FINAL TECHNICAL REPORT / RAPPORT TECHNIQUE FINAL
ANNEX 2: RESEARCH OUTPUTS

Susan Horton; Nadira Saleh; TCE Mosha;

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IDRC Grant / Subvention du CRDI: 107790-001-Promoting Locally Fortified Sunflower Oil Using E-Vouchers (CIFSRF Phase 2)
Annex 2.1.

**Title:** MASAVA: Mafuta Asili ya Alizeti yenye Vitamini A (Virgin Sunflower oil fortified with vitamin A)

**By:** Thom Dixon, Susan Horton and T. C. E. Mosha

**Project Output Type:** Presentation from stakeholder meeting in Singida, September 9 2015

**Date:** September 9 2015

**Institutions involved:**
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

**Abstract:**
This presentation summarizes progress from project start (August 2014) to end of August 2015, and includes summary findings from the household baseline survey

IDRC Project Number 107790

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Masaya: Mafuta Asili ya Alizeti yenye Vitamini A

[ Virgin Sunflower oil fortified with vitamin A]

September 9, 2015
Vitamin A deficiency in Tanzania: affects

34% of children age 6-59 months

37% of women reproductive age 15-49 years

Regions of Manyara and Shinyanga have some of the highest prevalence of vitamin A deficiency in children in Tanzania

*Tanzania DHS 2010
Vitamin A deficiency in children in Tanzania

Percent of children age 6-59 months with vitamin A deficiency after adjusting for infection/inflammation
Current project facts

- **Project Duration**: September 2014- January 2017
- **Target Area**: Manyara and Shinyanga regions, each region has three intervention districts and one control district
- **Primary target group**: 65,000 household- mainly children between 6-59 months and lactating mothers
- **Indirectly**: the project will benefit about 400,000 people.
- Work with 3 SMEs and a network of 300 registered retailers
The Masava Approach

Private sector fortification (3 SMEs)

Stimulate demand via e-Voucher and Communications Support (BCC)

Measure multiple outcomes
Reach: 150,000
Sample: 2 x 250 HH
MASAVA Partners

University of Waterloo and Sokoine University (Tanzania) measure nutrition and economic impacts of SME fortification

BASF providing technical assistance and supplying fortificant

MEDA providing e-Voucher platform, training retailers on use, manage SME operations
Research Objectives

Specific Objectives:

1. Test whether crude sunflower oil can be fortified by Small and Medium Enterprises (SMEs) for local consumption in contexts where inventory turnover is rapid and long shelf-life is not required
2. Test sustainable business models
3. Test whether using electronic vouchers can succeed in promoting consumption of fortified oil
4. Test whether the fortified product can reduce micronutrient deficiencies in vulnerable groups, specifically targeting the lactating mothers and children under 5
Progress to date

- Baseline survey complete, preliminary analysis available
- Fortification equipment installed in 3 SMEs, oil distributed to 20 pilot shops in Manyara and Shinyanga
- GMP/GHP training conducted
- Behaviour change communication campaign underway.
- eVoucher system running; 300 retailers trained to use eVoucher
Fortification unit at one of the SMEs
Mafuta ya Alizeti yaliyoongeza Vitamini A

YANAPATIKANA HAPA
### Total number of questionnaires and DBS and Oil samples collected

<table>
<thead>
<tr>
<th>Region</th>
<th>District</th>
<th>Category</th>
<th>No. of QNs</th>
<th>No. of DBS</th>
<th>No. of Oil Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manyara</td>
<td>Babati Urban</td>
<td>Intervention</td>
<td>63</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Babati Rural</td>
<td>Intervention</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Hanang</td>
<td>Intervention</td>
<td>77</td>
<td>77</td>
<td>77</td>
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<tr>
<td></td>
<td>Mbulu</td>
<td>Control</td>
<td>152</td>
<td>152</td>
<td>150</td>
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<tr>
<td>Shinyanga</td>
<td>Shinyanga Urban</td>
<td>Intervention</td>
<td>49</td>
<td>49</td>
<td>49</td>
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<td>Shinyanga Rural</td>
<td>Intervention</td>
<td>50</td>
<td>50</td>
<td>50</td>
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<tr>
<td></td>
<td>Kahama</td>
<td>Intervention</td>
<td>49</td>
<td>49</td>
<td>49</td>
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<tr>
<td></td>
<td>Kishapu</td>
<td>Control</td>
<td>50</td>
<td>50</td>
<td>48</td>
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<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>570</strong></td>
<td><strong>570</strong></td>
<td><strong>566</strong></td>
</tr>
</tbody>
</table>
## Preliminary Results

### Sample sizes

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Control</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>363</td>
<td>203</td>
<td>566</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manyara</th>
<th>Shinyanga</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>369</td>
<td>197</td>
<td>566</td>
</tr>
</tbody>
</table>

Final sample size may differ slightly – data cleaning is ongoing
Knowledge of vitamin A: % of sample who...

Note: first column is % of whole sample; remaining columns are % of only those who had heard of vitamin A
How much oil did you buy, at last purchase? (in ml or g)

Most common purchases for Manyara: 250ml; 500ml; 1 Litre or multiples of 1 Litre
Most common purchases for Shinyanga: 30, 60, 90 or 150 ml/g; 1 Litre/Kig or multiples thereof
How long does your oil purchase usually last?

- 1 day
- 2-6 days
- 7 days
- 8-29 days
- 30 days
- More than 30 days

Manyara

Shinyanga
eVoucher sales and redemption

November progress to date

<table>
<thead>
<tr>
<th>Weeks since launch</th>
<th>Issuances</th>
<th>Redemptions</th>
<th>Redemption Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>76</td>
<td>47</td>
<td>62%</td>
</tr>
<tr>
<td>Week 2</td>
<td>107</td>
<td>61</td>
<td>57%</td>
</tr>
<tr>
<td>Week 3</td>
<td>226</td>
<td>86</td>
<td>38%</td>
</tr>
<tr>
<td>Week 4</td>
<td>87</td>
<td>29</td>
<td>33%</td>
</tr>
<tr>
<td>Total</td>
<td>496</td>
<td>223</td>
<td>45%</td>
</tr>
</tbody>
</table>
Challenges:

1. High costs: Regulatory requirements for stainless steel tanks
2. Existing standards for product registration are difficult for SMEs – caused delays in project
3. Fortification enforcement irregular
4. Arrival of two large scale producers – high demand of seeds driving up cost of seed.
5. Challenging terrain for data collection
6. Technical challenges with eVouchers
Final thoughts

• Fortifying unrefined sunflower oil is technically possible

• Early but enthusiastic response to eVouchers

• There is a distinct need for vitamin-A enhanced food in Manyara and Shinyanga

• The private sector may be one of the most viable interventions to provide sustained access to these foods for rural communities
This work is carried out with the aid of a grant from the International Development Research Centre (IDRC), Ottawa, Canada, [www.idrc.ca](http://www.idrc.ca), and with financial support from the Government of Canada, provided through Foreign Affairs, Trade and Development Canada (DFATD), [www.international.gc.ca](http://www.international.gc.ca)
Title: Fortification of sunflower oil by small and medium enterprises in Tanzania.

By: Goodluck Mosha, Kenneth Nehimbi and Nadira Saleh (MEDA, Canada)
Theobald Mosha (Sokoine University of Agriculture, Tanzania)
John Belt and Marcelo Tyszler (Royal Tropical Institute, NL)
Susan Horton (University of Waterloo, Canada)

Project Output Type: Presentation at GAIN, Geneva.

Date: September 2016

Institutions involved:
Mennonite Economic Development Associates of Canada
Royal Tropical Institute, Netherlands
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract:
This presentation summarizes progress from September 2015 to August 2016, and includes summary findings from the eVoucher data, from the retailer baseline survey and resurvey, and analysis from the analysis of serum retinol binding protein, on vitamin A deficiency of mothers and children.

IDRC Project Number 107790

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Fortification of sunflower oil by small and medium enterprises in Tanzania

Goodluck Mosha, Kenneth Nchimbi & Nadira Saleh (MEDA)
Theobald Mosha (Sokoine University of Agriculture, Tanzania)
John Belt & Marcelo Tyszler (Royal Tropical Institute NL)
Sue Horton (University of Waterloo, Canada)

GAIN, September 2016
Tanzania DHS 2010 shows:

- 34% children 6-59 months are deficient
- 37% of women of reproductive age (15-49) are deficient
- Manyara and Shinyanga regions are particularly deficient

Since 2010:
- Government has mandated fortification of edible oil
- Coverage of vitamin A megadose has weakened
Research Objectives

1. Test whether crude sunflower oil can be fortified by Small and Medium Enterprises (SMEs) for local consumption in contexts where inventory turnover is rapid and long shelf-life is not required
2. Test sustainable business models
3. Test whether using electronic vouchers (eVouchers) can succeed in promoting consumption of fortified oil
4. Test whether the fortified product can reduce micronutrient deficiencies in vulnerable groups, specifically targeting the lactating mothers and children under 5
Current Project Facts

- **Project Duration**: August 2014 - September 2017
- **Target Area**: Manyara and Shinyanga regions, each region has three intervention districts and one control district
- **Primary target group**: 65,000 households - children between 6-59 months and lactating mothers
- **Indirectly**: the project will benefit about 400,000 people.
- Work with 3 SMEs and a network of 300 registered retailers
- As of end of July, just over 22,000 e-Vouchers had been issued and 15,536 redeemed; 40,000 litres of fortified oil had been produced and 35,000 sold, reaching an estimated 175,000 individuals
Business model

1) SME capacity to fortify oil
   Equipment designed and installed at 3 SMEs
   Vitamin A requirements determined (?) (East African/TZ standard)
   Training on fortification completed (GMP/GHP)

2) Demand created through behaviour change communication campaign
   “Hybrid” marketing campaign meets classic BCC with coordinated distribution approach

3) Preblend supply chain established
   500 Litres of preblend procured and distributed to SMEs

4) Distribution network created
   Network of 444 retailers, multiple distributors

5) Permit acquired to fortify oil
   Initial 1L bottle design, later 5L/10L/20L introduced
Fortification unit at one of the SMEs
Oil production by SMEs

**Total Production:**
14,608 litres - *Singida Sunshine*
13,000 litres – *Sweet Drop*
13,000 litres - *Shams*
*Total*: 40,608 litres

**Sales:** *Total*: 35,840 litres

*Potential reach of oil:*
179,200 individuals
Q3: Can eVoucher discounts stimulate demand?

1. A self-issued mobile discount used to stimulate demand, two-step phase out

2. eVoucher system manages:
   a) a temporary discount offered directly to consumers that purchase fortified sunflower oil in Manyara and Shinyanga
   b) manages a bonus offered to retailers for trading 5L, 10L and 20L

3. This technology collects real time data that feeds into our M & E data set
eVoucher issuances and redemptions (Nov 2015 – Aug 2016)

- 24,220 Issuances
- 18,236 Redemptions (75%)
- On average, redeemed e-vouchers were claimed in 2.2 days, with 65% redeemed on the issuance day
- 444 registered retailers:
  - 3 registered at least one sale (80 in Manyara and 123 in Shinyanga).
Challenges faced in previous eVoucher structure

1. Network outages and delays cause consumers and retailers to not want to use the eVoucher;
2. Even if the network was strong, the retailers described system delays
3. This resulted in retailers selling oil at discounted prices without the eVoucher, saved the barcodes for later at night and got together with groups of friends to issue and redeem them together
4. Examples of retailers and distributors refusing to join the program entirely because they did not want to deal with the eVoucher
Introduction of new volumes and new payment mechanism (eWallet)

• Given challenges with eVoucher, eWallet introduced to respond to challenges in the field
• Streamlines payment from project to retailer directly, alleviating burden from SMEs, distributors and consumers for larger volumes of oil (also demanded from the project)
Comparison of Utility

- More litres of oil traded in the period compared to the time where only 1L containers were available as follows;
- Same period (starting 20th June to date) saw a total of 9,766 litres in 1L containers traded, 6,760 litres in 20L containers traded and 800 litres in 5L traded, signifying that in a less than 3 month period almost 50% (44%) of MASAVA oil traded is coming from 5L and 20L.
Regional differences and preferences

44% of all transactions occurring in the Hanang district
Volume redeemed by retailers per region (Jun-August 2016)
Q2. Is the business model sustainable?
Research methods – sustainability study

• Is fortification by SMEs sustainable after initial project-sponsored sales promotion efforts including subsidies conclude—with fortification, distribution, and product consumption continuing indefinitely
• 2 Field trips: 16-29 May 2015 and 4-15 April 2016
• Location: all rural and urban districts where MASAVA is active
• Qualitative research: observations, semi-structured interviews, short survey
• Actors: the participating SMEs, wholesalers / distributors, retailers
Research tools

• Initial short baseline survey of retailers (quantitative)
• Resurvey of retailers one year later
• Short survey among 15 retailers (randomly picked, not sampled)
• Semi-structured interviews with wholesalers/distributors
• Observation and interviews at / with SMEs
• Update / insights / discussions with MEDA field and HQ team
Findings at resurvey: Retailers

- Willing to sell the fortified oil, ready to add to their portfolio
- Of the 444 registered retailers 203 are active (80 Shinyanga, 123 Manyara)
- Turnover of the fortified oil is generally still small (vs. other cooking oil)
- Margins for 1 lt. fortified oil are lower than from other cooking oil products
- eVoucher is cumbersome for most of them (complicated procedure, time consuming, network failure) - they need to attend their customers
- Dislike waiting for their eVoucher money
- Welcome the 5, 10 and 20 liters
Findings at resurvey: distributors/wholesalers

- Relationship / trust with SME is crucial
- SMEs do not have trustworthy distributor in all areas
- For the large ones: turnover of the fortified oil is really small
- For the small ones: overall turnover / market share is small
- Dislike the eVoucher and administrative requirements
- Most require credit from the SMEs
Findings at resurvey: SMEs

- Production and sales volumes are increasing
- One continues to face challenges, two are improving their performance
- Facing cash flow challenges (buying seed, giving credit)
- Network of distributors / retailers to be improved
- Geographical focus of project constraints them
- Content with adding 5, 10 and 20 liters to their portfolio
- Challenging to acquire hard business data
- Incipient business acumen
- Ready to promote fortification among the sector
- Expectations about enforcement of government policy on fortification
Expected outcomes

• Final conclusion on sustainability of the business model can only be drawn after eVoucher discount and project support has stopped

• Decisive factors:
  – SME cost price: packaging, electricity, labor, pre-blend, labels, depreciation of equipment
  – Price difference with other edible oils: sunflower and vegetable oil
  – Consumer’s capacity / willingness to pay
  – SMEs ability to reach appropriate market segments: probably the more affluent, urban consumer
  – Sector-wide response: more SMEs engage in fortification
  – Sector-wide acceptance depends on cost of equipment
  – Impact on the sector of government fortification policy and enforcement
Q4: Can fortified oil reduce deficiencies in vulnerable groups (lactating women, children < 5)

• Surveyed 535 households in 8 districts in 2 regions (intervention/control)
• Results from dried blood samples for children (data also collected for mothers)
• Analyzed by TFNC using ELISA for Retinol Binding Protein; used conversion factor to compare to cutoffs for serum retinol
Other Baseline Data Collected

✓ Household Survey with 6 modules
  ✓ Household roster
  ✓ Dietary diversity module for mother and index child (based on GAIN survey)
  ✓ Health and anthropometric module for index child (based on GAIN survey)
  ✓ Oil consumption survey (based on GAIN survey)
  ✓ Vitamin A knowledge, attitudes and practices (KAP) survey (based on Helen Keller survey from West Africa)
  ❑ Asset survey (using DHS methods) collected, but fine tuning construction.
✓ Household Oil Retinol (analyzed at TFDA using HPLC)
Vitamin A Deficiency in Children by Region

Prevalence of Vitamin A Deficiency (VAD) (Using <17.325 ug/mL cut-off)

<table>
<thead>
<tr>
<th></th>
<th>Prev. VAD %</th>
<th>Mean RBP mg/mL</th>
<th>SD</th>
<th>Median mg/mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manyara</td>
<td>72.1</td>
<td>14.87</td>
<td>4.99</td>
<td>14.20</td>
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<tr>
<td>Shinyanga</td>
<td>71.7</td>
<td>14.80</td>
<td>5.88</td>
<td>13.89</td>
</tr>
<tr>
<td>Intervention</td>
<td>71.3</td>
<td>14.87</td>
<td>5.37</td>
<td>14.00</td>
</tr>
<tr>
<td>Control</td>
<td>73.1</td>
<td>14.79</td>
<td>5.23</td>
<td>14.23</td>
</tr>
</tbody>
</table>

*No significant difference in mean RBP level between regions or intervention/control.
Vitamin A status (RBP levels) in Children by breastfeeding status

<table>
<thead>
<tr>
<th>Breastfeeding Status</th>
<th>Mean RBP mg/mL</th>
<th>SD</th>
<th>Med.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breastfed</td>
<td>15.31</td>
<td>5.50</td>
<td>14.94</td>
</tr>
<tr>
<td>Not Breastfed</td>
<td>14.03</td>
<td>4.90</td>
<td>13.24</td>
</tr>
</tbody>
</table>

*Significant* difference in mean RBP level between Children who are breastfed or not breastfed (F(1,525)=8.037,p=0.005).
**Vitamin A status (RBP levels) in children by mother’s vitamin A status**

<table>
<thead>
<tr>
<th>Breastfeeding/Maternal VAD Status</th>
<th>Mean RBP mg/mL</th>
<th>SD</th>
<th>Med.</th>
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</thead>
<tbody>
<tr>
<td>Breastfed</td>
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<tr>
<td>No Maternal VAD (@&lt;26.04 mg/mL)</td>
<td>16.93</td>
<td>5.86</td>
<td>14.94</td>
</tr>
<tr>
<td>No Maternal VAD (@&lt;26.04 mg/mL)</td>
<td>14.88</td>
<td>5.23</td>
<td>13.24</td>
</tr>
<tr>
<td>Not Breastfed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Maternal VAD (@&lt;26.04 mg/mL)</td>
<td>16.55</td>
<td>6.31</td>
<td>15.66</td>
</tr>
<tr>
<td>No Maternal VAD (@&lt;26.04 mg/mL)</td>
<td>13.61</td>
<td>4.39</td>
<td>13.16</td>
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</tbody>
</table>

*Significant* difference in mean RBP level in presence of Maternal VAD in breastfed children (F(1,323)=7.024,p=0.008) and children not breastfed (F(1,193)=10.387,p=0.001).
Vitamin A Deficiency in Children by VA Supplementation in last 6 months

Prevalence of VAD by Age and VAS in last 6 months

- Given Vitamin A Supplement
- Not given Vitamin A Supplement
Vitamin A Deficiency in Women by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Prev. VAD @&lt;17.325 mg/mL</th>
<th>Prev. VAD @&lt;126.04 mg/mL</th>
<th>Mean RBP mg/mL</th>
<th>SD</th>
<th>Med.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manyara</td>
<td>38.0</td>
<td>83.7</td>
<td>20.19</td>
<td>7.25</td>
<td>19.21</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>36.6</td>
<td>79.8</td>
<td>20.37</td>
<td>7.23</td>
<td>19.97</td>
</tr>
<tr>
<td>Intervention</td>
<td>84.1</td>
<td>41.3</td>
<td>19.72</td>
<td>7.12</td>
<td>18.88</td>
</tr>
<tr>
<td>Control</td>
<td>79.0</td>
<td>30.6</td>
<td>21.21**</td>
<td>7.26</td>
<td>20.88</td>
</tr>
</tbody>
</table>

*No significant difference in mean RBP level between regions.
**Significant difference in mean RBP level between Intervention and Control (F(1,515)=5.460, p=0.02).
Conclusion:

- No significant differences in vitamin A status
  - By region (children or mothers)
  - Intervention/control (children)
  - By age group (children)
  - By dietary diversity (mothers)
  - By mother’s education (children: still working on asset index data)
  - By household oil fortification level (children)
- Analysis using multivariate methods is still in process
This work is carried out with the aid of a grant from the International Development Research Centre (IDRC), Ottawa, Canada, [www.idrc.ca](http://www.idrc.ca), and with financial support from the Government of Canada, provided through Global Affairs, Canada [www.international.gc.ca](http://www.international.gc.ca).
Title: Mafuta Asili ya Alizeti yenye Vitamini A (Virgin sunflower oil fortified with vitamin A).

Presented by: Dr. TCE Mosha, on behalf of MASAVA project team

Project Output Type: Presentation at final stakeholder meeting, Dar-es-Salaam

Date: July 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract:
This presentation summarizes progress of the project over its three year span, from August 2014 to July 2017. It includes results from the oil storage stability study, from the eVoucher data, comparisons of results on vitamin A deficiency comparing end-line and baseline household surveys, and preliminary estimates of cost-effectiveness/sustainability of the business model.

IDRC Project Number 107790

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Mafuta Asili ya Alizeti yenye Vitamini A

[Virgin Sunflower oil fortified with vitamin A]

Presented by: Dr. T.C.E. Mosha

July 20, 2017
Tanzania DHS 2010 shows:
- 34% children 6-59 months are deficient
- 37% of women of reproductive age (15-49 yrs) are deficient
- Manyara and Shinyanga regions are particularly deficient

Since 2010:
- Government has mandated fortification of edible oil at SME level
- Vitamin A megadose has decentralized
Rural areas in Tanzania suffer from poor dietary diversity

• Rural diets are seasonally influenced = poor in micronutrients
• Large-scale centralised oil producers are now fortifying, but some areas of need may not be reached affordably from larger cities
• Small-scale oil producers can compete to meet the demand from rural consumers for low-cost unrefined oil (SME oil producers - market share 70%)
• Refining oil causes a loss of nearly 10% compared to unrefined oil product, leading to increased costs to the consumer.

CHALLENGE: Observe whether unrefined oil can be fortified locally to address the problem of Vitamin A deficiency in rural populations
Results from pilot study: Sep 2012-Nov 2013

GOAL of pilot
Explore the feasibility of manufacturing and marketing Vitamin A fortified local sunflower oil

ACTIVITIES:
• Oil fortification trials to determine how long Vitamin A remains active in unrefined oil
• Verification of shelf-life requirements for local markets
• Market tests of fortified oil with local consumers
Percentage of Vitamin A in Sunflower Oil over 9 weeks: Vitamin A content was almost unchanged after 9 weeks storage at 30°C (without light exposure)
Masava Project: Research questions

1. Can unrefined sunflower oil be fortified by Small and Medium Enterprises (SMEs) for local consumption
2. Can the business model be sustainable
3. Can electronic vouchers (eVouchers) succeed in promoting consumption of fortified oil
4. Can the fortified product reduce micronutrient deficiencies in vulnerable groups, especially lactating mothers and children under 5
Current Project Facts

- **Project Duration**: August 2014 - September 2017
- **Target Area**: Manyara and Shinyanga regions, each region has three intervention districts and one control district
- **Primary target group**: 65,000 households - children between 6-59 months and lactating mothers
- **Indirectly**: the project will benefit about 400,000 people.
- Work with 3 SMEs and a network of 300 registered retailers
- As of end of June, 2017 - 110,677 litres of fortified oil had been produced and 82,541 litres were sold, reaching an estimated 412,702 individuals
Storage stability of Vit. A in fortified sunflower oil (for 6 months)

![Graph showing vitamin A concentration over time for different samples.](image)

- **SME 1**
- **SME 2**
- **SME 3**
- **Palm 1**
- **Palm 2**

**Highlighted region indicates acceptable vit. A concentration per Tanzanian standards (20-40mg/kg)**
Vit. A concentration in scooped fortified sunflower oil (over 16 days)

**Highlighted region indicates acceptable vit. A concentration per Tanzanian standards (20-40mg/kg)**
Business model established

• SME capacity to fortify oil
  • Equipment designed and installed at 3 SMEs
  • Level of fortification complies with EA/TZ standard
  • Training on fortification completed (GMP/GHP)
• Demand created through behaviour change communication campaign
• Pre-blend supply chain established
• Distribution network of 319 retailers, multiple distributors
• Permit acquired to fortify oil – initially 1L, later 5L/10L/20L introduced
Fortification unit at one of the SMEs
Can eVoucher discounts stimulate demand?

1. eVoucher: A self-issued mobile discount used to stimulate demand

2. eVoucher system manages a temporary discount offered directly to consumers (subsequently to retailers)

3. This technology collects real time data allowing tracking of volume of sales, by location and density
Comparison of volumes sold in litres (October 2015 – June 2017)

• Sales accelerated when 5, 10 and 20L packaging sizes were added

• 54,613 L sold through eVoucher;
  • 46% through 1L,
  • 37% through 20L,
  • 14% through 5L,
  • 3% through 10L
Regional difference: total volume redeemed by container by region (June 2016-June 2017)

<table>
<thead>
<tr>
<th>Container Size</th>
<th>Manyara</th>
<th>Shinyanga</th>
</tr>
</thead>
<tbody>
<tr>
<td>1L</td>
<td>7205</td>
<td>4259</td>
</tr>
<tr>
<td>5L</td>
<td>3450</td>
<td>4000</td>
</tr>
<tr>
<td>10L</td>
<td>1870</td>
<td>0</td>
</tr>
<tr>
<td>20L</td>
<td>19720</td>
<td>200</td>
</tr>
</tbody>
</table>
### Result: estimated reach ending June 2017

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (overall impact of fortified oil)</td>
<td>110,677 L</td>
</tr>
<tr>
<td>Sales to distributors (Oil which is still in the chain to target areas)</td>
<td>82,541 L</td>
</tr>
<tr>
<td>eVoucher/eWallet redemptions (by individuals or retailers – indication of oil to households in target areas)</td>
<td>54,613 L</td>
</tr>
</tbody>
</table>
Household Survey Data Collection Process

• Baseline Household Survey: July-August 2015 (lactating women and index child < 5)

• Endline Household Survey: November 2016 - January 2017 (same individuals)

• Survey in 4 districts of each of Manyara and Shinyanga: 3 intervention districts (fortified sunflower oil) and 1 control in each region

• Dried Blood Samples (DBS) taken from all children and mothers and a subset gave venous blood / serum retinol sample
**Vitamin A Deficiency in Children**

<table>
<thead>
<tr>
<th>Region</th>
<th>Baseline Mean RBP mg/mL</th>
<th>Endline Mean RBP mg/mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manyara</td>
<td>14.85</td>
<td>15.04</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>14.71</td>
<td>18.42*</td>
</tr>
<tr>
<td>Intervention</td>
<td>14.83</td>
<td>17.20**</td>
</tr>
<tr>
<td>Control</td>
<td>14.74</td>
<td>14.37</td>
</tr>
</tbody>
</table>

No significant difference in mean RBP level between regions or intervention/control at baseline.

*Shinyanga had significantly higher mean RBP at endline (F(1,410)=11.225, p=0.001).

**Intervention group had significantly higher mean RBP at endline (F(1,410)=7.892, p=0.005).
Vitamin A Deficiency in Mothers @<26.04 mg/mL

<table>
<thead>
<tr>
<th>Location</th>
<th>Baseline Mean RBP mg/mL</th>
<th>Endline Mean RBP mg/mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manyara</td>
<td>20.21</td>
<td>19.06</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>20.32</td>
<td>23.05**</td>
</tr>
<tr>
<td>Intervention</td>
<td>19.72</td>
<td>20.41</td>
</tr>
<tr>
<td>Control</td>
<td>21.21*</td>
<td>20.48</td>
</tr>
</tbody>
</table>

*Significant difference in mean RBP level between Intervention and Control at baseline (F(1,533)=5.267, p=0.005).

**Shinyanga had significantly higher mean RBP at endline (F(1,423)=14.882, p=0.000).
Interpretation of VAD results

• VAD prevalence in children declined between baseline and endline in Shinyanga region, the intervention districts, in most wealth quintiles, and all age groups <5.

• VAD in mothers declined between baseline and endline in Shinyanga region and the intervention districts.

• Dietary diversity did not improve; small improvements in coverage with supplements for children cannot explain effect for mothers.

• Fortification works! Results suggest that fortification of palm oil contributed to improvements in Shinyanga; fortification of sunflower oil contributed to improvements in Manyara, but more limited as MASAVA only fortified sunflower oil from a few SMEs.
Costs of fortification per Litre of oil (20L containers), by size of enterprise

**Current**: Using stainless steel tanks currently used

**Hypothetical**: includes using mild steel mixing tanks (medium enterprises) and plastic (small)
Conclusions: cost-effectiveness

• Oil fortification is a very cost-effective way to improve health: estimate for Uganda is $18 per DALY averted - Disease Burden due to VAD or Disability averted due to VAD (“very cost-effective” – per WHO) (Fiedler & Afrida, Food Nutr Bull 2010)

• If fortification costs were 5x higher, still “very cost-effective”

• BUT poor consumers are less likely to buy more costly fortified oil

• When evaluating cost-effectiveness:
  • Also need to think about equity: the poorest/most rural consumers often face the most health issues, but costs more to reach them (buy from SMEs)
  • Health benefits of sunflower oil relative to palm oil (less saturated fat)
  • Local employment impact of SMEs
Oil continues to flow after discounts ended

- eWallet issuances ended May 2017
- 1000 L of fortified oil sold to Mbeya by Singida SME in May
- 10,000 L of fortified oil sent to Kahama (Shinyanga) in July by Singida SME.
- 2000L of oil fortified late-July, intention to distribute to Chalinze
- Demand as far as Mwanza and Kigoma for fortified oil (external retailers have been reaching out to retailers in Shinyanga)
1. Retinol is stable in oil, both stored and when scooped from larger volumes

2. A sustainable business model for SMEs can be well established

3. eVouchers can be used to stimulate demand if well designed

4. Fortification works! It must be expanded to the SME level to reach more vulnerable rural populations
Call to action: Scaling up from Masava

1. Clarify technical fortification standards
2. Enforcement of regulatory standards should be universalized to support fair competition among processors
3. Appropriate equipment and packaging standards for SMEs
4. Streamline processors getting approval (TFDA, TBS)
5. Enable processors to absorb the costs of fortification through improved working capital (TADB), higher yielding seed varieties and through achieving business economies of scale
Call to action: Progression and Next Steps

1. DANIDA-funded pilot project that demonstrated unrefined sunflower oil could be fortified

2. GAC/IDRC funded Masava project demonstrates fortification works and can be taken on by SMEs

3. Forward looking: a large scale value-chain integrated project that reaches new regions (Dodoma, Singida) and a larger number of SMEs

4. Scaling to other sunflower producing regions (Iringa, Rukwa) and countries (e.g. Burundi, Uganda, Malawi, Kenya) to reach millions of people with vitamin A deficiency
This work is carried out with the aid of a grant from the International Development Research Centre (IDRC), Ottawa, Canada, www.idrc.ca, and with financial support from the Government of Canada, provided through Global Affairs, Canada www.international.gc.ca.
Annex 2.4.

Title: Market approaches to nutrition: fortifying unrefined sunflower oil with vitamin A in Tanzania

By: Nadira Saleh (MEDA, Canada), Victor Guo (University of Waterloo) and Thoko Phiri (University of Waterloo)

Project Output Type: Poster presented at Canadian Conference on Global Health, Montreal.

Date: October 2015

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract:
This poster presents results on stability of retinol in oil from the initial trial, and results on consumption of type of oil, and of foods containing vitamin A, from the household baseline survey.

IDRC Project Number 107790

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Malnutrition is a critical development challenge in Tanzania. Vitamin A deficiency is a strong contributor to childhood mortality, accounting for 5% of under-five deaths worldwide. In Tanzania, a third of children and women of reproductive age are vitamin A deficient, mostly due to poverty and a lack of dietary diversity. This is especially true in Manyara and Shinyanga regions, where vitamin A deficiency ranges from 35-45% for children 6-59 months. Sunflower oil is locally produced and milled in Northern Tanzania, but has not been fortified at the small scale without prior refining. The refinement of sunflower oil requires specialized equipment and causes a loss of nearly 10% compared to an unrefined oil product, leading to increased costs to the consumer. Although large-scale centralised oil producers are now fortifying foods, these areas are often not reached affordably from larger cities.

Masava works with three small and medium enterprises (SMEs) to provide access to the appropriate technology and expertise to fortify unrefined sunflower oil with Vitamin A. This project tests two emerging technologies, focusing on two regions most affected by Vitamin A deficiency, Manyara and Shinyanga:

1) To test the sustainability of a business model for oil fortification at the local small and medium enterprise (SME) level resulting in improved Vitamin A intake among local populations.
2) To test an innovative electronic voucher to promote sales of the new fortified product among consumers while jump-starting demand for the new fortified oil from SMEs.

Baseline results: household survey

Household data was collected using a structured, pre-tested paper questionnaire and administered using SUA-trained enumerators. The survey includes sections on respondent characteristics, household characteristics, infant and young child feeding, mother and child dietary diversity, health and nutrition data, consumption of oil and vitamin A knowledge, attitudes and practices. The baseline survey took place between June and July, 2015 and includes 566 households; 363 in the intervention area, 203 in the control.

DIETARY DIVERSITY: Masava uses a dietary diversity index developed by GAIN. Mothers were asked if, in the last 24 hours, they consumed food or beverages from 17 different food groups, which were then grouped into 9 groups.

Consumption of vitamin A

The mean overall dietary diversity in both groups was a score of 3.5 (range of 1-7); with scores of 3.5 and 3.4 in intervention and control groups, respectively (SD = 1.1 in all cases). Figure 2 illustrates consumption of vitamin A rich foods (VARF) in the last 24 hours; 72.3% of intervention respondents and 81.2% of control respondents reported having consumed VARF (overall average of 75.5%).

TYPE OF OIL CONSUMED: When asked about the predominant edible oil consumed in the households, 93.2% of Manyara and 12.2% of Shinyanga household reported consumption of sunflower oil. In contrast, 4.1% of Manyara households and 83.8% of Shinyanga households reported vegetable oil consumption. These results are depicted in Figure 3.

Conclusion and upcoming results

The Masava project is a pilot designed to determine whether SME sunflower oil fortification is feasible chemically and whether through the private sector, it can be both economically viable for SMEs while contributing to a reduction in vitamin A deficiency for consumers. Thus far, results have demonstrated that vitamin A is stable in unrefined sunflower oil for 9 weeks in a lab setting. As the oil is released on to the market, the project will determine whether this result is consistent for all three SMEs and at each stage along the value chain, including at the household level. Baseline results from the household survey demonstrate that approximately one quarter of the sample did not consume any vitamin A rich food in the previous day. The project will determine whether there is a correlation between this and vitamin A status in these respondents (or index children age 6-59 months) at the time of baseline survey. The research will also consider whether subsequent reported and eVoucher recorded purchase of vitamin A fortified sunflower oil correlates with any change in vitamin A status.

The household survey also highlighted the difference between sunflower oil consumption in Manyara and Shinyanga. While a sunflower oil product is expected to be more readily accepted in Manyara, it remains to be seen whether the eVoucher discount can sway consumers in Shinyanga to switch to sunflower oil.

Lastly, as sales are generated, and the discount is removed, the research will consider whether the business model is viable for the private sector to both maintain and scale as a lasting solution to vitamin A deficiency.
Annex 2.5.

Title: Fortification of locally-produced oil: Determinants of baseline vitamin-A deficiency in Tanzanian children

By: Dylan Walters, Edna Ndau, Elina Maseta, Nadira Saleh, Theobald Mosha and Susan Horton

Project Output Type: Poster presented at Micronutrient Forum, Cancun, Mexico

Date: October 2016

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract:
This poster presents results on household characteristics, vitamin A deficiency levels in children below age of 5, and the correlates of deficiency, from the baseline household survey.

IDRC Project Number 107790

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Fortification of locally-produced oil: Determinants of baseline vitamin-A deficiency in Tanzanian children

Dylan Walters1, Edna Naisi2, Ebie Masawi2, Nadira Saleh2, Dr. Theobald Mochite2, and Dr. Susan Horton2

Abstract: #0023

The MALAVA project aims to reduce VAD through fortification of vegetable oil by SMEs, oil processors, and retailers. VAD rates in children are high in Manyara (72.3%) and Shinyanga (73.7%) regions of Tanzania - higher than previously reported and proceeded by long-standing vitamin A supplementation campaigns. Household survey and blood sampling at baseline found no significant difference mean retinol binding protein (RBP) levels - a proxy for vitamin A in blood - in the 3 samples by regions.

INTRODUCTION
Women of childbearing age (WCHA) are attributed 40% of child mortality (or deaths 0-1 year) globally, and 14% in Tanzania. Women with a monthly income of less than $100 are the primary caregivers in rural households, but they are more likely to have low levels of education and wealth. The Tanzanian DHS 2010 estimated that 31% of WCHA are anemic (1).

RBP levels have been validated as a proxy for vitamin A in blood and are a significant determinant of vitamin A deficiency. Many regions of Africa have inadequate fortification of vitamin A into oil, with a median of 37,109-40,400 mg/L (or 0.2-0.44 mg/L). Vitamin A deficiency has been shown to decrease RBP levels by half of its original level in many studies (2).

Many regions of Africa have inadequate fortification of vitamin A into oil, with a median of 37,109-40,400 mg/L (or 0.2-0.44 mg/L). Vitamin A deficiency has been shown to decrease RBP levels by half of its original level in many studies (2).

The study was part of the Shinyanga and Manyara fortification and distribution project. A study measured RBP levels in children across districts.

RESEARCH OBJECTIVES
1. Determine the baseline vitamin-A status of children in the districts.
2. Assess the effectiveness of fortification and distribution in reducing vitamin A deficiency.
3. Assess the factors associated with baseline vitamin A deficiency.

METHODS
Data were collected through a cross-sectional, non-randomized cluster sampling method. The villages were selected by listing all villages in the intervention and control districts. The households were selected by a systematic random sampling technique. In each household, a child aged 6-59 months was selected for the study.

A total of 1200 children were selected, distributed across the intervention and control districts. The children were aged 6-59 months and were eligible to participate in the study. The children were divided into intervention and control groups based on the fortification status.

MEASURES
RBP levels were measured using the RBP assay kit (4). The percentage of children with RBP levels below the cutoff point for vitamin A deficiency was calculated.

RESULTS
A total of 1200 children were selected, distributed across the intervention and control districts. The children were aged 6-59 months and were eligible to participate in the study. The children were divided into intervention and control groups based on the fortification status.

DISCUSSIONS
A total of 1200 children were selected, distributed across the intervention and control districts. The children were aged 6-59 months and were eligible to participate in the study. The children were divided into intervention and control groups based on the fortification status.

REFERENCES


SUMMARY
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A total of 1200 children were selected, distributed across the intervention and control districts. The children were aged 6-59 months and were eligible to participate in the study. The children were divided into intervention and control groups based on the fortification status.

LIMITATIONS
A total of 1200 children were selected, distributed across the intervention and control districts. The children were aged 6-59 months and were eligible to participate in the study. The children were divided into intervention and control groups based on the fortification status.

CONCLUSION
A total of 1200 children were selected, distributed across the intervention and control districts. The children were aged 6-59 months and were eligible to participate in the study. The children were divided into intervention and control groups based on the fortification status.

ACKNOWLEDGEMENTS
The authors would like to thank all the participants who volunteered for the study. The authors would like to thank all the participants who volunteered for the study. The authors would like to thank all the participants who volunteered for the study.

THE MALAVA project aims to reduce VAD through fortification of vegetable oil by SMEs, oil processors, and retailers. VAD rates in children are high in Manyara (72.3%) and Shinyanga (73.7%) regions of Tanzania - higher than previously reported and proceeded by long-standing vitamin A supplementation campaigns. Household survey and blood sampling at baseline found no significant difference mean retinol binding protein (RBP) levels - a proxy for vitamin A in blood - in the 3 samples by regions.
Annex 2.6.

Title: Fortification of locally-produced sunflower oil: Determinants of vitamin-A deficiency among women in Tanzania

By: Edna Ndau, Dylan Walters, Daphne Wu, Nadira Saleh, Susan Horton and Theobald Mosha.

Project Output Type: Poster presented at Micronutrient Forum, Cancun, Mexico

Date: October 2016

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract:
This poster presents results on levels of vitamin A deficiency in lactating mothers, analyzed according to selected household characteristics, retinol levels in oil consumed at the household level, dietary diversity scores and knowledge concerning vitamin A, from the baseline household survey.

IDRC Project Number 107790

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Fortification of locally-produced Sunflower oil: Determinants of vitamin-A deficiency among women in Tanzania

Edna N Maka, Dyana Wallen, Damele W, Nadia Saleh, Dr. Susan Horton and Dr. Theobald Mitsho

Abstract #0030

**INTRODUCTION**

Vitamin A deficiency (VAD) is a major problem that the World is facing today and more prevalent in low income countries in Tanzania (1).

- Human undernourishment if it is diet, which is chronically insufficient with Vitamin A.
- In Tanzania, women's health problems among children under 5 and pregnant women live in chronic vitamin A and retinol deficiency and morbidity.
- Microvitamin deficiencies including Vitamin A cost the economy over 8.1 billion dollars, which is about 2% of Tanzania’s GDP (World Bank, 2015).
- Assessing 2013 (2), about 9.9% of women are pregnant and 7% of lactating women have VAD. However, studies in Tanzania on lactating women (53.4% and 64.9%) respectively were higher than the national average (57%).
- Nutritional interventions (such as Fortification) are being implemented globally to boost Vitamin A levels in mother and breast milk, and the results can be seen in national and community levels.
- In Tanzania, fortification could not be done flawlessly as a result of poor control region, high poverty, and lack of capacity to prepare fortified oil. However, the monitoring and evaluation of the project during the first year of the study was successful. Nutritional interventions (such as fortified sunflower oil by SMEs) had indicated that VAD was greater for (but not significantly) female breast-fed infants.
- Dietary diversity, dietary diversity scores (DDS), household expectations that the project would bring oil directly to the household, household average, nearest five prevalent location and knowledge about Vitamin A in the province, attitude of mothers regarding to vitamin A deficiency were observed.

**METHODS**

A randomized controlled trial was conducted in Manyara and Shinyanga regions. 1,000 women who were pregnant and lactating mothers were divided into intervention areas with 40% in Manyara and 60% in Shinyanga.

Fortification was performed on sunflower oil by medium-sized entrepreneurs in Manyara and Shinyanga regions. During the project, the oil was fortified with Vitamin A by 20% RDA levels of Vitamin A. However, there was no significant difference in breast milk vitamin A levels with Manyara and Shinyanga.

**RESULTS**

- The main underlying cause of it is diet, which is chronically insufficient with Vitamin A.
- VAD is a major problem that the world is facing today and more prevalent in low income countries in Tanzania (1).
- In Tanzania, women's health problems among children under 5 and pregnant women live in chronic Vitamin A and retinol deficiency and morbidity. Microvitamin deficiencies including Vitamin A cost the economy over 8.1 billion dollars, which is about 2% of Tanzania’s GDP (World Bank, 2015).
- Assessing 2013 (2), about 9.9% of women are pregnant and 7% of lactating women have VAD. However, studies in Tanzania on lactating women (53.4% and 64.9%) respectively were higher than the national average (57%).
- Nutritional interventions (such as fortification) are being implemented globally to boost Vitamin A levels in mother and breast milk, and the results can be seen in national and community levels. In Tanzania, fortification could not be done flawlessly as a result of poor control region, high poverty, and lack of capacity to prepare fortified oil. However, the monitoring and evaluation of the project during the first year of the study was successful. Nutritional interventions (such as fortified sunflower oil by SMEs) had indicated that VAD was greater for (but not significantly) female breast-fed infants.

- Dietary diversity, dietary diversity scores (DDS), household expectations that the project would bring oil directly to the household, household average, nearest five prevalent location and knowledge about Vitamin A in the province, attitude of mothers regarding to vitamin A deficiency were observed.

**HYPOTHESIS**

- E 1. Vitamin A status among lactating mothers is lower in the intervention village (VAD) than in the control village (VAD).
- E 2. Vitamin A knowledge among lactating mothers is higher in the intervention village (VAD) than in the control village (VAD).
- E 3. Economic impact of the intervention is greater in the intervention village (VAD) than in the control village (VAD).

**CONCLUSION**

- The study was an intervention to improve Vitamin A levels in breast-fed infants and breastfeeding mothers. However, the study was limited to assessing the intervention in only two villages in Tanzania. The study findings, however, need to be validated by conducting a large-scale intervention in different parts of the country.

**REFERENCE**

Annex 2.7.

**Title:** Addressing inequities in access to fortified sunflower oil: costs of small, medium and large-scale fortification in Tanzania.

**By:** Dylan Walters, Edna Ndau, Elina Maseta, Nadira Saleh, Theobald Mosha and Susan Horton.

**Project Output Type:** Poster presented at Consortium of Universities in Global Health Conference, Washington DC.

**Date:** April 2017

**Institutions involved:**
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

**Abstract:** this poster presents results on the level of retinol present in oil at the household level, and estimates of actual costs of fortification in the current pilot study, as well as modelled costs for a hypothetical scale up using modified technology.

**IDRC Project Number** 107790

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The MASAVA project aims to reduce VAD through sunflower oil fortification with vitamin A by SME oil processors and retailers. VAD rates in children are high in Manyara (72.1%) and Shinyanga (71.7%) regions of Tanzania — higher than previously reported.

The incremental cost of fortification is estimated to range from 0.6% for large-scale (or $0.04 per capita/year) to a high of 22.1% (or $1.51 per capita/year) for small-scale enterprises producing oil in 20L containers compared to the lowest price of unfortified oil.

Low-cost and available options for fortification equipment and packaging in formats preferred can substantially reduce the incremental cost of SME fortification from $0.51 to $0.10 per litre, if government approves their use and removes a new VAT in order to increase access and affordability in rural and poorer regions. Improving access to fortified sunflower oil in rural and poorer regions of Tanzania requires innovation by SMEs and regulators to incorporate low-cost options that suit needs of the most vulnerable households with children and mothers at risk of VAD.

**SUMMARY**

**INTRODUCTION**

Vitamin A Deficiency (VAD) is attributed with 157,000 child deaths (6-59 months) globally each year (1). In Tanzania, VAD is considered a severe public health problem responsible for a high burden of the child mortality and morbidity. The Tanzania DHS 2010 estimated that the rate of VAD is 38% in children (2). Hunger, lack of food diversity, limited consumption of vitamin-A rich foods and poverty are main determinants of VAD. In Tanzania, Vitamin A is found naturally in some foods but consumption is less than optimal. In Manyara and Shinyanga, Only 51% and 85% children (6-23 months) consumed vitamin-A rich in the past 24 hours respectively (3). 37% and 27% of children (6-59 months) received vitamin-A in supplements in the 6 months prior (i.e. Aug. 2015-Feb. 2016) to survey in Manyara and Shinyanga (3). Fortifying staple foods with vitamins can be an effective vehicle for improving dietary consumption of deficient micronutrients but is often limited to foods produced through large food manufacturers, which are not accessible to poorer and rural households.

The MASAVA project, in the Manyara and Shinyanga regions of Tanzania, works with small and medium-sized enterprise (SME) sunflower oil processors and retailers to fortify and distribute sunflower oil with Vitamin A to households vulnerable to VAD — particularly households with lactating women and young children. The goal of the project is to reduce the prevalence of VAD in these regions, 48% and 42% in 2010 respectively (2) by implementing a sustainable business model for vitamin A fortification in these regions between 2014 and 2017.

**RESULTS**

**CONTINUED**

The modelled incremental cost (IC) of fortification is estimated to range from $0.01 and $0.28 per litre sold in 20L containers for large, medium, and small-scale enterprises compared to unfortified oil.

This represents a range of 0.66% increase in large-scale oil, or $0.04 per capita per year, to 22.1% increase for small-scale enterprise oil, or $1.51 per capita per year, compared to unfortified.

The largest annuitized cost component of fortification for large-scale enterprises producing oil in 20L is the premix cost (60%) whereas for medium-scale it is premix (31%) and equipment (21%) and for small-scale it is mainly equipment (48%).

Low-cost small-scale scenario:

• The packaging cost for 1L containers for small- and medium-scale producers itself can add up to $0.23 cents per litre, or 18% increased cost per litre for small-scale producers. Using 20L containers is the largest factor in increasing costs for SMEs currently.

• Allowing SMEs to distribute sunflower oil in 250g and 500g sachets would reduce the IC per litre by $0.16, and safer for rural households who typically purchase oil by the “scoup”.

• Approving SME usage of low-cost plastic or mild steel tank for mixing and removing the 18% VAT on oil would reduce incremental cost by $0.04 and $0.05 per litre.

• All three measures combined could reduce the incremental cost of medium-scale production to only 9% higher than lowest price of oil (270 TSH per litre).

**Limitations**

This costing model is preliminary and relies on cost data and assumptions about the production based on project reports and literature. Work underway on costs components and prices of oil and equipment/materials would improve the accuracy. This does not include public sector costs of fortification for advocacy, social marketing, QA and M&E, nor fluctuations in seasonal costs.

**DISCUSSION**

The incremental cost of fortification is minimal for large-scale producers, similar to the experience in Uganda (4). Knowing that increasing access to SME-produced oil is likely necessary to bridge the urban/rural divide in access to fortified oil, SMEs need to innovate to reduce the high equipment and packaging costs. Removal of the new 18% VAT for SMEs may also help make fortified oil affordable. Reducing costs may be essential for creating the incentive to enter the fortification market, produce affordable product for poorer and rural households that are key to reducing VAD.

Conclusion

Results of costing analysis model emphasize the need for government regulators and SMEs in the sunflower oil industry to consider innovating with low-cost or cost-saving actions to increase equity in access to fortified oil and, ultimately, sustainable reductions in VAD in children and mothers. Endline baseline data will help estimate the impact of the intervention reducing VAD in children and mothers.

**FUNDING SUPPORT**

This project is undertaken with the financial support of the International Development Research Centre (IDRC) and the Government of Canada through global Affairs Canada (GAC).

**REFERENCES**

Annex 2.8.

Title: Effectiveness of behavior change communication strategies on improving knowledge, attitude and practices towards vitamin A-fortified oil in Tanzania.

By: Daphne Wu, Susan Horton, Nadira Saleh and Nazir Yusuph.

Project Output Type: Poster to be presented at Canadian Conference on Global Health, Ottawa.

Date: October 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: this poster presents results on knowledge, attitudes and practices regarding vitamin A and fortified oil before and after a 14-month behavior change communications intervention.

IDRC Project Number 107790

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Effectiveness of behavior change communication strategies on improving knowledge, attitude and practices towards vitamin A-fortified oil in Tanzania

Daphne Wu¹, Dr. Sue Horton², Nadira Saleh³, Nazir Yusuph⁴

¹MSc Candidate, Public Health and Health Systems, University of Waterloo; ²Professor, CIGI Chair in Global Health Economics, School of Public Health and Health Systems, University of Waterloo; ³Project Manager, Mennonite Economic Development Associates, Canada; ⁴Monitoring and Evaluation Officer, Tanzania Communication and Development Center, Tanzania.

**Issue/Problem**

- Vitamin A deficiency (VAD) is a public health problem, particularly affecting pregnant women and children in developing countries. In 2010, one-third of children aged 6-59 months and 37 percent of reproductive-aged women in Tanzania are estimated to be vitamin A deficient.
- In order to reduce the prevalence of VAD in Tanzania, the MASAVA project was implemented to support small and medium-sized enterprises to fortify unrefined sunflower oil with vitamin A for local consumption in the regions of Manyara and Shinyanga from August 2014 to September 2017.
- To increase awareness about the health benefits of vitamin A and promote the consumption of the vitamin A-fortified oil, behavior change communication (BCC) campaigns were conducted from February 2016 to March 2017.

**Objective and Methods**

**Objective:** To evaluate the impact of the BCC interventions on knowledge, attitude and practices of consumers of the vitamin A-fortified oil.

**Methods:** Interviews were conducted with 308 representatives of households in the two regions in December 2014 before the implementation of the BCC interventions, and in April 2017 after 14 months of interventions.

**Results**

After 14 months of interventions:

- Knowledge of fortified foods improved from 17.5% to 77.8%.
- Among those who have heard about fortification, 82.3% of women reported hearing the information from clinic shows, followed by radio broadcasts, and cultural shows. For men, radio was the most common source of information reported by 55.6% of all men interviewed, followed up by clinic shows and information, exchange and communication (IEC) materials.
- Among those who heard the fortification messages, 48.3% reported using the fortified oil at least three times a week, and 10% were not using the oil at all.
- The primary reason for not using the oil was that it was not sold in stores near the respondents’ homes.

**Lessons to date**

- BCC interventions are effective in improving knowledge and consumption of fortified oil.
- The sources of information differ between men and women. Clinic shows are effective in reaching women, whereas radio broadcasts are more effective in reaching men.

**Main messages**

- BCC interventions, particularly community events and mass media, are effective in improving knowledge, attitudes and practices towards fortified oil.
- Besides creating motivation through knowledge generation, behaviour change is also influenced by the opportunity to perform the action, created by making the fortified oil available in stores near the respondent’s homes.

**Funding Support**
Title: Cost-effectiveness of using sunflower oil fortified with vitamin A.

By: Susan Horton, Theobald Mosha, Nadira Saleh, John Belt, Edna Ndau and Dylan Walters.

Project Output Type: Abstract accepted for presentation at International Congress of Nutrition, Buenos Aires.

Date: October 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: This presentation analyzes the cost-effectiveness of vitamin A fortification by small and medium enterprises in Tanzania both in the pilot project, and in a potential scale-up with less costly technology. It also examines equity effects of fortification by small and medium enterprises, i.e. whether oil from these enterprises reaches poorer or more rural consumers.

IDRC Project Number 107790

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Cost-effectiveness of using sunflower oil fortified with vitamin A: Results from Tanzania


Theobald Mosha. PhD. Professor. Faculty of Agriculture. Sokoine University of Agriculture. Tanzania.


Edna Ndau. MSc. Doctoral student. Faculty of Agriculture. Sokoine University of Agriculture. Tanzania.

Dylan Walters. MSc. Doctoral student. Institute for Health Policy, Management and Evaluation. University of Toronto. Canada

Abstract:

This study aims to estimate the cost-effectiveness of fortified unrefined sunflower oil produced by small and medium enterprises (SMEs). Tanzania has high levels of vitamin A deficiency which has negative consequences for morbidity and mortality especially in children under five. Although there is mandatory fortification of edible oils, until recently this has applied only to large-scale producers. However some regions prefer locally-grown and locally-milled sunflower oil, and fortified oil currently does not reach many poor and remote households.

We utilize data from a three-year project piloting production of fortified oil by three SMEs in two regions of Tanzania. The data include information from the producers on costs and technology, and information from retailer surveys and from eVouchers regarding sales. Baseline and endline household surveys were conducted for intervention and control areas, which collected socio-demographic and health information from lactating women and their children under five, household oil samples which were tested for retinol content, and finger-prick blood samples from mothers and children for retinol binding protein.

Findings are as follows:

- “Gold standard” technology was used for the pilot, but a lower cost technology would need to be used for scale-up, provided regulatory approval could be obtained
- SMEs are able to produce oil which maintains vitamin A content up to the point of consumption by households, and SMEs are key to reaching vulnerable households

We use this information to model the cost-effectiveness of fortification by enterprises of varying scale among the SME sector.

Conclusions:

- Fortification is a key way to improve vitamin A levels for pregnant and lactating women, who are key to the vitamin A status of infants. Safety concerns mean that mega-dose supplements cannot be used for this group
• Fortification by SMEs can – if implemented appropriately – be a cost-effective intervention

**Keywords:**

Cost-effectiveness; vitamin A; fortification; Tanzania; small and medium enterprises
Annex 2.10.

Title: Towards nutrition security: can eVouchers be used to generate demand for vitamin A-fortified sunflower oil?.


Project Output Type: Abstract for journal article

Date: August 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: This paper uses qualitative and quantitative data (interviews with retailers, distributors and producers, and eVoucher monitoring data) to assess the impact of eVouchers on demand for fortified oil.

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Manuscript title: Towards nutrition security: Can eVouchers be used to generate demand for vitamin A-fortified sunflower oil?

Authors: Katherine Wihry, Stephen Lam, Nadira Saleh, Kenneth Nchimbi, TCE Mosha, Susan Horton

Abstract:
Promoting demand for fortified foods, including edible oils, is an important strategy for addressing nutrient deficiencies in development contexts. This article reflects on the challenges and opportunities of an electronic voucher (eVoucher) as a means of stimulating demand for fortified oil using the MASAVA project as a case study. The article draws on feedback from 17 retailers collected during a field visit to the project sites in June of 2017, input from project staff and quantitative data collected via the eVoucher system over a nineteen-month timeframe.

The initial eVoucher design was consumer-focused and faced several implementation challenges as evidenced by early stakeholder feedback. Project partners were largely able to overcome these challenges by switching to a retailer-focused incentive, modifying the eVoucher delivery mechanism and introducing packaging sizes (5L, 10L and 20L volumes) to accommodate local “scooping” and repackaging practices. The net effect was an incentive system that better met the needs of stakeholders interviewed.

As a demand-generation strategy, retailer feedback suggests that the eVoucher was effective; retailers cited the product’s low price and high quality as factors contributing to its popularity. The volume of oil purchased increased over the project timeframe, and this increase was likely due, in part, to the introduction of larger volume sizes and the retailer-focused incentive. Volume size preferences varied by region, however, which may reflect the interplay of local purchasing practices and the retailer-focused incentive in determining demand. Retailers widely regarded the project-supported oil as having a future in the market, but voiced concerns about its saleability at market price and the implications of limited and/or inconsistent supply on consumer demand for the oil.

Key words: Tanzania; Nutrition Deficiency; Voucher; Subsidy; Consumer Demand; Food Fortification.

For submission to: Enterprise Development and Microfinance or Food Chain or a similar journal.
Annex 2.11.

Title: Fortification of sunflower oil by small and medium producers in Tanzania: is there a sustainable business model?

By: Katherine Wihry, Nadira Saleh, Goodluck Mosha, others TBA.

Project Output Type: Abstract for journal article

Date: August 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: This paper examines the feasibility and sustainability of the SME-produced fortified sunflower oil business model. The study uses both qualitative data collected from a sample of supply chain actors (small and medium enterprises, distributors and retailers) as well as quantitative data collected via the eVoucher system.

IDRC Project Number 107790

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Fortification of sunflower oil by small and medium producers in Tanzania: is there a sustainable business model?

Authors: Katherine Wihry, Nadira Saleh, Ashlea Webber, Sue Horton, T.C.E. Mosha

Abstract

The MASAVA project in Tanzania piloted the production, distribution and sale of vitamin A-fortified unrefined sunflower oil from three small and medium enterprises (SMEs) in two regions with high levels of deficiency. The project assisted participating SMEs in sourcing premix, training the firms in Good Manufacturing Practices, and helping them secure approval from the regulatory authority (Tanzania Food and Drug Administration). The project also helped create demand for the new product through a Behavior Change Communications (BCC) campaign and an electronic voucher (eVouchers) to deliver an incentive to cover the additional cost of new packaging requirements. Over approximately eighteen months, the SMEs produced and sold close to 100,000 Litres of fortified oil.

This paper examines the feasibility and sustainability of the SME-produced fortified sunflower oil business model. The study uses both qualitative data collected from a sample of supply chain actors (SMEs, distributors, and retailers) and quantitative data collected via the eVoucher system. Some of the key findings are as follows:

- Consumers in the two regions have low incomes and are very price-sensitive. The incentive delivered through the eVoucher made the price of fortified and unfortified oil comparable and supported demand;
- Consumers also care about quality of the oil, and demand for the fortified product was helped by increased awareness of the health properties associated with fortification;
- Greater flexibility in packaging sizes helped increase demand;
- A retailer-oriented eVoucher worked much better than the original consumer-oriented system;
- Small producers face many constraints. In particular, their lack of sufficient working capital makes stock outs more frequent and limits their ability to produce during the months when seeds are scarce and costly.

Research indicates that a market for this new product was successfully created and that demand for the project-supported oil could be met by SMEs. However, a sustainable business model will require further support, including more appropriate regulatory requirements on production, improvements in business efficiency and BCC campaigns over a broader region of the country.

Key words: Tanzania; Small and Medium Enterprise; Consumer Demand; Food Fortification; Sustainable business model.

For submission to: Enterprise Development and Microfinance or Food Chain or a similar journal.
Annex 2.12.

Title: Economics of maternal and child health nutrition: food fortification with vitamin A in Tanzania.

By: Dylan Walters

Project Output Type: Abstract of PhD thesis proposal

Date: August 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: The three questions of focus in this dissertation are 1) what are the determinants of vitamin A deficiency in children under the age of five; 2) is the local production and distribution of sunflower oil fortified with vitamin A by small- and medium-sized enterprises effective in reducing vitamin A deficiency in children; and 3) is the local production and distribution of sunflower oil fortified with vitamin A by small- and medium-sized enterprises cost-effective compared to large scale producers?

IDRC Project Number 107790

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ECONOMICS OF MATERNAL AND CHILD HEALTH NUTRITION: FOOD FORTIFICATION WITH VITAMIN A IN TANZANIA

A Dissertation Proposal by Dylan Walters, Institute for Health, Policy, Management and Evaluation, University of Toronto

Abstract

Vitamin A is an essential nutrient needed by humans for key physiological functioning. Vitamin A deficiency (VAD) in young children and mothers is a severe public health problem in many low- and middle-income countries and a major contributor to the problem of global malnutrition.

VAD affects people of any age, but the greatest risk for morbidity and mortality is in young children under the age of five. The global prevalence of VAD is 33% and it is associated with approximately 157,000 deaths of children each year. Pregnant and lactating women require additional vitamin A to support fetal growth and to account for losses incurred during breastfeeding. The global prevalence of VAD in women is estimated at 15.3%.

This dissertation focuses on three research questions: 1) What are the determinants of vitamin A deficiency in children under the age of five?; 2) Is the local production and distribution of sunflower oil fortified with vitamin A by small- and medium-sized enterprises effective in reducing vitamin A deficiency in children?; and 3) Is the local production and distribution of sunflower oil fortified with vitamin A by small- and medium-sized enterprises cost-effective compared to large-scale producers?

These research questions will be analyzed using data drawn from a research trial conducted under the MASAVA project. This initiative, operated by the MEDA, the University of Waterloo, and the Sokoine University of Agriculture, aimed to initiate the local production and distribution of sunflower oil fortified with vitamin A by small- and medium-sized enterprises in the edible oil sector to households vulnerable to VAD in two regions of Tanzania between 2014 and 2017.

Title: Association between social marketing interventions and knowledge, attitudes and practise towards consumption of vitamin A-fortified oil in rural Tanzania: a quantitative and spatial analysis.

By: Daphne Wu

Project Output Type: Abstract of Master’s thesis proposal

Date: August 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: This dissertation uses two sets of surveys undertaken before and after a behavior change communications intervention designed to improve knowledge, attitudes and practices regarding vitamin A consumption, particularly from fortified oil. Spatial analysis using sales data will also be used.

IDRC Project Number 107790

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Association between Social Marketing Interventions and Knowledge, Attitudes and Practices towards Consumption of Vitamin A-Fortified Oil in Rural Tanzania: A Quantitative and Spatial Analysis

Master’s thesis proposal

Daphne Chen Nee Wu, September 2017

Abstract

Vitamin A deficiency (VAD) is associated with increased risk of measles, malaria and other infectious diseases in children, and increases the risk of all-cause infant mortality and maternal morbidity and mortality in pregnant women. In 2010, one-third of children aged 6-59 months and 37 percent of reproductive-aged women in Tanzania were vitamin A deficient. The MASAVA project was implemented to improve vitamin A intake in rural Tanzania by supporting small and medium-sized enterprises to fortify unrefined sunflower oil with vitamin A and distribute it in the regions of Manyara and Shinyanga from August 2014 to September 2017.

This study seeks to evaluate the social marketing components of the Masava project, in improving knowledge, attitudes and practices (KAP) towards consumption of the fortified oil. For the study, two sets of surveys were conducted to collect information on KAP towards consumption of the fortified oil: the household survey and the Tanzania Communications and Development Centre (TCDC) survey. For the household survey, only lactating women with children under 5 years were recruited (n=568 at baseline, n=494 at endline), whereas both women and men were recruited to participate in the TCDC survey (n=308 at baseline, n=442 at midline, n=442 at endline).

After nine months of intervention, the household survey found no statistically significant difference in knowledge of vitamin A and the number of women mentioning using vitamin A-fortified foods to improve vitamin A intake in the intervention districts. However, results from the TCDC survey, which was conducted after 14 months of intervention, found that knowledge of fortified oil improved significantly by 60.3 percent. Using the results of both the household and the TCDC surveys, we found that health centre was the major source of information for women, whereas radio was the most important
source of information for men. Despite the difference in the results on knowledge of vitamin A and the fortified oil reported by the household and the TCDC surveys, this study provided important information on major sources of information for women and men in rural Tanzania.
Title: Factors influencing vitamin A status of lactating mothers in Manyara and Shinyanga regions of Tanzania.

By: Edna Ndau, Dylan Walters, Daphne Wu, Nadira Saleh, TCE Mosha, Susan Horton and SH Laswai.

Project Output Type: Abstract of paper which comes from PhD dissertation

Date: August 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: This paper analyzes the vitamin A status of 569 lactating mothers surveyed in 2015 in two regions of Tanzania. Consumption of vitamin A-rich foods was low, and the majority of mothers could not identify vitamin A-rich foods. Vitamin A status was significantly affected by maternal dietary diversity and knowledge about vitamin-A rich foods.

IDRC Project Number 107790

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Factors influencing Vitamin A status of lactating mothers in Manyara and Shinyanga regions of Tanzania


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Abstract

Vitamin A Deficiency (VAD) is a major public health problem that the world is facing today. It is more prevalent in low income countries including Tanzania. This study was conducted to determine factors influencing Vitamin A status of lactating mothers in selected regions of Manyara and Shinyanga, Tanzania. Purposive and random sampling were used to obtain a sample of 569 lactating mothers categorized in age groups - young age (15-19 years) middle age (20-34 years) and elderly (35-49 years). Results showed that, majority of households (98%) were headed by males and only few (2%) were headed by females. Prevalence of VAD was of public health significance (prevalence >50%) among the lactating mothers in all the districts studied. Prevalence of VAD among the lactating mothers was 88.5% for young mothers, 84.6% for middle age mothers and 86.3% for elderly mothers. Vitamin A status of the lactating mothers was significantly (P<0.05) associated with maternal dietary diversity score (MDDS), knowledge about vitamin A rich foods and consumption of dairy products. Majority of lactating mothers (68%) lacked knowledge about vitamin A and fortified oil 98.2%, n=418). Most of the lactating mothers (87%) had positive attitude towards consumption of vitamin A, however, consumption of vitamin A rich foods and fortified foods was generally low. Only 40% of the lactating mothers consumed animal products, 30% consumed yellow/orange fruits while 20% consumed yellow/orange root foods including orange fleshed sweet potatoes. It was concluded from this study that, prevalence of VAD among lactating women was high. Factors that significantly influenced vitamin A status included knowledge about vitamin A rich foods, maternal dietary diversity and consumption of dairy products. It was recommended based on this study that, to address the vitamin A deficiency problem, nutrition and healthy planners should put more efforts on food fortification especially of edible oil and promote consumption of diverse diets at the household level. Also, there is a need to educate lactating mothers and the community as a whole on the importance of consuming fortified oil and selection of foods rich in vitamin A. Furthermore, the community needs to be educated on how to identify the fortified oil in the market by recognizing the fortification logo on the packages and/or reading the label before buying the oil or other fortified foods.

Key words: Vitamin A status, lactating mothers, socio-economic factors, Tanzania

For submission to a journal
Annex 2.15.

Title: Physico-chemical characteristics of oil consumed at the household level and shelf stability of vitamin A in fortified vegetable oil in Manyara and Shinyanga, Tanzania.

By: Edna Ndau and others TBA

Project Output Type: Abstract of paper which comes from draft doctoral thesis

Date: August 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: This paper analyzes the physico-chemical properties of cooking oil collected from households in Tanzania in 2015 and notes the poor quality of these oils. It also assess retinol loss in storage, first on the shelf for six months, and second under conditions of “scooping” in a retail store for up to sixteen days.

IDRC Project Number 107790

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Physico-chemical characteristics of oil consumed at the household level and shelf-stability of vitamin A in fortified vegetable oil in Manyara and Shinyanga, Tanzania

First authors: Edna Ndau, Sokoine University of Agriculture. Other authors TBA.

Abstract
Poor quality of edible oils is a severe major public health problem in Tanzania. This study was conducted to determine the physicochemical properties namely; refractive index, free fatty acids, and acid, peroxide and anisidine and malonaldehyde values of the oil consumed at the households in Manyara and Shinyanga regions of Tanzania. The oil properties were determined using standard procedures of the Association of Official Analytical Chemists (AOAC). Results showed that, refractive index values ranged from 1.4660 to 1.4750. The means of acids, free fatty acids, peroxides anisidine and Malondialdehyde values were for sunflower oil 9.5380±3.1956, 3.36±0.767, 2.82±1.4832, 31.96±5.37 and 1.496±0.038 while those of palm oil was 6.73±1.5391, 4.7±1.6552, 2.7400±0.67676, 26.28±4.258, and 1.2±0.154 respectively. High values for anisidine and presence of malondialdehyde (signifying that, the oils had already undergone the primary oxidation and oxidation was at the advanced stage) implies that the oils were of poor quality. Thus the household oils were of poor quality whereby poor quality of the oils may lead to poor health, specifically for poor growth and development and risks of coronary artery disease, hypertension, diabetics, arthritis, other inflammatory and autoimmune disorders and cancer. Therefore, from this study, it is recommended that, education should be provided to the community on good storage of edible oils and its role in nutrition in prevention of diseases. Also, processors need more education on how to select good seeds for processing oils, for example seeds for oil processing must be free from being attacked by insects and must have low moisture content to avoid deterioration of the oil through oxidation. Results are also provided on the storage of fortified sunflower oil both on the shelf unopened for up to six months, and in retail conditions (in opened containers from which oil is scooped, for up to sixteen days). In both cases retinol loss is quite small.

Key words: Physico-chemical characteristics; Oils/fats

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For submission to a journal TBA
Annex 2.16.

Title: Vitamin A status of mothers of young children, before and after increased access to fortified oil

By: Edna Ndau and others TBA

Project Output Type: Abstract of paper for submission to a journal (3rd paper of Edna’s PhD dissertation)

Date: September 2017

Institutions involved:
Mennonite Economic Development Associates of Canada
Sokoine University of Agriculture, Tanzania
University of Waterloo, Canada

Abstract: This abstract presents the results of analysis of vitamin A deficiency in mothers of young children beginning at the time when access to fortified oil was scaling up, compared to fourteen months later after cumulative impact of exposure to fortified oil. There is a significant drop in any vitamin A deficiency.

IDRC Project Number 107790

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**Vitamin A status of mothers of young children, before and after increased access to fortified oil**

**Edna Ndau, Sokoine University of Agriculture (other authors TBA)**

**Abstract**

In Tanzania, fortification of edible oil by large-scale producers became mandatory in November 2014, and a project (Masava) introduced fortification of unrefined sunflower oil by small and medium enterprises in November 2015. The paper compares vitamin A status of mothers of young children in June-August 2015 (as large-scale fortification was getting under way), with that fourteen months later (when the fortification program was more mature). The study is an observational pre-post trial with intervention and control groups.

Results show that the proportion of mothers exhibiting any vitamin A deficiency dropped significantly (by approximately 20 percentage points) over this period. There were no significant improvements in dietary diversity or other factors likely to improve vitamin A status, while improvements were stronger in households consuming fortified oil. Since mother’s stores of vitamin A are vital for the birth stores of newborns, and since breastmilk is a significant source of vitamin A in children in the first six months of life, the results have implications for vitamin A status of children under six.

For submission to a journal such as *Maternal and Child Nutrition, Public Health Nutrition, Food and Nutrition Bulletin* or similar