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DETERMINANTS OF FARM PRODUCTIVITY IN AFRICA: A SYNTHESIS OF FOUR CASE STUDIES

By

Thomas Reardon, Valerie Kelly, Eric Crawford,
Thomas Jayne, Kimseyinga Savadogo, and Daniel Clay



Office of West Africa
Affairs
Sahel Regional Program

Food Security II Cooperative Agreement Between U.S. Agency for International Development, Global Bureau, Economic Growth Center, Office of Agriculture and Food Security and Department of Agricultural Economics, Michigan State University

BACKGROUND: Over the past two decades, many cropping systems in Africa have been in a major transition--from land-abundant to land-constrained. Pressure to produce more from less and lower quality land has increased soil degradation. Yields of many major staple crops have fallen or stagnated. Rural households have diversified incomes into noncropping activities, and farming has become increasingly linked to the market economy. Structural adjustment programs have cut fertilizer subsidies and farm-support services, but have increased incentives for export crop production.

OBJECTIVES: The bulk of studies on farm productivity were done in the 1960s and 1970s before land became constraining. Our understanding of African farm productivity needs to be updated to see how farmers are responding to recent policy, economic, and environmental changes. We aim in this report to "dig below" aggregate trends to uncover differences in patterns and determinants of productivity over agroclimatic zones, types of technology, degrees of environmental degradation, and levels of improved inputs. The report synthesizes studies in four countries. The Burkina Faso, Rwanda, and Senegal studies use detailed farm-survey data from the past decade. The Zimbabwe study uses aggregate data from the past two decades which is stratified by farm type (commercial and smallholder).

FINDINGS

I. *Productivity Patterns*

Rates of growth in yields (output per hectare) and returns per labor day were generally low in the four study countries but differed by crop, zone, technology, and farm size, providing some success stories.

- a. Yields increased for government-promoted cash crops in Burkina Faso (cotton and maize) and in Rwanda (maize, wheat, and soybeans). Total factor productivity of smallholder maize in Zimbabwe grew over 1980-1986, then fell when government support was cut.
- b. By contrast, yields were stagnant or declined for many subsistence staples, such as millet in Burkina Faso and Senegal or tubers in Rwanda.
- c. Yields in more favorable agroclimatic zones were 2 to 3 times greater than those in poorer zones.
- d. Large swings in yields occurred between years of good and bad rainfall in the semi-arid zones, making farming very risky and analysis of longitudinal trends very sensitive to years covered.

II. Productivity Determinants

1. Fertilizer

a. Farmer-managed trials in Senegal show physical response and profitability (but also riskiness) of fertilizer use. Survey data from Burkina Faso show positive fertilizer impacts on crop output.

b. Observed fertilizer use varied widely by zone and crop (from under 10 to over 110 kg/ha, compared with an African average of 8 kg/ha). Greatest use was in higher rainfall areas, on cash crops, where parastatal agencies handled distribution, credit, marketing and credit recovery, and where households had more noncropping income.

c. The elimination of credit and fertilizer subsidies and a switch from government to private-sector distribution (reducing the area served) reduced fertilizer use in the study countries. In Senegal, fertilizer use on peanuts went from 38,000 t in 1976 to 3,000 t in 1988. Overall consumption of fertilizer went from 75,000 tons in 1980/81 (roughly its average in the 1970s) to 27,100 tons in 1985/86, 19,900 in 1986/87, and 22,400 in 1987/88. Farmers used much of the fertilizer on cotton, irrigated rice, and vegetables, i.e., where subsidies and credit remain (cotton) or where water is controlled (rice, vegetables). In Zimbabwe, elimination of fertilizer credit/subsidy in the mid 1980s caused a decline in fertilizer use on hybrid maize by small farmers.

2. Seed

a. The case studies in Senegal and Zimbabwe point to seed as an important determinant of productivity.

b. Plant-breeding programs have developed improved cultivars that have increased productivity (hybrid maize in Zimbabwe) or maintained productivity in the face of worsening environmental conditions (short-cycle peanuts in Senegal).

c. For seed to make its full contribution to productivity, public and private sector institutions must assure seed quality, availability, and affordability, through both research and supportive policies.

d. In Senegal the government seed distribution and credit programs have been cut back and seed prices increased by structural adjustment programs. In Senegal, the result was limited access to seeds, a marked drop in use of peanut seed, and a substantial

acreage shift from peanuts to millet (hence less nitrogen fixation by peanuts).

e. Given previous constraints on the development of private sector input supply networks and rural financial markets, seed distribution in Africa has tended to work better when a single organization (1) provides seeds on credit in conjunction with complementary inputs and (2) recovers credit by controlling output marketing (e.g., cotton and confectionery peanuts in Senegal, and cotton in Burkina Faso). This approach has tended to deal more effectively with the problems of coordinating input delivery, credit, and output markets than more decentralized and unintegrated networks found in much of Africa. The integrated approach has also tended to work better for cash crops than for food crops, which have scattered, small marketing outlets.

3. Animal traction

a. The main effect of animal traction shown in Africa to date has been to reduce field labor inputs and facilitate area expansion (especially on light soils), rather than to increase yields.

b. However, our case study in Burkina Faso showed strong positive farm-level impacts of animal traction on land productivity and labor returns in cotton in the favorable agroclimates as well as on supply responsiveness, efficiency of resource allocation, and manure use.

c. Investment in animal traction is more likely for households that have access to more land, earn more noncropping income, and grow cash crops.

4. Organic inputs and conservation investments

a. Practices that add organic matter to soil, conserve soil (prevent erosion) and help water retention (e.g., bunds, tied ridges, terraces) increase productivity by increasing soil moisture and the effect of fertilizer. Conservation investments are complementary with improved inputs and organic matter. The effects can be dramatic on the farms of the poor who are struggling to survive in fragile environments. In Rwanda, increasing soil conservation investments (moving from "low" to "high") increased yields by 25 percent. By contrast, moving from low to high erosion decreased yields by 35 percent.

b. Investment in soil conservation is more likely for farmers with smaller holdings (hence have less ability

to fallow), earn more noncropping income, and grow cash crops.

5. Farm size and land tenure

a. In Rwanda, land rental (as compared to ownership) discourages use of fertilizer, organic matter, and soil conservation.

b. Smaller Rwandan farms, which had much higher land productivity than did larger farms, tended to have surplus labor. They also made more soil conservation investments, though they had similar levels of improved inputs per hectare compared to larger farms.

c. Commercial farms in Zimbabwe tended to have higher yields than smallholders, mainly because of better access to improved inputs and better land.

6. Noncropping income

a. Noncropping income is an important indirect determinant of productivity via its effect on farm input acquisition and investments.

b. Noncropping income can increase purchased inputs or capital investments where credit is unavailable or costly to use, or where other sources of cash income for loan repayment are lacking.

c. Noncropping income helps pay for soil conservation investments, for which credit is rarely available. Noncropping activities reduce household income instability and help to reduce risk by diversifying income sources.

d. The poor tend to have less access to noncropping jobs and less ability to start small businesses. This is worrisome because unequal access to noncropping income translates into unequal access to farm inputs in the face of limited credit access.

e. Noncropping income generally is correlated with improved input use (fertilizer and animal traction in Burkina Faso and Senegal, peanut seed in Senegal, and conservation investments and fertilizer in Rwanda). Yet in some areas, more noncropping activity is related to poorer farm performance, with the latter pushing the former.

7. Well-functioning input and output markets

a. Markets are also an indirect determinant of farm productivity as they affect profitability of farming, outlets, and input access.

b. Well-functioning markets help farmers acquire and use improved inputs and profitably sell outputs by reducing transaction costs and risks (e.g., from imperfect information, or price volatility due to a thin market). They also assure that more benefits from improved productivity will be passed on to consumers.

c. Parastatals assured vertical integration and coordination functions (input supply, credit, output marketing) for cotton (Senegal, Burkina Faso), maize (Senegal), and coffee (Rwanda). In Zimbabwe, government marketing depots and loans helped spur adoption of hybrid maize and use of fertilizer. The costs of these programs were high, however. Higher consumer prices were increased due to grain movement controls that forced the bulk of marketed grain output into the State marketing channels and onward into private large-scale milling (that tends to make grain more expensive to consumers than do alternative channels).

d. Nevertheless, in situations with poor farming conditions, market proximity can act to pull rural people out of farming and provide them alternatives.

POLICY IMPLICATIONS AND RECOMMENDATIONS

Case study reports provide specific recommendations per country. The general findings are as follows.

1. To improve long-term food security in Africa, farmers must be able to pursue sustainable intensification of farm production by use of improved inputs. Use of fertilizer, organic inputs, animal traction, and conservation investments needs to rise dramatically.

2. Strategies will need to differ, however, between favorable and unfavorable agroclimatic zones. With proper conditions, increased productivity can be expected in the favorable zones. Expectations for cropping intensification are more modest for the agroclimatically unfavorable and fragile zones where attention will need to be paid to alternative income sources off-farm. This will promote food security in the agroclimatically unfavorable zones and increase effective demand for farm products from favorable zones.

3. The environment and the farm productivity agendas are linked. Degradation and pressure on marginal lands cannot be halted without raising farm productivity. Intensification of already-cultivated land reduces pressure to crop fragile marginal lands. Yet

interventions to improve farm productivity must be accompanied by conservation investments.

4. Noncropping employment and the farm productivity agendas are linked. In many areas, noncropping income is a critical means to pay for farm inputs and investments and achieve food security. Moreover, much noncropping activity is linked to the farm sector (downstream or upstream). Micro-enterprise promotion programs that provide rural employment while reducing the cost of farm inputs and increasing the off-farm multipliers from farm output growth are desirable.

The flip-side of this argument is that new cropping technology proposed for farmer adoption must not only be financially and economically profitable, but also attractive relative to alternative uses of household resources outside of cropping.

5. Cash-cropping programs spur productivity by providing cash for improved inputs. Depending on how they are organized, they can increase access (from the supply side) to improved inputs and to low-risk output marketing.

6. Promotion of improved inputs will need to be innovative to be consistent with widespread fiscal constraints and the goals of structural adjustment. Input use has traditionally been promoted in ways that are not economically sustainable. Yet the reduction of government programs and subsidies associated with structural adjustment appears to have discouraged the use of fertilizer and improved seed by raising costs and reducing access.

The upshot is that farm input costs must be reduced without returning to generalized subsidies. We advocate a “middle path” between fiscally unsustainable government outlays and complete government withdrawal from support to agriculture. Policy reform (exchange and interest rate policy, market liberalization) is **necessary but not sufficient** to spur higher farm productivity. The “middle path” addresses long-term structural problems via substantial public and private investment in agricultural research, human capital, and production and market infrastructure. Governments and donors need to invest in understanding how to promote the economic use of the tools of sustainable intensification—fertilizer, animal traction, organic inputs, water, and soil conservation.

Public investment should complement and spur private investment on-farm, in the input distribution system, and in primary product processing and distribution.

Thus the debate should be reopened on identifying cost-effective ways of increasing access to inputs, improving the delivery of inputs, and helping farmers find ways to earn cash income to pay for them. This effort is especially appropriate in countries whose macroeconomic environment has become more favorable through structural adjustment. This should be a priority policy issue in Africa in the 21st century.

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Thomas Reardon is Associate Professor, Valerie Kelly is Visiting Assistant Professor, Eric Crawford is Professor, and Thomas Jayne is Visiting Associate Professor in the Department of Agricultural Economics, MSU. Daniel Clay is Professor in the Institute for International Agriculture, MSU. Kimseyinga Savadogo is Professor, FASEG, Université de Ouagadougou, Burkina Faso. The views expressed in this document are exclusively those of the authors.

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East Lansing, Michigan 48824-1039

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