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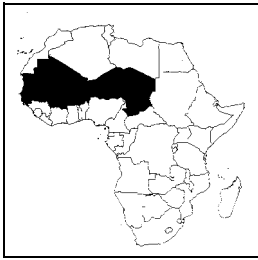
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WILL THE CFA FRANC DEVALUATION ENHANCE SUSTAINABLE AGRICULTURAL INTENSIFICATION IN THE SENEGALESE PEANUT BASIN?

By

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BACKGROUND: During the last several decades Senegal has experienced a series of changes in its social, physical, and economic environment. High population (2.7 percent per year) and urbanization (3.8 percent) growth rates have increased the demand for food and fiber. Average rainfall has declined (1 percent per year); growing seasons have become shorter; arable land per capita has fallen, fallows have been shortened or abandoned, and soil quality has deteriorated. Growth in agricultural production (about 1 percent per year) has not kept pace with population increases. Overall growth in the economy has also been slow. One of the desired outcomes of the January 1994 devaluation of the CFA franc was to reverse the poor performance of Senegal's agricultural sector.

The devaluation was expected to increase farm incomes by increasing producer prices of export crops (peanuts and cotton) and improving the competitiveness of locally produced cereals compared to imported rice. Policy makers hoped that increases in farmers incomes resulting from the devaluation would encourage them to invest in productivity-enhancing technologies, ultimately reversing the process of environmental degradation documented by many recent studies.

OBJECTIVES: This research examines the impact of the devaluation on agricultural production in the Peanut Basin -- a zone of rainfed crop production where more than half of Senegal's rural

population lives. Three key questions are addressed:

- (1) Has the devaluation changed the profitability of the main crops?
- (2) Has the devaluation affected the choice of crop mix and technology?
- (3) Has the devaluation encouraged farmers to intensify in an economically and environmentally sustainable manner?

METHODS AND DATA: These questions are answered using: (1) partial crop budgets based on pre- and post-devaluation prices and (2) a linear programming model. The model is based on a "typical" household whose characteristics and production patterns are derived primarily from ISRA/IFPRI survey data collected during the 1989/90 cropping season for 70 households in the central and southeastern Peanut Basin. The survey data are supplemented by crop production parameters reported in secondary sources. Model results are "normative"; they show not necessarily what farmers do, but rather what they ought to do to ensure maximum short-run profits given the various objectives and constraints built into the model and described below. Note that maximizing profits in the short-run (1 year) does not ensure long-run profitability if the technology adopted leads to declining productivity over time. But the short-run focus may accurately depict the behavior of poor farmers struggling to survive from day to day.



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FINDINGS: Profitability of peanuts and millet has increased since devaluation.

Gross margins per hectare (value of production minus costs of all variable inputs but labor) were higher after the devaluation for all crops and technologies examined in the southeastern Peanut Basin. Gross margins rose because producer prices increased more than input prices. Producer prices increased from 40 to 70 percent after the devaluation, while input prices rose 20 to 50 percent, except for the price of urea (rarely used in the Peanut Basin) which jumped 90 percent. In the central Peanut Basin, gross margins per hectare increased for peanuts and millet, but declined for cowpeas due to a drop in the producer price after the devaluation.

Relative prices after devaluation provide a strong incentive for farmers to increase the share of peanuts in their crop mix.

The increase in gross margins is larger for peanuts than for millet -- 87 percent versus 43 percent (for crops grown using the most prevalent technologies). Farmers responded strongly to these incentives during the first planting season following the devaluation -- peanut area increased by 30 percent while millet area declined by 10 percent.

Relative prices after devaluation do not provide incentives for farmers to adopt more intensive, soil enhancing technologies.

Unfertilized peanut fields planted with higher-than-recommended seeding rates are consistently more profitable than unfertilized fields planted with recommended seeding densities. In the southeast, the high-density module was 26 percent more profitable before devaluation and 30 percent more profitable after devaluation. The comparable numbers for the central Peanut Basin are 28 and 37 percent. In other words, the devaluation resulted in a small increase in the competitive advantage associated with the high-density module.

Peanut fields planted using high-density seeding practices are also more profitable than fields planted with recommended seeding and fertilizer application rates. In the southeast, the high-density field was 50 percent more profitable than the fertilized field before the devaluation and 48

percent more profitable afterward. The comparable figures for the central Peanut Basin are 36 and 30 percent. Although the devaluation reduced slightly the competitive edge of the high-density seeding technique, it remains considerably more profitable than the recommended fertilizer technology--hardly an incentive for farmers to use fertilizer.

The devaluation had no impact on the relative profitability of the four millet technologies examined.

Millet grown with manure is the most profitable millet technology before and after the devaluation. In the southeastern Peanut Basin millet grown with manure continues to be 12 percent more profitable than millet grown with recommended doses of fertilizer and 58 percent more profitable than millet grown without fertilizer. In the central Peanut Basin, millet grown with manure continues to be 36 percent more profitable than millet grown with fertilizer and 43 percent more profitable than millet grown with no fertilizer. Unfortunately, manure is extremely limited and the somewhat greater profitability of the fertilizer technology over the nonfertilizer technology (36 percent in the southeast and 5 percent in the center) does not appear to provide adequate incentive for farmers to use fertilizer in the risky Sahelian environment.

Farmers' resource allocation decisions must take into account factors other than just maximizing gross margins. The linear programming model, therefore, examined the impact of the devaluation on resource allocation decisions given different assumptions about crop rotation, food security, and cash constraints. The linear programming model helps us answer more precisely the question about how the devaluation influences farmers' decisions to intensify in an economically sustainable manner. The key constraints imposed were the resource base, crop rotation practices, food security needs, start-up cash, and the share of nonfarm income in total income.

The **resource base** for the typical farm was limited to 11 hectares of cultivable land, 4 man days of household labor, and one horse, seeder,



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hoe, and cart for the southeast. For the central basin only the hectares (8) changed.

To account for **crop rotation** practices the peanut area could not exceed 50 percent of cultivated area. This constraint permitted nitrogen-consuming cereal crops to be rotated annually with nitrogen-fixing peanuts.

To reflect the rural households' **food security** concerns, home-produced millet had to cover 50 percent of household cereal needs, estimated at 185 kilograms of grain per person per year.

Based on information from survey data, **start-up cash** at the beginning of the cropping season was limited to 50,000 CFA francs in the southeastern Peanut Basin and 30,000 CFA francs in the central Peanut Basin.

The maximum share of income earned from **nonfarm** sources was limited to 10 percent in the southeast and 20 percent in the center to reflect the limited opportunities to earn nonfarm income in the areas studied.

When these constraints were imposed, the model showed that the devaluation had no impact on the optimal crop mix and choice of technology in either zone, but it did result in more off-farm employment (46 percent increase in the southeast and 38 percent in the center). The income impact was strongly positive in the southeast (91 percent increase in nominal income) and mildly positive in the center (63 percent increase).



The noteworthy characteristics of these optimal plans were that: (1) peanuts were grown in both zones using extremely high seeding densities which can mine the soil and reduce seed quality, (2) no millet was grown with fertilizer in the southeast, (3) only three-tenths of a hectare of millet were grown with fertilizer in the central basin, and (4) farmers in the southeast allocated land equally between peanuts and millet while farmers in the center allocated 68 percent of their land to cereals in order to meet modeling constraints for food security. The model also shows that both before and after devaluation, labor

availability constrains output in the southeast (1.8 hectares of land are not cultivated) while land availability constrains output in the central basin.

Several important lessons were learned by relaxing selected constraints. For example, even doubling the amount of start-up capital does not increase the use of fertilizer either before or after the devaluation. This result suggests that it is relative profitability of fertilizer vis a vis other technologies, rather than a cash flow constraint, that limits fertilizer use.

The superior profitability of peanuts in these two zones was well illustrated when both the crop rotation and the food security constraints were relaxed. Without these constraints, the optimal solution allocated all land to peanuts. By shifting from a mix of peanuts and millet to only peanuts, farmers in the central basin could increase income by 42 percent and those in the southeast could increase income by 124 percent. Unfortunately, peanut monoculture -- particularly using no fertilizer and extremely high seeding densities -- is not a sustainable technology. Fortunately, farmers are unlikely to move to a peanut monoculture because it would require them to rely entirely on relatively volatile cereal markets for their basic foods.

The programming model confirms that **peanut production is the most profitable way to use agricultural land and labor in the Peanut Basin after the devaluation** -- households would pursue peanut monocropping were it not for food security and land rotation constraints. The model also confirms that **soil degradation will continue (and perhaps accelerate due to the increased profitability of peanuts) because chemical fertilizers are not economically competitive with the soil-mining practices.**

In the southeast, the crop rotation constraint is most binding and pushes farmers to use higher peanut seeding densities to maximize profit. When the constraint is lifted, farmers allocate more land to peanuts (7.1 hectares versus 4.55) and less than 10 percent of that area is densely-seeded -- the rest is planted at recommended densities without fertilizer.



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In the center, low millet yields make the food security constraint the most binding on peanut production; when the constraint is relaxed, peanut area increases from 2.6 to 4 hectares (the maximum allowed by the rotation constraint). In this zone of extremely poor soils, more land for peanuts does not mean less dense seeding -- the entire 4 hectares were most profitably cultivated using higher than recommended seeding rates and no fertilizer.

POLICY IMPLICATIONS AND RECOMMENDATIONS: Modeling results provide no evidence that the changes in relative prices associated with the devaluation of the CFA franc can, in the short-run, move Senegalese farmers in the Peanut Basin toward sustainable patterns of agricultural intensification characterized by higher levels of fertilizer use. Very low fertilizer use on the already degraded soils in the Peanut Basin plus the extensive use of high peanut seeding densities (which increase profits while mining the soil) provide maximum profits in the short-run but cannot be sustained in the long-run. **Although the devaluation increased gross margins and nominal income in the short-run period covered by this analysis, it has also increased the negative impact of agriculture on the environment by encouraging farmers to raise peanut production without adopting technologies that will return nutrients to the soil, guard against soil erosion, and improve the quality of their seed stock.**

These modeling results suggest that there is a need for field surveys to determine how farmers are investing their higher profits. Are the profits going entirely into peanut seed to increase area planted and seeding densities, or are complementary investments with a longer-term perspective being made (soil conservation investments such as composting or anti-erosion barriers, for example)

Paradoxically, a broad and long-term interpretation of the results presented above suggests that **policies and programs to stimulate fertilizer use are needed.** High seeding density is partly motivated by declining soil quality due to a lack of fertilizer. Improving the access to, and profita-

bility of, fertilizer would encourage its use as a complement to denser seeding, and avoid some of the long-term side effects of the seeding practice. Devaluation alone has not been able to do this. It is clearly necessary to consider other price and nonprice policies that will complement the devaluation by ensuring that the higher nominal incomes are not undermined by inflation or increased consumption, but funnelled into sustainable, productivity-enhancing farm investments.

A two-pronged attack should be considered -- one that searches for means of making fertilizer (1) more profitable and (2) more affordable. Making fertilizer more profitable might require increased attention to applied and adaptive research on different types of fertilizer or combinations of fertilizer with improved natural resource management practices. Such research may need to be coupled with greater attention to the effectiveness of extension programs. To make fertilizer more affordable, production and marketing costs need to be reduced. Among the many actions to consider are the liberalization of input markets, investment in infrastructure that reduces transportation costs, and the reduction of taxes and bureaucratic red-tape that frequently add to production and marketing costs.

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This paper is a summary of a report entitled: "Will the CFA Franc Devaluation Enhance Sustainable Agricultural Intensification in the Senegalese Peanut Basin?" It can be obtained by writing to:

MSU Bulletin Office
10-B Agriculture Hall
Michigan State University
East Lansing, Michigan 48824-1039

This paper is also forthcoming as an SD Publication Series technical paper. It can be obtained through USAID's development information system (CDIE).