Can fortification be implemented in rural African communities where micronutrient deficiencies are greatest? Lessons from Projects in Malawi, Senegal and Tanzania

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Key Message
Including community level fortification in national frameworks and establishing sustainable systems for premix delivery, quality assurance and cost recovery will increase access to essential micronutrients by rural communities who have very limited access to large scale fortification initiatives.

Abstract
Fortifying commonly eaten foods with vitamins and minerals is a recognized, effective strategy for decreasing micronutrient deficiencies at a population level. National fortification initiatives often do not impact remote communities who may be unreached by commercially produced food. In this paper, we review the innovative implementation of community based fortification of staple grains in rural communities in three Sub-Saharan African countries. Strong advocacy influenced national policy and the legislation for mandatory national level fortification of staple grains, while piloting community based fortification led to community acceptance of the benefit of consuming fortified foods. Further work is needed to determine contextually feasible and sustainable mechanisms for premix supply, quality control and cost-recovery. Incorporating this work into national fortification frameworks is recommended for countries where a significant proportion of the population may have very limited access to commercially fortified foods.

Background
Hidden hunger, a chronic lack of vitamins and minerals in the diet, affects about one third of the world’s population. Deficiencies in micronutrients such as iron, zinc and vitamin A compromise the physical and cognitive capacity of millions of people, contributing to the perpetuation of poverty, poor health and underdevelopment. The greatest burden of micronutrient deficiencies is found in low resource communities where the typical diet is high in starches but low in micronutrients. Iron deficiency anaemia is the most common form of malnutrition, affecting over 2 billion people globally.

Fortifying commonly eaten foods with tiny quantities of essential vitamins and minerals is an effective strategy for decreasing micronutrient deficiencies at a population level, and is widely practiced in high income countries. Over the past 15 years national governments and the global nutrition community have invested significant efforts in bringing the benefits of fortification of staple foods to lower and middle income countries. Currently 79 countries have legislated mandatory fortification of wheat, maize and/or rice, making a vital contribution to the global reduction of micronutrient deficiencies. However in many lower income countries, particularly in South
Asia and sub-Saharan Africa, a significant proportion of the population live in rural areas and rely on smallholder agriculture for their food supply, with limited access to the benefits of commercially fortified foods. Community level fortification has the potential to extend the reach of national, large scale fortification initiatives to rural communities.

Throughout this paper, community level fortification is used as a collective term encompassing three different modes of decentralized food fortification. All three methods involve the addition of a multi-micronutrient premix to grains either during or after milling. The premix is typically diluted with flour to form a preblend, which makes it easier to measure the quantities required to fortify small batches. **Medium Scale Fortification (MSF)** mills process less than 40 metric tonnes (MT) per day and may have the capacity to make the preblend. **Small Scale Fortification (SSF)** hammer mills process small volumes (less than 20 MT/day) of high extraction flour. Measured amounts of micronutrient preblend may be added during milling or mixed in afterwards, but SSF units cannot make the preblend. Most of the SSF mills within the project milled approximately 1 MT/day. **Home Fortification (HF)** is the addition of micronutrient preblend in a sachet or measured scoop to a food during meal preparation.

Developing sustainable fortification models suited to smallholder agricultural communities is challenging. Large scale commercial food enterprises with inbuilt mechanisms for quality control, marketing and distribution can achieve economies of scale which minimize the additional cost of fortification to consumers. Community level fortification requires establishing systems for procurement, storage and dosing of the micronutrient premix, and for quality control to ensure that fortification protocols are adhered to, for safety and effectiveness. Costs are not absorbed across a broader system as with large scale enterprises.

In the late 1990s, World Vision began to investigate the potential of community level fortification within MICAH, a large-scale, multi-country integrated nutrition and health program funded by the Canadian International Development Agency. On MICAH’s conclusion, private funds were used to extend the investigative projects. An exploratory approach was used, focused on developing appropriate community based methods and processes for flour fortification in Malawi (1998–2009), Senegal (2004–2006; 2008–2012) and Tanzania (2001–2009). The fortification initiatives evolved over the implementation period as new challenges were encountered. This paper presents the findings of a review which was conducted in 2012 to document the implementation process, identify barriers and enablers related to implementation, sustainability and effectiveness, and evaluate the potential for replication and/or scale up of the intervention. The review included Key Informant Interviews with project leaders and advisors, review of reports from the three projects, and site visits including focus group discussions with community members in Malawi and Tanzania.

**Program Description**

The three projects were all embedded within a broader nutrition and health program (MICAH), which facilitated community engagement, capacity building and social mobilization. As the coordinating NGO, World Vision provided funding, technical expertise, a larger financial and management framework, monitoring and accountability mechanisms. Highly motivated national staff committed time, energy, resources and creative thinking into developing necessary policies, procedures, systems and networks. Fortification was previously unknown in the project communities, but social mobilization activities led by the strong networks of community partners which were already well established through the MICAH program and trusted by the communities, facilitated its introduction and acceptance. Village coordination committees comprised of village health workers, health care providers, community leaders and volunteers, were trained by project staff. They sensitized and educated community members through drama, dance, song, discussion and demonstration. This focussed public awareness campaign and behaviour change communication messaging overcame initial wariness regarding fortification, increased demand and facilitated its broad acceptance.
Communities were also directly engaged in the distribution and monitoring of premix supplies through these committees. Extensive capacity building and technical support at national, district and village levels strengthened implementation and commitment.

Collaborative partnerships with Ministries of Health, universities, NGOS and technical experts were established in all three countries. Project staff played a central role in the establishment of National Fortification Alliances (NFAs) in Malawi and Tanzania. The advocacy efforts of the NFAs influenced national policy in favor of fortification, including removing import tariffs on fortificants and equipment. This laid the groundwork for the eventual legislation of mandatory large scale fortification although community level fortification did not become a national priority. In Senegal, the NFA was already well established, having launched a five-year national fortification strategy in 2006, which led to national legislation mandating the fortification of wheat and oil by large scale producers.

Within this broader common framework, each project had unique features and adaptations based on the local context.

Malawi:

The fortification initiative in Malawi began in 1998 with two MSF units being established by two local agencies who were partners of the MICAH program. World Vision consulted with fortification experts to select the micronutrient premix formulation, which each MSF unit then independently sourced from a private supplier in South Africa. They diluted the premix with maize flour to produce a preblend which was then added to both maize flour and Likuni Phala, a complementary food targeted to young children but consumed by the whole family. The MSF units produced these fortified products for sale to institutions, hospitals and NGOs as well as making preblend sachets for household use.

The MSF units were licensed and monitored by the Malawi Bureau of Standards who performed quarterly quality audits. These audits examined all aspects of production, including equipment, buildings, raw material storage, packaging, staff hygiene and medical records. Samples of fortified products were evaluated quarterly for micronutrient and moisture content, quality of blending, colour and taste. However, feedback was often delayed and not always conclusive. Several fortification and milling experts visited the MSF units to assess the quality control systems which led to adjustments in equipment and processing techniques.

After three years, in 2001, the project expanded to include SSF. With MICAH project funds, the MSF units produced preblend that was distributed to local hammer mills, eventually covering 19 villages. Initially, no charge was passed on to the consumer or the miller. Monitors, trained and paid by the project, were based at the hammer mills to monitor processes and promote fortification to clients. The project also began distributing preblend in small sachets for HF through community level Fortification Committees and Village Health Committees. Due to frequent mill equipment breakdowns as well as the later introduction of the cost recovery system for preblend, hammer mills eventually stopped fortifying maize. The sale of Likuni Phala and creamed maize by the MSF units helped to cover the cost of producing preblend sachets which were sold to communities at subsidized prices. Community Public Health Chairmen purchased preblend sachets from the MSF units and distributed them to community fortification volunteers. Each sachet fortified 2 kg of maize and was sold by the volunteers to community members for approximately $0.02 (7–10 kwacha). These funds were used as a part of a savings and loans bank for the community to obtain more sachets.

At the end of project funding, some communities were continuing to promote and sell preblend sachets for HF. Consultants assisted to develop a business plan focused on productivity, profitability and sustainability for one of the MSF units, to address the challenge of absorbing costs formerly paid through donor funds. Strategies included reviewing organizational structures, staffing and training to optimize efficiency and productivity; developing short- and long-term sales, markets and production objectives to decrease dependence on preblend
income; projecting financial trends based on present and future markets; and investing in mass media social marketing campaigns with the potential of reaching more customers. However, as a small business initiative with a health emphasis, the mixed mandate between private enterprise and charitable mission made the plan a challenge to implement. The other MSF unit, while still under the auspices of the local mission hospital, struggled to increase sales and decrease production costs to remain financially viable.

Senegal:

Fortification activities were initially developed in the final years of the MICAH program (2004–2006), then were recommenced with private funding in 2008, and integrated with a USAID-funded multi-NGO community health program until 2012. The review focussed on the 2008–2012 fortification project. This project built two mills to process grain, offering communities an alternative to the traditional method of pounding grain to make flour. The mills were run as community-managed businesses, with mill operators retaining any profits. The milled or pounded grain was fortified in the home using preblend provided to households in monthly batches. The project also constructed two small buildings, known as fortification units, for storing and diluting premix, and two bakeries, which produced bread using fortified flour for sale in the communities. The fortification units were staffed by volunteers, selected and supervised by community management committees. The bakery staff was paid and bakery profits were managed by community fortification management committees for future premix procurement. Fortified flour was also sold at a subsidized rate to local schools for use in meal preparation.

The project used a premix available from a commercial supplier in Dakar. The communities, with project staff supervision, became responsible for the dilution of premix at the fortification units, and the monthly distribution of preblend to households and schools. The difficulty in obtaining an appropriate sieve to efficiently process millet resulted in a more labor intensive preblend production process, which decreased output and expansion potential. Seasonal food insecurity posed another major challenge. July to September is the lean season when staple cereal grains are in short supply so fortification activities were significantly reduced during this period each year.

Institut de Technologie Alimentaire (ITA), the national food technology agency, provided training, technical support and quality control monitoring for the project. ITA collected and analysed samples of fortified flour two or three times per year. They also analyzed samples of fortified foods before and after cooking to determine micronutrient content. The level of iron was consistently higher in the fortified vs. unfortified flour, but varied depending on mixing technique or the type of grain used.\(^9\)

The sustainability strategy, developed in the final year of the project, was to generate sufficient profits through the sale of fortified bread to allow the community management committees (formed as income generating enterprises) to independently purchase premix. Volunteers would continue premix dilution at the fortification units established by the project. Community committees would also continue their premix distribution and monitoring activities using bicycles provided by the project. An independent project evaluation in October 2012 found that the committees were insufficiently prepared and resourced to fulfill these roles, particularly sourcing and transporting premix from Dakar,\(^10\) and indeed fortification activities have not continued one year after the end of funding (personal communication with Babacar Ndour, National Health Director, World Vision Senegal, Dec 2013).

Tanzania:

In Tanzania, SSF was initially implemented through hammer mills. Project staff sourced preblend in large quantities from the food production branch of a local mission and repackaged it into sachets containing the appropriate amount of preblend to fortify 1 kg of maize before delivering the sachets to hammer mill operators. Later, the supplier produced these premeasured preblend sachets. The mill operators contributed the milling and mixing space but had no obligation to fortify nor received any economic advantage, thus reducing their
commitment. All costs were covered by the project requiring no cost sharing by the beneficiaries. For these reasons and due to frequent breakdowns of mill equipment, SSF was eventually stopped at the mill level. However, prior to this, HF was introduced and beneficiaries began to pay a nominal price per sachet. Preblend sachets continued to be sourced and delivered to communities by project staff. Fortification Committees comprising of village health workers and community members were established in each community. Trained by project staff, they were responsible for the supply and delivery of premix within the community, educating families on the proper mixing and monitoring the use of premix. Samples from the mills and later from the communities were tested periodically at a university laboratory.

Free distribution of premix at the beginning of the project resulted in the need for considerable sensitization to achieve the acceptance of a minimal cost sharing initiative. Beneficiaries paid approximately $0.01 (20Ts) /10 g sachet which was sufficient to fortify 1 kg maize. This price covered half the cost of premix purchase, excluding transportation costs from the factory to the project site.

As project funds ended, communities did not have the knowledge or capacity to procure the premix sachets independently. Therefore, technical staff supported the communities to develop a food-to-food fortification initiative. They combined, dried and ground selected types of locally available foods to produce a mix with high nutritional value which was cooked into a porridge. Fortification Committees actively promoted and monitored this initiative and there were anecdotal indicators of change in behaviour towards a more intentionally diversified diet. However, during the 2012 review, community leaders and members expressed great interest in re-establishing flour fortification.

Results

Community level fortification, a novel method of increasing micronutrient intake of rural populations, was implemented in three different contexts with strong community acceptance and participation. The projects were not designed to evaluate the effect of community level fortification on micronutrient status, but to explore implementation feasibility.

Coverage: In Tanzania, annual coverage ranged from 9,350 households in 2001 with SSF alone to 22,950 households in 2006 with both SSF and HF. In 2008, with mills no longer fortifying maize and the introduction of a cost recovery system for HF, coverage dropped to 4,600 households and remained at that level until the project concluded in 2010. Coverage in Malawi also varied, affected by diverse factors. By 2005 SSF was implemented in 19 mills covering at least 22,500 households. One MSF unit expanded fortified Likuni Phala production from 36 MT in 2000 to 408 MT in 2010. Demand for preblend sachets for HF declined when this MSF unit introduced a cost recovery program. However in 2011, two years after project funding ended, the other MSF still produced approximately 725 MT of preblend sachets, sufficient to fortify maize for approximately 10,000 households. The Senegal project was implemented on a smaller scale, reaching over 750 households across 32 communities. Three secondary schools and 12 primary schools also used fortified flour in at least one meal per day for students in boarding.

Policy: The projects were instrumental in raising awareness of the need and benefits of fortification, particularly in Malawi and Tanzania where they played a key role in establishing National Fortification Alliances in partnership with the respective Ministries of Health. The work of the NFAs influenced national policy and led to legislation for mandatory national level fortification of staple grains. However, this legislation did not extend to community mills, for logistical reasons, and community level fortification remains outside the national fortification framework in Malawi and Senegal. Tanzania’s National Nutrition Strategy for 2011–2015 committed to developing a fortification plan and mentioned the need for exploration of community level fortification.
**Sustainability:** Sustainability of community level fortification without external funding was very limited. In Malawi, hammer mill fortification was discontinued while the two MSF units continued to produce premix sachets for sale to local communities, although demand declined when cost-recovery measures were introduced. The MSF units continued to produce fortified products for sale to institutional buyers. In Tanzania, although community interest in fortification remained high, cost-recovery measures were insufficient to sustain activities. Food-to-food fortification was prioritized instead. In Senegal, continued potential for community based fortification remains with established facilities and equipment. Although a sustainability plan was developed, this was done late in the project and fortification activities ceased with the end of project funds.

**Discussion**

In the late 1990s when the Malawi and Tanzania projects began, few lower income countries had fortification programs in place, but the concept was beginning to attract interest at both national and global levels. International goals set at the 1990 World Summit for Children (UNICEF) focused attention and resources on the huge burden of preventable micronutrient deficiencies. As national networks for fortification were established and began to formulate strategies, organizations working at the community level recognized that the rural poor would be largely excluded from the benefits of large scale food fortification. Pilot projects of community level fortification were launched by non-governmental organizations in at least four African countries, and the Micronutrient Initiative (MI) provided technical support, feasibility studies and knowledge sharing forums. However, with the obvious benefits of national fortification, and the complexity of implementing community level fortification, global attention increasingly focussed on supporting national fortification initiatives.

Technical standards and guidelines for large scale fortification are now developed\(^\text{13}\) and more technical expertise is available, including tools to support the design of evidence-based fortification programs.\(^\text{14}\) However, community level fortification continues to be perceived, not without justification, as overly complex and cost-ineffective\(^\text{15}\) despite the acknowledgement that national fortification initiatives exclude a significant nutritionally vulnerable proportion of the population. A fundamental challenge is the absence of economy of scale, particularly in SSF, such that full cost-recovery is not achievable by end-users paying for fortification. Maize flour, the staple grain of Malawi, Tanzania and several other sub-Saharan African countries with a high burden of malnutrition, has been identified as one of the most costly staple foods to fortify due to the large number of mills that need to be equipped and monitored.\(^\text{16}\) The logistical challenges of establishing a reliable premix supply and conducting adequate and regular quality control monitoring are magnified in rural areas.

World Vision’s experience implementing the three projects demonstrates both the complexity and the potential of community level fortification. With the support of project resources and leadership, community level fortification activities were established in various forms in the different contexts. The chosen methods of fortification were adapted to the local situation and were well accepted by communities. The projects engaged existing national resources for implementation guidance, premix supply and quality control, as well as leveraging community confidence, organizational structures and nutrition knowledge built through the broader MICAH program. However, national fortification initiatives did not accommodate tangible support for community level fortification, so that sustainability relied on communities’ ability to fund and manage the fortification activities themselves upon the completion of project funding.

While it proved unfeasible for communities to sustain fortification on their own, the project in Malawi identified the potential for MSF to provide a supportive structure for SSF.\(^\text{11}\) This approach is being pursued by Sanku Fortification (Sanku), a new initiative focussed on developing viable methods for community level fortification.\(^\text{17}\)

Sanku developed innovative technology to address the challenges of human error issues, sanitation concerns and lack of guarantee that mills were actually using the premix. This technology for gravimetric dosing of a highly concentrated premix directly into hammer mills is similar to that used at the large scale. A miller simply
opens the 5 kg aluminum bag and pours the concentrated premix into the dosifier. There is no need for the miller to perform any additional tasks or to dilute further. The dosifier stores operational data such as hours and days of operation, total grain milled and premix dispensed. This data is easily retrieved and used for monitoring the homogeneity and use of premix and ensuring good practices. By comparing the amount of premix a mill receives and consumes with the remaining stock, the miller’s compliance with fortification standards can be assessed. The data can also be used to map fortified flour consumption patterns in a region.

At the MSF level, the increased cost of fortification is negligible due to economy of scale, providing a platform from which to support and subsidize SSF. In Tanzania, for example, Sanku calculates that the cost of premix purchase and transport for MSF of maize flour is 0.27% of average annual household income. Although this figure does not include the one time dosifier purchase and ongoing promotional and monitoring costs, it suggests that MSF can be financially viable. The advantage of scaling up a SSF program in countries that have mandatory fortification legislation is that active social marketing and a certain level of market demand would already be present.

By leveraging the networks, systems and tools already in place for large scale fortification, Sanku aims to expand the reach of fortified flour first through MSF units and then to SSF, beginning in Tanzania but with the expectation of replication in other east African countries. (personal communication with Felix Brooks-Church, Founding Technology Officer, Sanku Fortification, Dec 2013).

This renewed interest in SSF with its concerted effort to resolve challenging issues related to accurate dosing, monitoring and logistics offers great potential to improve the nutritional status of the more vulnerable, rural populations.

**Conclusion**

Community level fortification of staple grains is very challenging to implement in rural communities of Sub-Saharan Africa. However this innovation has great potential to address the unmet need for micronutrients in vulnerable populations, World Vision’s experience demonstrates the acceptability of community level fortification and the potential for implementation models to be developed. Further work is needed to determine contextually feasible and sustainable mechanisms for premix supply, quality control and cost-recovery. The complexity of small scale fortification places high demands on community capacity and may be best developed and supported through medium scale initiatives. Incorporating this work into national fortification frameworks is recommended for countries where a significant proportion of the population has very limited access to commercially fortified foods.
References


