Gender and Soil Fertility in Africa: Introduction

CHRISTINA H. GLADWIN

Abstract: Soil fertility is the number-one natural resource in Africa; yet its depletion on smallholder farms has led to stagnant or decreasing per capita food production all over Africa during the last two decades. Unexamined – except in this special edition – are the gender impacts of the soil fertility crisis in Africa. The papers in this issue, the result of a University of Florida project called "Gender and Soil Fertility in Africa," assume — if one generalization can be made about the diverse farming systems and multitude of cultural traditions in sub-Saharan Africa – that women farmers usually produce the subsistence food crops, while men produce export and cash crops. African women on small rainfed farms produce up to 70-80% of the domestic food supply in most sub-Saharan African societies and also provide 46% of the agricultural labor. However, women's food-crop yields are generally low -- too low by Green Revolution standards, and much lower than men's yields. The papers collected here examine different projects in Africa with respect to the different methods used to reach women farmers in order to improve their soils and increase their yields. Such methods include fertilizer vouchers and grants, microcredit, small bags of fertilizer, agroforestry and legume innovations, and increased cash cropping by women. Results demonstrate to African policy makers which methods work, and reach women farmers with different household compositions, so that they can reverse the alarming trend toward declining per capita food production.

Introduction

Papers in this special edition, the result of a University of Florida project called "Gender and Soil Fertility in Africa," assume that-- if one generalization can be made about the diverse farming systems and multitude of cultural traditions in sub-Saharan Africa, women farmers usually produce the subsistence food crops, while men produce export and cash crops. [1] African women on small rainfed farms produce up to 70-80% of the domestic food supply in

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most sub-Saharan African societies. On average, they also provide 46% of the agricultural labor. [2] However, women's yields are too low by Green Revolution standards (three to four tons per hectare for food grains), and much lower than men's yields in societies where a comparison can be made (e.g., where men grow the same crops on different fields or yields of female headed households can be compared to those of male headed households. [3] In these situations, gender differences in productivity have been shown to be due to differences in the *intensity of use* of productive inputs (such as fertilizer, manure, land and labor, credit, extension training, and education) rather than in differences in the efficiency or management styles of men and women. [4] Because women farmers lack access to cash and/or credit to acquire modern yield-increasing inputs of production, they tend to produce less, and more of their crops are consumed within the family. [5] Estimates show that if productive inputs like fertilizer, manure, and labor could only be reallocated within the African household from men's to women's crops, in some societies the results could mean an increase in the value of household output of 10-20%.[6]

In most parts of Africa, farming for women means more than monetary rewards. African women consider farming for food as part of what makes them women and gives them a gender identity. The cultural categories of gender in Africa today usually link farming-female-food as a gender marker. [7] The analogy in Europe and the Americas is that women consider the cooking of food to be feminine and to define them as women, such that "A good woman is a good cook" is a norm many women learn during childhood when gender identities are first formed. In contrast, African rural women define themselves by their ability to wield a hoe and grow the food for the household. [8] For them, "A good woman is a good food farmer and a good cook."

Unfortunately, as Goheen points out for the case of Cameroon, ideology regarding gender categories has been a major stumbling block to women's access to resources, particularly to land. [9] The designation of women as primary food farmers/ providers used to encourage a relative equality and complementarity between male and female qualities, but with changing material conditions the complementary roles played by men and women have become much less equal. [10] "The contradictions in women's role as primary food farmers have deepened, and there is now evident a 'feminization of poverty'…" partly because government has institutionalized these cultural constraints and created *socio-legal* obstacles for women farmers. [11] Whereas previously, custom alone dictated that "men owned the land, women begged for it," now government under the pretext of land reform has put up many hurdles for new land acquisition. Only urban elites and "big men" can jump them and invest in land, leaving rural women on very small landholdings.

Another barrier for women is that cash crops (and cash activities in general) have long been considered part of the male domain in many African societies. Subsistence food crops, those not sold but consumed in the household, are usually considered part of the female domain. This means women food producers usually do not have access to money from the sale of cash crops in order to buy yield-increasing inputs. They are dependent on their husbands or sons to buy them fertilizer. Some agricultural experts claim this exclusion of women from cash cropping was changing even before structural adjustment reforms occurred in the early 1990s. In Uganda, women started to grow coffee while in Malawi women grew burley tobacco and new hybrid maize varieties. In Zambia, women were growing cotton. Yet in Malawi, wives of

tobacco farmers claim that their husbands buy them a few dresses and keep the rest of the additional income from tobacco, irrespective of the amount of labor provided by the women. In Dowa, Malawi, the NGO VEZA/HODESA has a program directed at women only. Project staff report that husbands decide if and how much credit (in bags of hybrid maize harvested by both men and women) is repaid to the program, because hybrid maize is still considered part of the male domain. [12]

In many African societies, men and women do have separate income streams, and this gives some autonomy to African women. [13] Women's incomes, however, don't necessarily give them *power*, which usually accrues to the male household head. [14] The relative powerlessness of African women as compared to men is symbolized by their long hours spent head-loading water and firewood, their devotion to subsistence crops rather than cash crops, as well as their lack of political voice.

African women also tend to be "de facto" female household heads for some period in their lives, so that 25% of African households are female-headed households (FHHs) with relatively more autonomy and decision-making power in the household than women in male headed households (MHHs). [15] They are generally poorer than women and men in MHHs, however, and therefore less powerful in their rural communities. Due's data from Zambia and Tanzania show FHHs have less adult labor, less access to credit and smaller incomes than male headed households. FHHs plant smaller crop acreages, more subsistence crops relative to cash crops, and are not as productive as male-headed households. [16] Quisumbing notes this is not *directly* due to their gender, but rather their low incomes which prevent their purchase of "modern" yield-increasing inputs of production such as fertilizer, hired labor, etc. [17] Gladwin et al. claim that due to their relative poverty, FHHs have a greater tendency to be chronically food-insecure than do women and men in MHHs. Policy solutions should diversify and strengthen multiple livelihood strategies for FHHs. [18]

IMPACTS OF STRUCTURAL ADJUSTMENT PROGRAMS IN AFRICA

Due to their lower incomes, rural women and especially rural FHHs, are considered a vulnerable group. They are the first to suffer when a macroeconomic downturn or recession hits, and the last to recover from it. [19] Women in particular have borne the social costs of structural adjustment programs (SAPs) in sub-Saharan Africa. Because women are in charge of reproduction of the household, they suffer first when the costs of food, education, health care, and medicines rise due to government budget cutbacks mandated by SAPs. [20] Women are in charge of provisioning the household with food, so they suffer first when repeated devaluations of the local currency and the removal of fertilizer subsidies result in the rise of fertilizer prices making its use on hybrid maize varieties unprofitable and unaffordable. [21] As Uttaro (in this special issue) argues, women, who in the late 1980s and early 1990s changed maize varieties from unfertilized local varieties to new fertilized flint hybrids, are now being forced to switch back to local unfertilized varieties due to higher fertilizer prices. As a result, they again get lower maize yields and watch their granaries empty earlier in the hungry season. Because gender ideologies tell women they are the ones responsible for feeding the family, they

especially suffer when the hungry season lengthens as a result of the changes they've been forced to make after structural adjustment "reforms." [22]

This is not to say that the "bitter pill" of structural reform in sub-Saharan Africa was unnecessary. By now, most observers realize that *globalization* demands changes in the way open economies formulate their macroeconomic policies and finance their budget expenditures. States can no longer hang on to an overvalued exchange rate and negative current account balance for very long. [23] Since the early 1980s, African governments have thus been forced to learn the rhetoric of stabilization, fiscal and monetary policies, and market liberalization measures.

The deflationary measures mandated by structural reform, however, have impacted most severely on women in African households, especially on FHHs. Because most FHHs are *net buyers* and not net sellers of food crops, they sell little if any of the export crops or tradables encouraged by SAPs. Therefore, they are unable to benefit from increased price incentives for tradables and market liberalization programs. [24] FHHs thus suffer when the price of food is allowed to rise making fertilizer use on food and cash crops once again profitable, especially if government has no safety net program in place to ameliorate the negative impacts of SAPs. They also suffer when safety net programs treat them not as producers but only consumers of food, creating more dependency on government handouts of the subsistence crop that they can grow themselves.

THE SOIL FERTILITY CRISIS AND AGRICULTURAL STAGNATION IN AFRICA

The impacts of structural adjustment programs on African women have been amply documented. Far less examined – except in this special issue of African Studies Quarterly – are the gender impacts of the soil fertility crisis in Africa, in part a result of structural adjustment policies. Noted agriculturalists such as Sanchez et al. claim that soil fertility is the number-one natural resource in Africa; yet its depletion on smallholder farms is the biophysical root cause of declining per-capita food production all over Africa. [25] Smaling et al. estimate that soils in sub-Saharan Africa are being depleted at annual rates of 22 kilograms per hectare (kg/ha) for nitrogen (N), 2.5 kg/ha for phosphorus (P), and 15 kg/ha of potassium (K). [26]

The evidence of Africa's declining food production is by now common knowledge: Africa's per capita food production growth rates have steadily decreased at two percent per year since 1960. In contrast, food production growth rates in China have recently soared. Aggregate data for the early 1990s for all developing regions show that China leads the developing world in per capita food production indices while sub-Saharan Africa trails all developing regions. Cereal yields follow the same trend: China's 1992-94 averages at 4482 kg/ha are the highest of the developing world and Africa's are the lowest (1023 kg/ha). [27] In contrast, sub-Saharan Africa's population growth rates 1990-1995 are the highest in the world at three percent per annum, while China's are now a low 1.4 percent per annum. These indicators show that Africa's per capita food production cannot keep up with its population growth rates. It is a continent of farmers that enigmatically imports one-third of its food grains— nine of its ten largest countries are net importers of food. Yet most African economies are agriculturally-

based, with 75 to 80 percent of the labor force still employed in agriculture and most of the gross domestic product (GDP) still generated by the agricultural sector.

The impacts of this decline in agricultural productivity are likely to be particularly severe for African rural women, whose economic livelihoods are so closely linked to the production or sale of agricultural products and services. Because women are the main food producers in many African societies, they are also the key to *reversing the crisis* and increasing domestic food production in Africa. Yet their lack of power at the household, community, and national levels present constraints to national goals of food security not present in the 1960s and 70s when Asian and Latin American countries set out to achieve Green Revolution yields and thus transform their mostly agrarian economies. This is termed the *invisibility factor* in the African food security literature, most of which is de-linked from the women in development (WID) literature. Food security analysts correctly argue that to be effective development strategies need to reach African smallholders, but they ignore the fact that constraints facing women smallholders may be an important part of the problem. Eicher, for example, consistently fails to mention that 45% of the smallholders responsible for Zimbabwe's second Green Revolution (1980-1986) are women, nor does he indicate the percentage of hybrid maize adopted by women nor the percentage of fertilizer subsidies benefiting women. [28] Similarly, Smale's report on Malawi's *delayed* Green Revolution does not indicate women's adoption of hybrid maize. [29] Yet women's maize varieties (as shown here by Uttaro) are mostly local maize varieties, while hybrid varieties are mostly cash crops sold by men.

Reversing the alarming trends of declining food productivity is therefore the subject of the papers in this special edition, which treats gender relations as an important factor in the current crisis. Most authors agree that if governments' aim to increase food production, then they should improve the soil fertility and replenish the nutrients recycled out of producers' fields, who in Africa happen to be women farmers. But *how this can be accomplished* is the problem vexing most governments and donors.

WOMEN IN STRUCTURAL TRANSFORMATION

The main goal of development is to improve rural incomes and increase agricultural productivity so that Africa can "structurally transform" or diversify its currently agrarian economies, creating three complementary sectors including: a fledgling manufacturing sector, a larger services sector, and a gradually-diminishing agricultural sector. [30] This long-term process has been termed "structural transformation" because the process changes the entire economy, from the flow of goods to wage and profits patterns. Tomich et al. estimate it will take quite a long time to diversify an economy at the early stages of structural transformation, from an economy mostly dependent on agriculture to one with developed agricultural, manufacturing, and service sectors. [31] The time required for a *CARL* (country with abundant rural labor) to diversify its economic structure is related to the "structural transformation turning point," defined as the point in time when the absolute size of the agricultural labor force peaks and begins to decline. For African countries, which comprise most of the 58 countries now identified as CARLs this is an extremely important consideration because their high population growth rates, ranging from 2.5 to 4 percent per year, impede their reaching the structural

transformation turning point – when the economy *begins* to diversify – any time soon. [32] For example, in countries with population growth rates of 3.3 percent per year and 75-80 percent of the labor force still in agriculture, Tomich et al. estimate that the time required for structural transformation ranges *from 32 to 58 years*, even given the most optimistic (5-6 percent) annual rates of growth of labor absorption from agricultural into nonagricultural sectors. Unfortunately, given these high population growth rates, the nonagricultural labor force cannot absorb enough of the total labor force to quickly decrease the size of the rural population dependent on agriculture for its income.

If diversification of a CARL takes this long, how realistic is it that African rural women can quickly acquire off-farm employment and thus significantly expand the scope of their nonfarm income-earning activities? Not very. Women farmers will need at least this amount of time to acquire formal off-farm employment—– more formal than the informal income generating activities they now perform, because rural women are the least educated and least connected to powerful people with nonfarm jobs in town. [33] African rural women will therefore have to rely on the more informal "small money" income-generating activities to create their cash income for a significant time to come. During this time period, some women, especially the FHHs, may need a *safety net* program to give them public assistance. Safety nets imply a process of moving from government programs that are open to all, regardless of income level, to programs where eligibility is related to poverty and the level of benefits is related to the level of poverty. This topic emerges again in Gough's article for this special edition. [34]

The articles in the special issue are thus more concerned about accelerating the long-term development process in Africa, and identifying how women fit into that process, than they are about guaranteeing *gender equity* to African women. While equity for rural women is a worthwhile goal in itself, it is not as urgent a problem in Africa today as the goal of bringing the whole continent out of the stagnation and despair that now engulfs it. [35] Immersed in what Chege calls "the paradigm of doom," Africa is presently inundated by gloomy reports about its civil wars, famines, high HIV infection rates, geographical isolation, chronic mismanagement, and negative or minimal growth rates. [36] This set of papers examines how governments and policy planners can increase women farmers' productivity and thus bring Africa closer to the structural transformation turning point, so that the continent as a whole can see the light at the end of the tunnel. Yet much confusion exists in Africa today, both about gender equity and about women's role in the process we term "structural transformation."

This is to be expected. In the 1960s and 1970s, Asians and Latin Americans were equally confused about the aims of small farmer projects, often associating them with a communist ideology. Similarly, many Africans are now confused about the goals of WID projects, and identify them with perceived attempts at hegemony by "Beijing women." The result is that thirty years after Ester Boserup first published *Woman's Role in Economic Development*, gender impacts on development are still poorly understood, as witnessed by the phethora of books about the topic from anthropologists, [37] geographers, [38] and political scientists. [39]

OBJECTIVES OF THIS SPECIAL EDITION

The purpose of the papers in this special edition is to help clear up some of misunderstandings about women's roles in increasing Africa's agricultural productivity and to outline ways African governments can use women farmers to bring their economies further along the path to structural transformation. The papers also summarize the results of the project known as "Gender and Soil Fertility in Africa," which was funded from 1997 to 2002 by the United States Agency for International Development (USAID) through the Soils Management Collaborative Research Support Project (Soils CRSP). In 1997 the authors of this edition began to explore, test, and compare the many different ways African governments, non-governmental agencies (NGOs), private volunteer organizations (PVOs), and agricultural research/extension centers (CGIARs and NARs) can improve the soil fertility on women farmers' fields and gardens devoted to their food crops. The different policy options African governments can use to reach or target women farmers include:

improve women's access to chemical fertilizers via introducing *grants or vouchers* targeted directly at women farmers, especially women in the poorer FHHs

improve women's access to chemical fertilizers by encouraging the introduction of *small bags* of fertilizer in local shops or market stalls, or sales of fertilizer by the kilogram

improve women's access to inorganic fertilizers by introducing *credit* or *microcredit* for fertilizer to women farmers

improve women's access to biological nitrogen fixation (BNF) technologies via *agroforestry* innovations or *grain legumes* to women farmers

improve the *soil organic matter* on women's fields for their food crops via *green manures* or biomass transfer

introduce a *cash crop* into women's cropping systems whereby women farmers can pay for fertilizer use on their food crops with cash-crop receipts

introduce any combination of the above

SOLUTIONS INVOLVING USE OF INORGANIC FERTILIZER

Vouchers

Target support for small amounts of fertilizer in the form of vouchers directly at cash-poor women farmers producing food crops. A voucher system would allow an African government burdened with fiscal deficits to do something about food security by targeting the subsidy directly at women farmers who produce most of the food. This would also encourage healthy competition between private distributors in the fertilizer industry. With such a voucher system, members of women's clubs would receive vouchers to take to private distributors, from whom they would buy fertilizer at a discount. The government would then remunerate distributors for the vouchers. In this way, the government's physical presence in the fertilizer distribution system would be minimized, and its total subsidy bill would be less than when fertilizer subsidies were freely extended to all growers of food and export crops, men and women alike.

The vouchers would be discontinued after a number of years. Women would buy fertilizer from local merchants on the open market at the market price, with or without credit. The temporary program of vouchers would be coupled with a plan for supervision of women's application of fertilizer in order to reduce leakages (the use of vouchers for crops other than women's). The plan would also strengthen the revolving credit funds used by many women's clubs to bail out individual defaulting members. Clubs would receive a stipend to supervise the application of vouchered fertilizer on women's fields. Women's clubs can thus serve not only to expand credit to women but also to supervise the proper use of fertilizer vouchers.

Donors like the World Bank, however, have spent the last ten years removing fertilizer subsidies. Their policy now is to move to full market cost of fertilizers. [40] In fact, most food policy analysts recommend that input subsidies, and particularly fertilizer subsidies, should be eliminated entirely because they are a common technique used to increase the profitability of intensive agriculture while keeping food prices artificially low. [41] Only when total fertilizer use is low and the ratio of incremental grain yield to fertilizer application is high can such subsidies be cost-effective, relative to higher output prices or greater food imports. African governments burdened with large fiscal deficits should therefore consider whether fertilizer subsidies represent the best use of their limited resources. After all, *someone must pay for the subsidy*. Economists thus conclude "all subsidies tend to distort the intensity of use of inputs from their economically optimal levels, and significant waste is a result. Since not all inputs can be equally subsidized, output price increases will have a greater impact on productivity than will input subsidies, especially in the long run". [42]

This line of reasoning makes sense when applied to Asia and Latin America today. But it did not make sense during the eras of their Green Revolutions in the 1960s and 1970s, when fertilizer use contributed fifty to seventy-five percent of the increase in yields in food crops. [43] At that time the adoption of fertilizer-responsive "modern" varieties depended on fertilizer subsidies. [44] This line of reasoning does not apply to current conditions in sub-Saharan Africa where average fertilizer use — not nutrient use — is a mere seven to eleven kg per ha, and women food producers commonly use no fertilizer. [45] Larson and Frisvold conclude that average fertilizer application rates in Africa need to increase from ten kg per ha to fifty kg per

ha within ten years (an eighteen annual growth rate) to prevent mining of soil nutrients. [46] Yet due to the current high price of inorganic fertilizers, farmers are now forced to extensify their agricultural practices and clear relatively unused areas (forests and old bush) to increase total output, rather than intensify their land use. This has led to a loss of biodiversity of aquatic as well as woody species. Hence near-term environmental concerns in Africa stem more from the persistent decline of soil fertility rather than from an over-use of fertilizers.

Policy interventions are thus needed to encourage women food producers to increase their yields of traditional as well as modern varieties; and fertilizer subsidies in the form of vouchers are the most direct policy tool planners have at their disposal to do that. [47] From the viewpoint of the women farmers, such vouchers are preferable to an expansion of credit opportunities because women face many more constraints to credit use than men. They are either too poor, too old, or lack control over a cash crop with which they can repay a fertilizer loan. [48] Without a cash crop, the risk of borrowing is particularly high for women, because they probably have to sell some of their subsistence crop in the hungry months and deny their children food in order to repay the loan. Rather than take that risk, they will often decide not to get credit, not to use fertilizer, and not to increase their yields.

Fertilizer subsidies delivered by means of vouchers can decrease this risk for resource-poor women farmers and thereby play an important role in increasing their yields and productivity. [49] Some agricultural economists agree. Eicher, for example, accuses the donor community of failing to present a balanced view of the substantial role subsidies played (and still play) in Asia's Green Revolution. He points out that, "currently donors in Africa are focused on a number of policy reforms such as correcting overvalued exchange rates and removing fertilizer subsidies rather than long-term, institution-building activities, the hallmark of donor assistance in Asia in the 1960s and 1970s. In their zeal to remove fertilizer subsidies in Africa, however, some donors are neglecting to inform African policy makers about the role of subsidies in Asian agriculture." [50]

Pinstrup-Anderson claims that fertilizer subsidies can serve as a temporary measure to compensate for the factors that make it difficult for African (as opposed to Asian) entrepreneurs to freely compete in an open fertilizer market. [51] Among these factors are:

> the small volume of fertilizer that most African countries import, which weakens their bargaining position in negotiating for lower prices
>
> high transportation costs within most African countries
>
> high storage costs, which increase the expense of fertilizer distribution
>
> unpredictable government policies and unstable institutions which scare off private entrepreneurs from investing in input distribution systems
>
> the relative ease of government's acquiring fertilizer in the past as foreign aid

> the tendency of governments to maintain large fertilizer stocks, which may be released anytime and at any price and thus upset a private distribution system.

Pinstrup-Anderson concludes that governments should privatize fertilizer distribution in a way that assures competition. Ootherwise, the private sector fertilizer distribution system may be no more efficient than the public sector system it replaced. If monopoly profits accrue, it will actually be more expensive. He also believes fertilizer prices can only be brought down if, in the long run, governments invest in the infrastructure to reduce transportation and marketing costs. But until they do, "there is a place for fertilizer subsidies" to compensate for the factors resulting in very high fertilizer prices. [52]

Small Bag Option

Improve the availability of small amounts of fertilizer in local markets and shops by repackaging 50 kg bags. Since most fertilizer for family food production must be carried both to the home as well as to the food plots, the weight of the bag is an important issue. So is the amount of cash or credit needed for the purchase. Due to its high cost today in Africa, few farmers can afford to buy a 50-kg bag of fertilizer. It no longer is a divisible input in Africa. Further, the cost of transporting fertilizer from the market to the home and/or field is also a factor in the scope of its use. Having fertilizer available in smaller bags would make it both more affordable and easier to carry.

The small-bag strategy is compatible with the views of many economists who believe that *accessibility* of fertilizer is the main constraint to its increased use. [53] If fertilizer were widely sold in local markets like cement and available in weights that could be headloaded home, women farmers would be more likely to buy it. Also, small bags reduce the risk associated with open bags of fertilizer absorbing moisture and becoming difficult to store over several months. For these reasons, the sale of fertilizers in five-, ten-, and twenty-kilogram bags at local markets should increase fertilizer use by women farmers.

As shown by Uttaro's paper in this edition, however, there are some negative features of small bags of fertilizer. One is their lack of availability in all but the biggest market centers. Another is the higher costs per kg of the fertilizer. Making small bags available assumes that fertilizer distributors in Africa today would be willing to bulk-blend imported fertilizers and assemble the product in smaller bags in Africa, rather than directly importing the bagged fertilizer. Finally, there are higher transactions costs for a smaller bag because the cost of the bag itself as well as the labor costs of bagging would have to be spread over only twenty-five kg rather than fifty kg of fertilizer.

Uttaro points out that one way around this is for fertilizer distributors to sell fertilizer "by the kg" and cut contents of a fifty-kg bag of fertilizer into smaller amounts. While this has been done, distributors sometimes have added other inputs to the smaller bags, e.g., sand. Farmers are now very skeptical of local traders who sell fertilizer in smaller amounts. What is needed in now needed in Malawi, according to Uttaro, is to build farmers' trust that they will get "an honest kg for an honest kwacha."

Microcredit Option

Expand the fertilizer credit market for women farmers via community banks operating on the Grameen Bank model. The Grameen Bank in Bangladesh targets very small loans to groups of virtually landless women producers. [54] With two million borrowers and a recovery rate of more than 90%, it is clearly a compelling model. By 1994, it served half of all villages in Bangladesh, lent about US$ 385 million, and mobilized another US$ 306 million as savings and deposits. [55] The bank is unique in that its explicit goals are to alleviate poverty and create self-employment opportunities for illiterate people (who own less than half an acre of land and have never received a loan from the formal financial system). Since 1985, it has specifically channeled credit to women, who are less empowered among the rural poor. Increasingly, women receive the bulk of the loans and are the majority of the members. Their share of total cumulative disbursement rose from a little more than half in 1985 to 91% in 1994. Female membership grew from 65.5% of the total in 1985 to over 94% in 1994. [56] Strict observance of the norms forces group members to be accountable to each other. Based on a group of five, the first two women to receive credit must repay regularly for others to obtain loans. The group leader is customarily the last to receive credit. This creates pressure among group members to enforce the contracts, screen out bad borrowers and encourage savings. In 1994, women's savings amounted to 74% of total savings mobilized. [57]

What lessons can Africa learn from the Grameen Bank? The first lesson is that a bank with poverty-alleviation goals can also be sustainable as a bank by lending at market interest rates. The Grameen's lending rate has been twenty percent since 1991. [58] Its subsidy dependency index (SDI) has decreased over time from 180% in the 1980s to 36% in 1994. [59] The second is that women are often better credit risks than men, since loan recovery rates for general loans have been higher for women (97% in 1992) than for men (89%). [60] Whether it can be replicated in Africa is now being tested by Sasakawa Global 2000 programs such as Benin's CREPs (Caisse Rurale d'Epargne et de Pret) that mobilize savings before loaning to farmers, twenty percent of whom are now women. [61]

Free Bag Option

For a short time only, introduce a system of grants – or safety net program -- of small bags of fertilizer targeted at the poorest women farmers. The term *safety net* refers to programs that attempt to address a food consumption deficit in households of either the chronically poor and food insecure or the transitory food insecure. In cases of chronic food insecurity, safety nets are targeted at the poorest quintile or two (and rarely three) of the population, and would thus include the majority of FHHs. In Malawi, for example, the poor comprise forty-one percent of rural households, forty percent of whom are female-headed. Except in rare cases of severe drought or devaluation, safety nets should *not* be given universally as were Malawi's "starter packs" in 1998-2000. [63]

The advantage of safety net programs, as opposed to subsidies, is that they can work through the markets instead of disrupting them. There are several kinds of safety nets that satisfy this criterion: "food-for-work" programs, public employment programs, "inputs-for-

work" programs, and "vouchers-for-work" programs. If they are also "productivity-enhancing safety nets (PES-nets)," then they target the people who are food insecure while *not* detracting from the national goal of increased productivity to move the country as a whole toward structural transformation. Devereux points out why a safety net program should also strive to increase productivity in Africa. Because African food insecurity is caused by *low productivity*, it is "best addressed by interventions to raise returns to effort" instead of merely using food transfers to bridge a consumption deficit. "Reducing production or income deficits is a pre-emptive strategy to reduce consumption deficits, thereby minimizing the need for safety net interventions." [64] Safety nets that provide consumption support to people below the poverty line – especially farmers who know how to produce their own food, "have no beneficial impact on livelihood systems," divide the poor into "workers" and "dependents," are not sustainable, and merely deepen dependency.

PES-nets in the form of public works programs will improve the food security of participating households if the time spent on them does not conflict with food production activities. However, public works programs typically focus on male tasks (e.g., rebuilding roads, bridges and water canals, reforestation projects), and thus employ mostly men. To benefit poor rural women public works programs should also include tasks that women typically perform, such as communal gardening, caring for communal (agroforestry) nurseries, soil conservation programs, care of the sick or orphans of AIDs (a task usually left to grandmother-FHHs), and care of the communal water kiosk, rubbish disposal pit, or soak-away pit. Public works programs could also remunerate men's and women's participation in group training sessions about family planning, literacy, and crime prevention. The definition of "work" in "food-for-work" programs needs to be broadened, and the definition of remuneration-for-work should be expanded. Female participation rates are higher (sixty percent vs. twenty percent) when food payments are offered as opposed to cash wages in Malawi's public works projects. [65]

For women farmers, the most optimal PES-net would be fertilizer vouchers received for work in "fertilizer-for-work" programs, (as suggested by Anderson's paper in this special issue), because they are more cost-effective than programs offering a food wage and do not deepen dependency. In Malawi, the current nitrogen to hybrid-maize price ratio is now so high that only small amounts of fertilizer (e.g., 37 kg/ha of nitrogen) are still profitable or "optimal" for food production. [66] At these low levels of fertilizer, however, the response from an additional kilo of nitrogen is high. [67] Therefore, the cost of maize to the farmer growing her own maize with fertilizer is *much less* than the market price of maize. This means that a safety net program that gives a fertilizer voucher, redeemable from any private fertilizer distributor, should be more effective than one exchanging food (maize) for work . [68] This is supported by Tsoka and Mvula whose results show that the majority of rural residents in southern Malawi (both FHHs and MHHs) prefer payment from public work programs in fertilizer rather than in cash or food. [69] "The evidence is overwhelming: the rural poor in Malawi see access to agricultural inputs as a priority, and inputs-for-work for part of the year as a means of obtaining fertilizers and seeds. [70]

The disadvantage of a safety net program in Africa is that numbers of targeted clientele may be substantial. Kumwenda et al. estimate the food insecure comprise forty percent of the

smallholder population in Malawi. [62] Another concern that has been raised is that farmers might *sell* the fertilizer given to them as a safety net, rather than apply it to their food crops. For example, some of the fertilizer starter packs that were distributed in Malawi in 1998/99 were sold by farmers who desperately needed the cash. [71] To see the impacts of this activity, Anderson's paper models the situation of a poor FHH that sells a 25-kg bag of fertilizer granted for K100. Anderson's example, based on linear programming modeling, shows that although some farmers are desperate enough to sell grants of fertilizer and other inputs, their livelihood systems are unsustainable as a result.

SOIL ORGANIC INPUTS AND BIOLOGICAL NITROGEN FIXATION OPTIONS

Women's constrained supply of cash, together with the removal of price subsidies on fertilizers and rising costs may compel a majority of them to rely only on organic sources of nutrients -- especially legumes that fix atmospheric nitrogen — as the only available strategy for increased soil fertility. At current levels of availability and use, however, "organic inputs are rarely sufficient to meet crop demand for nutrients or maintain soil organic matter." [72] The use of inorganic fertilizer can be supplemented or enhanced with use of organic sources of nutrients increased considerably by enhancing the level of soil organic matter. [73] Therefore the following are possible options for getting organic nutrients to women farmers.

Soil Organic Matter Option

Make soil organic materials of farm origin more accessible. In addition to serving as sources of nutrients, organic materials can influence nutrient availability by:

acting as an energy source for soil microbial activity

serving as precursors to soil organic matter

influencing the release pattern of plant-available nutrients

reducing phosphorus sorption of soil.

In on-farm trials, options would include use of green manure, animal manures, improved fallowing, biomass transfer, and legumes as sole crops in rotation or intercropped with cereals. [74] Information can be diffused via extension workshops, field days for women, and gender "training of trainers" for extension agents. Microcredit programs can be used to improve access to organic inputs for women farmers.

Biological Nitrogen Fixation Options

Make biological nitrogen fixation technologies more accessible. Nitrogen-fixing technologies involve crops grown in rotation with maize such as velvetbean [*Mucuna pruriens* (L.)], pigeonpea [*Cajanus cajan*], sunnhemp [*Crotalaria juncea*], lablab bean [Lablab purpureus], and

crotalaria [*Crotalaria ochroleuca*], as well as trees and shrubs used in new agroforestry technologies (such as hedgerow intercropping, biomass transfers, and improved fallow technologies). These nitrogen-fixing technologies can be promoted by making seeds, seedlings, and extension education more accessible to women farmers. ICRAF researchers and World Vision extension agents are now doing this in eastern Zambia and Malawi, as well as in western Kenya and Uganda. Other examples are the "doubling-up legumes" technology tried in central and southern Malawi, where land is too scarce to take it out of production to plant a tree or shrub in an improved fallow. [75] By experimenting with women farmers' test plots that intercrop two different types of legumes (e.g., pigeon pea and groundnuts) or rotate legumes with cereals, Snapp has shown that women farmers can improve both legume and cereal yields. Giller et al. conclude that nitrogen-fixation from legumes can sustain tropical agriculture at moderate levels of output, often doubling those currently achieved. [76]

Organic-Inorganic Options

Make combinations of organic and inorganic inputs in small amounts more accessible. Organic materials are frequently in limited supply and hence cannot by themselves provide the productivity boost needed by African smallholders. [77] The combination of available organic materials with small amounts of inorganic chemical fertilizers may be a very appropriate option for women smallholders, especially the poorer FHHs. [78] Unfortunately, none of the studies here found a naturally-occurring experiment that formally tested this option. Where inorganic fertilizers were used, they were in combination with some maize stover and weeds, usually turned under when farmers ridge their fields prior to planting. Unfortunately in most cases, not much organic material in the fields is still green when farmers make their new ridges for the next year.

Cash Crop Option

Introduce a cash crop into women's subsistence farming systems. Sustainable food production is an important goal of development, but only when women farmers obtain *cash* will they have a sustainable way either to buy food and cash inputs or repay loans. Cash cropping on a small portion of women's land normally devoted to subsistence crop(s) can be encouraged by women's clubs such as Malawi's Tikalore Clubs or tobacco clubs. These clubs give fertilizer credit to women for both food and cash crops. The loan is repaid from proceeds of the cash crop. Credit programs for food crops alone should not be recommended at adverse fertilizer-food crop price ratios, because their use will only result in a negative debt spiral. However, when women get fertilizer under credit schemes intended to improve cash cropping, they should be free to decide to which crops they apply the fertilizer, as farmers are often better judges of the markets and risks than outside analysts. Government can encourage women earning cash income by expanding microcredit/ microenterprise programs for women, which allow them to acquire credit for whatever income-earning activity they desire, whether a farm or nonfarm enterprise. All these programs should recognize the interdependencies between women's subsistence food production and income-earning opportunities. In Malawi, for

example, women farmers are now growing burley tobacco (*Nicotiana tabacum* L.) and using its receipts to pay back loans for fertilizer use on both subsistence maize and tobacco. [79]

THE UNIVERSITY OF FLORIDA SOILS CRSP PROJECT

Clearly, an African government can encourage any of these different policy options, and one may work better than others in a particular locale. Given the extremely heterogeneous agroclimatic and socioeconomic conditions in Africa, the authors in this special edition focused on several naturally-occurring experiments in which an African government, NGO, or agricultural research center tried to reach women farmers. We did not attempt to manage a research or extension project ourselves. Nor did we plant on-farm trials (due to limited funding). Nor did we try to revisit the issues of how to improve extension services for women farmers. [80] Instead, we selected particular regions in several African countries and monitored projects already in operation, to assess the efficacy of methods to target women farmers there with soil fertility amendments. Most of the articles here should therefore be considered *case* studies or *micro-level* studies in particular regions that might not have been representative of the entire country, and certainly not the entire continent. At the end of the five-year project, we had done five separate micro-level studies in Malawi (of which four are presented here), three in Uganda (of which two are presented), four in Zambia (two are presented), and one in Ethiopia, Kenya, Senegal, and Zimbabwe. Therefore, our focus was mainly on southern and eastern Africa.

Nevertheless, results from the micro-level studies give some indication of the popularity and efficacy of the various strategies to target women farmers in Africa. We found, for example, almost no use of fertilizer vouchers in all the projects we monitored. Gough's paper is the only study of fertilizer voucher use in Malawi's Starter Pack program of 1998-2000, an input grants program designed to give every rural household in Malawi small quantities of chemical fertilizer, hybrid maize seed, and legume seeds as a safety net. Similarly, sales of small bags of fertilizer in local markets and shops are rare, and only examined by Uttaro's paper. Credit use for fertilizer was also infrequent, partly due to the collapse of credit institutions during the structural reforms and droughts of the 1990s. But it is examined by Sullivan's and Anderson's linear programming models in this edition. In contrast, agroforestry innovations in the form of biomass transfers, and especially improved fallow technologies, were the subject of much innovative research by biological and social scientists in Kenya, Uganda, Eastern Zambia, and Malawi. These are discussed here in papers by Gladwin et al. and Thangata et al. Similarly, research on grain legumes that fix nitrogen was popular and promising in Africa during 1997-2002, and is described by Gilbert et al. and Mudhara et al. Indeed, both these biological nitrogen fixation technologies were more frequently seen than animal manure use in the micro climes and regions we focused on. The reduction in manure use as an organic fertilizer, due to a decline in grazing land and decreased cattle production, is described by Dougherty for southern Ethiopia; but the decline in its use was also observed in Malawi, Zambia, and Zimbabwe. Notable in all the papers, but especially in papers by Nkedi-Kizza et al., Goldman and Heldenbrand, and Uttaro, is the ubiquitous decline in farmers' use of chemical fertilizer since the start of structural adjustment reforms. This last topic, and the resulting decrease in

agricultural productivity of both women and men farmers, is unfortunately the one common thread seen in all the papers of this special edition.

The methodologies employed by these authors to assess the efficacies of various methods to target women are also diverse. This was done purposefully, so that our results might be robust across a variety of methodologies, and speak to researchers across disciplines in the bio-physical, environmental, and social sciences. This diversity also reflected the multi-disciplinary nature of our research team. At the faculty level, the team consisted of an agricultural economist, one agricultural economist/ anthropologist, one geographer, two agronomists, and one soil scientist. We were also fortunate to attract graduate students from anthropology, economics, agricultural education and communications, geography, conservation and natural resources, and political science. Given this diversity, we wanted the micro-level studies to complement each other, if possible. So this collection of papers does not focus on any special methodology. As a result, four of the papers in this collection use ethnographic linear programming (LP) modeling, two papers use ethnographic decision-tree modeling, two papers use consumer-to-producer ratios a la Chayanon, one paper uses scripts, one paper uses geographical surveys, and one paper uses soil sampling techniques. All use personal ethnographic interviews to some extent.

PREVIEW OF OUR CONCLUSIONS: HOW TO TARGET WOMEN FARMERS AND INCREASE FOOD PRODUCTIVITY IN AFRICA

Unfortunately, our conclusions do not paint as rosy a picture as this heading suggests. We did not find easy answers to the question of how to target women farmers, replenish their depleted soils, and thus increase their productivity, especially on fields planted to food crops. Instead, we sometimes found that the policy options expected to work are not viable options for women to improve their soil fertility, even though they worked for men. In other locations, we found that options that worked for married women in MHHs did not work for FHHs, usually poorer than married women. In all the sites, we found location-specific and historical conditions made it difficult to generalize results across all the micro climes. Yet, in order to preview the more complicated stories presented in this special edition, the following is a brief summary of our conclusions:

> Fertilizer voucher distribution is almost non-existent in Africa. We did not find a naturally-occurring experiment in which to assess fertilizer vouchers targeted at women food producers.
>
> Small bags in local shops are bought by both men and women in MHHs, but are usually used on men's cash crops rather than on women's food crops. Small bags are rarely bought by FHHs. Fertilizer in local markets, unlike cement, is rarely sold by the kilogram.
>
> Credit targeted directly at women is problematic. For women in MHHs, it leaks to men in locations where cash income is the man's domain. Women use informal credit more

than formal credit. Household composition also affects credit use as FHHs are still considered bad credit risks.

Grants of fertilizer targeted only at the poorest FHHs did not occur in Africa. Vouchers for grants of fertilizer are problematic when grants are universally distributed.

Women plant grain legumes for food and do not plow them under when green, so they do not usually serve as a soil fertility amendment in Africa.

Lack of land, labor, awareness-knowledge, and technical-knowledge limit women's adoption of agroforestry innovations. Where land is available and extension efforts alleviate the lack of knowledge constraints, poor FHHs do test and adopt improved fallow technologies (even more so than married women in MHHs).

Combinations of small amounts of chemical and organic fertilizers may show promise. But once again, we did not find a naturally-occurring experiment disseminating innovative new combinations of inorganic and organic fertilizers in a formal manner, and so we could not study this option.

Women's access to cash crops does not ensure their use of soil-fertility amendments, but does help relieve women's cash constraints so that cash-allocation decisions may be made about fertilizer use. In locations where women receive fertilizer credit for cash crops, they usually use some of it on their food crops.

Given this list of rather bleak findings, we conclude that married women, like men in MHHs, do have some good options for improving their soils: small bags of inorganic fertilizers, fertilizer sold by the kg in local markets, microcredit programs for fertilizer use, safety-net programs, more cash cropping, and organic options (including legumes and agroforestry innovations). For these women, government should encourage market-liberalization programs that include women, as well as men, as the targeted clientele. For example, private traders of cash crops should be encouraged to buy directly from women; private stockists of fertilizer should be urged to carry small bags of fertilizer in local shops and markets, and extension programs that target women should be supported.

But African women farmers are not all alike. For the poorer FHHs, the options are fewer because their resources of land, labor, and capital are less. In our opinion, their soil-fertility options boil down to safety net programs, cash cropping, and nitrogen-fixation technologies (improved fallows or doubling-up legumes). This is because FHHs do not have the access to cash or credit to acquire chemical fertilizers. For these women and thus twenty-five to thirty percent of African households, if improved fallow technologies do not diffuse or markets for cash crops fail, soil fertility improvements will have to come in the form of safety net programs.

These findings do not bode well for the future, given Africa's limited set of resources and its relative inexperience with safety net programs. The design and implementation of safety net programs in Africa is a complicated business at best and a political minefield at worst. When grants are universally distributed, their benefits are too small to significantly increase

household cash incomes. When they are directly targeted at female-headed households, local men use existing power asymmetries to gain some measure of control over these resources. As one reviewer suggested, it might be simpler to target safety net programs to very poor and poor households, most of which are *de facto* or *de jure* female-headed anyway. Yet, as the majority of smallholder farmers, women need to be better supported in their role as farmers if Africa is to ever experience a "Green Revolution" transformation. Perhaps gender-sensitive safety net programs that recognize women as agricultural producers, rather than simply as poor consumers or helpless victims, will be worth the effort.

Notes

1. Boserup 1970.
2. Dixon 1982, Gladwin and McMillan 1989.
3. Due and White 1986, Due 1991.
4. Quisumbing 1996.
5. Due and Gladwin 1991, Gladwin 1996, 1997.
6. Udry 1996. In Malawi in 1996/97, for example, an across-the-board 20% increase in household maize yields would have meant an increase in aggregate maize yields of 180,000 metric tons. With the price of maize now valued at Malawi Kwacha 24.00 per kg, up from MK 1.55 per kg in 1997, this would now mean an enormous savings in the costs of importing maize. The impact of these findings is thus quite large -- in savings of import costs of food crops -- if governments would only adopt policies to reach African women farmers with productive inputs for their food crops.
7. Goheen 1991: 240.
8. Moock 1986.
9. Goheen 1991, 1996.
10. Kaberry 1952
11. Goheen 1991:241.
12. D'Arcy 1997.
13. Polly Hill 1963, Gladwin 1976, Gladwin and McMillan 1989.
14. Ensminger 1987.
15. Due 1991: p. 103.
16. Due 1991:107.
17. Quisumbing 1996.
18. Gladwin et al. 2001.
19. Elabor-Idemudia 1991.
20. Meena 1991.
21. Bumb et al. 1996, Gladwin 1991.
22. Goheen 1991, Uttaro 1998.
23. Henderson 1998.
24. Mehra 1992.
25. Sanchez et al. 1997.
26. Smaling 1997: 521997: 52.

27. FAO 1998.
28. Eicher 1982, 1995.
29. Smale 1995.
30. Tomich, Kilby, and Johnston 1995.
31. Tomich et al.1995:14.
32. Tomich et al. 1995: Table 1.
33. This length of time is also required for a country to develop strong reliable markets and a distribution system in food crops that rural people can depend on, as well as the physical and governmental infrastructure to support them. One year of poor harvests and no food crops in the markets is all it takes for confidence in the markets, infrastructure, and government to plummet. In the following seasons, women will decrease cash crop production and revert to subsistence farming.
34. Deaton 1980, Bezuneh et al. 1980.
35. Chege 1997: 552.
36. Sachs 1997.
37. Bay 1982, Sacks 1982, Clark 1994, Davison 1988.
38. Rocheleau 1995, Thomas-Slayter and Rocheleau 1995.
39. Parpart and Staudt 1989; Gordon 1996.
40. Donovan, 1996; Saito et al. 1994.
41. Timmer et al. 1983, p.288.
42. Timmer et al., 1983, p. 288.
43. Byerlee and Heisey, 1992.
44. Harris, 1984; Van der Eng, 1994; Eicher, 1995; Goldman and Smith, 1995.
45. Lele et al. 1989.
46. Larson and Frisvold 1996.
47. Gladwin, 1991, 1992.
48. Gladwin, 1992, 1996.
49. Gladwin, 1997.
50. Eicher 1995: 807b, World Bank 1994.
51. Pinstrup-Anderson 1992: 106.
52. Pinstrup-Anderson, 1992: 105.
53. Lele et al., 1989.
54. Von Pischke, 1991 p. 233; Khandker et al., 1995.
55. Khandker et al., 1995, p.: xi.
56. Khandker et al., 1995, p.: 25-26.
57. Khandker et al., 1995: p. 31.
58. Khandker et al., 1995, p.: 66.
59. Yaron, 1992, 1996.
60. Khandker et al., 1995, p.: 18.
61. Galiba, 1996.
62. Kumwenda et al. 1996: 21.
63. Mann 1998, Longley, Coulter, and Thompson 1999, Gough in this edition.
64. Devereux 1999: 57.

65. Dil 1996.
66. Only small amounts of fertilizer (e.g., 32-37 kg/ha of nitrogen from calcium ammonium nitrate or CAN) are still profitable for food production (Benson 1997). These figures assume the farmer gets no credit for food crops, pays Malawi Kwacha (MK) 700 per 50 kilo bag of CAN, and the price of maize is a high MK 6.5, a four-fold increase from its previous price of MK 1.5 in 1997. The price ratio of nitrogen to maize is thus 10.5 with these assumptions. It also assumes farmers take risk into account, rather than maximize profits, so that they use inputs only up to the point where the value of the inputs is greater than or equal to *twice* their costs. Using these conservative assumptions, the risk averse farmer should apply 32 to 37 kg/ha of nitrogen per hectare.
67. Using Benson's response function for nitrogen on maize from 1600 on-farm trials conducted in Malawi in 1995/96, we calculate that with the optimal amount of 37 kg Nitrogen per hectare, a farmer gets roughly 26 kg maize from 1 kg of nitrogen, a very high response rate, if she does not count her own labor as a variable cost (a common assumption for smallholders). With CAN costing MK 14 per kg, one kg of Nitrogen costs MK 68.3, meaning the cost of a kilo of maize for a farmer growing her own is only MK 2.62, much less than MK 6.5, the cost if she were to buy it. For this reason, farmers realize they need chemical fertilizer, and it has become a political football in the politics of Malawi (Uttaro, personal communication).
68. An example is the fertilizer-for-work program initiated by Stephen Carr (1997) with the EU in 1991/92 when 10,000 tons fertilizer were distributed in a pilot program. Field assistants contacted local communities to ascertain what the community or village wanted done (e.g., more classrooms, wells, access roads, or teachers' houses). In June and July when the harvest was in and there was plenty of food, and school was out, village women would provide the labor to build a teacher's house in return for a fertilizer voucher that they could cash at planting time in November-December.
69. Tsoka and Mvula 1999.
70. Devereux 1999: 58.
71. Longley et al. 1999, Gough 2002.
72. Palm et al. 1997; Kumwenda et al., 1996: 9.
73. Palm et al., 1997, Kumwenda et al., 1996: 24.
74. Palm et al. 1997, Giller et al. 1997, Wortmann and Allen 1994.
75. Snapp 1999.
76. Kumwenda et al., 1996: 9.
77. Kumwenda et al. 1996: 5.
78. Palm et al., 1997; Kumwenda et al., 1996: 25.
79. Brown et al., 1996; Stephen Carr, personal communication, Anderson in this edition.
80. Staudt, 1975; Olayiwole 1991.

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