

OBSTACLES TO TRANSFERRING TECHNOLOGY
TO THE AFRICAN SMALLHOLDER

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by

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The views and interpretations expressed in this report are those of the author and should not be attributed to the Agency for International Development.

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This paper demonstrates a seldom used writing technology: E-Prime. It consists of English minus the verb to be. It adds life to writing. It forces writers to name an agent for each action and to find a more precise verb than the passive, colorless, but ubiquitous to be. No doubt much of the praise reviewers have given this paper belongs to E-Prime. The two hours of instruction in E-Prime by Dr. Ruth S. Ralph have become the author's most cost-effective learning experience in writing. Dr. Ralph includes E-Prime in the writing course she teaches for the State Department entitled, "Effective Writing for Managers."

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Stagnation of the economies of Sub-Sahara Africa has become a world-wide concern. Between 1960 and 1970, the per capita average annual growth rate for all those economies came to 1.3 percent; this rate fell to 0.8 for the 1970-79 period.¹ Between 1960 and 1979, nine of the forty-five countries in the region had annual growth rates of over 2.5 percent per capita, while nineteen countries had rates of less than one percent. During the last decade, fifteen countries experienced negative annual growth rates.² Agriculture constitutes the single most important determinant of the economic growth of Sub-Sahara countries. In the 1960s, their volume of agricultural production grew 2.3 percent annually; population grew at roughly the same rate. In the 1970s, however, this annual growth in volume fell to about 1.3 percent, while growth in population rose to about 2.7 percent.

An action plan formulated by the United Nations and endorsed by the states of Sub-Sahara Africa would rely upon African subsistence farmers to reverse this gloomy trend in agricultural production. The architects of the plan chose these farmers because they already account for most of the agricultural output in Sub-Saharan countries; they live in poverty and they constitute the most cost effective means for increasing output.³ Nevertheless, African governments and foreign assistance donors have not always achieved success in their past attempts to increase these farmers' production.

Smallholders in Sub-Sahara Africa have adopted new farming techniques very slowly. Nevertheless, these farmers appear to make their decisions related to farming in an orthodox manner; i.e., they respond to economic incentives.

Subsistence farmers in Malawi, for example, seem extremely sensitive to price in growing tobacco. They increase production as the price of tobacco rises and vice versa. Moreover, as the prices for cash crops fall, the number of farmers leaving for Rhodesia and South Africa to work in the mines increases. Subsistence farmers apparently have a clear idea of the opportunity cost of their labor. Furthermore, studies show that their social attitudes have not impeded significantly the adoption of new technologies. Their social attitudes tend to adjust to accommodate innovations that provide sufficient economic benefits.⁴

These characteristics force one to conclude that lack of economic incentives must play a major role in the smallholders' reluctance to grow more cash crops or adopt technologies aimed at increasing agricultural productivity. Some development specialists argue that cash crops and many cash crop technologies promoted among smallholders in Sub-Saharan Africa do not, in fact, offer adequate incentives for adoption. This happens, they argue, (1) because government policies provide an environment that inhibits agricultural production and the diffusion of new technologies, (2) because planners impute different weights to economic variables than farmers impute to them, and (3) because planners fail to provide technologies to attack the obstacles that constrain production most.⁵

Governments in Sub-Saharan Africa inhibit agricultural production by setting prices for most agricultural commodities well below the market price. Farmers in selected African countries receive from twenty-five to forty-five percent of the amount justified by the world market price for cocoa; from twenty-three to sixty percent for coffee; from forty-three to seventy-one percent for peanuts; from forty-four to 105 percent for cotton; from seventy to 134

percent for maize; from fifty-nine to eighty-eight percent for sesame; and farmers receive from twenty-eight to eighty-eight percent of the amount justified by the world market price for tobacco. These governments also have set food crop prices low. Prices in the parallel market--the unregulated market--often range two to three times higher than official prices.

Low price policies have inhibited agricultural production. For example, a review of twenty-seven agricultural projects of the World Bank in Africa shows that seven of nine projects implemented under favorable pricing policies achieved or surpassed production objectives. However, thirteen of eighteen projects implemented under unfavorable prices failed to reach production objectives.⁶ In Zambia, returns from cash crops appear lower than the going wage rate for casual labor. Hence, farmers grow cash crops only to the extent that family labor finds time to grow them.⁷ In Zaire low prices have combined with other factors to cause many subsistence farmers with access to off-farm income to limit production to household needs and to not adopt a variety of improved maize, a cash crop.⁸

Low price policies have also inhibited adoption of technology aimed at increasing agricultural productivity. An examination of adoption of twenty-two livestock technologies promoted in Tanzania, which included vaccinating cattle and dipping sheep and goats, infers low adoption rates overall. Pastoralists, however, who enjoyed the higher prices of the Kenya black market, registered significantly higher adoption rates.⁹ In view of the pervasive negative impact of present pricing policies, it appears that higher prices for agricultural commodities have become a prerequisite to expanding farm production and to adopting technology that increases farm productivity.

Policies followed by governments in Sub-Sahara Africa also have caused marketing to become a serious disincentive to production. Public sector entities in charge of supplying inputs and purchasing farm commodities constitute the root of the problem. Serious inefficiencies characterize most marketing agencies. Late delivery of farm inputs, late pickup of harvested crops, late payment to farmers for commodities sold and inadequate performance of other services all add to the farmers' risk and discourage their producing cash crops.¹⁰ Failure to maintain market infrastructure also inhibits farm production. The deteriorated infrastructure in Zaire discourages farmers from growing cash crops. Lack of bridges and roads make motor vehicle traffic almost impossible in some places, and adds greatly to the cost of getting any crops to the market. Only the government can feasibly rehabilitate such infrastructure.¹¹

Sometimes no markets exist for cash crops, and governments can help get them established. In Uganda, for example, in just two years the proportion of subsistence farmers engaged in growing rice rose from eight to forty percent of total farmers and the average amount of land devoted to rice increased by fifty percent. This resulted from the government organizing the critically needed marketing element.¹² The Nigerian government recognized the need for a market for maize, and, with World Bank assistance, it has arranged a guaranteed market.¹³ To make the marketing structure as responsive as possible to the needs of the subsistence farmers, African governments should encourage the development of private sector marketing enterprises. The profit motive combined with adequate competition, which governments could foster, would do most to ensure the timely delivery of farm inputs and timely pick up and payment for cash crops.

Governments must also deal more effectively with cor-

ruption. Scarcity of goods and economic insecurity cause special problems for some countries. Schatzberg (1980) explained that under such conditions people have the natural impulse to accumulate wealth as rapidly as possible. Officials will try to convert their authority into wealth by using it to extract resources from anyone they can coerce. In one African country where scarcity and insecurity reign, some estimate that sixty percent of regular state revenues disappear through irregular maneuvers by officials. One researcher finds it difficult to imagine that rural development can get the resources it requires in that atmosphere.¹⁴

Another cause of corruption grows out of the low salaries generally paid to civil servants in developing countries. This leads some of them to supplement their incomes with tips for the services they render as government employees. Payment for getting civil servants to do their jobs has become a habit in some countries.¹⁵ The extension agent or other government representative who requires tips must become aware that this practice adds to farmers' costs of production, decreases their profit margin and discourages them from farming.

Besides adopting policies that improve the overall production environment, governments need planners who understand subsistence farming and who can plan effective assistance for subsistence farmers.

Planners often miscalculate the weights that farmers give to various economic variables. For example, the planner tends to overestimate the labor that smallholders will devote to cultivating cash crops. Health and nutrition factors probably lower their capacity for work; but, in addition, they have many other activities competing for their time. Most smallholders must devote some time to cultivating food

crops. Some have permanent commitments to off-farm activities. Even during the month of peak demand for labor, subsistence farmers in Hausaland, Nigeria work seven days in nonfarm activities.¹⁶ Also, it takes considerable time to prepare food and many apparent social visits may actually focus on business. Moreover, these farmers seem to place a high value on leisure. Therefore, the opportunity cost of their labor may remain quite high. Hence, subsistence farmers may not adopt innovations that require marked increases in labor even though the innovation would increase their return.

Swamp rice in Sierra Leone returned one and one-half times more than upland rice; however, it required more person days per acre to grow it. Adoption came slowly until government subsidies made returns to swamp rice double those of upland rice.¹⁷ Subsistence farmers may adopt technologies that permit them to devote less time to cash crops. This behavior may not result from their desire for leisure alone, but may simply result from the low return received from such crops.

The smallholders' apparent apathy to increasing cash crop production may also seem to imply a low demand for consumption goods. Farmers appear to assign a lower value to increased consumption than planners ascribe to it. Perhaps limited availability of consumer goods keeps this demand low. The low demand, in turn, reduces the farmers' incentive to increase cash crop production and, hence, their incentive to adopt new technologies designed for cash crop production.

This situation may call for promoting consumption goods and new technologies together. In Gambia, promotion of new practices, coupled with increased commercial contacts, raised farmers' consumption expectations. In a Ghanaian village, road improvements without promotion of new crops or

commercial contacts brought about no such change. Absence of economic stimuli may have caused the difference. Road improvement and extension, complemented by expanding the market for consumables in the highlands of the Mount Meru region of Kenya, seem to have fostered change in farming patterns and methods. Farming in the highlands now contrasts sharply with farming in the lower slopes which the program bypassed.¹⁸ These examples suggest that low consumption demand presents an unexpected impediment to the diffusion of new technologies.

Subsistence farmers ascribe higher values to risk factors than planners assign to them. In calculating the benefits of a new technology, extension agents tend to consider yield averages for their regions. Farmers, on the other hand, consider local yields. Local yields experience greater variations than average regional yields and, accordingly, cause farmers to ascribe a greater risk than extension agents infer. Moreover, the farmer may view low-paid civil servants as persons likely to extort gratifications and view any contact with them as risky.¹⁹ Therefore, farmers may feel acutely the loss of control over their environment which follows the adoption of new practices. They would have to rely increasingly upon others to deliver the crucial seeds, fertilizers and insecticides needed at critical times. These inputs, generally imported, could arrive late for many reasons beyond the control of the extension agent--bad roads, port problems, shipping strikes, administrative errors. Farmers must also pay the price if their crops require more inputs than the extension agent estimates.

Most farmers probably will not adopt a new crop until they have had time to learn about all the characteristics relevant to growing it profitably. Early adopters will likely discount significantly the yields from demonstration

farms in making the decision to adopt. Extension personnel can help reduce this discount, which represents the difference between the farmer's perception and the actual profit potential and risk of a new crop. They can set up test plots in fields cultivated by farmers. Such plots can become the most effective instruments for merging perception with reality.²⁰

Technology transfer efforts often fail to consider the high priority subsistence farmers give to their food crops. As their name implies, the primary goal of these farmers consists of growing an adequate food supply. Cash croppers in Malawi did not give up growing food crops to specialize in cash crops, apparently because of high risks. In poor years they cannot obtain maize locally.²¹ Subsistence farmers take on cash cropping as a supplementary activity; they resolve conflicting labor demands in favor of food crops. The Sierra Leone swamp-rice scheme had discouraging results the first year: forty percent of the participating farmers had yields lower than upland rice. Systematic interviews revealed that villagers viewed upland rice cultivation as the very "central activity" to the livelihood of all; they viewed swamp rice cultivation merely as a supplementary activity. At the labor demand peak, therefore, many swamp rice cultivators had to delay operations until villagers had completed the upland rice activities.²²

Farmers in Nyanza and Coastal Kenya adopted new cotton technologies at a discouraging rate. One new practice, early planting, promised high returns but met considerable resistance. Early planting conflicted with cultivation of food crops, and farmers would not divert labor from food crops to plant cotton.²³ In Nigeria, farmer reluctance to plant cotton earlier has led to research on cotton varieties that respond more favorably to late planting. Earlier planting of

cotton conflicts with planting and weeding of food crops; later planting results in lower cotton yields, but it meshes with the indigeneous farming system.²⁴ Cash crops have a better chance of adoption if their labor requirements complement those of the food crops. Smallholders in Teso District, Uganda rapidly adopted rice cultivation. Among other advantages, most of the labor requirements for growing rice occurred during a relatively slack season for food crops.²⁵

Technology transfer efforts have failed to consider that African pastoralists do not gear livestock production to the market economy. Animal husbandry has not become a specialized activity. Pastoral societies have developed around livestock production. Cattle not only provide food but also endow their owners with prestige and hedge them against disasters; for pastoral nomads, cattle become equivalent to mobile savings accounts that inflation cannot erode. Therefore, pastoralists have incentives to maximize the size of their herds rather than maximize profit from cattle sales. Accordingly, some interventions have yielded unexpected results.

Famine relief and development efforts have kept the animal population from declining and coming into balance, and have allowed the process of range degradation to accelerate. A fisheries project in Lake Turkana, Kenya, designed to offer an alternative to pastoral subsistence, merely allowed families to build up their herds faster. Some even used earnings from fishing to import cattle. Known complexities of pastoral societies mandate completion of a comprehensive examination of all groups involved which identifies clearly the constraints to production. Interventions should provide continuous monitoring of adoption of and adaption to the innovations and provide the flexibility to adjust plans as trends dictate.²⁶

Technology transfer efforts also have failed to consider the mixed cropping nature of subsistence agriculture. Subsistence farmers in Nigeria plant mixed crops in preference to sole crops to maximize returns and security. Empirical tests show that mixed cropping, typical of African farming, provides lower yields per crop, but higher total yields per unit of land and labor. For example, sole crops of Hausa farmers in Nigeria returned an average of \$21.50 per acre, while mixed crops returned an average of \$34.80. The returns per hour of labor averaged \$.40 and \$.50, respectively, during months of peak labor requirements; and both cropping systems gave an overall average return to labor of \$.10 per hour.

Tests also show less variation in gross return per unit of input for mixed crops, inferring less risk or more security.²⁷ Although many mixed croppers live in them, Franco-phone countries have not produced technologies for mixed crops. More research on mixed cropping seems justified in all the Sahelian countries.²⁸ Research that considers the mixed cropping system would enhance the development of technologies to overcome the constraint of peak labor demand and, thereby, enable farmers to use seasonal slacktime to produce crops instead of seeking off-farm employment.

In addition to miscalculating weights farmers give to economic variables, planners regularly promote technologies that do not address the real constraints to greater productivity. To develop useful technology for subsistence farmers, researchers need to gain an understanding of the entire subsistence farming system. Researchers should begin by examining existing peasant practices and concentrating on resolving the constraints to increased production. They should carefully delineate the constraints that farmers perceive. Improved technology should build upon farmers'

traditional technology.²⁹

In contrast to using these procedures, planners generally begin by addressing national goals. After examination of such goals, planners determine the research dictated by the goals and develop technology for farmers they never consulted. Planners have the technical package delivered to farmers who generally find it unprofitable and, accordingly, do not adopt it. Then the planners blame the conservatism of the peasantry for nonadoption of the unprofitable package.³⁰

Planners, for example, frequently identify institutional credit as an important facilitator of technology transfer. Surveys of subsistence farmers, however, do not show such credit as a crucial factor to adoption of technology. A detailed survey of Ghanaian farmers found no significant relationship between receipt of loans and adoption of new techniques. Most farmers say that without credit they could not have adopted certain techniques; nevertheless, studies belie their claims. Farmers appear readily able to raise the small sums required to adopt simple innovations. They get the cash either from personal savings or from relatives.

A surprising amount of development has occurred in Africa in places where no institutional credit exists.³¹ Accordingly, planners appear to have selected a minor problem to address in choosing to promote credit. On the other hand, they regularly overlook one of the subsistence farmers' most binding constraints--lack of labor.

Planners seldom identify labor as a major constraint to increased productivity. Lack of labor, however, has repeatedly constrained the subsistence farmer's production. It causes Nigerian farmers to plant cotton later than the optimum time. Earlier planting conflicts with planting and weeding of food crops.³² Lack of labor kept Ugandan farmers

from adopting the more efficient row planting. Among other advantages, row planting would reduce weeding and thinning labor by thirty-five percent, increase harvesting productivity by twenty percent, and increase yields by five to fifteen percent. Farmers could not adopt row planting, however, because it required more labor at a crucial time--planting time.³³

Lack of labor also constrained the introduction of swamp rice in Sierra Leone. Upland rice had the first claim on labor.³⁴ Adopters of improved maize in Zaire had more wives, and hence more labor, than nonadopters.³⁵ Adopters of swamp rice in Sierra Leone had access to larger labor pools than nonadopters. Adopters had more children over age five in their families, and held more positions of authority. Rank helps to obtain labor from adult children, neighbors and dependents predisposed by traditional obligation to work for authorities.³⁶

Allocating labor during periods of peak demand has become the most crucial decision for Kamba farmers in Kenya. The amount of labor available during June and July largely determines the amount of land used and the level of agricultural activity during the rest of the year for Kamba and other farmers.³⁷

Yet many planners persist in introducing improved seeds, which do not necessarily address the labor constraint, instead of introducing implements which will address this constraint.³⁸ It seems, however, that subsistence farmers may have recognized the labor constraint long ago. They responded to the constraint with mixed cropping which, along with providing more security, permits farmers to space out labor requirements somewhat. A single crop has much larger fluctuations in its labor requirements.³⁹

A 1920 Belgian publication recognized the labor

constraints among African farmers and cites a shortage of hoes, axes and machetes as the major obstacle to expanding their production. Researchers have noted the need for implements. Farmers surveyed in Zaire listed lack of hand tools as the major constraint to increasing their production.⁴⁰ Some planners have started to do something about this constraint. Nigeria, for example, has increased research on the weeding bottleneck in June and July. Herbicides and fertilizers hold some prospects for relieving the labor constraint for Nigerian farmers, and, as a consequence, hold prospects for increasing production.⁴¹

Most planners have given too little attention to management requirements of improved technology. Use of most improved inputs requires higher level skills and management capacity. Subsistence farmers have achieved success in adopting new crops, agricultural chemicals and animal traction. Early experiments with mechanization, however, encountered high drop-out rates. In Nigeria, settlers could not cope fully with the intensive regulated farming systems prescribed. A survey of the Kenya Land Settlement Scheme suggests that the human element has less capacity for absorbing rapid change than the rest of the farming structure. Bridging the gap between subsistence grazing and migratory grazing on one hand, and crop rotation and dairying on the other, proved too great for one generation of farmers.⁴²

One study shows a paucity of farmers capable of managing more advanced farming systems. It points to the stock of farm skills, inadequate to support improved farming systems, as a major constraint to adoption of innovations by African farmers. Subsistence farmers need new crops and farming techniques that allow them to become more efficient without increasing the requirements for management.⁴³

Increasing the production of subsistence farmers in Sub-Saharan Africa appears technically feasible. Providing the incentives required to bring forth that production, however, may not constitute a low cost endeavor for most governments of that region. Increasing food prices will pit those governments against their politically powerful urban populations. Moving marketing activities into the private sector will threaten affected bureaucracies and might carry negative ideological overtones. Developing relevant technology for subsistence farmers will require the agricultural technician to spend more time with them, which will increase the costs of agricultural extension activities. Governments of Sub-Saharan countries have shown little interest in these measures in the past. Nevertheless, declining production and increasing population, coupled with decreasing foreign aid budgets, should provide adequate incentives for those governments to weigh seriously the indicated policy changes, and for them and for aid donors both to gain a better understanding of smallholder agriculture.

END NOTES

¹ Accelerated Development in Sub-Sahara Africa (Washington: The World Bank, 1981), p.3.

² The World Bank, p. 2.

³ The World Bank, p. 50.

⁴ J. Doyle, "Productivity, Technical Change, and the Peasant Producer: A Profile of the African Cultivator," Food Research Institute Studies, XIII, No. 1 (1974), 61,62.

⁵ The World Bank, pp. 55-57; and Doyle, p. 62.

⁶ The World Bank, pp. 55-57.

⁷ Doyle, p. 71.

⁸ Terry Lee Hardt, "Decisionmaking Role in the Rural Household and the Adoption and Diffusion of an Improved Maize Variety in Northern Shaba Province, Zaire," Ph.D. dissertation, Iowa State University, 1981, p. 86.

⁹ G.M. Sullivan, et al, "A Socio-Economic Analysis of Technology Adoption in an African Livestock Industry," Zeitschrift fur Auslandsische Landwirtschaft, 17, No. 2 (1978), p. 157.

¹⁰ World Bank, p. 59.

¹¹ Hardt, p. 33.

¹² David J. Vail, The Public Sector as Stimulus of Innovation Adoption in African Smallholder Agriculture: A Case Study in Teso District, Uganda (Michigan: University Microfilm, 1972), p. 88.

¹³ David W. Norman, et al, "Technical Change and the Small Farmer in Hausaland, Northern Nigeria," African Rural Economy Paper, No. 21, African Rural Economy Program, Department of Agricultural Economics, Michigan State University, 1979, p. 106.

¹⁴ Hardt, p. 34.

15 Some years ago the writer had to obtain pre-feasibility information for a number of agribusinesses in a Latin American country. He asked the consultant to account for all costs--including an oral estimate of the costs of getting the documents processed through the government for licenses and tax breaks. The consultant estimated such fees at more than ten percent of total project costs. Information obtained informally leads the writer to believe that the cost of such services would come higher in Africa.

16 Norman, p. 46.

17 Doyle, p. 63.

18 Doyle, pp. 63-65.

19 Andrew Pearse, Seeds of Plenty, Seeds of Want (Oxford: Clarendon Press, 1980), p. 49.

20 Tradition and Dynamics in Small Farm Agriculture, Economic Studies in Asia, Africa and Latin America, Robert D. Stevens, ed. (Iowa: Iowa State University Press, 1977), p. 89.

21 Doyle, p. 65.

22 Pearse, p. 47.

23 Doyle, p. 65

24 Norman, p. 105.

25 Vail, Innovation Adoption, p. 87.

26 Johan Helland, "Sociological Aspects of Pastoral Livestock Production in Africa," Proceedings of the First International Rangeland Congress. Donald N. Hyder, ed. (Denver: 1978), p 79.

27 Stevens, pp. 84-85.

28 Norman, p. 105.

29 Norman, pp. 111-113.

30 Pearse, p. 16.

31 Doyle, p. 69.

- 32 Norman, p. 105.
- 33 Vail, Innovation Adoption, pp. 90-91.
- 34 Pearse, p. 47.
- 35 Hardt, p. 86.
- 36 Pearse, p. 48.
- 37 Doyle, p. 70 and Pearse, p. 71.
- 38 David J. Vail, "Induced Techniques and Derived Scientific Research Strategy," East Africa Journal of Rural Development, 6, Nos. 1 and 2 (1973), pp. 5-10.
- 39 Doyle, p. 70.
- 40 Hardt, pp. 51-52.
- 41 Norman, p. 106.
- 42 Doyle, p. 72.
- 43 Doyle, p. 73.

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