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Chimanga Cha Makolo, Hybrids and Composites: Farmers' Adoption of Maize Technology in Malawi, 1989-90*

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Objective

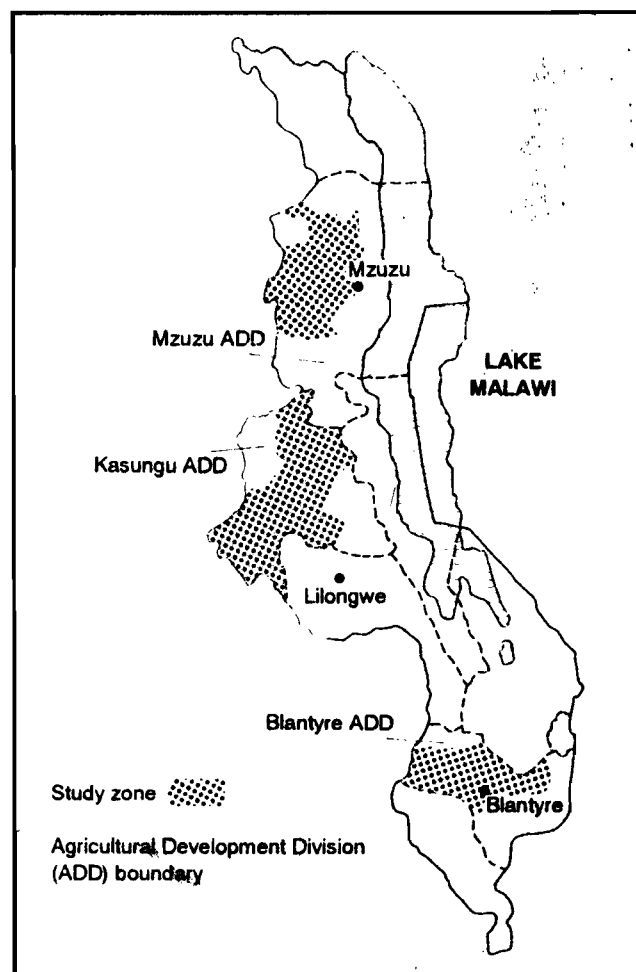
During the 1989-90 and 1990-91 cropping seasons, researchers from CIMMYT and the Evaluation Units of the Malawian Ministry of Agriculture (MOA) collected data to profile farmers' adoption behavior and varietal choices, and to elucidate how farm household factors influence farmers' selection of maize varieties in Malawi. Survey areas are shown in Map 1. This paper is a brief summary of selected findings for the 1989-90 season. More complete data and interpretation can be found in CIMMYT Economics Working Paper 91/04.

Selected Findings

Selected statistics on maize technology and varietal adoption in Malawi are presented in the Table 1. The most striking finding revealed by the data is the complexity of farmers' adoption patterns. Farmers' adoption decisions consist of several interrelated but distinguishable choices. The first choice — *adoption* — is the decision to adopt or not to adopt the recommended variety and related practices, and in what combination. The second choice — *extent of adoption* — is how much land to allocate to the new and old techniques. The third choice — *intensity of adoption* — is the level per hectare, or rate of application, of inputs such as fertilizer.

The percentage of farmers adopting hybrid maize seed (*adoption*) appears to vary sharply by agro-economic zone. Only 14% of sample farmers in Blantyre, nearly 40% in Mzuzu, and about 33% in Kasungu sowed hybrid seed in the 1989-90 season. Few farmers in any zone grew composite maize. The proportion of farmers who used fertilizer on their local maize was similar across survey zones, although Blantyre farmers were slightly less likely than Kasungu and Mzuzu farmers to apply fertilizer to

local maize. Over all zones, roughly half of the sample farmers fertilized local maize. Almost all farmers used fertilizer on hybrid maize, but compared to the Mzuzu and Kasungu farmers, Blantyre farmers were less likely to adopt *both* seed and fertilizer in the 1989-90 season.



Map 1. Location of study areas in Blantyre, Kasungu, and Mzuzu Agricultural Development Divisions, Malawi, 1989-90.

* This paper is a brief summary of Smale et al. 'Chimanga Cha Makolo', *Hybrids, and Composites: An Analysis of Farmers' Adoption of Maize Technology in Malawi, 1989-91*, CIMMYT Economics Working Paper 91/04 (Mexico, D.F.: CIMMYT, 1991).

The average proportion of farmers' maize area allocated to hybrid maize (*extent of adoption*) varied little by agro-economic zone. Farmers universally grew local maize for home consumption, and even when they chose to adopt hybrid maize, they tended to devote over 60% of their maize area to local

varieties. This feature of maize varietal choice, although not unique to Malawi, appears to be more pronounced in Malawi than in other nations that have experienced similar seed-fertilizer transformations. The similarity of this pattern across agro-economic zones also suggests that the factors affecting the

Table 1. Selected statistics on maize technology and varietal adoption, 1989-90

| Characteristic | Economic stratum ^a | | | All strata |
|---|-------------------------------|---------|-------|------------|
| | Blantyre | Kasungu | Mzuzu | |
| General | | | | |
| Cultivated area (ha) | 0.8 * | 1.4 | 1.5 | 1.2 |
| Maize as percent of farm area | 98 * | 84 | 85 | 89 |
| Adoption of seed | | | | |
| Percent of farmers growing: | | | | |
| Local maize | 97 | 99 | 97 | 98 |
| Hybrid maize | 14 * | 33 | 38 | 27 |
| Recycled hybrid | 4 * | 7 | 9 | 6 |
| Composite variety | 4 | 4 | 5 | 4 |
| Percent of farm maize area sown to hybrid maize by adopters | | | | |
| | 30 * | 35 | 42 | 34 |
| Percent of aggregate maize area in: | | | | |
| Local maize | 91 | 84 | 74 | 85 |
| Hybrid maize | 6 | 13 | 22 | 12 |
| Recycled hybrid | 1 | 2 | 2 | 2 |
| Composite variety | 1 | 1 | 2 | 1 |
| Hybrid maize as percent of aggregate maize output | | | | |
| | 18 | 44 | 47 | 35 |
| Adoption of fertilizer | | | | |
| Percent of local maize growers apply | 44 * | 52 | 58 | 50 |
| Percent of hybrid maize growers apply | 71 * | 97 | 97 | 87 |
| Application rate of adopters (kg N ha ⁻¹) | | | | |
| Local maize | 48 * | 37 | 37 | 41 |
| Hybrid maize | 64 * | 86 * | 111 | 82 |
| Other agronomic practices | | | | |
| Percent of aggregate area intercropped | | | | |
| Local maize | 32 | 2 | 16 | 15 |
| Hybrid maize | 31 | 3 | 1 | 13 |
| Percent of aggregate area weeded twice | | | | |
| Local maize | 77 | 54 | 56 | 63 |
| Hybrid maize | 90 | 68 | 66 | 76 |
| Yield (t/ha) | | | | |
| Local maize, unfertilized | 0.7 | 0.9 | 0.6 | 0.8 |
| Local maize, fertilized | 1.2 | 1.4 | 1.2 | 1.3 |
| Hybrid maize, fertilized | 2.2 * | 3.0 | 2.9 | 2.7 |

Source: Maize Variety and Technology Adoption Survey, CIMMYT/MOA, 1989-90.

a Strata correspond to higher potential maize-producing zones in Blantyre, Mzuzu, and Kasungu Agricultural Development Divisions. Combined figures are weighted by probability of selection. Strata n=140. Total N=420.

* Indicates statistically significant differences between strata (5%), pairwise Chi-square or t-test.

land allocation decision are not necessarily the same factors that affect farmers' initial choice to sow new seed.

The third aspect of the technology adoption decision (*intensity of adoption*) is illustrated by farmers' choice of fertilizer application rates. The mean and modal nitrogen application rates in all three zones were near recommended levels for local maize, and in Kasungu and Mzuzu the same was true for hybrid maize. Relative to the Mzuzu and Kasungu farmers, Blantyre farmers reveal a propensity to apply higher rates of fertilizer to local maize and lower rates to hybrid maize.

Because hybrid maize adopters continue to allocate a large proportion of their maize area to local varieties, aggregate maize area sown to hybrid varieties, recycled hybrids, and composites remains fairly low, or about 15% of the maize area in the combined survey zones. Although hybrid maize may represent a fairly small percentage of aggregate maize area, aggregate hybrid maize output constitutes a sizeable percentage of total maize output (slightly under 20% in Blantyre and over 40% in both Kasungu and Mzuzu). The fact that hybrid maize represents a relatively large proportion of aggregate output, and the evidence that many food-deficit farm households must and do rely on their own or purchased hybrid maize to bridge annual consumption needs, underscore the growing role of hybrid maize in both national and household food security.

Selected agronomic practices associated with local and hybrid maize varieties are also presented in the summary table. The percentage of maize area that is intercropped is highest, for either local or hybrid maize, among the Blantyre farmers. Mzuzu and Kasungu farmers, who tend to have larger land areas, are more likely to bring fallow land into maize cultivation, especially for hybrid varieties. Corresponding to general rainfall patterns, the frequency of plots planted after mid-December is higher the more northern the location, but planting is also shifted to later dates for hybrid maize in all zones. Blantyre farmers, with their limited land areas, are more likely to weed either their local or hybrid maize plots twice.

The divergent patterns found among the survey zones probably reflect different objectives and constraints faced by farmers, some of which are hypothesized in greater detail in CIMMYT Economics Working Paper 91/04 and tested elsewhere, although a brief summary will be presented below.¹ For example, most of the Blantyre hybrid maize growers learned about hybrid maize on their own or from neighbouring farmers, rather than from extension agents, and purchased their inputs with cash earned from off-farm employment rather than through the formal credit system. The combination of practices these self-styled hybrid maize growers select is distinctly different from the practices found among the full-time, larger maize producers of the Mzuzu and Kasungu zones, who are more likely to use credit and obtain extension advice.

Implications

The data suggest that no single variable determines a farmer's adoption choice in Malawi. To increase aggregate area sown to hybrid maize, the Government of Malawi can choose from several sets of options, including actions that affect the choice of whether to grow hybrid maize or not (*adoption*) and actions that can influence farmers' choice of land allocation to local and hybrid maize (*extent of adoption*). Pursuing a goal of increasing aggregate hybrid maize production may involve a third set of options designed to improve the efficiency of hybrid maize production among adopters by shifting their yield or net returns distributions toward higher values.

Each set of options is associated with distinct national welfare and distributional consequences. A combination of options may be more likely to produce measurable and desirable long-term results. For example, actions that affect *adoption* opportunities may be primarily institutional. Factors such as credit, timely provision of appropriate seed for a particular locality at the proper planting time, and provision of fertilizer and seed to markets to enable farmers to obtain inputs with cash rather than on credit, can result in a larger number of farmers growing at least some hybrid maize. The social welfare considerations associated with these actions include

¹ See also M. Smale, *Risk, Disaster Avoidance, and Farmer Experimentation: The Microeconomics of HYV Adoption in Malawi*, unpublished Ph.D. dissertation (College Park, Maryland: University of Maryland, 1992).

household food security, since higher yield potential on some plots can improve the conditions of even the smallest farmers.

Aggregate hybrid maize output and area can also be increased through actions that affect the area hybrid adopters allocate to hybrid maize (that is, the *extent of adoption*). Such actions include current efforts to breed and diffuse flintier hybrids and to educate farmers about storage and processing alternatives for dentier hybrids. Farmers appear to plan their production according to the belief that local maize continues to be superior in processing and storage, which suggests that a flint hybrid is likely to have broader appeal than a dent hybrid. Those who are now adopting may allocate larger portions of their maize area to hybrid maize if that hybrid is more substitutable in consumption. Those who are able to adopt but have not adopted may be more willing to grow a flint hybrid maize than a dent variety.

Because these more technical options primarily affect farmers who are already capable of adoption, they do not have the same distributional welfare implications as the institutional options cited above, although they can improve national welfare. For example, flintier hybrids cannot relieve underlying expenditure constraints or inability to qualify for credit. Even those farmers who can afford to purchase inputs cannot be expected to relinquish

their local sources of seed until they can rely on marketing institutions for timely, certain delivery of quality seed meeting their own specifications. Even then, comparison of net returns distributions indicates that varietal diversification may remain an objective that is consistent with reducing total economic risk.

A third set of policy actions involves improving technical and economic efficiency among hybrid producers through developing recommendations that are more closely tailored to their various operating conditions and concentrating on agronomic practices. As long as overall adoption rates are modest, investments of this type can improve the welfare of only a limited proportion of farmers, although they could increase aggregate output.

Finally, efforts to breed more varieties with other desirable traits, such as early maturity, and to provide farmers with seed-fertilizer packages of varying composition and a wider range of sizes, are likely to improve adoption rates. The data show that farmers are willing to try diverse combinations of technological options and may find them to be consistent with their objectives. The data at this stage are sufficient to confirm that the overall adoption pattern in Malawi does not express farmers' rejection of new technology, but constrained acceptance.