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N O T E

Agriculture-Health Interactions for Improved Malaria Outcomes in Uganda
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Malaria in Uganda: Improved Outcomes when the Health Sector joins forces with Agriculture

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Introduction

Malaria outcomes are closely related to agricultural settings. How, when and where crops are grown, livestock is raised and irrigation is developed all affect malaria rates in a given local area. Moreover, evaluations of health-only focused interventions suggest that while these interventions produce dramatic declines in infection, morbidity, and mortality, the declines are not sufficient to interrupt transmission. Finally, the WHO estimates that 30 to 53 percent of the global malaria burden (half a million deaths) is attributable to *modifiable* environmental factors.

Despite this, malaria is still largely considered a health issue, and almost all interventions have a health focus (key interventions include insecticide treated bed nets and anti-malaria medication), even though those most at risk of malaria spend much of their daylight hours in agriculture and related activities.

Few interdisciplinary analyses bridge the gaps in understanding between health and agricultural experts. And there is very limited research and practical experience on how collaboration across the agriculture and health sectors can simultaneously improve both health and agricultural outcomes while sharing the costs of combatting the disease. Furthermore, there is even less translation of such empirical evidence into policy programs or interventions designed to exploit these opportunities.

With the financial support from the German Federal Ministry for Economic Cooperation and Development (BMZ), the International Food Policy Research Institute (IFPRI) together with the Center for Development Research (Bonn, Germany) and Makerere University in Uganda have undertaken exploratory research to expand the range of cost-effective policy tools available to both agricultural development and public health stakeholders in malaria-endemic circumstances. We assessed the potential of Farmer Field Schools (FFSs) and Integrated Pest and Vector Management (IPVM) interventions as options to reduce the malaria burden in agricultural communities in Uganda. FFS is a group-based education and extension approach for farmers built upon principles of participatory and interactive learning. IPVM is a program developed by the FAO and UNEP that addresses the dual role of agricultural systems in producing food as well as fostering or reducing disease vectors. IPVM engages communities in a rational decision making process to simultaneously achieve reductions in both agricultural and health pest species.

The case study location is Uganda because malaria is endemic in more than 95 percent of the country. Uganda has the highest malaria parasite transmission reported in the world and is also subject to the world's highest malaria incidence rate, with roughly 10 million cases per year in a population of 30 million.

Based on our analysis and our final policy workshop held in Uganda in December 2012 we believe that at costs of US$800 for two seasons and 25 farm families FFS and IPVM may well provide a cost-effective and integrated solution for improving both health and agricultural outcomes, compared to much costlier health-based interventions, with interventions ranging from US$123 to US$1000 per death averted. However, a true cost benefit comparison will require actual implementation of a malaria focused FFS curriculum.

The linkage between malaria and agriculture

Our literature review suggests that in stable malaria areas irrigation can reduce malaria prevalence due to increased malaria prevention measures by relatively wealthier households; whereas in other areas, irrigation can contribute to increased malaria prevalence. Other studies have found that some trees are associated with increased malaria incidence, including acacia, avocado, and mango trees which are used as mosquito breeding sites. Finally, some studies have found that hybrid maize varieties, whose pollination coincides with mosquito breeding times—with larvae feeding on maize pollen—increases the life expectancy of mosquitoes and the number of mosquitoes per human host. Hybrid maize is not yet common in Uganda.

Livestock is known to play a role as an alternative blood-meal source for vector populations; this characteristic has led to research on two contrary potential impacts on human malaria prevalence. Greater livestock density may reduce human malaria if vectors prefer livestock meals; or greater livestock density may increase human malaria if the larger food resource increases vector populations that continue to feed on humans.

Our regression analysis finds that malaria prevalence is clearly associated (positively or negatively) with a wide variety of crop-choices, as well as socioeconomic and demographic variables. Wealth, education, gender, and bed-net use are associated with malaria at the household level, with malaria risk differing across age groups.

We find that almost all households in Uganda are spending income on malaria treatment when the disease is diagnosed or suspected. Any reduction in malaria prevalence would therefore reduce constraints on household budgets. Urban households were associated with less malaria compared to rural households. Male headed households reported lower malaria prevalence than female-headed households except for the children-under-5 age group where female headed households reported lower malaria prevalence. Bet-net use was positively correlated with malaria prevalence for children under-5 and children under-10.

Daily Maximum Temperature was negatively correlated with malaria prevalence, while daily minimum temperatures were positively correlated with malaria prevalence. These findings confirm that trends documented in the broader literature on malaria forecasting are applicable to the local Ugandan context. We find that growing sweet potatoes/yams, beans, millet, and 'other crops' increases the likelihood of malaria compared to maize, whereas millet was associated with lower malaria prevalence than maize.

The Role of Farmer Field Schools (FFS)

FFS are an agricultural extension approach built on the principles of adult education, experiential, group-based, participatory and interactive processes and social learning. Through FFSs, farmers come together to identify and prioritize the challenges facing their community, study such problems in their own plots over a growing season and combine local knowledge with new information such as agro-ecosystem analysis to make logical farm management decisions.

The International Food Policy Research Institute (IFPRI) and the International Fund for Agricultural Development (IFAD) previously conducted a joint evaluation of the East African FFS experience to provide robust evidence for policymakers, donors, and farmers on how FFSs can contribute to agricultural productivity and poverty alleviation in East Africa. We re-examined the Uganda household data to consider how FFS programs may be adapted to deliver health and vector management knowledge along with agricultural-learning.

FFSs allow people with lower education to significantly improve their crop-yields irrespective of technology adoption. This suggests that FFS is an effective delivery mechanism for education to more socially and economically marginal households with little or no formal education. However, female headed households participate less in FFSs which is of particular importance to malaria education as there is a robust relationship between maternal education and child health outcomes.

Malaria Curriculum for Farmer Field Schools

The UN Food and Agriculture Organization (FAO) developed a FFS manual for Uganda recommending Integrated Pest Management (IPM) as a holistic approach to farming. Under IPM, environmentally friendly agricultural production and pest management practices are recommended to farmers to balance ecological with economic aspects in their farm business. IPM principles are useful for malaria monitoring as well, and have been used in Sri Lanka

before. By introducing IPVM into the FFS curriculum in Uganda, FFS may apply the same participatory learning approaches successful in management of agricultural pests to the health problems identified by farming communities while informing participants about these Neglected Tropical Diseases.

Participatory approaches to learning have to guide the farmer field schools with facilitated questions rather than prescriptive information. Based on empirical analyses and extensive literature review this research program has developed suggested elements to a malaria curriculum for Farmer Field Schools, which includes the following questions in addition to elements of Agro-Ecosystem analysis and Human Ecosystem Analysis to monitor changes over the typically two crop season length of a farmer field school:

- Is malaria a high-priority problem in this community?
  This is essential to the community-demand foundation of the FFS approach and limiting the out-scaling of the approach to locations where local environmental conditions are supporting malaria transmission.
- What are the community's perceptions about malaria, its causes, cures, etc… and are there any misconceptions?
  Establishing basic information can be the easiest and most cost-effective form of intervention. Many individuals may not know how malaria is transmitted, who is most at risk, how to protect themselves with bed-nets, and may also hold misconceptions that can be addressed by the FFS facilitator or a village health team.
- Who is most affected in the community?
  The facilitator may prompt with groups such as children, forestry workers, rice farmers, households in a particular area of the community, poorer or less educated households, etc…
- Can the farmers / pest or vector control facilitators identify where mosquito larvae are reproducing?
  These areas could be ponds of stagnant water, irrigated areas with poor drainage, natural wetlands, borrow pits, rainwater harvesting barrels, livestock pastures, or any location where participants notice concentrated populations of mosquitoes.
- Are the larvae in an economically valuable area such as an irrigated rice field or timber-stand, or is the area able to be environmentally modified without harming livelihoods such as a disused drain or borrow-pit?
  It is important for the local FFS to make determinations about the impact of the malaria vectors with respect to livelihoods so that the decisions made do not damage the economic welfare or health of households through loss of income.
- Is there irrigation being practiced and if so of what types? (gravity, rainwater havesting, etc.) And if so does such irrigation coincide with seasonal malaria transmission?
  Irrigation may have many unexpected interactions with malarial or other disease vectors. Irrigation systems may favor mosquito species that do not transmit malaria over those that do or be associated with malaria declines due to improved socio-economic status, referred to as the "paddies paradox".
- Are there seasonal patterns to the malaria problem? Does this coincide with crop pollination or livestock watering patterns?
  Cropping calendars and seasonal planning are already a well-established practice in FFS to address seasonal livestock disease patterns. Applying the same approach to human diseases can help communities advocate for health program visits during seasonal malaria transmission.

These are just a few examples of how an FFS program can integrate malaria and vector-borne disease control. FFS present many opportunities for sharing malaria information with farmers. By supporting the dissemination of health information through participatory learning approaches, FFS can supplement health programs. Agricultural experts in pest-management can share their expertise with the health-sector pursuing vector control. Both the Agricultural and Health Sectors can benefit through integrating health and agriculture messages into FFS programs as FAO demonstrated in Sri Lanka through FFS-IPVM programs. Ultimately, this approach can simultaneously improve economic and health outcomes in communities that identify malaria as both a significant problem and one with local environmental mitigation options.

Stakeholder Feedback

Following empirical analyses of IFAD-FAO FFS programs and the development of FFS curriculum elements, results were presented at a workshop at Makerere University where the Ministries of Health and Agriculture, FAO, and various NGOs and private companies involved in health and rural development were engaged to discuss the potential application of this research in Uganda. Agricultural and Health practitioners found that they had many questions for one another prompting discussions comparing the two sectors' relationships to government, donors, and community interventions.

The most pervasive message from stakeholders was that Ugandan institutions face a variety of challenges and obstacles to sharing financial and intellectual resources between the agriculture and health sectors. This concern regarding institutional barriers to collaboration, according to the stakeholders, could be addressed through: 1) increased local capacity at the community and district level; 2) greater opportunities for knowledge sharing between the sectors; and 3) a joint-policy framework addressing financial cost-sharing and integrated data collection.

Nutrition and water-sanitation were also identified by stakeholders as key issues around which the Agriculture and Health sectors might collaborate in Uganda. Rural water use frequently relies on the same water sources for both agricultural and household water consumption.

In the course of discussions, stakeholders identified Village Health Teams organized by the Ministry of Health as a potential partner for FFS Facilitators. Village Health Teams provide a parallel rural service delivery model that could be invited to collaborate with FFS by participating in health-related discussions with the FFS and providing participants with health education and referrals to district level health resources.

Conclusions

Integrated agriculture-health interventions for environmentally driven diseases, such as malaria, can help address the common agro-ecological basis of the agricultural and health sectors. Joint interventions can likely foster improvements in agricultural income, input costs, pesticide resistance in agricultural pests and disease vectors, pesticide poisoning, vector-borne diseases, efficacy of health interventions against malaria, health-related expenses at the household level, and health-related labor losses.

While more robust evaluations are required to establish the precise causal avenues between agricultural practices and malaria transmission, it is already possible to experiment with collaborative interventions such FFS, Integrated Pest-Vector Management, and collaboration between agricultural extension providers and village health teams. Such collaborations foster knowledge-sharing between the agricultural and health sectors, which offer complimentary expertise in rural service delivery to agricultural communities in Uganda.

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