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IN MALAWI

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CHAPTER 6 : ASSOCIATIONS BETWEEN IRRIGATED FARMING AND IMPROVED NUTRITION IN MALAWIAN FARM HOUSEHOLDS

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Expansion of irrigation is a recurrent objective of the agricultural development plans formulated by successive governments in Malawi. 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 agricultural 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, there is little empirical evidence from Malawi or elsewhere to confirm whether irrigation improves nutritional status.

Using data from the Third Malawi Integrated Household Survey (IHS3) of 2010–2011, this chapter presents an assessment of whether increased use of irrigated farming by smallholders in Malawi might improve household-level diet 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 children in those households. However, we do find that irrigating households tended to have more diverse diets—including vegetables—than households that do not irrigate, suggesting that irrigation enables households to produce a wider range of crops for home consumption than they can with purely rain-fed production. 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.

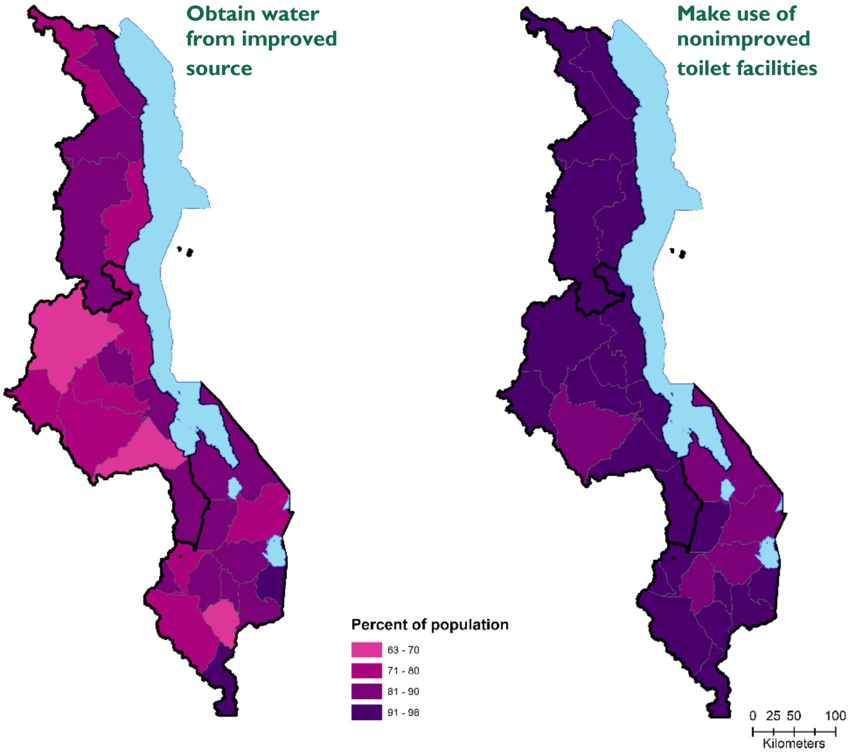
6.1—Plausible impact pathways

There are several direct pathways through which irrigation can be hypothesized to affect the nutritional status of farm households:

- Irrigation can improve food security—an immediate and underlying determinant of nutrition—through 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 from the same area.
- Irrigation may improve dietary quality by enabling production of a broader diversity of crops. 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 the IHS3, 40 percent were used for vegetable production, while 58 percent were used for staple crops (primarily production of maize for green maize consumption) (NSO 2012). Vegetables are important sources of vitamin A and iron—both of which are lacking in many Malawians' diets. With irrigated production of micronutrient-dense crops such as vegetables, household dietary diversity might increase, resulting in improved micronutrient intake, with subsequent reductions in the incidence of health problems linked to micronutrient deficiencies.

- As mentioned in Chapter 1, inadequate dietary intake weakens the immune system and increases susceptibility to disease. Infectious disease, in turn, increases nutrient requirements and weakens the immune system. Irrigation can help disrupt this vicious circle by increasing access to safe water, thus improving sanitation and reducing the burden of disease in communities. (See Figure 6.1 on use of improved water sources and unimproved toilet facilities in Malawi.) However, irrigation may also increase exposure to malaria and schistosomiasis, the vectors of which—*Anopheles* mosquitoes and freshwater snails—thrive in surface water. In these scenarios, nutrition would be *adversely* affected by infections facilitated by irrigation-related circumstance. However, there is evidence that these potential health shocks due to irrigation often are offset by the increased income resulting from the use of irrigation (Keiser et al. 2005).

Figure 6.1—District-level maps of percentage of households obtaining water from an improved source and using traditional, nonimproved toilet facilities



Source: Analysis by M. Kedir, IFPRI, of DHS data.

- 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 are able to 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).

6.2—Methods

In order to better understand the impact that irrigation might have on the nutritional status of Malawian smallholders, we used data from the IHS3 to investigate (1) whether irrigation was significantly associated with the height-for-age of children in IHS3 sample households and (2) whether there was a significant association between irrigation and the dietary diversity of surveyed households.

The IHS3 was a national household consumption survey administered by the National Statistical Office of Malawi between March 2010 and March 2011. The survey included a household questionnaire on a range of topics, including income, food and non-food consumption, demographics, education, asset holdings, and employment, as well as data collection on the height and weight of young children (6 months to 5 years) from surveyed households. The latter were used to calculate height-for-age z scores (HAZ), which is the gold standard for measuring stunting in young children. Stunting is caused by long-term insufficient nutrient intake and frequent infections.

For the 9,750 surveyed households who reported undertaking agricultural activities, an additional agricultural questionnaire was administered to them. Of these households, 1,132 (11.6 percent) reported irrigating some of their crops. Our analysis used data from this agricultural subsample, differentiating in our analysis between irrigating and non-irrigating farm households.

We used two indicators as outcome variables in our models: HAZ scores for young children[12] and Household Dietary Diversity Scores (HDDS) for households. HAZ scores were computed by comparing the height-for-age of each child in the subsample with the 2006 child growth norms of WHO, as described in Chapter 2. HDDS were 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.

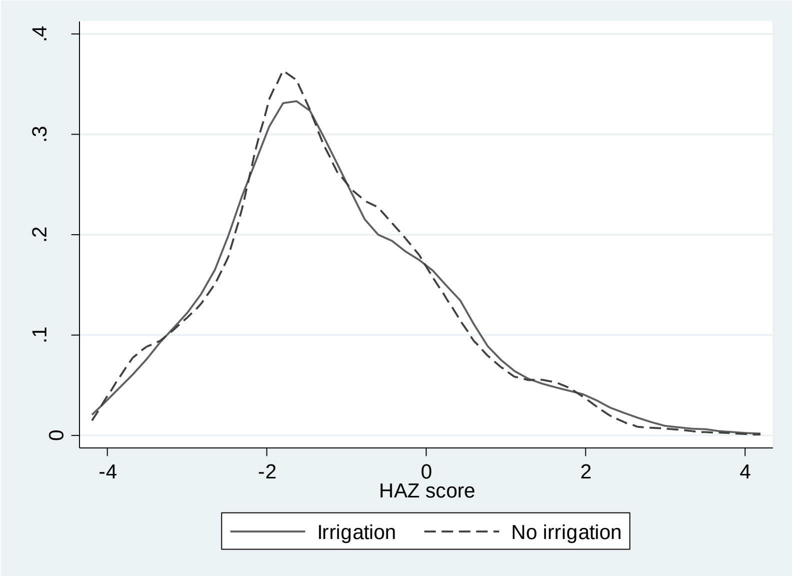
We conducted means comparisons and used a series of regression analyses to model the impact of irrigation on both of these outcomes. For each regression, we controlled for demographic and socioeconomic characteristics, agricultural and agroecological characteristics, and institutional factors. For models looking at household dietary diversity, we also included fixed-effect variables for the month that the sample household was interviewed. This allowed us to investigate seasonal differences in dietary diversity between irrigating and non-irrigating farm households.

6.3—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 6.2). These results were confirmed in the regressions. None of the models found a statistically significant association between predictors of irrigated farming, related independent 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.

[12] The quality of the anthropometric data in the IHS3 data have been called into question as they differ significantly from those in Malawi's 2010 Demographic and Health Survey that was implemented at about the same time (see Chapter 2). However in this analysis, measurement error of prevalence rates was of less concern than the difference in means between irrigating and non-irrigating households. As such, we report on IHS stunting data here, but with this important caveat.

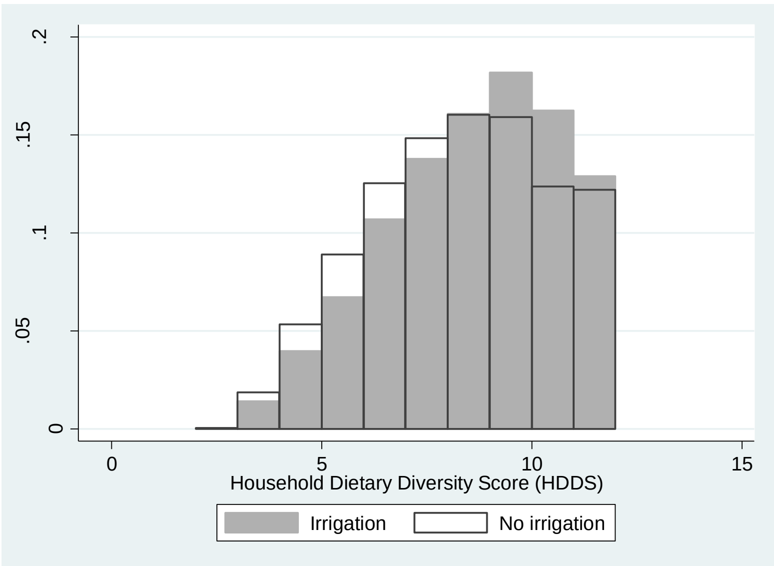
Figure 6.2—Distribution of children's HAZ scores, disaggregated by whether households engage in irrigated agriculture



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

Conversely, on the mean, we found that irrigating households tend to have more diverse diets than households that do not irrigate (Figure 6.3), suggesting that irrigation enables households to produce a wider range of crops for home consumption than they can with purely rain-fed 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.

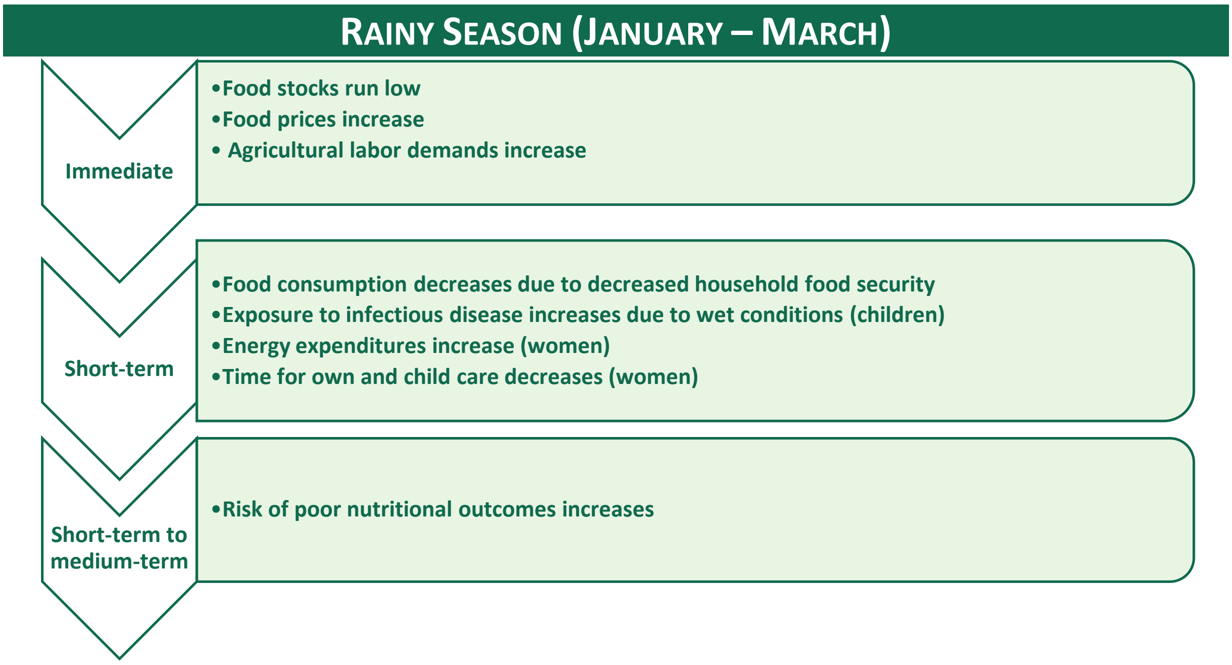
Figure 6.3—Histogram of household dietary diversity scores for Malawi farm households, disaggregated by whether households engage in irrigated agriculture



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

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 6.4).

Figure 6.4—Effects of the rainy and hungry season, through a nutrition lens



Source: FAO 2014

Our modelling 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 diet 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.

6.4—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 performance 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 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 that are most vulnerable to malnutrition—are highly susceptible to 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 and access to different foods have been identified as a constraint to successful Infant and Young Child Feeding (IYCF) interventions by WHO and UNICEF (Daelmans et al. 2009). As such, irrigation's mitigation of seasonal food insecurity is far from a negligible impact from a nutrition perspective.

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 health care, adequate care and feeding practices for all household members—must also be in place.

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