Chapter 6 IRRIGATED FARMING AND IMPROVED NUTRITION IN MALAWIAN FARM HOUSEHOLDS

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ABSTRACT: THIS CHAPTER PROVIDES SELECTED FINDINGS FROM AN ASSESSMENT OF whether increased use in the dry season of irrigated farming by smallholders in Malawi might improve household-level dietary diversity or child nutrition outcomes. We find no strong association between the use of irrigation by farm households in Malawi and the growth performance of those households' children. However, we do find that irrigating households tend to have more diverse diets than households that do not irrigate, leading to the hypothesis that irrigation enables households to produce a wider range of crops for home consumption than they can with purely rainfed production. In line with these results, we also find that irrigation reduces the negative effects of seasonal food insecurity. The insight we take from these findings is that one of the principal contributions that irrigation can make to improved nutrition outcomes, particularly for subsistence farming households, is to ensure reliable, year-round access to a diverse diet that facilitates access to micronutrient-rich foods, such as vegetables.

Expansion of irrigation is a recurrent objective of the agricultural development plans formulated by successive governments in Malawi. The Greenbelt Initiative was launched in 2010 with the goal of irrigating a million hectares of land; the initiative remains in place (Chinsinga 2016). Reports in the Malawian press suggest that any savings from modifications to the design of the Farm Input Subsidy Program (FISP) since 2014 have targeted irrigation as the principal subsector into which these funds will be channeled. More intensive and continual use of Malawi's water and agricultural land resources is expected to increase and stabilize production of food and export crops, thereby increasing farm incomes, spurring growth in the agriculture sector, and enabling the country to more reliably meet the increasing food needs of its growing population.

In addition, irrigation should allow for a more diverse set of crops to be grown throughout the year, with significant expansion desired particularly in the production of micronutrient-rich vegetables and fruit. With increasing use of irrigation across the country, Malawians will gain greater access to more food and a more diverse range of foods. The nutritional status of young children and other vulnerable groups should improve as a result. Conceptually, this nutritional argument to build support for expanding investments in irrigation in Malawi seems reasonable; however, little empirical evidence from Malawi or elsewhere exists to confirm whether irrigation improves nutritional status.

PLAUSIBLE IMPACT PATHWAYS

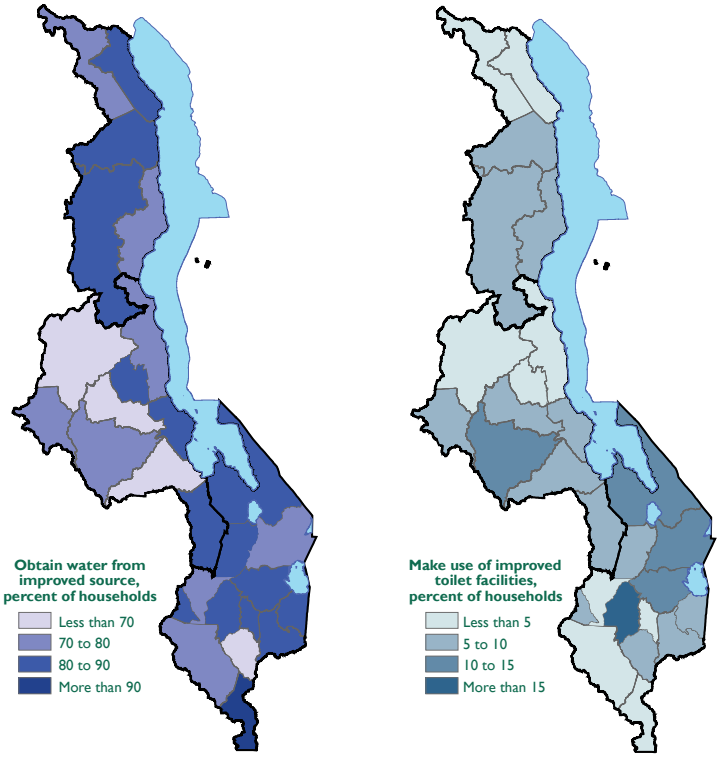
Several direct pathways through which irrigation can be hypothesized to affect the nutritional status of farm households are as follows:

- Irrigation can improve food security—an immediate and underlying determinant of nutrition—by increasing agricultural production per unit area. Particularly in climates with sharply seasonal rainfall patterns, such as Malawi's, irrigation enables exploitation of arable land for production throughout the

year, significantly increasing the amount of food that a farm household can produce in a year from the same area (von Braun, Johm, and Puetz 1994).

- Irrigation in the dry season may improve dietary quality by enabling production of a broader diversity of crops year-round. For example, vegetables are commonly produced in many of the small, traditional irrigated plots in Malawi. Of the almost 1,300 irrigated plots reported on by Malawi's Third Integrated Household Survey (IHS3), 40 percent were used, at least in part, for vegetable production, while 58 percent were used for staple crops (primarily production of maize for green maize consumption) (NSO 2012a). Vegetables are important sources of vitamin A and iron—both of which are lacking in many Malawians' diets. With irrigated production of such micronutrient-dense crops, household dietary diversity might increase, resulting in improved micronutrient intake, with subsequent reductions in the incidence of health problems linked to micronutrient deficiencies (Burney and Naylor 2012).
- Finally, the indirect income effects of irrigation on nutrition are potentially significant. If irrigation is used to produce marketable, higher-value crops, and local markets can offer producers good prices for those crops, subsequent increases in purchasing power may be used to better meet the food, health, and sanitation needs of household members. Further, if a significant portion of this income is controlled by women—for example, via the sale of horticultural crops traditionally grown by women—additional nutritional benefits may be realized, as the resources and income flows that women control have been shown to have disproportionately positive impacts on nutrition (Smith et al. 2003; World Bank 2005; Herforth and Harris 2014).

FIGURE 14 DISTRICT-LEVEL MAPS OF PERCENTAGE OF HOUSEHOLDS OBTAINING DRINKING WATER FROM AN IMPROVED SOURCE AND OF HOUSEHOLDS USING IMPROVED TOILET FACILITIES



Source: Maps by M. Kedir Jemal, IFPRI, of 2010 Malawi Demographic and Health Survey results.

METHODS

To better understand the impact that irrigation might have on the nutritional status of Malawian smallholders, we used data from the IHS3 of 2010–2011 to investigate whether irrigation was significantly associated with the height-for-age of children in IHS3 sample households and whether there was a significant association between irrigation and the dietary diversity of surveyed households.

The IHS3 is a national household consumption survey administered by the National Statistical Office (NSO) of Malawi between March 2010 and March 2011. The survey included a household questionnaire on a range of topics, including income, food and nonfood consumption, demographics, education, asset holdings, and employment, as well as data collection on the height and weight of young children (six months to five years) from surveyed households. The latter were used to calculate height-for-age Z-scores (HAZ) as a measure of stunting. Stunting is caused by long-term insufficient nutrient intake and frequent infections.

For the 9,750 surveyed households that reported undertaking agricultural activities, an additional agricultural questionnaire was administered. Of these households, 1,132 (11.6 percent) reported producing crops in the dry season by using irrigation. Irrigating households were identified as those for which information on farm plots used during the dry season and the crops grown in them was recorded in IHS3 agricultural questionnaire module "Ag-Module K: Plot Details—Dry (Dimba) Season." Rudimentary technologies are generally used for irrigation. Watering cans are used by 81 percent of irrigating households to irrigate their crops, most drawing water from wells or nearby surface water sources by hand. (Less than 7 percent of irrigating households in the sample supply water to their plots using pumps, whether motorized, treadle, or hand pumps.) Ten percent rely on flood irrigation. The balance use hose pipes or sprinkler or drip irrigation systems. Irrigating households are distributed across the country, but with somewhat higher prevalence in Central Region. While 35.6 percent of the farm households in our analytical sample are in Central Region, 45.6 percent of irrigating households are located there. The corresponding shares for Northern Region are 16.4 percent of farm households and 13.5 percent of irrigating households, while for Southern Region, these figures are 48.0 percent and 40.9 percent, respectively.

Our analysis used data from this agricultural subsample, differentiating between irrigating and nonirrigating farm households. Our analyses were not weighted, but standard errors were corrected for by the clustered design of the sample.

The first analytical method used to examine associations between irrigation and improved nutrition was a means comparison. The objective in the means comparison analysis was to identify any statistically significant differences in the characteristics of young children or their households based on whether the household engaged in irrigation or the child was stunted.

Our second analytical method was to identify through regression analysis whether any irrigation-related factors were significant determinants of nutritional status. We used two indicators as outcome variables in our regression analyses: HAZ scores for young children and Household Dietary Diversity Scores (HDDSs) for households.

HAZ scores were computed by comparing the height-for-age of each child aged 6 to 60 months in the subsample to the WHO's 2006 child growth norms, as described in Chapter 2. Anthropometric information was collected from 5,908 children in the farm households in our sample.[11] Of these, 763 (12.9 percent) were members of households practicing some irrigated farming.

An HDDS was calculated for each sample household based on a simple counted score of whether household members consumed any food from each of 12 food groups over the previous seven days. This was constructed from IHS3 recall data on food expenditures and household consumption, as described in Chapter 2.

Two regression approaches were used—ordinary least squares (OLS) regression for modeling the HAZ score of young children and Poisson regression for modeling farm households' HDDSs. The HDDS is a count variable for which the Poisson regression

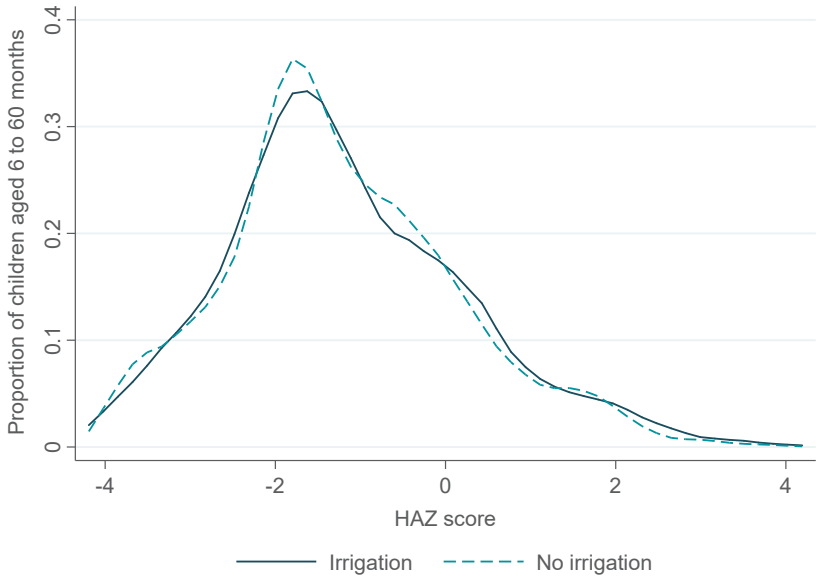
model is appropriate. For each regression, among the independent variables used were several reflecting the use of irrigation by the sample household. Our interest was whether the coefficients for these variables were statistically significantly different from zero. We also controlled for demographic and socioeconomic characteristics, agricultural and agroecological characteristics, and institutional factors. For the models looking at household dietary diversity, we also included fixed-effect variables for the month when the sample household was interviewed. This allowed us to investigate seasonal differences in dietary diversity between irrigating and non-irrigating farm households.[12]

FINDINGS

For our initial means comparison, we found virtually no difference in the distribution of HAZ scores between young children in irrigating households and those in non-irrigating households (Figure 15). These results were confirmed in the regressions. None of the models found a statistically significant association between irrigated farming-related variables and the HAZ scores of young children. These findings do not negate the expectation that irrigated farming, through its impact on the food consumption and incomes of farm households, is of considerable benefit to the nutrition of young children in those households. However, it does indicate that the pathways through which irrigated farming can lead to improved child growth are more complex and indirect.

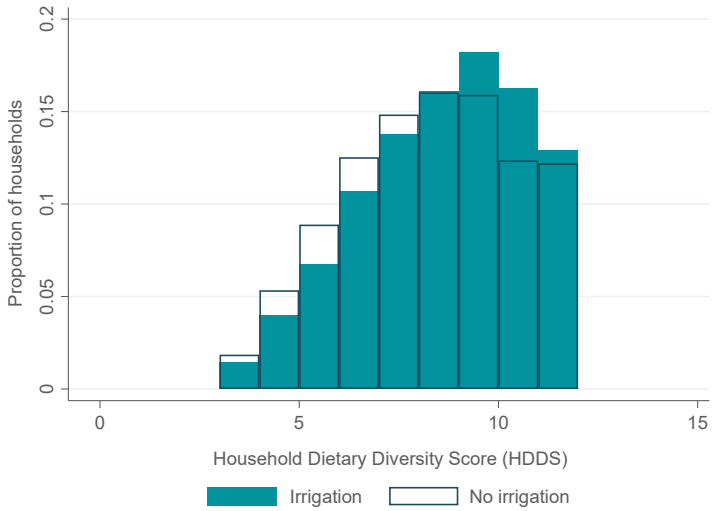
Conversely, on average, we found that irrigating households tend to have more diverse diets than households that do not irrigate (Figure 16), suggesting that irrigation enables households to produce a wider range of crops for home consumption than they can with purely rainfed production. This hypothesis was also supported in our regression results. In our models, a statistically significant result was obtained across all specifications for the variable on household production of irrigated vegetables. In the most tightly controlled model (which included variables for district and monthly seasonal effects), production of irrigated vegetables was found to increase dietary diversity by 2.7 percent. In contrast, the production of irrigated staple crops and the proportion of household land that was irrigated did not significantly affect household dietary diversity.

FIGURE 15 DISTRIBUTION OF CHILDREN'S HAZ SCORES, DISAGGREGATED BY WHETHER HOUSEHOLDS ENGAGE IN IRRIGATED AGRICULTURE



Source: Author's analysis of IHS3 data (NSO 2012a).

FIGURE 16 HISTOGRAM OF HOUSEHOLD DIETARY DIVERSITY SCORES FOR MALAWIAN FARM HOUSEHOLDS, DISAGGREGATED BY WHETHER HOUSEHOLDS ENGAGE IN IRRIGATED AGRICULTURE



Source: Author's analysis of IHS3 data (NSO 2012a).

The addition of monthly fixed-effect variables to the HDDS model provided useful insight into how irrigation can reduce the negative effects of seasonal food insecurity on the diversity of diets consumed by farm households. Many Malawians experience a hungry season every year in the months just prior to and during the rains (October through March) before green maize, groundnuts, and other early crops are mature enough for consumption or sale. During this season, food stocks run low, food prices increase, and food consumption decreases. The rainy season is also a period of intensive agricultural work with higher energy needs, coupled with greater exposure to infectious diseases due to wet conditions (Wijesinha-Bettoni et al. 2013). Because women are actively involved in agriculture—especially during the busy planting season—and children are especially susceptible to infections, the nutrition status of these vulnerable groups is negatively affected (Figure 17).

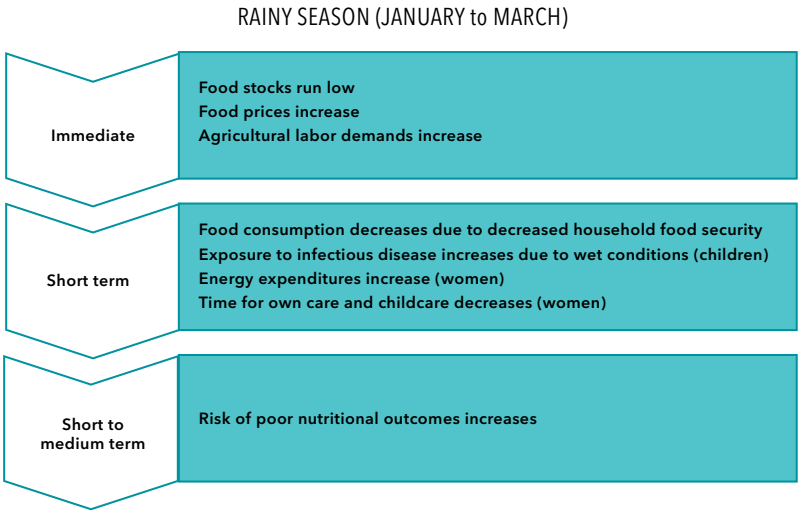
Our modeling of the association between irrigation and HDDS provides some insight into how irrigation reduces these seasonal effects. When the model was adjusted to include monthly fixed effects, a pattern of seasonal food insecurity was clearly reflected in the dietary diversity scores for the non-irrigating households subsample. Scores for this group were lowest in the "hungry season" months of February and March.

In contrast, no significant seasonality in the diversity of household diets was evident in the models developed from the irrigating households subsample. The insight we take from this result is that one of the principal contributions that irrigation can make to improved nutrition outcomes—particularly for subsistence farming households—is to ensure reliable, year-round access to a diverse diet that facilitates access to micronutrient-rich foods, such as vegetables.

DISCUSSION

There is some merit in using nutritional arguments to support increased public investment in irrigation in Malawi. The analyses reported on here provide no evidence that irrigation has adverse effects on nutrition. However, our models did not generate any evidence that irrigation can be a significant determinant of improved child nutritional status—we found no strong association between the use of irrigation by farm households in Malawi and the growth per-

FIGURE 17 EFFECTS OF THE RAINY AND HUNGRY SEASON, THROUGH A NUTRITION LENS



Source: FAO (2014).

formance of children in those households. Using improved child nutrition outcomes as a development objective to support the expansion of irrigation is a vague argument at best. A stronger argument may be made, however, for the contribution of irrigated farming to the diversity of foods consumed by farm households, particularly because irrigation was shown to be an important component in reducing seasonal food insecurity.

Women and children—the two populations most vulnerable to malnutrition—are highly susceptible to the effects of seasonality. Increased exposure to infections, decreased caloric intake, and increased energy expenditure can all increase risk of malnutrition during these periods. Indeed, seasonal availability of and access to different foods were identified as constraints to successful infant and young child feeding interventions by WHO and UNICEF (Daelmans et al. 2009). As such, the contributions that irrigated farming make to mitigating seasonal food insecurity are far from negligible from a nutrition perspective (von Braun, Johm, and Puetz 1994).

That said, as demonstrated by our analyses, the pathways through which irrigated farming can lead to improved nutrition outcomes are indirect and difficult to assess empirically. Though increased use of irrigation can contribute to household food security, it must be recognized that household food security does not ensure improved nutrition. A broader range of equally necessary determinants—sanitation, access to clean water and healthcare, and adequate care and feeding practices for all household members—must also be in place.