediate isohyet of the WASAT); (c) the Guinean zone (moderately-good agroclimatically; 700-1100 mm. annual rainfall, the southern isohyet of the WASAT). Matlon (1987) In Niger we distinguish the Sudano-Sahelian (400-600 mm. rainfall) and the Sudano-Guinean (600-900 mm.).

The paper proceeds as follows. Section 2 describes aggregate trends in sectoral composition of GDP in the region. Section 3 reviews evidence from household surveys on the extent, the determinants, and the food security effects of household income diversification. Section 4 discusses differences in the extent and nature of diversification over household income strata. Section 5 describes the share of income from production linkage activities. Section 6 concludes.

2. The Composition of WASAT Aggregate Income

Table 1 shows the sectoral structure of WASAT economies (except Gambia and Nigeria) in the early 1960s and the early 1980s. Relative to 'all low-income countries' as defined by the World Bank, (i) the shares of agriculture in GDP are similar; (ii) the shares of services (and its growth rate) are much larger; (iii) the shares of industry are much smaller; (iv) the growth in per capita food production is slower; (v) the growth in the share of population in cities is higher; (vi) and the share of population employed in agriculture is higher, though dropping rapidly in the last two decades.

By the 1980s the contribution of agriculture to national income had fallen sharply in most WASAT countries. With the exception of Mali and Mauritania, the growth rate of agriculture has not exceeded 2 percent, and has been lower than that of industry in most countries. The share of services in GDP exceeded that of agriculture. The contribution of industry hardly grew over the period (with the exception of Niger, and to a lesser extent, Senegal).

Stagnation in agriculture and weak growth in the (formal) industrial sector have coincided with rural labor moving into the growing (informal) service sector (not shown in the table, but based on observation). High population growth rates and urbanization rates, plus the limited growth in agriculture and industry, suggests that rural labor has been moving into both rural and urban service sectors, leading to further diversification of income at an aggregate level. Rapid urban growth despite stagnation in agriculture and industry suggests that outside factors (such as foreign assistance and remittances) fueled the expansion of services.

These aggregate patterns, however, mask differences over agroecological zones and socioeconomic groups. To capture these, one must turn to household-level data.

². Senegal and Niger are more comparable as the exchange rate (FCFA per dollar) was much lower in the late 1980s relative to the first half.

3. Household-Level Diversification by agroecological zone

3.1 *Traditional view and critiques*

In agricultural policy debate in the WASAT over the last few decades, policymakers and researchers have tended to view sedentary rural households as dependent almost exclusively on their own cereal production to assure household food security.³ Two sets of evidence have recently undermined this view. Field surveys in the 1980's in Mali, Burkina, Niger, and Senegal, have showed that many WASAT households are net food purchasers with an important share of consumption based on purchases.⁴ Field survey evidence (reviewed below) also showed that there is substantial income diversification by rural households.

3.2. *Diversification across countries*

Haggblade, Hazell, and Brown (HHB) (1989) reviewed evidence of rural nonfarm employment in sub-Saharan Africa, and found that nonfarm income ranged from 25 to 30 percent of total income (over household averages from case studies). We present evidence in Table 2 from six newer studies in the WASAT showing that the range of diversification there exceeds that found by HHB. The table shows two indexes of income diversification for a set of WASAT field surveys: the share of nonfarm income (all income but cropping and livestock income) in total income, and the share of non-cropping income (all income but cropping income) in total income. The table includes two studies from northern Nigeria referenced by HHB, plus six other more recent (1980s) studies. The 1970s northern Nigeria studies only treated the Guinean zone and one year, most of the 1980s studies treated multiple zones and years.

Among the 1980s studies, nonfarm income varied from 20 to 64 percent of total incomes (simple average of 39 percent), and non-cropping income ranged from 31 to 83 percent (simple average of 48 percent). These ranges are much wider than those found by HHB for sub-Saharan Africa as a whole, and much greater than the 23 to 30 percent of nonfarm income in total income of the 1970s Northern Nigeria studies.⁵

3.3 *Degree and orientation of diversification by zone*

Six points emerge from Tables 2-5 concerning cross-zone differences in degree of diversification for Burkina, Niger, and Senegal (the studies that allow comparisons over agroecological zones). First, diversification is higher in the Sahelian as compared to the Sudanian zone, although both are drought-prone. Sudanian households are thus more dependent on the highly risky agriculture shared by the two

³. See for example Kowal and Kassam; CILSS/Club du Sahel, 1981; Giri; Hyden; OECD.

⁴ See Dione, and Reardon (1993) for reviews of this evidence.

⁵ Why are the northern Nigeria samples' incomes much less diversified than those of Burkina and Senegal (comparing Guinean zones only)? Two hypotheses are plausible. First, the Nigeria surveys were done in the early to mid 1970's, while the Burkina and Senegal surveys were done 10-15 years later. The WASAT farm economy has probably changed over that period. Second, in the mid-1970s the multiplier effects in northern areas from the Nigerian oil sector were not yet fully developed.

zones. Reardon, Matlon, and Delgado (1988) noted that Sahelian zone households have traditionally been forced to diversify away from the local cropping economy to reduce income variability from historically large variability in rainfall. But historically rainfall and cropping in the Sudanian zone have been adequate; only in the last few decades have recurring droughts and degradation undermined cropping, and few farm households have yet developed coping mechanisms similar to those in the North.

Second, in all three countries, about 40 percent of Guinean incomes are from nonfarm activities. In all countries it is higher than the nonfarm share in the Sudanian zone. In Senegal and Niger (in contrast to Burkina), the Guinean nonfarm share is well below the nonfarm share in the Sahelian zone. The Guinean zone in those countries is relatively isolated, the roads poor and few, population density is relatively low (e.g. only 23 in Niger's Sudano-Guinean versus 56 in the Sahelo-Sudanian).⁶ The Senegalese Guinean zone is quite different in the west, nearer Dakar (where population density is 85 persons per square km.), relative to the east, which has only 7; compare that to 33 in the Sahelian and 67 in the Sudanian zone of Senegal. By contrast, the Guinean zone in Burkina has relatively good roads, 55 persons per square km., and many markets. Anderson and Leiserson note that road and population density are key determinants of the extent of production-linkage nonfarm activity in a given area.

Third, in five of the eight study zones, the share of livestock income in total income is 5-10 percent, and in the others it ranges from 15 to 20 percent. It tends to be higher in the Sahelian (the traditional agropastoral zones) than in the Sudanian zone. But (Senegalese) Sudanian zone livestock income can climb quite high in some years; (23 percent following a poor harvest), as distress sales (although in other parts of the Sudanian zone such as Colobane livestock sales is a normal income strategy). This illustrates the critical role that livestock income has in smoothing total income across years, reflects differences within a zone reflect differential access to water and pastures, as well as household income strategies.

In the last three decades livestock have been moving south into the Guinean zone due to more pasture land and water, and being sedentarized there (Josserand). That might account for livestock income being as high or higher in the Guinean zone than other zones in Burkina and Niger. (Note that these are just net sales, not stocks, so this is just part of the story.) Although the average for Senegal's Guinean areas is only 9 percent, variation across study areas is high. Livestock was consistently a low share of income (4 percent) in the more densely-populated western Guinean zone and consistently high (13-22 percent) in the less densely-populated eastern Guinean areas.

Yet the ratio of livestock income to all non-cropping income is on average about 1 to 5 in all zones taken together. Hence, livestock income is important, but is only a minor part of the full non-cropping economy, which points to the importance of local nonfarm activities and migration.

Fourth, migration income differs across zones; it is mainly seasonal. Its share is higher in the Sahelian zone, 11 percent (averaged over countries), versus 3 for the Sudanian and 2 for the Guinean.⁷

⁶ Offsetting low density in Niger's south is intense cross-border trade with Nigeria and Benin (Hopkins and Reardon 1992).

⁷ Note however that the eastern Guinean in Senegal shows 15 percent, but near 0 in the western part; in the east, there is important outmigration to Europe and other African countries, occurring in the Senegal River valley for quite some time. Based on raw data from the ISRA/IFPRI survey, from

Households in the northerly zones need to diversify geographically (to minimize dependence on the local risky crop economy), which migration represents. Moreover, opportunities for local production-linkage nonfarm employment are greater in the south where cropping is more dynamic.

Fifth, evidence from the northern Nigeria studies as well as the Burkina, Niger, and Senegal studies show that inter-household transfers is quantitatively very minor, and is a much less important way for households to cope with cropping shortfalls than are nonfarm or livestock husbandry earnings. This contradicts a common contention that inter-household transfers are a quantitatively-important "social safety net" in African villages. Net borrowing is a form of disguised inter-household transfer, but this is also minimal. Christensen, and Barrett *et al.* for Burkina, and Kelly *et al.* for Senegal found it played a very minor in financing food, capital, or variable input purchase.

Sixth, diversification varies greatly over years in a given zone (not shown in the tables). In northern zones it tends to be higher in drought years to offset crop losses; in southern zones it is higher in normal years because of production-linkage opportunities.

3.4 Causes of diversification

There are "push" and "pull" determinants of diversification at the household level. Push factors increase cropping risk and thus induce diversification into non-cropping activities (the returns to which are less than perfectly correlated with cropping's) to lower overall income risk. Poorer households tend to be more risk averse, thus more influenced by push factors. (Newbery and Stiglitz)

Reardon, Delgado, and Matlon (1992) identify five possible push factors in the Sahelian and Sudanian zones: (a) low and unstable yields; (b) short growing season; (c) lack of irrigation; (d) credit/capital market failure; (e) land constraints. Using four years of household data, they found that diversification was driven by the need to compensate for bad harvests – thus a reaction to a stagnating and risky agriculture. Households with liquefiable assets and cash crops are more able to diversify, implying credit market constraints or failure. But land constraints were not found to drive diversification, despite evidence that there are growing land constraints in the Sahelian and Sudanian zones (Matlon 1990).

Pull factors induce reallocation of resources to non-cropping activities to exploit profitable opportunities and increase incomes. Examples of pull factors include: (a) terms of trade (intersectoral factor returns) between agriculture and non-agriculture; (b) migration opportunities in cities or extractive sector or plantations; (c) local nonfarm opportunities in backward or forward production-linkages with

Senegal's Sahelian zone, 6 % of temporary migrants go to foreign countries (mainly France), 60 % to Dakar, and 34 % to towns in the Peanut Basin. All the migrants from the Sudanian zone go to Dakar. By contrast, 36 % of migrants from Missirah go to foreign countries (mainly France), 18 % to Dakar, and 46 % to towns in Southeastern Senegal.

As for Burkina's Sahelian zone, Zachariah and Conde found (in 1975) that three-quarters of Sahel migration was to humid-zone agriculture in Côte d'Ivoire and Ghana. The balance is mainly to Ouagadougou and some temporary migration south to the cotton zones.

agriculture. The latter two are explored in the conclusion section and the linkages section below; the first is treated below.

Mundlak (1979) treated aggregate flows of capital and labor between sectors. Such flows can be spurred by "Dutch Disease" where a boom in a sector pushes up the real exchange rate, and changes relative prices and factor returns and aggregate demand, which induce resource shifts into the boom sector.

Although resource booms have been relatively rare in the WASAT (mainly the Nigerian and Nigerien cases; see Oyejide re the oil boom in Nigeria), substantial foreign assistance flows would affect rates of urbanization, relative prices, and urban wages in the WASAT; this would act to pull resources from rural economies. Delgado and Mellor hypothesized but did not empirically test this. Chenery and Strout, Taylor (1983), and van Wijnbergen⁸ show theoretically that foreign aid receipts can have effect similar to Dutch Disease from a resource boom. This has not been explored empirically for the WASAT.

Some household-level studies find that WASAT households' intersectoral factor allocation and hence income diversification is sensitive to the sectoral terms-of-trade which in turn are affected by macro and sectoral policies. Norman (1973) found intersectoral returns influence labor allocation of northern Nigerian households between dry season gardening and nonfarm work. Reardon, Delgado, and Matlon (1992) found terms-of-trade affect income diversification in Burkina. Delgado (1989) found that the relative wage rates between nonfarm and farm sectors influences animal traction adoption.

3.5 Effects

At the zone level, income diversification smoothes inter-zone differences in average incomes. Tables 3-5 show that household income by agroecological zone is not closely related to the zones agroclimatic level.

At the household level, nonfarm earnings and livestock sale proceeds are crucial to household food security, compensating poor harvests, smoothing incomes and consumption over years, and raising incomes. (for Senegal, Fall and Diagana, 1992; for Burkina, Reardon, Delgado, and Matlon 1992) Reardon and Mercado-Peters showed for Burkina that nonfarm income is by far the most important source of cash for food purchases among grain deficit households. By extension, where diversification is lacking but agriculture is unstable, vulnerable households suffer food insecurity. For example, hunger was more prevalent among Sudanian than among Sahelian households in the 1984/85 drought in Burkina, despite (similarly-poor) per person crop yields, due to more food purchases in the latter, based on more diversified, higher incomes (Reardon and Matlon).

Diversification is also important to long-term food security through increasing input use and hence cropping productivity. In most of the region formal credit is lacking, and informal credit markets are very underdeveloped (Gaye); access to nonfarm income tends to be crucial to farm input purchase. Reardon and Kelly found that households in the Guinean and the Sudanian zones of Burkina (but not in the

⁸ Chenery and Strout present the general two-gap model treating foreign assistance effects on the economy, but without price effects; Taylor (1983) presents the theoretical exposition on the Dutch Disease-like effects of foreign assistance on the real exchange rate; and van Wijnbergen presents the general theory behind the Dutch Disease.

Sahelian zone) that earn more nonfarm income buy more fertilizer, all else equal. Kelly found similar results for the Peanut Basin of Senegal. Moreover, cottage manufacturing and services can also reduce the price and increase the availability of farm inputs.

But under some circumstances, especially in the northern zones where cropping is most risky, nonfarm activities can compete for labor and cash for crop technology improvements in the cropping season and for investments in land improvements in the dry season (Reardon and Islam). For example, Norman found that nonfarm activities in northern Nigeria compete for labor in off-season cropping. Christensen found that income from nonfarm activities in Burkina reduces investment in farm assets in the northern zones.

4. Diversification by income stratum

In Northern Nigeria in the mid-1970's, Matlon (1979) found a "U-shaped" relationship between income diversification and household income (with poorest stratum very diversified, middle much less so, and richest stratum very diversified again).⁹ This is a finding typical of Asian studies (see e.g. Walker *et al.*).¹⁰

By contrast, Tables 3-5 show that in Burkina, Senegal, and Niger in the 1980s, diversification was positively correlated with household income (with low levels of diversification for the poor, and high levels for richer households). Below we examine categories of diversification income (migration, livestock husbandry, and local nonfarm), distinguishing income strata.

In almost all areas, the richer households earn much more (in relative and absolute terms) migration income than the poor; the exception is the Sahelian and Sudanian zones of Senegal. The Burkina, Niger, and Senegalese Guinean zone results (lower participation in migration by the poorer strata) is a common finding in migration research (e.g. Taylor 1987). It is usually attributed to capital constraints that make it difficult for the poor to pay transaction costs of migration.

Why are the northern Senegal results different? Poor migrants have relatively easy access to the large services market in Dakar and Kaolack (central Peanut Basin). Sixty percent of temporary migrants from the Sahelian zone of Senegal go to Dakar, and 34 percent to towns in the Peanut Basin; all the migrants from the Sudanian zone go to Dakar. But in Burkina the migration destination is distant and transport costly. Zachariah and Conde found that three-quarters of Sahel migration (from Burkina and other interior countries) is to humid-zone plantation agriculture in Côte d'Ivoire and Ghana; the balance is mainly to Ouagadougou and some temporary migration south to the cotton zones in Burkina. Richer

⁹. No determination was made of causal direction (diversification and income level) by Matlon, nor do we in this text.

¹⁰. Walker *et al.* found that the poor diversify their incomes much more than do the rich; the latter specialize in cropping. The context, however, differs from that of the WASAT: (i) the agricultural labor market is much less developed in the WASAT (for example, agricultural wages in Burkina and Senegal compose a very minor share of average income); (ii) landholding patterns are more skewed; and (iii) technical change in cropping has proceeded much further.

migrants can pay transport and setup costs to migrate internationally; the poor usually cannot, and either cannot migrate, or can only migrate locally.

Recall from section 3 migration is much more important to households in the eastern part of the Senegalese Guinean zone, and of almost no importance in the western part. In the east, migration's share in income is greatest for the upper tercile. The distance to cities and foreign destinations is much greater from southeast Senegal than other zones, making migration more expensive and risky.

The share of livestock income is similar for lower and upper tercile households, despite the poor having much smaller livestock holdings. The Sahelian zone in 1988/89 in Senegal is an exception, where 24 percent of the poor's income was from livestock sales (distress sales to buy food after a severe drought) versus only 14 percent for the rich.

Participation in local nonfarm activities also differs across income strata in all three countries. Poorer households tend to engage in activities with low capital requirement and high labor intensity, while richer households pursue more capital intensive activities.

Agricultural wage labor income (which we class as local nonfarm income because it is earned on others' farms) represents a very minor share in incomes in all three countries, 1-2 percent in most areas. The share is higher for the lower tercile except in Niger's Sudano-Guinean zone, but still is only 3-4 percent of income. This low share reflects both low demand and low supply due to the absence of landless households, the nature of technology, and the covariation of labor demands across households during the rainy season.

In most zones in all three countries the share of commerce in income is far higher for the upper tercile. The type of commerce practiced differs across strata, with the rich undertaking the more capital intensive commerce -- often requiring vehicles, storage facilities, large initial cash balances to constitute inventories (given credit constraints); they undertake relatively larger-scale cereal and fish commerce, and general stores. The poor undertake petty commerce, and assist larger merchants. There are unusually many opportunities for petty commerce in the central Peanut Basin in Senegal (dense population and ties with the peanut trade), hence the exceptional amount of commerce income among the poor in the Senegalese Sudanian zone.

Cottage manufacturing also has a far greater share in upper tercile incomes. The type undertaken by higher income households is more capital intensive, such as blacksmithing, tailoring, and carpentry. The poor undertake basket weaving, bamboo bed and screen making (often using locally-gathered materials).

Gathering is not a major source of cash income, but where it is of modest importance (5 percent in the Guinean zone of Burkina) it tends to be more the domain of the poor (low capital intensity, easy access).

The share of services also tends to be higher in the upper tercile households, who tend to undertake for example veterinary services, work for local government services (such as weigh-stations), repair vehicles, and dig wells -- activities that require skills or capital or both. The poor tend to for example hand-mill or winnow grain, tress hair, do unskilled manual hired labor.

In general, the share of food preparation does not differ much across income strata, except in the Guinean zone of Burkina where a restaurant sector (more capital intensive preparation) serving local markets has emerged. The activities in the other areas are generally of low capital intensity, are undertaken by women, and include for example biscuit making and beer brewing, and condiment preparation.

In sum, it is interesting that despite a few exceptions, the patterns are very similar across all three countries. Lower tercile households rely more on own-cropping, and when they labor off-farm they concentrate on agricultural wage labor and gathering, and labor-intensive commerce, services, and cottage manufacturing. These results coincide with Matlon's (1979) findings for the mid-1970's for the Guinean zone of northern Nigeria.

5. Production-side linkages with local agriculture

In this section we examine the share of diversification income from production-linkage activities for Burkina, Senegal, and Niger.

5.1 Burkina

Table 3 shows that in Burkina's Sahelian zone, 24 percent of total income comes from local nonfarm activities, decomposed as follows. (1) Commerce is 35 percent of local nonfarm income, consisting mainly of trade in products made outside the zone (cola nuts, tobacco, and spare parts); it is the least directly-related to local agriculture. Only a third of local commerce is based on local agricultural products. (2) Small-scale manufacturing represents 47 percent of local nonfarm income, and is closely related to local agriculture and the commons. Weavings and mats are made from crop by-products and reeds, and farm tools (dabas) are made for the local market. (3) Food preparation is forward-linked with local agriculture. Its share is only 5 percent, lower than in the other zones because there is no beer-brewing (it being mainly a Moslem area). (4) Gathering is based both on agricultural land and commons, and constitutes another 5 percent.

Overall, 50 percent of total income in the Sahelian zone comes from cropping, 14 percent from livestock husbandry, and 10 percent from migration, and 24 percent from local nonfarm activity. Sixty percent of the latter is in forward or backward production-linkages with local agriculture. Hence, 80 percent of total income comes directly from local agriculture or from activities linked to it.

In the Sudanian zone, 27 percent of total income comes from local nonfarm activities. That can be decomposed as follows: (1) Commerce consists mostly of trade in coarse grains, hence directly forward-linked. Its share is 15 percent of local nonfarm income. (2) Small-scale manufacturing mainly produces baskets and mats from crop by-products and reeds, and is thus linked forward and backward to local agriculture and the commons. Its share is 19 percent. (3) Food preparation, a forward linkage activity, mainly involves sorghum beer brewing. Its share is 15 percent. (4) The service sector mainly involves NGO employment in local agricultural projects. Its share is 52 percent.

Overall, 61 percent of total income in the Sudanian zone comes from cropping, 6 percent from livestock husbandry, 2 percent from migration, and 27 percent from local nonfarm activity, of which all is linked either forward or backward to local agriculture. Hence, 98 percent of income comes directly from local agriculture or from activities linked to it. The other 2 percent comes from migration.

In the Guinean zone, 38 percent of total income comes from local nonfarm activities. (1) Commerce is roughly equally divided into trade in local agricultural products and inputs (forward and backward linkage activities), and the rest in diverse non-agricultural consumer goods. Its share is 24 percent of local nonfarm income. (2) Small-scale manufacturing consists mainly of production of cloth and blankets, forward from local cotton production, and some manufacturing of baskets and mats from crop by-products and reeds (hence forward linkage activities). Its share is 16 percent. (3) Food preparation is an important forward linkage activity, consisting of sorghum beer-brewing, condiment preparation, meat grilling, and cooking grain dishes to be sold in the active local markets. It is thus an important forward linkage activity. Its share is 38 percent, the highest of all the zones. (4) The service sector mainly comprises crops processing; its share is 16 percent.

Overall, 39 percent of income in the Guinean zone comes from cropping, 20 percent from livestock husbandry, 1 percent from migration, and 38 percent from local nonfarm activity, of which 90 percent is directly linked forward or backward with local agriculture.

Hence, in the Guinean zone, 95 percent of total income comes directly from local agriculture or from an activity linked to it, with only 1 percent from migration and 4 percent from commerce not linked directly to agriculture.

In short, production-side linkages are more important in southern than in northern Burkina Faso. Other evidence in Burkina with which to compare these findings is scant, and limited to those for a smaller sample in the Guinean zone of Eastern Burkina. Wilcock found, for a sample of small-scale rural enterprises, that 80 percent of employment in off-farm enterprises is forward of local agriculture (beer brewing, grain milling, etc.), and about 10 percent in backward linkages (blacksmithing, etc.). The other 10 percent of employment nonfarm is in general services (bicycle repair, carpentry, etc.). These numbers are very close to our results for all three zones (although we measure income share and theirs are employment shares).

5.2 Senegal

Table 4 shows income composition by subsector. Table 6 shows the shares of local nonfarm income from: (i) forward linkages to cropping; (ii) linkages to gathering products from the commons; (iii) backward linkages to cropping; (iv) linkages to livestock husbandry; (v) indirect linkage activities (based on local expenditures) (vi) activities not linked to local agriculture.

In the Sahelian zone (northern Peanut Basin), 17 percent of income comes from cropping, 19 from livestock husbandry, 6 from migration, and 51 from local nonfarm activity (7 percent 'non identified'), of which 40 percent is in forward or backward production linkages with local cropping and livestock husbandry, somewhat less than in Burkina's Sahelian zone. Forward linkages from cropping are relatively weak (compared to the other zones with more dynamic local cropping), while backward linkages (mainly repair of carts) to cropping, and linkages both ways from livestock husbandry dominate. These linkage activities are mainly in commerce, services, and small-scale manufacturing.

Hence in the Sahelian zone, 58 percent of total income comes directly from local cropping and livestock husbandry or from an activity production-linked to it, with 6 percent from migration, and the rest from activities not linked to local agriculture.

In the Sudanian zone (central Peanut Basin), 65 percent of income comes from cropping, 11 from livestock husbandry, 4 from migration, and only 20 from local nonfarm activity, of which 38 percent is in forward or backward production linkages with local cropping and livestock husbandry, much less than in Burkina's Sudanian zone. The bulk of linkage activities are in commerce and services; these forward linkages from cropping dominate linkage activities, based mainly on processing and commerce in peanuts. The 'indirect linkages' are dominated by services and local manufacturing. These are more important in the central Peanut Basin than in Burkina's Central Plateau because there is (i) a much denser transport network, (ii) much higher urbanization, and (iii) much more penetration of the local economy of inputs for local manufacturing, and of manufactured consumer goods.

Hence, in the Sudanian zone, 85 percent of total income comes directly from local agriculture or from an activity linked to it, with 3 percent from migration, and the rest from activities not linked to local agriculture, but mainly to the local urban economy.

In the Guinean zone (the southern Peanut Basin plus Senegal Oriental), 48 percent of income comes from cropping, 9 from livestock husbandry, 2 from migration, leaving 41 percent from local nonfarm activity, of which, in the western subzone, 40 percent is in forward or backward production linkages with local cropping and livestock husbandry, less than in Burkina's Guinean, but similar to other Senegalese zones. The bulk of linkage activities are in commerce and services. The 'indirect linkages' activities are dominated by ties to local cities. In the eastern subzone, local production-side growth linkages are far less developed, as only 28 percent of local nonfarm activities are production linkages (as Anderson and Leiserson would predict, given the very low population densities and few roads).

Hence, in the Guinean zone, 78-81 percent of total income comes directly from local agriculture or from an activity linked to it, with 5 percent from migration, and the rest from activities not linked to local agriculture, but mainly to the local urban economy or indirectly to the migration economy.

5.3 Niger

Table 7 shows shares of income in production linkages with local agriculture. Four points are to note. First, only 30 percent of local nonfarm income is linked to either agriculture or the commons in the northern most zone where population density, degradation, and land constraints highest; in all other regions 53-62 percent of local nonfarm income is linked to local agriculture or the commons.

Second, overall, 65-88 percent of total household income is either from agriculture or has direct production linkages with agriculture; higher in the Sudano-Guinean zone (76-88 percent) but still high in the Sudano-Sahelian zone (65-66 percent).

Third, the Sudano-Guinean interior subzone (a major peanut cash-cropping area) exhibits the highest share of nonfarm income in production-linkage activities (88 percent).

Fourth, the southern subzone has the highest share of nonfarm income directly linked with agriculture in the Sahelo-Sudanian zone. It has the most developed infrastructure (paved and laterite roads, local markets, and proximity to urban areas).

In sum, in all three countries, the great bulk of local income is based directly or through production-side growth linkages with local agriculture. The degree of 'delinkage' increases as one goes north into areas where rural households prudently diversify their activities between the local agricultural

economy and its derivatives, and outside economies that allow them to compensate for local risk. The linkage of incomes to the local agricultural economy is somewhat more in the 'interior WASAT' (Burkina) as opposed to the 'coastal WASAT' (Senegal), which is not surprising as Senegal rural areas, at least in the Peanut Basin, are more urbanized, more densely populated, and more endowed with transport infrastructure, with an enormous market for services in Dakar.

6. Conclusions

Nine conclusions arise from the evidence presented above.

First, rural households in the WASAT have incomes very diversified into nonfarm activities, more so than the typical range in Sub-Saharan Africa. This contradicts the traditional image of WASAT farmers limited to their farms for "food entitlement". By extension it suggests new policy and technology assumptions to replace conventional ones: (a) price policy will have important demand-side consequences, not just supply-side impacts in rural areas; (b) food aid needs to be targeted according to overall purchasing power of areas and households, not just cropping outcomes; (c) agricultural researchers and environmentalists cannot expect rural WASAT households to adopt new technologies automatically (for example soil conservation investments, or fertilizer), unless the innovations are at least as profitable or as stable as alternate opportunities for investment of household labor and cash nonfarm.

Second, most nonfarm activity in the WASAT exhibits either upstream or downstream 'production linkages' to local agriculture (part of Mellor's "growth linkages"). Crop and livestock growth will thus have important multipliers in the local nonfarm economy. Classical and classical-revival economists (Ricardo, Lewis, Mellor, and Lele) note that we can also expect cheaper foodgrains to increase the profitability of production-linkage activities, inducing further growth.

Third, the first two conclusions imply that total productivity of labor and land in the WASAT is greater, in terms of income generation, than a narrow examination of crop yields suggests; a day of farm labor or an hectare of land produces its immediate product plus growth multipliers nonfarm. The multiplier effect is stronger than traditionally assumed, because the share of production-linkage activity in total income is much higher than previously thought. Anticipating this point, Eicher and Baker (1982) lament that most farm productivity studies focus narrowly on the product of one sector -- rainfed cropping, in the rainy season, and neglect the total multisectoral product of farm families derived from farm and nonfarm activities. The present evidence should redress that lament.

Fourth, household income diversification varies in nature by agroecological zone. In 'low potential zones' (the Sahelian and the Sudanian) where rainfall is low and unstable and agriculture highly risky, nonfarm activities are relatively linked to the economies of nearby towns and to migration than to local agriculture, though the majority of their income is still based directly or through linkages on local cropping and livestock husbandry. This relative "outward orientation" helps offset local cropping risk and compensate harvest shortfalls. Underdeveloped or absent insurance and credit markets exacerbate the need to diversify to assure food security over years. In 'high potential zones' (the Guinean), where agriculture does better due to higher and more stable rainfall, nonfarm activities tend to be linked to local cropping and livestock activities, and to proliferate where infrastructure is adequate and population dense.

Fifth, Timmer reminds us that the history of agricultural transformation is one of increasing specialization, which would appear to speak ill for the future of household income diversification in the

WASAT if and where agricultural transformation is taking place. We think, however, that for at least several more decades, diversification will be important to rural households for several reasons: (a) Without major increases in irrigation and hence multiple cropping (unlikely in the next few decades), farmers will want or need to earn income in non-agriculture or livestock husbandry in the dry season. Farm households only tend to specialize in cropping where they can crop two seasons. (b) WASAT agriculture is risky, and it would be very costly to stabilize crop incomes or to develop insurance and capital markets to the point where they eliminate the need for farmers' reliance on nonfarm activities. Agricultural development will mean more, not less, of these activities due to production-side growth linkages; growing land constraints, plus adoption of labor-saving inputs, will free farm labor to pursue them.

Sixth, income diversification is important to food security. Our evidence shows that it compensates harvest shortfalls, and allows households to buy food. It also allows WASAT farmers to overcome credit/capital constraints and invest in productivity-raising inputs such as fertilizer or animal traction. Diversification can thus help families cope with short-term stress, as well as serve as a long-term strategy of the household to raise income.

Seventh, participation in nonfarm activities is inequitably distributed — poorer households depend overwhelmingly on their farms and thus are vulnerable to the vicissitudes of weather, but richer households have much more diversified incomes.¹¹ This contrasts with the U-shaped relation of diversification and household income/farm size found in Asian research. The poor must content themselves with the few labor-intensive jobs with low capital entry barriers. Richer households can start relatively capital-intensive nonfarm enterprises, because they have their own cash and are less bound by credit constraints.

Policies and programs that increase the poor's ability to start nonfarm enterprises will promote food security. Moreover, Structural Adjustment has reduced public farm input credit programs. More emphasis is thus placed on own-liquidity sources to finance farm input purchase. As the poor have less recourse to nonfarm activity, they also then have limited access to farm inputs. Improving capital/credit markets will increase access to farm and nonfarm activity inputs for the poor.

Sixth, where diversification is not locally 'agriculture-led', it depends on sources the future and stability of which appear to us to be problematic or uncertain. These include: extractive subsectors such as fishing and mining; service, commerce, and manufacturing activities in Sahel cities; and work in humid coast plantations and cities. How dependable are these sources for rural households in the Sahel? To answer that question thoroughly is beyond the scope of this paper, but a few points are in order. (a) The extractive and plantation subsectors are not expanding rapidly. (b) Sahel cities do not appear to offer rapidly expanding opportunities in the medium run.

It appears to us that Sahel urban economies depend to a substantial degree on uncertain foreign assistance flows. Sahel countries are among the highest per capita recipients of aid. For example, sixty dollars per person of aid goes to Senegal each year — a third of the per person rural income shown in Table 4. Given a small domestic manufacturing base, the substantial urban incomes aid generates, and the high import content of urban consumption, the main domestic impact of aid is probably in the service sector. Fiscal austerity and reduced aid will have ripple effects from formal sector employment to the

¹¹. There is of course ambiguity of causality here that longer-term dynamic research would clarify.

informal service economy, and by extension to demand for migrants' services and to livestock and grain from Sahel farmers.¹²

Hence, policies that affect urban employment, such as Structural Adjustment programs, will have indirect consequences that affect the rural poor via their income diversification inter alia; these indirect effects are neglected in policy debate. This conclusion reinforces the need to increase productivity of cropping and livestock husbandry as a mainstay of rural incomes.

Ninth, central to the future of WASAT agriculture is whether and how much nonfarm income is reinvested in agriculture, and whether policy conditions are present that can encourage this (Lele and Stone's "policy-led intensification"). If policy conditions are not present, and given that private informal and formal credit markets are severely underdeveloped, policymakers and researchers need to reduce expectations that inputs will be purchased, bunds built, and farm laborers hired.

¹². There has been little empirical work on this hypothesis that we know of, but given aid's importance in quantitative terms at least, it should be a research priority.

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Table 1
STRUCTURE AND GROWTH OF WASAT ECONOMIES

Countries	Share in GDP						Annual Sector growth (percent)						Labor force (percent)				Index of per capita food production in 1980 - 1982 (1969/70=100)	Urbanization growth rate 1960s - 1970s			
	Agriculture		Industry		Services		Agriculture		Industry		Services		Agriculture		Industry				Services		
	1960	1982	1960	1982	1960	1982	1960s	1970s	1960s	1970s	1960s	1970s	1960	1982	1960	1982			1960	1982	
Burkina Faso	55	41	16	16	31	43	--	1.4	--	2.9	--	5.4	92	82	05	13	03	05	95	5.7	6.0
Chad	52	64	11	07	37	29	--	-1.0	--	-2.0	--	-5.5	95	85	02	07	03	07	95	6.8	6.4
Mali	55	43	10	10	35	47	--	3.8	--	2.1	--	5.4	94	73	03	12	03	15	83	5.4	4.7
Mauritania	44	29	21	25	35	46	1.4	3.4	14.1	-3.5	7.4	5.2	91	69	03	08	06	23	73	5.5	8.1
Niger	69	31	09	30	22	39	3.3	-2.4	13.9	10.8	--	6.9	95	91	01	03	04	06	88	7.0	7.2
Senegal	24	22	17	25	59	53	2.9	2.3	4.1	3.8	1.8	2.8	84	77	05	10	11	13	93	4.9	3.7
Low income economies	49	37	26	32	25	31	2.2	2.3	6.6	4.2	4.2	4.5			09	13	14	15	110	4.1	4.4

Source: World Bank: World Development Report 1984.

Table 2 -- Household Income Composition in the WASAT

AREA	AGRO- ECOLOGICAL ZONE	YEAR(S)	PERCENTAGE OF NONFARM IN TOTAL	PERCENTAGE OF NON CROPPING IN TOTAL INCOME	PERCENTAGE OF NON CROPPING IN TOTAL INCOME *
1. Northern Nigeria (Kano) (a)	Guinean	1974/5	30		
2. Northern Nigeria (Zaria) (b)	Guinean	1966/67	23	23	
3. MSU Burkina (c)	Guinean	1978/9	22	22	
4. ICRISAT Burkina (d)	Sahelian	1981-5	37	52	
	Sudanian	1981-5	20	26	
	Guinean	1981-5	40	57	
5. Gambia (e)	River basin	1985/86	26	26	
6. Senegal (f)	Sahelian	1988/89	64	83	
	Sudanian	1988-90	24	35	
	Guinean	1988-90	43	52	
7. Niger (g)	Sahelo-Sudanian	1989/90	52	60	
	Sudano-Guinean	1989/90	43	51	
8. Mali (h)	Guinean	1988/89, rainy	63		75
	Guinean	1988/89, dry	55		61

Notes:

Nonfarm income plus livestock sector income = non-cropping income

Ag wages is included in off-farm income.

The ranges in the columns are over village averages.

All figures include simple averages across years and over villages per sample zone; in Niger study, figures are simple averages over study areas in each agroclimatic zone. In the Senegal study, averages for agroclimatic zones have been weighted by estimates of relative size of population.

**** Nonfarm and non-cropping income are nearly the same; for most village groupings, livestock sector income was very small and negative.

Sources: (a) Matlon 1979; 3 villages, 105 households.

(b) Norman 1973; 3 villages, 104 households. April 1966 to March 1967

(c) Barrett *et al* (1982); MSU survey; 13 villages, 216 households, May 1978 to April 1979.

(d) ICRISAT Survey in Burkina Faso, 1981-5; see Matlon (1988) for survey methods and zone characteristics. 6 villages, 150 households; taken from Reardon, Delgado, and Matlon 1992.

(e) von Braun, Puetz and Webb 1989; IFPRI/PPMU survey: averaged over 10 villages covering "upland irrigation project villages"; lowland irrigation project" villages, and villages outside the irrigation project.

(f) IFPRI/ISRA survey in Senegal, 1988/89 for Sahelian zone and 1988/89-1989/90 for Sudanian and Guinean zones; source: Kelly *et al*. 1993; sample size is 29 in Sahelian zone, 58-67 (depending on year) in Sudanian zone, and 92-102 in the Guinean zone.

(g) IFPRI/INRAH survey in Western Niger, 1989/90 for both zones; includes two study zones in the Sudanian agroclimatic zone (Northern and Southern Boboye, totaling 60 households), and includes three study zones in the Guinean agroclimatic zone (Dallol Maouri, Gaya Plateau, Gaya river totaling 90 households), from Hopkins and Reardon (1993)

(h) OHV/MSU Food Consumption and Expenditure Survey in southern Mali, 1988/89, 3 two-month rounds, July-August 1988 (here shown as rainy season), Sept.-October, and January-February (here shown as dry season); 90 households in 8 villages, from Sundberg (1989)

Table 3: Net Income composition over subsectors in Burkina Faso, 1981-5

Percentages of total income

Zone	Crop Prud	Ag Wages	Live- stock	Trans- port	cons- truc	Com- merce	Manuf	Gather	Srvc	Food Prep	Migra- tion	Trans- fers	Total Income per AE	\$
Sahelian														
overall	49	1	14	0	1	8	11	1	1	1	10	3	100	98
low 1/3	64	2	17	0	0	0	5	1	0	1	5	7	100	58
high 1/3	36	0	17	0	0	15	20	0	0	0	9	2	100	180
Sudanian														
overall	60	1	6	0	0	4	5	0	14	4	2	3	100	60
low 1/3	51	1	5	0	0	0	4	1	0	3	2	3	100	40
high 1/3	63	1	6	0	0	2	2	0	10	2	5	3	100	124
Guinean														
overall	37	2	20	1	0	9	6	3	6	13	1	1	100	117
low 1/3	53	4	18	0	0	1	3	5	1	4	2	3	100	76
high 1/3	30	1	19	1	0	14	8	0	11	14	1	0	100	245

* indicates less than 1 percent.

Source: ICRISAT survey in Burkina Faso, calculated from raw data: 1981-5 (four harvest years) for all three zones: 50 households in the Sahelian zone (northwest Burkina near Djibo), 50 households in the Sudanian zone (center-west Burkina near Yako), and 50 households in the Guinean zone (southwest Burkina near Boromo).

Table 4 Net Income composition over subsectors in Senegal, 1988/89-1989/90

Figures are percentages of total household income

Zone	crops	ag wages	lvstk	comm	serv	transpt	food prep	gath	manuf	transf	Net borr	Migr	non id	Ttl Rev	per AE in \$
Sahelian (1988/89 only)															
overall	17	1	19	9	9	*	4	*	21	4	1	6	8	100	145
low 1/3	36	4	24	*	2	*	2	*	1	2	1	11	18	100	86
high 1/3	11	1	14	17	17	*	*	*	31	3	1	1	4	100	260
Sudanian (1988-90)															
overall	65	*	11	6	6	2	3	*	4	*	*	4	*	100	140
low 1/3	62	1	10	11	6	*	2	*	2	1	*	6	*	100	100
high 1/3	68	*	8	4	5	4	3	*	5	*	1	3	*	100	238
Guinean (1988-90)															
overall	48	2	9	13	13	2	1	1	3	1	1	2	*	100	191
low 1/3	75	3	6	3	5	2	1	1	2	2	1	1	*	100	99
high 1/3	52	1	6	18	14	1	*	1	3	*	*	2	*	100	368

Shares rounded to integers. Averages for agroclimatic zones have been weighted by estimates of relative size of population.

* indicates less than 1 percent.

290 FCFA per dollar was used to deflate the FCFA values.

Source: calculated from data presented in Kelly et al. (1993), tables 4.5 and 4.7.

IFPRI/ISRA survey in Senegal, 1988/89 for Sahelian zone and 1988/89-1989/90 for Sudanian and Guinean zones; source: Kelly et al. 1993; sample size is 29 in Sahelian zone, 58-67 (depending on year) in Sudanian zone, and 92-102 in the Guinean zone.

Table 5. Net income composition over agroecological zones and income strata in Niger 1989/90

	Crop Prod.	Ag. Wages	Live-stock	Trans-port	Cons-truc.	Com-merce	Arti-sanal	Gath-ering	Serv-ices	Food Prep	Migra-tion	Trans-fers	Total Income
Sudano-Sahelian													
Overall	40	2	8	0	1	6	6	1	10	6	18	4	100
Lowest tercile	55	2	6	0	0	2	6	1	5	2	10	10	100
Highest tercile	26	1	8	0	1	11	8	1	14	7	22	1	100
Sudano-Guinean													
Overall	49	6	8	1	1	9	6	2	7	5	4	2	100
Lowest tercile	54	3	9	0	1	6	6	2	9	6	1	3	100
Highest tercile	45	6	9	1	1	11	4	3	8	5	7	0	100

Source: Hopkins, IFPRI/INRAN survey

Table 6. Senegal production-linkages

Numbers are percentages of total local nonfarm income exhibiting the specified linkage.

	Forward from crops	Natural Resources backward\ forward	Backward crops	Forward\ backward livestock	Indirect (local)	Not related (not local)	Total
Sahelian (Sagatta; 1988 only) 1988	11	1	15	15	58	1	100 percent
Sudanian (Niakhar, Colobane) 1988-1990	22	1	11	6	45	13	100 percent
Guinean -west (Dioli, Passy) 1988-90	26	6	3	11	55	1	100 percent
Guinean-East (Missirah) 1988-90	7	3	9	14	58	10	100 percent

Source: IFPRI/ISRA survey; calculated from raw data for 1988-1990 (two harvest years)

Notes:

1. Forward linkage activities: nonfarm activities that use as input the output of local agriculture (cropping and livestock)
2. Backward linkage activities: nonfarm activities whose outputs are used as inputs in local agriculture.
3. Indirect linkage activities: these are local nonfarm activities other than (1) and (2); when agricultural income rises the expenditure on these will rise.
4. Local means in the same study zone.
5. Local unrelated activities are those not linked backward or forward with local agriculture, and the demand for which is not based in local farm incomes (e.g. pensions, or products made locally and sold outside of zone)

Table 7. Niger Production Linkages 1989/90

Zone	Non-agricultural					Total Income
	Agric.	Non- local	Local		No link	
			Direct agric. link	Natural resource link		
Sudano-Sahelian						
All	49	22	11	5	13	100
Northern	63	27	1	2	7	100
Southern	35	17	22	8	18	100
Sudano-Guinean						
All	63	5	12	5	15	100
Border	57	7	14	5	17	100
Interior	76	2	7	5	10	100

Source: Hopkins, IFPRI/INRAM Survey