

FINAL TECHNICAL REPORT / RAPPORT TECHNIQUE FINAL

ANNEX 2: RESEARCH OUTPUTS

Susan Horton;Nadira Saleh;TCE Mosha;

;

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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

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MEDA

Vitamin A deficiency in Tanzania: affects

34%



OF CHILDREN AGE 6-59
MONTHS

37%



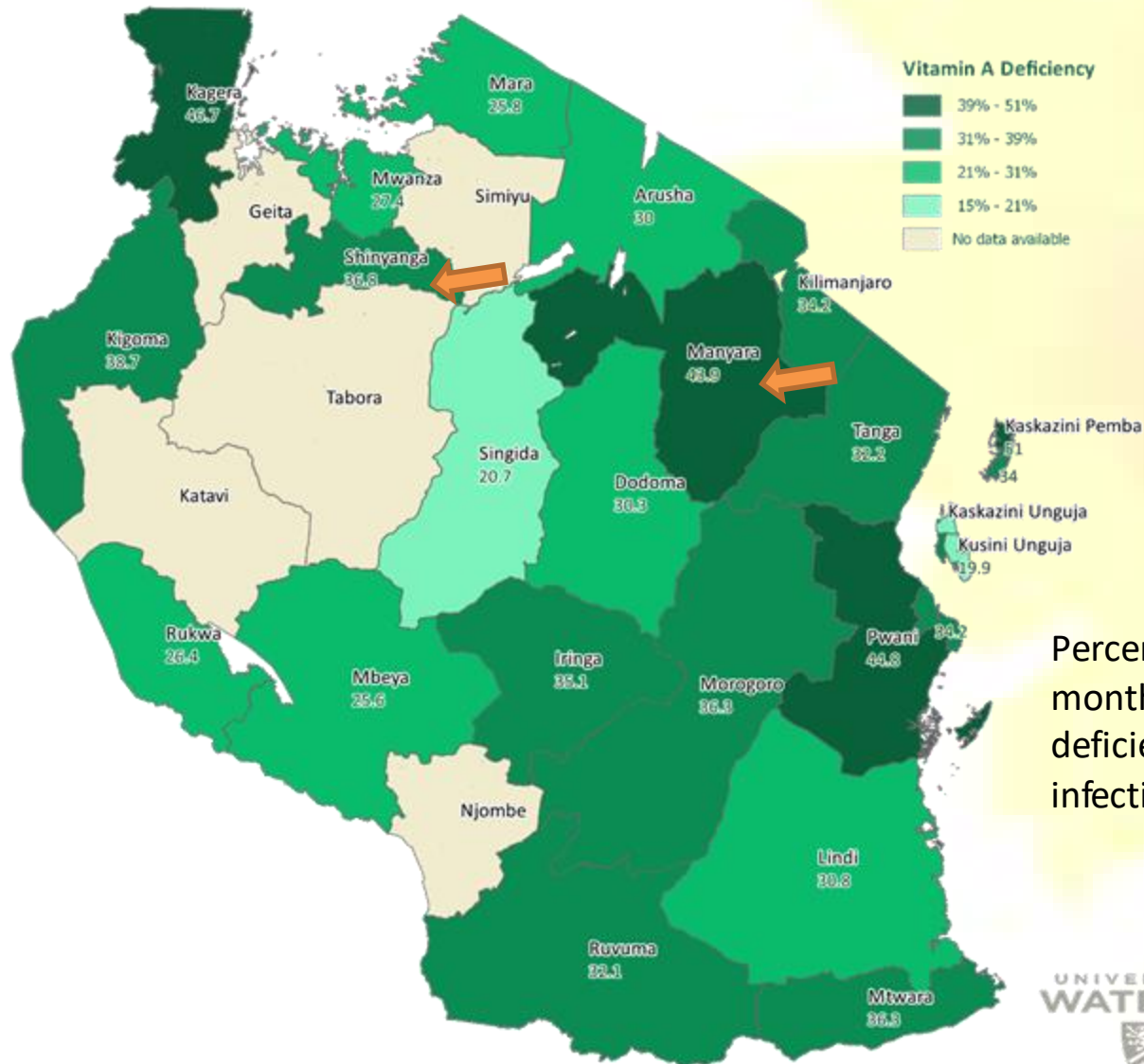
OF WOMEN REPRODUCTIVE
AGE 15-49 YEARS

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 6-59months 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)



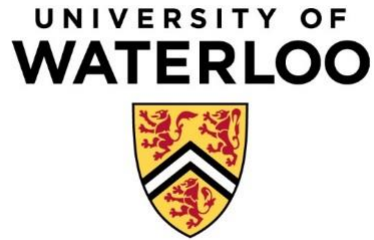
Stimulate demand
via e-Voucher and
Communications
Support (BCC)



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
yaliyoongezwa
Vitamini A**



YANAPATIKANA HAPA



**SINGIDA
SUNFLOWER OIL**



PURE SUNFLOWER OIL

MAFUTA HALISI YA ALIZETI

Total number of questionnaires and DBS and Oil samples collected

Region	District	Category	No. of QNs	No. of DBS	No. of Oil Samples
Manyara	Babati Urban	Intervention	63	63	63
	Babati Rural	Intervention	80	80	80
	Hanang	Intervention	77	77	77
	Mbulu	Control	152	152	150
Shinyanga	Shinyanga Urban	Intervention	49	49	49
	Shinyanga Rural	Intervention	50	50	50
	Kahama	Intervention	49	49	49
	Kishapu	Control	50	50	48
	Grand Total		570	570	566

Preliminary Results

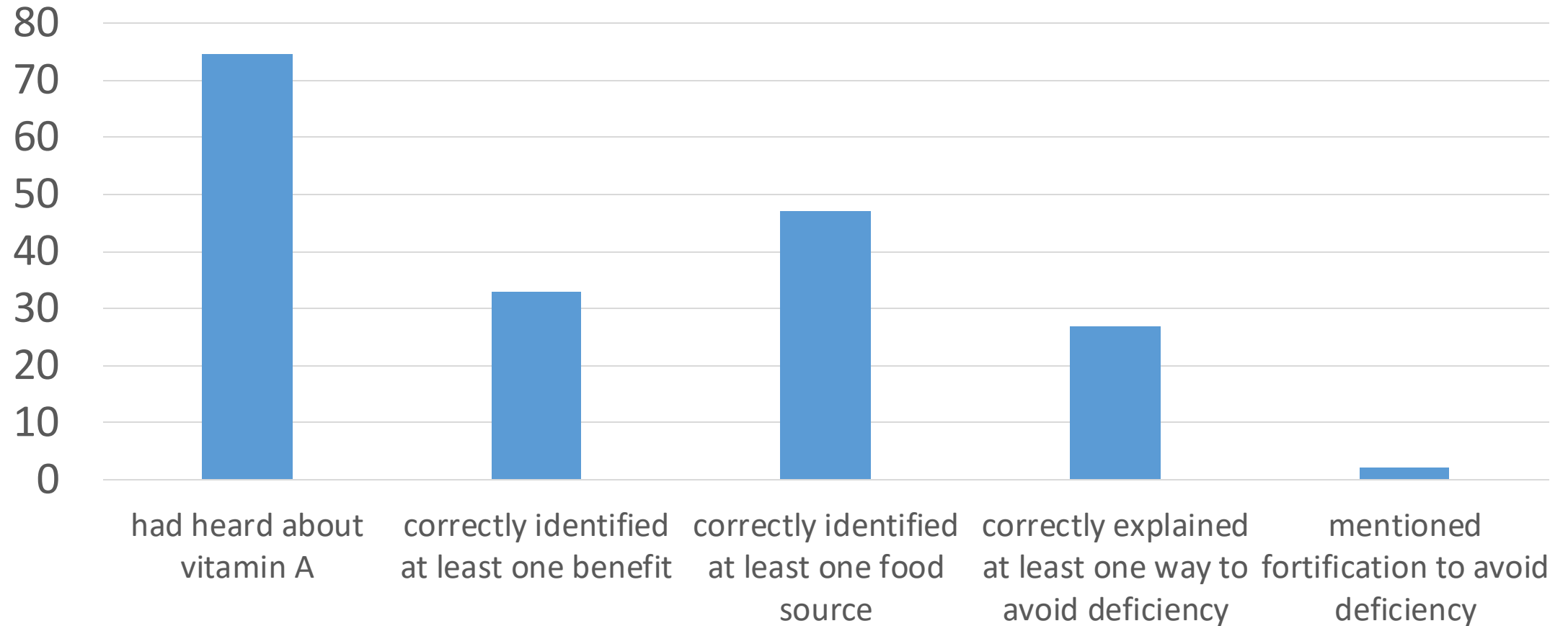
Sample sizes

Intervention	Control	Overall
363	203	566

Manyara	Shinyanga	Overall
369	197	566

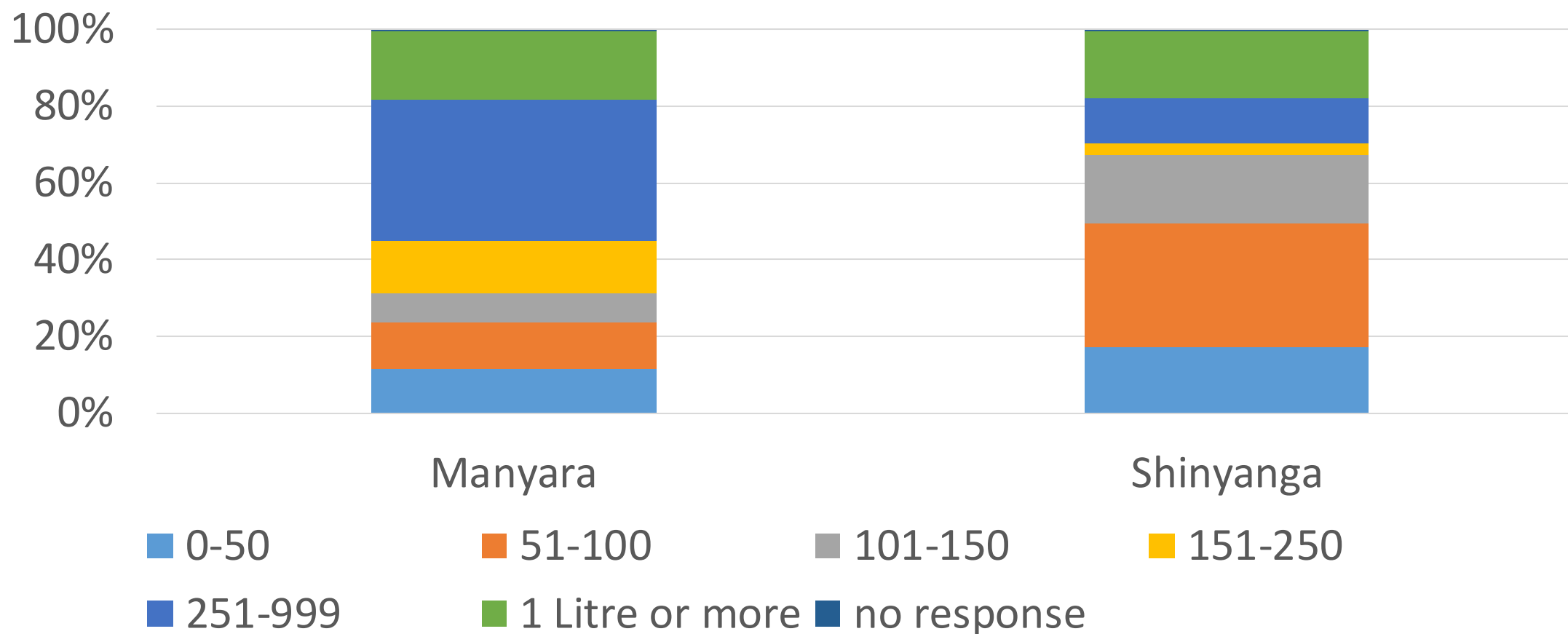
Final sample size may differ slightly – data cleaning is ongoing

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

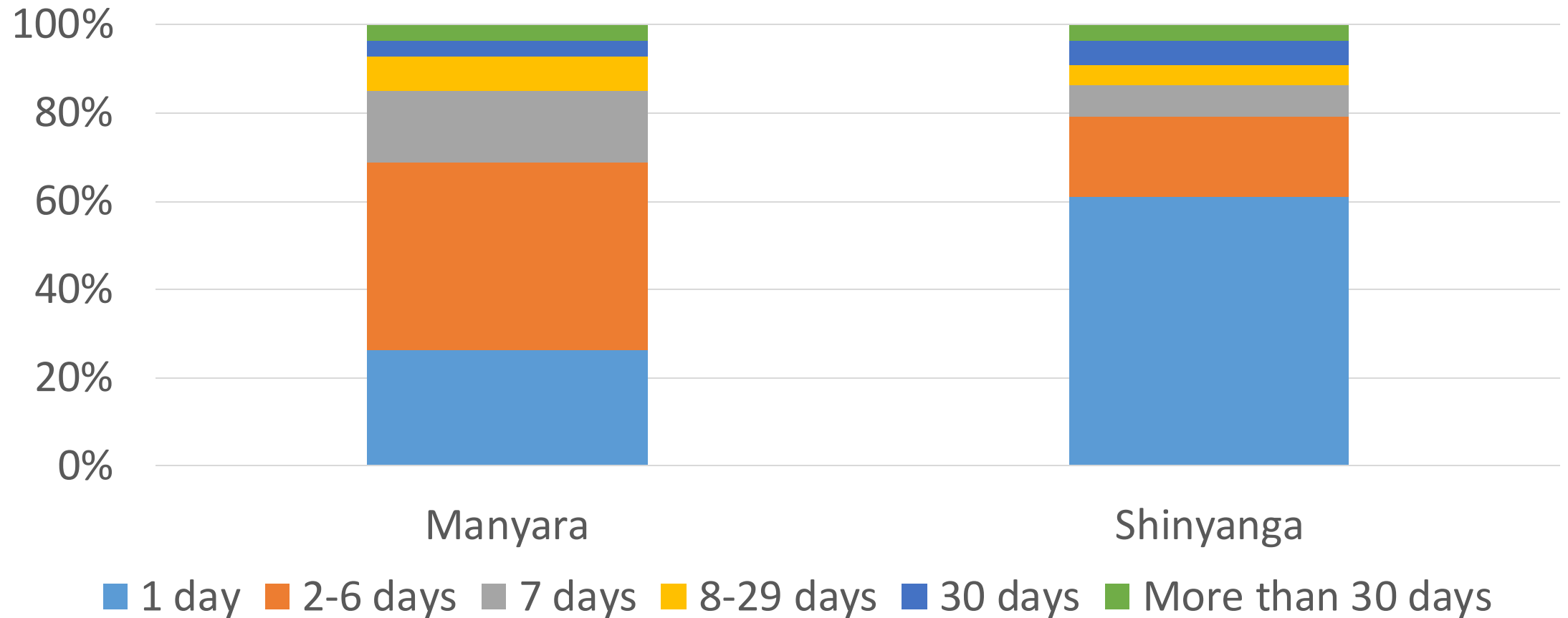
How much oil did you buy, at last purchase? (in ml or g)



Most common purchases for Manyara: 250ml; 500ml; 1 Litre or multiples of 1 Litre

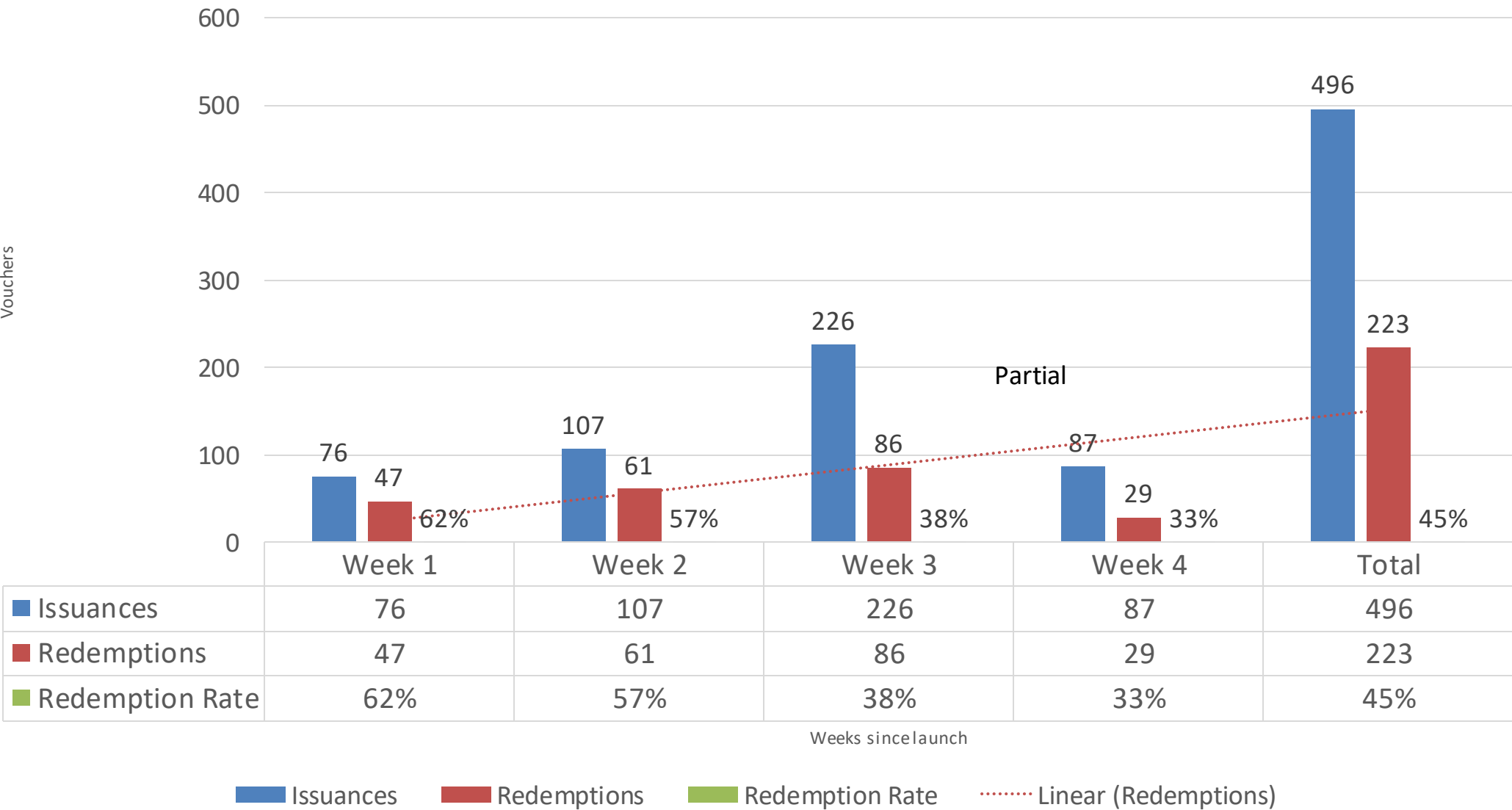
Most common purchases for Shinyanga: 30, 60, 90 or 150 ml/g; 1 Litre/Kig or multiples thereof

How long does your oil purchase usually last?



eVoucher sales and redemption

November progress to date



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



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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 Foreign Affairs, Trade and Development Canada (DFATD), www.international.gc.ca

Annex 2.2.

Title: Fortification of sunflower oil by small and medium enterprises in Tanzania.

By: Goodluck Mosha, Kenneth Nchimbi 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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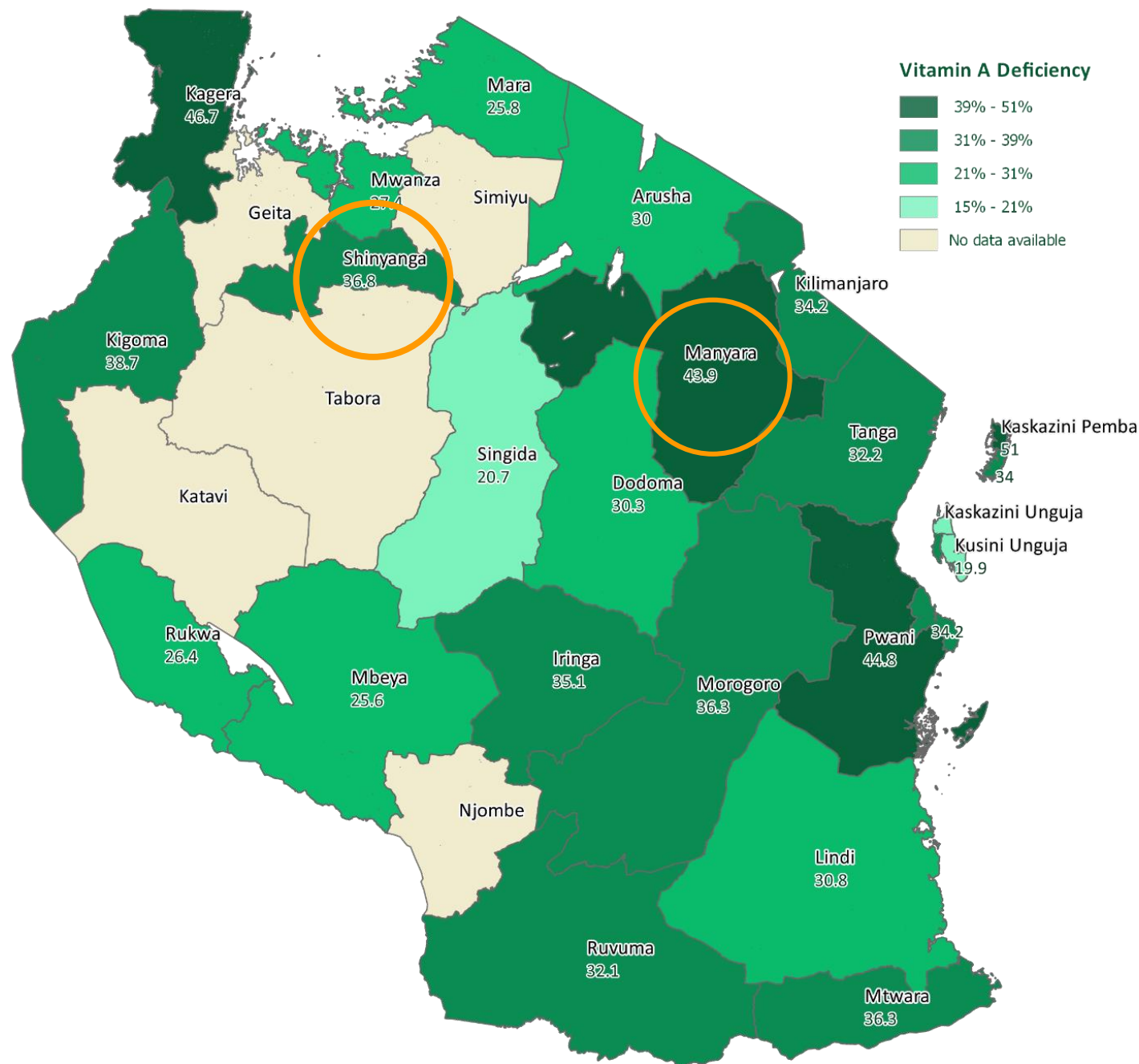
Fortification of sunflower oil by small and medium enterprises in Tanzania

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

UNIVERSITY OF
WATERLOO





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***



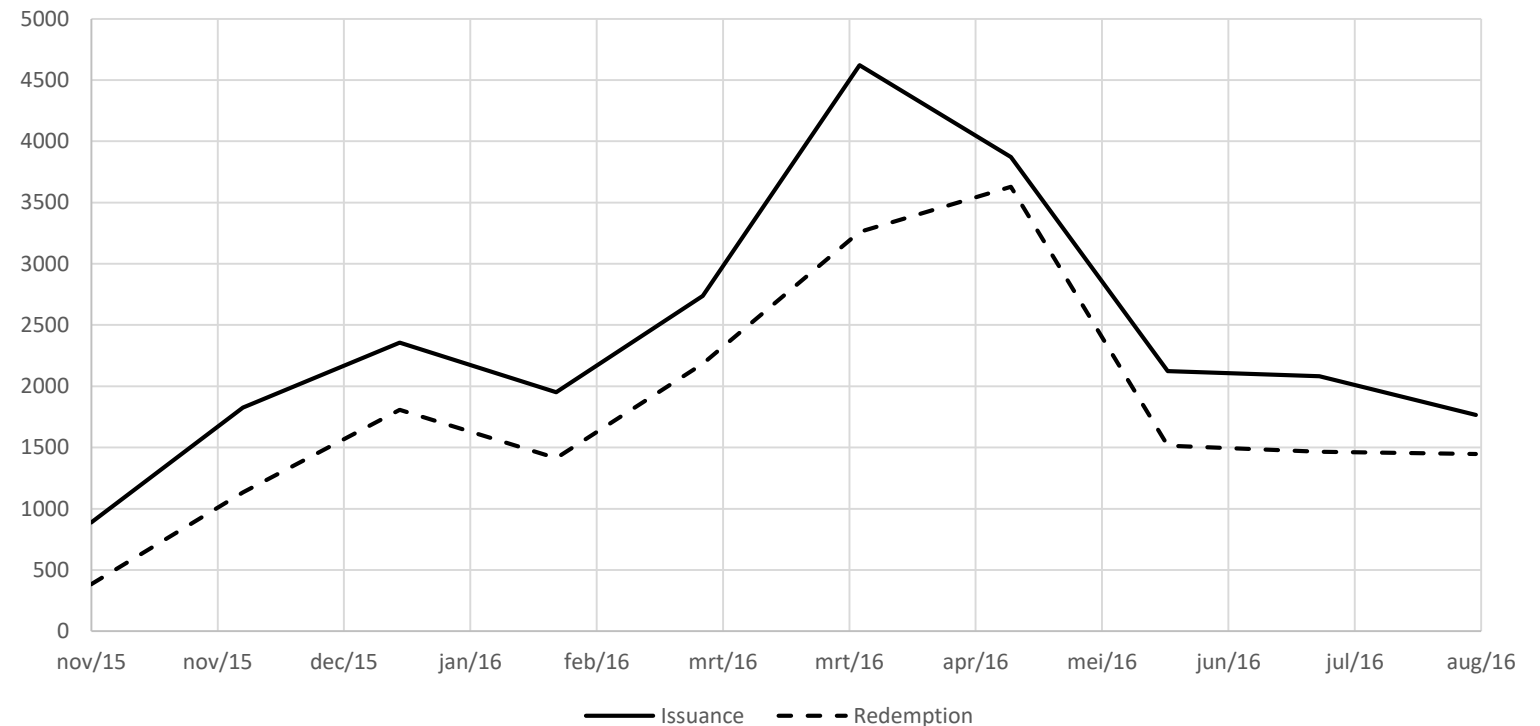
Q3: Can eVoucher discounts stimulate demand?

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



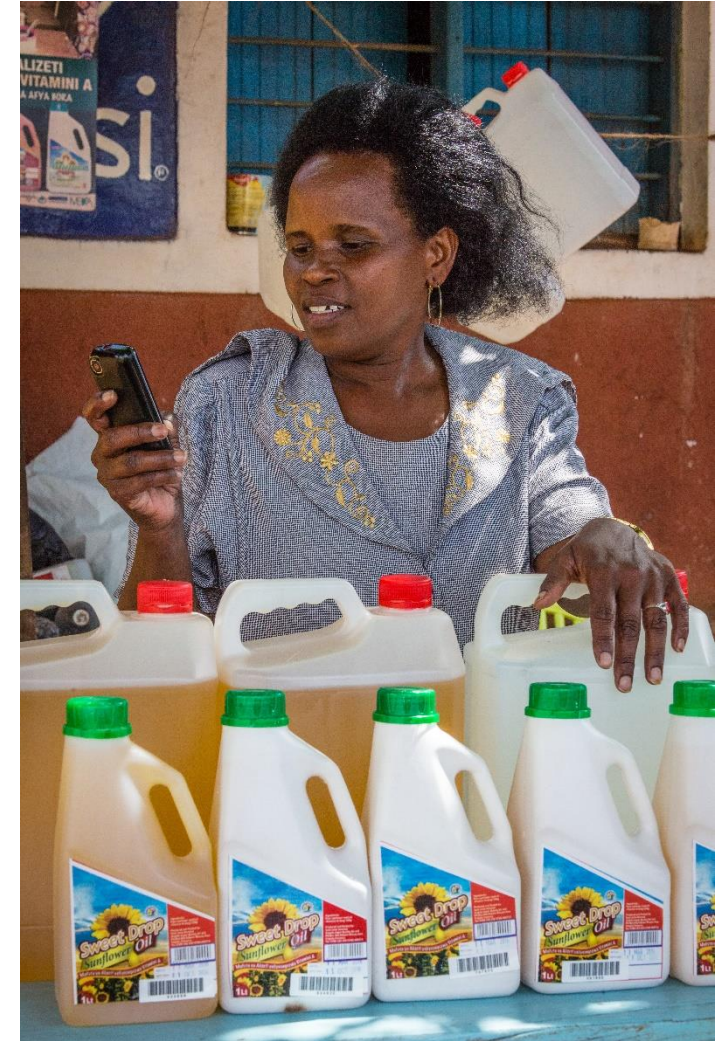
eVoucher issuances and redemptions (Nov 2015 –Aug 2016)

- 24,220 Issuances
- 18,236 Redemptions (75%)
- On average, redeemed evouchers 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).



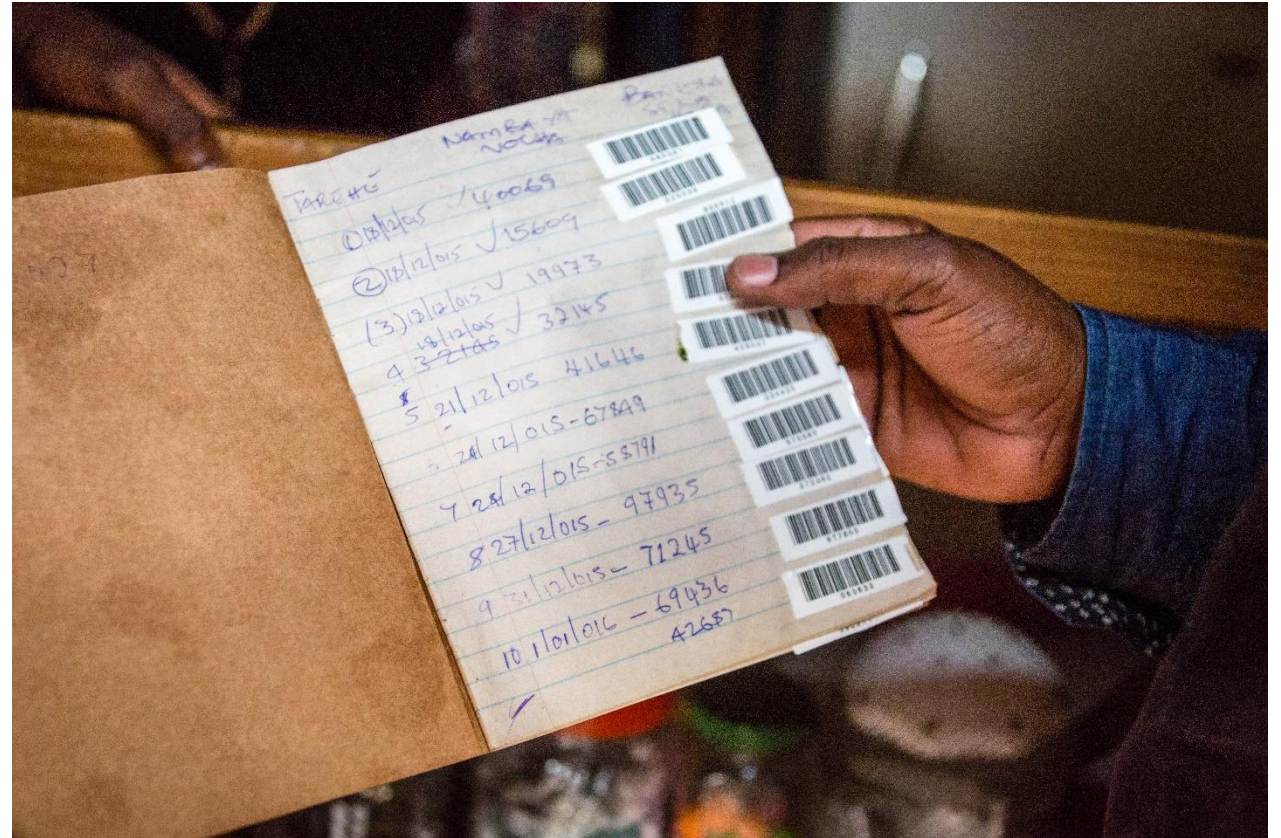
Challenges faced in previous eVoucher structure

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)

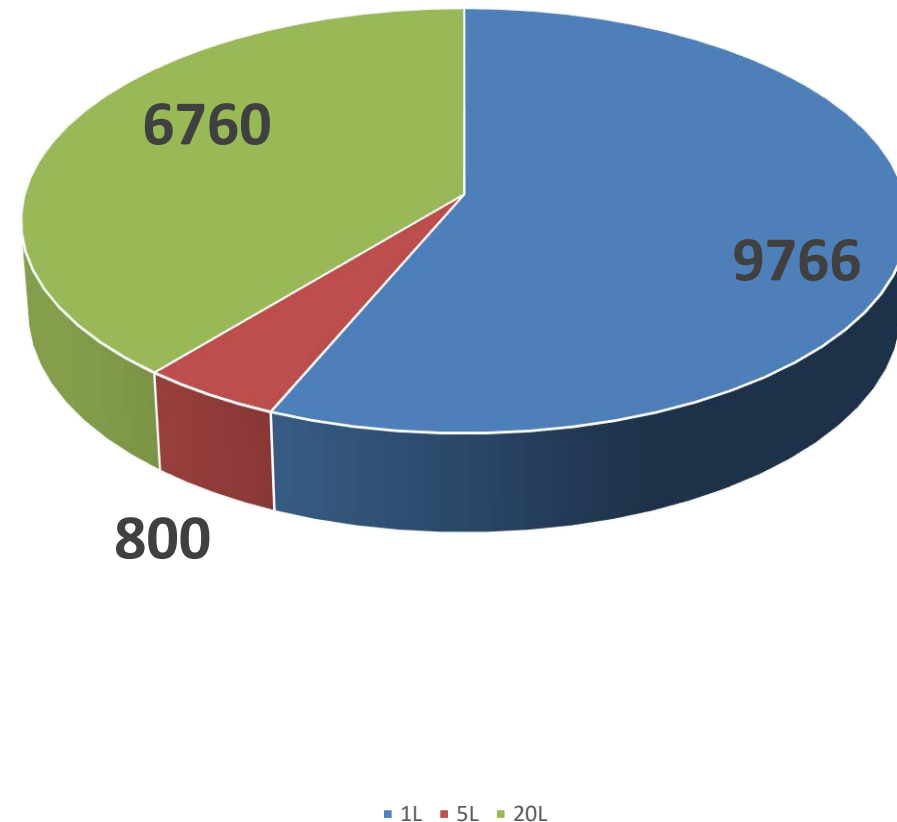
- Given challenges with eVoucher, eWallet introduced to respond to challenges in the field
- Streamlines payment from project to retailer directly, alleviating burden from SMEs, distributors and consumers for larger volumes of oil (also demanded from the project)



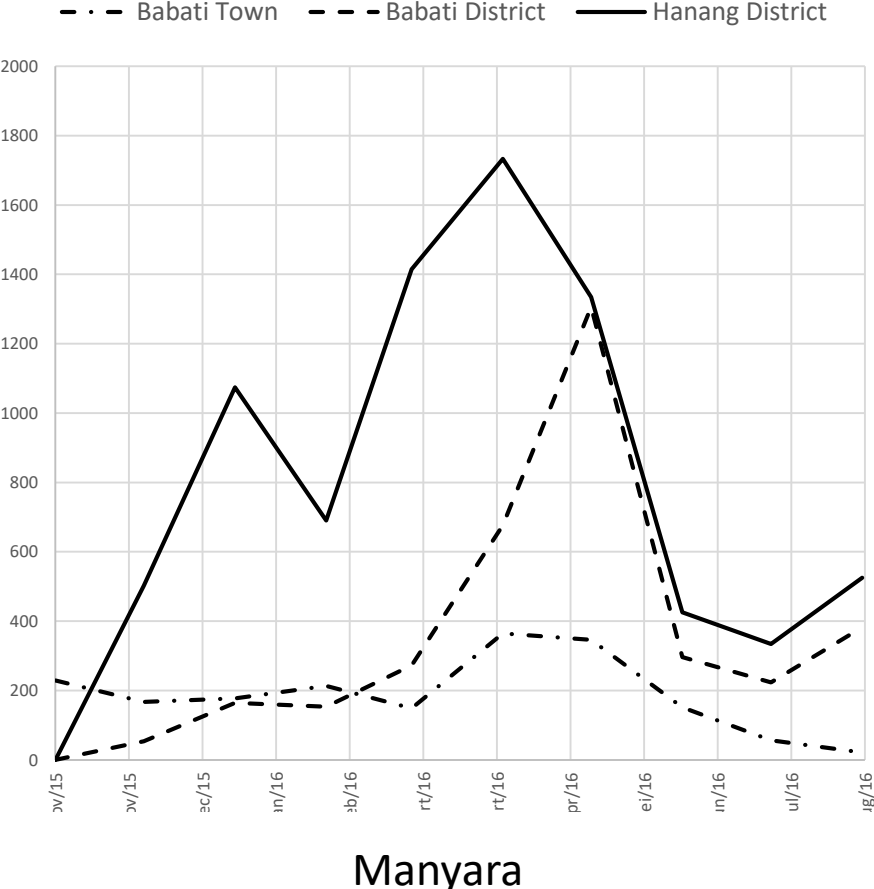
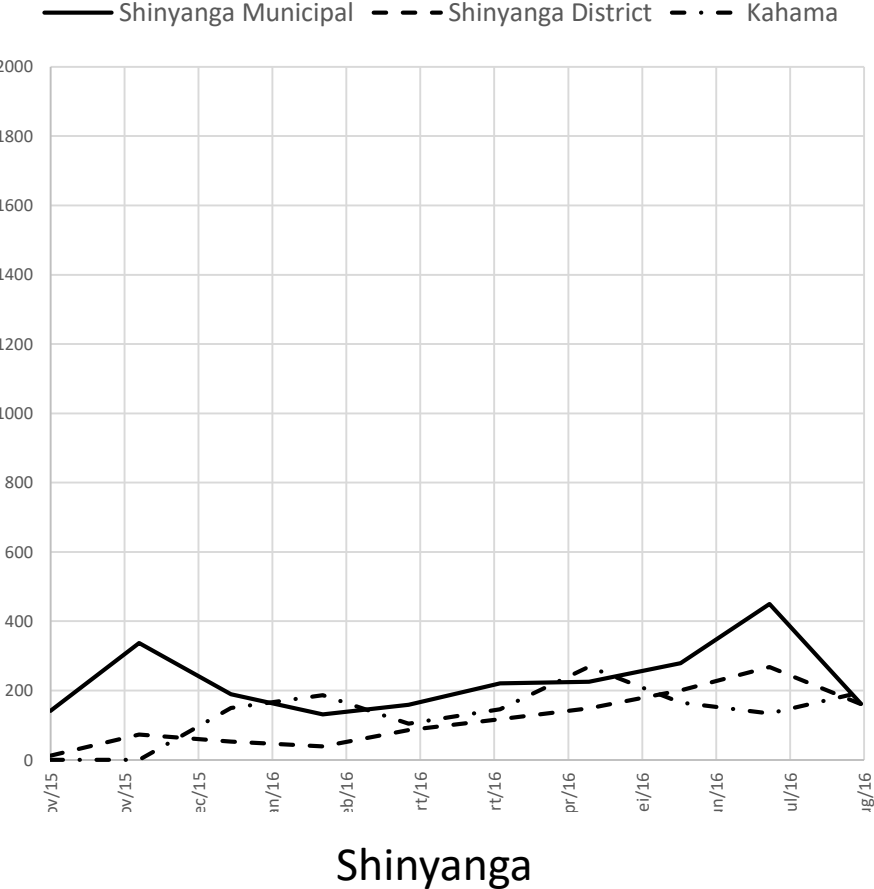
Comparison of Utility

- 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, 6760 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

Litres of Oil sold in the last 90 days

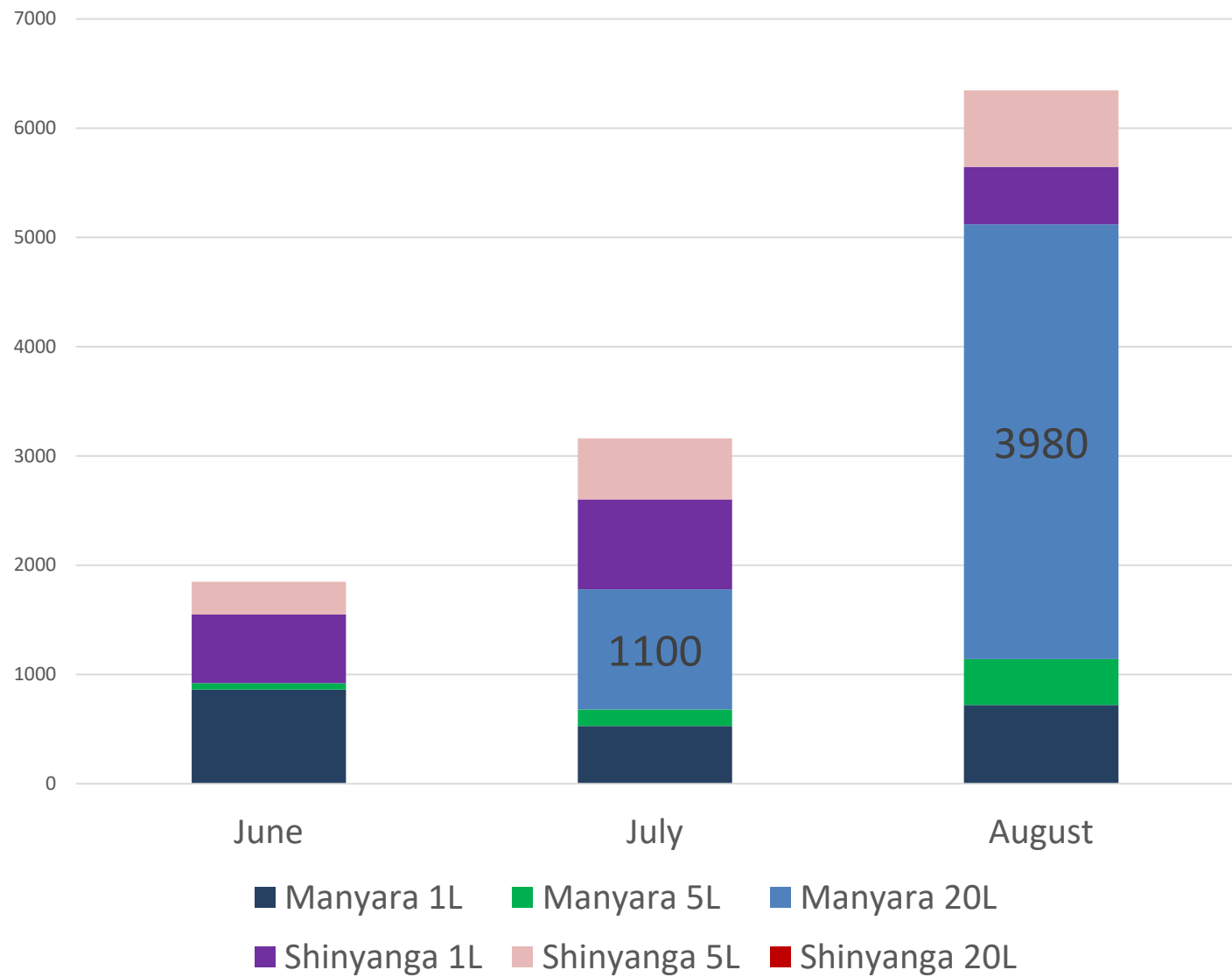


Regional differences and preferences



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

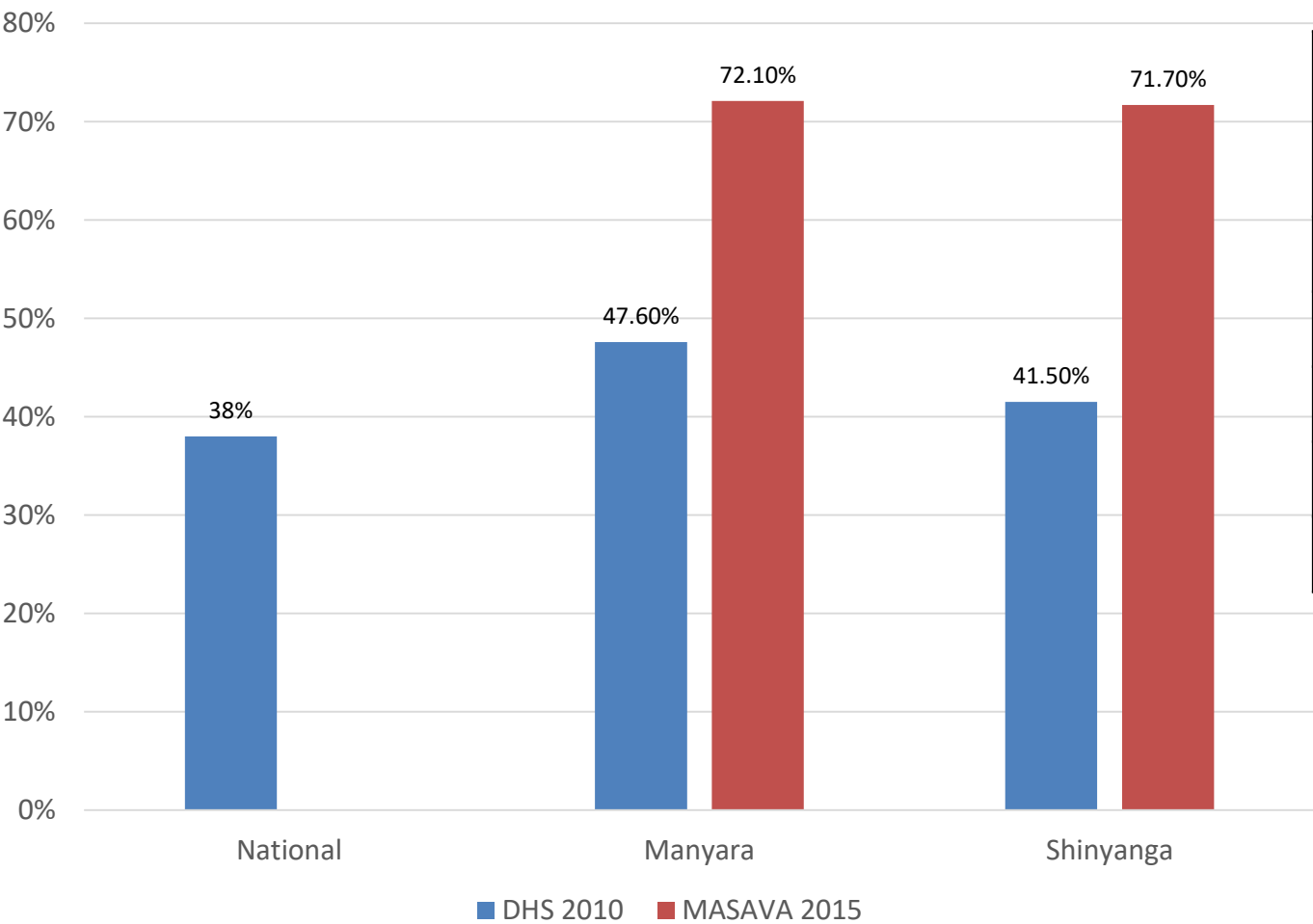


Other Baseline Data Collected

- ✓ 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

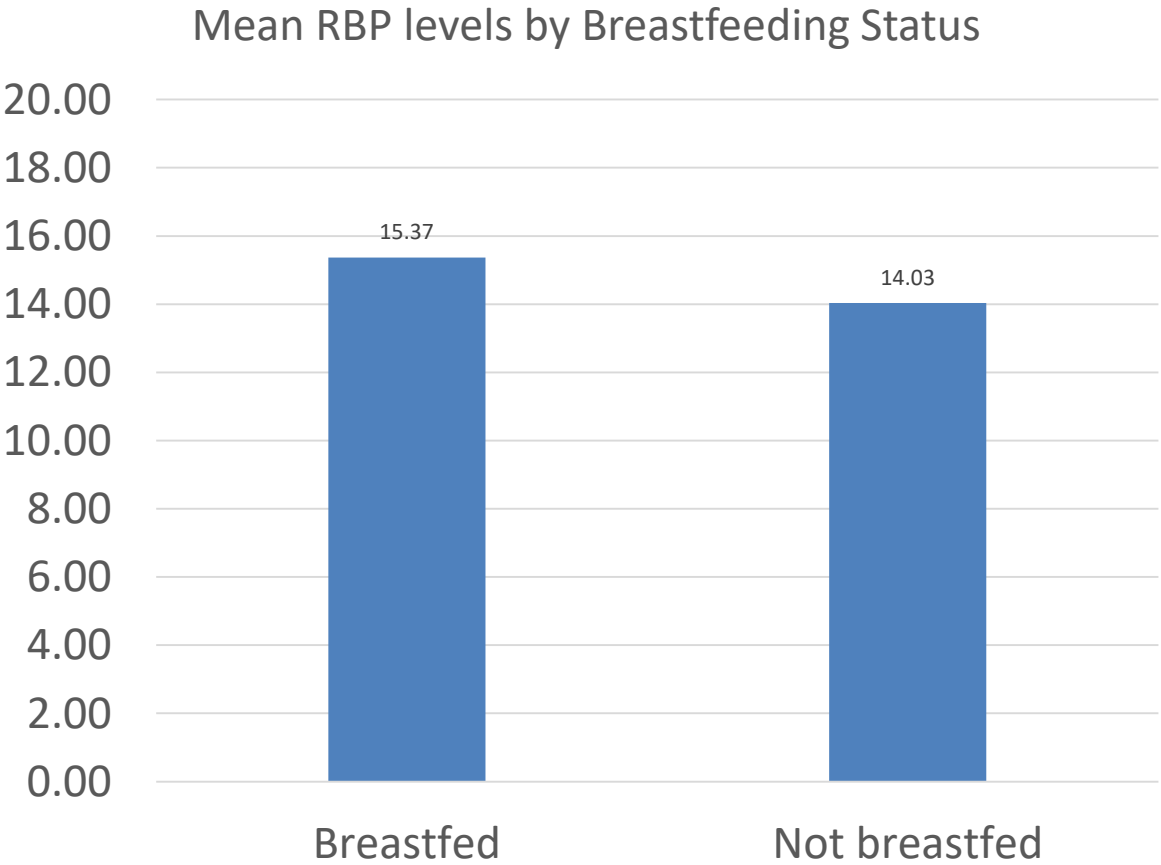
Prevalence of Vitamin A Deficiency (VAD)
(Using <17.325 ug/mL cut-off)



	Prev. VAD %	Mean RBP mg/mL	SD	Median mg/mL
Manyara	72.1	14.87	4.99	14.20
Shinyanga	71.7	14.80	5.88	13.89
Intervention	71.3	14.87	5.37	14.00
Control	73.1	14.79	5.23	14.23

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

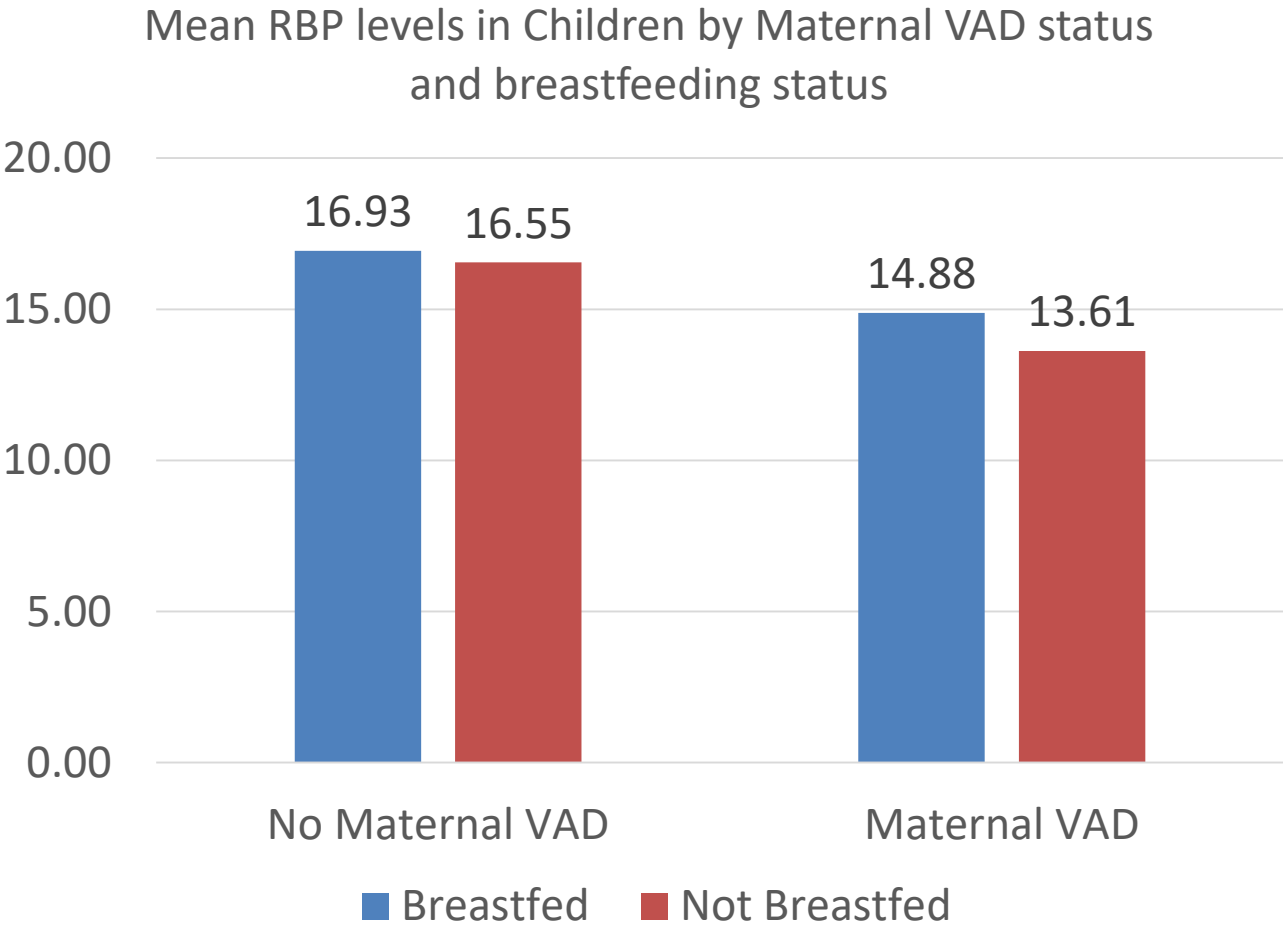
Vitamin A status (RBP levels) in Children by breastfeeding status



Breastfeeding Status	Mean RBP mg/mL	SD	Med.
Breastfed	15.31	5.50	14.94
Not Breastfed	14.03	4.90	13.24

***Significant** difference in mean RBP level between Children who are breastfed or not breastfed ($F(1,525)=8.037, p=0.005$).

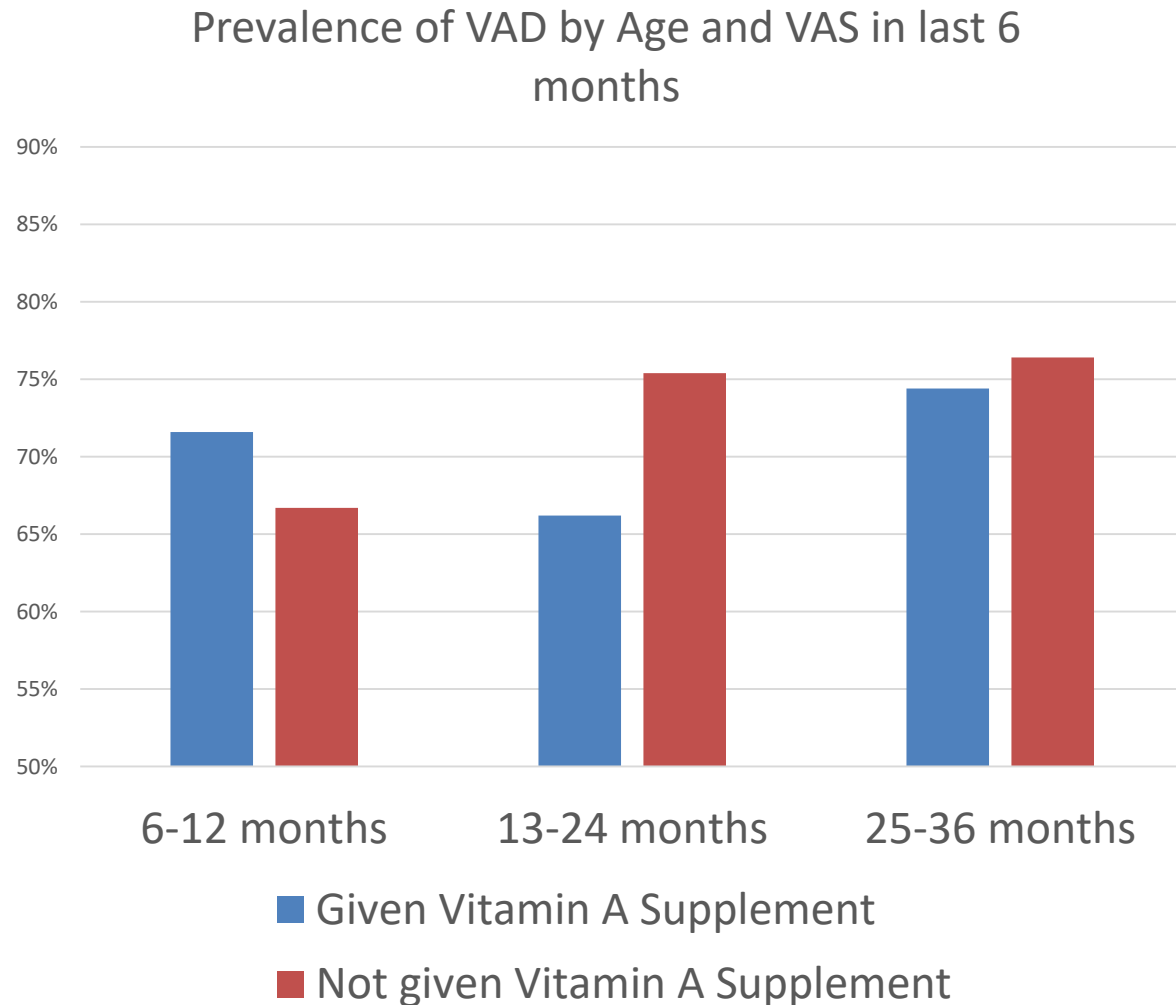
Vitamin A status (RBP levels) in children by mother's vitamin A status



Breastfeeding/Maternal VAD Status	Mean RBP mg/mL	SD	Med.
Breastfed			
No Maternal VAD (@<26.04 mg/mL)	16.93	5.86	14.94
No Maternal VAD (@<26.04 mg/mL)	14.88	5.23	13.24
Not Breastfed			
No Maternal VAD (@<26.04 mg/mL)	16.55	6.31	15.66
No Maternal VAD (@<26.04 mg/mL)	13.61	4.39	13.16

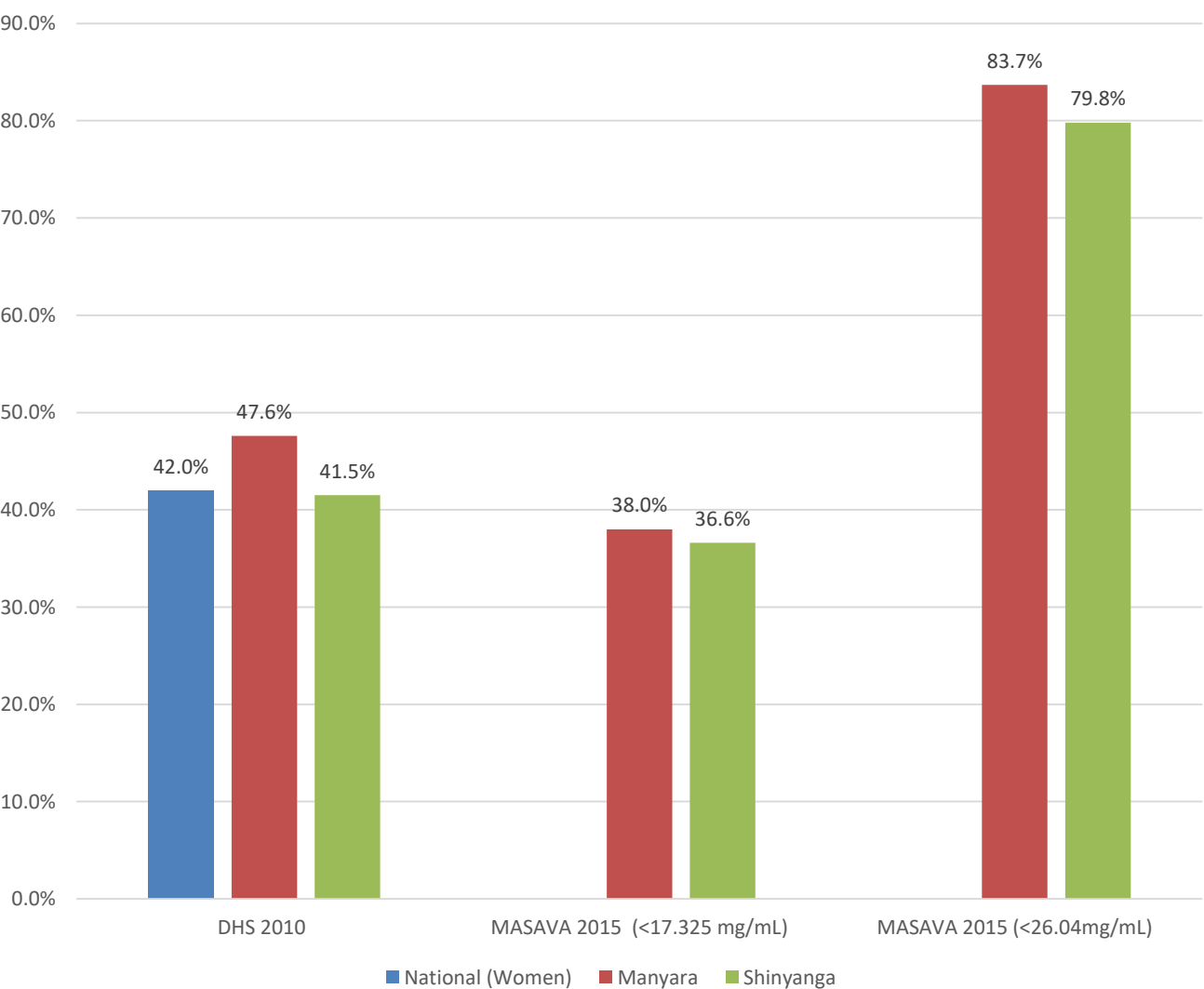
***Significant** difference in mean RBP level in presence of Maternal VAD in breastfed children (F(1,323)=7.024,p=0.008) and children not breastfed (F(1,193)=10.387,p=0.001).

Vitamin A Deficiency in Children by VA Supplementation in last 6 months



Vitamin A Deficiency in Women by Region

Prevalence of VAD



	Prev. VAD % @<17.325 mg/mL	Prev. VAD % @<126.04 mg/mL	Mean RBP mg/mL	SD	Med.
Manyara	38.0	83.7	20.19	7.25	19.21
Shinyanga	36.6	79.8	20.37	7.23	19.97
Intervention	84.1	41.3	19.72	7.12	18.88
Control	79.0	30.6	21.21**	7.26	20.88

*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



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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 2.3.

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

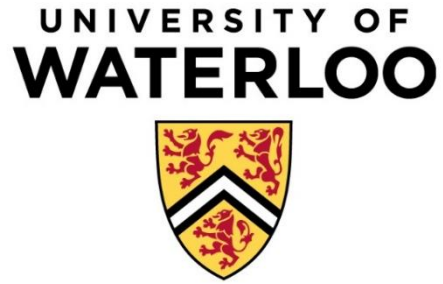
University of Waterloo, Canada

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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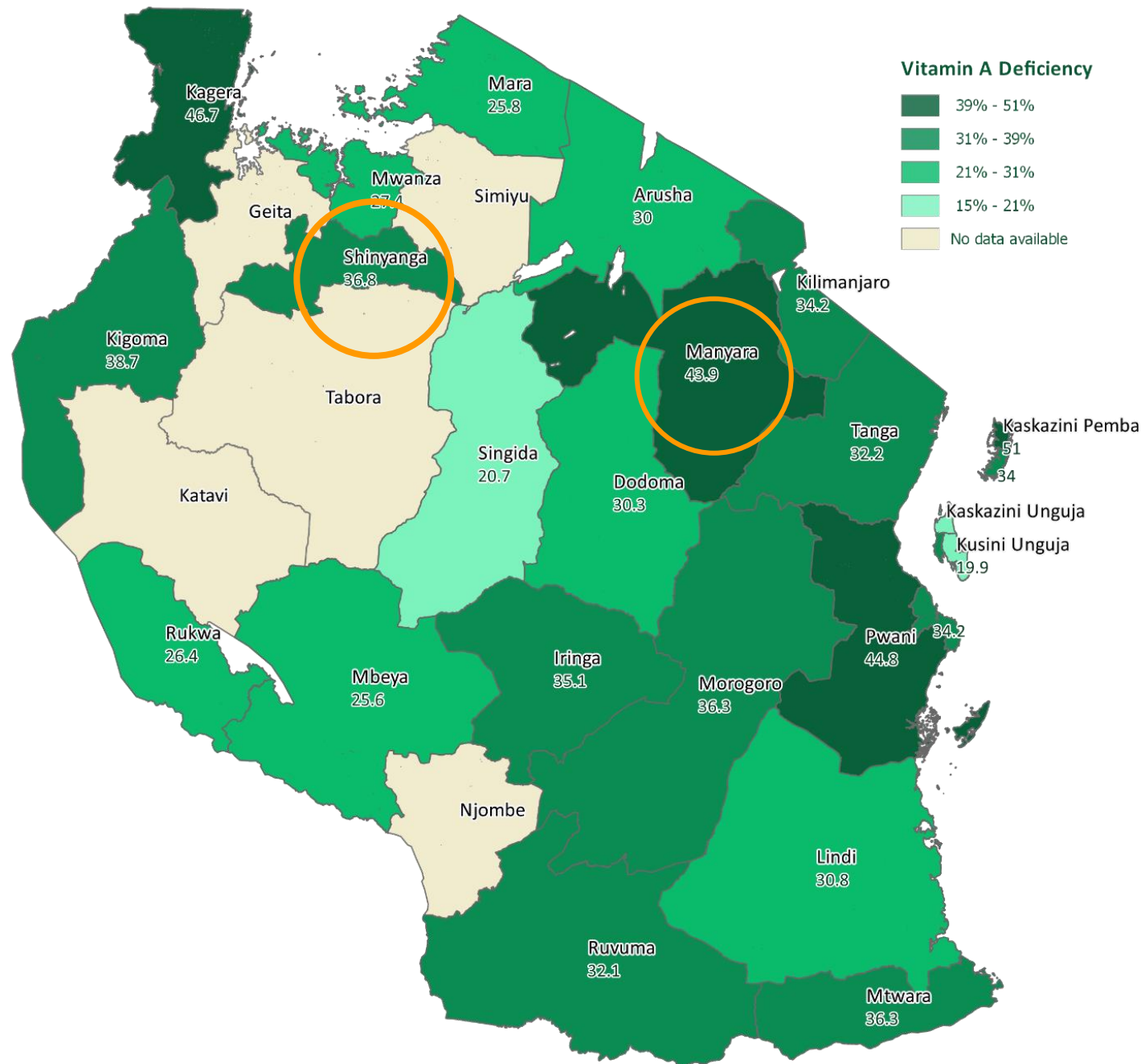


Mafuta Asili ya Alizeti yenye Vitamini A

[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

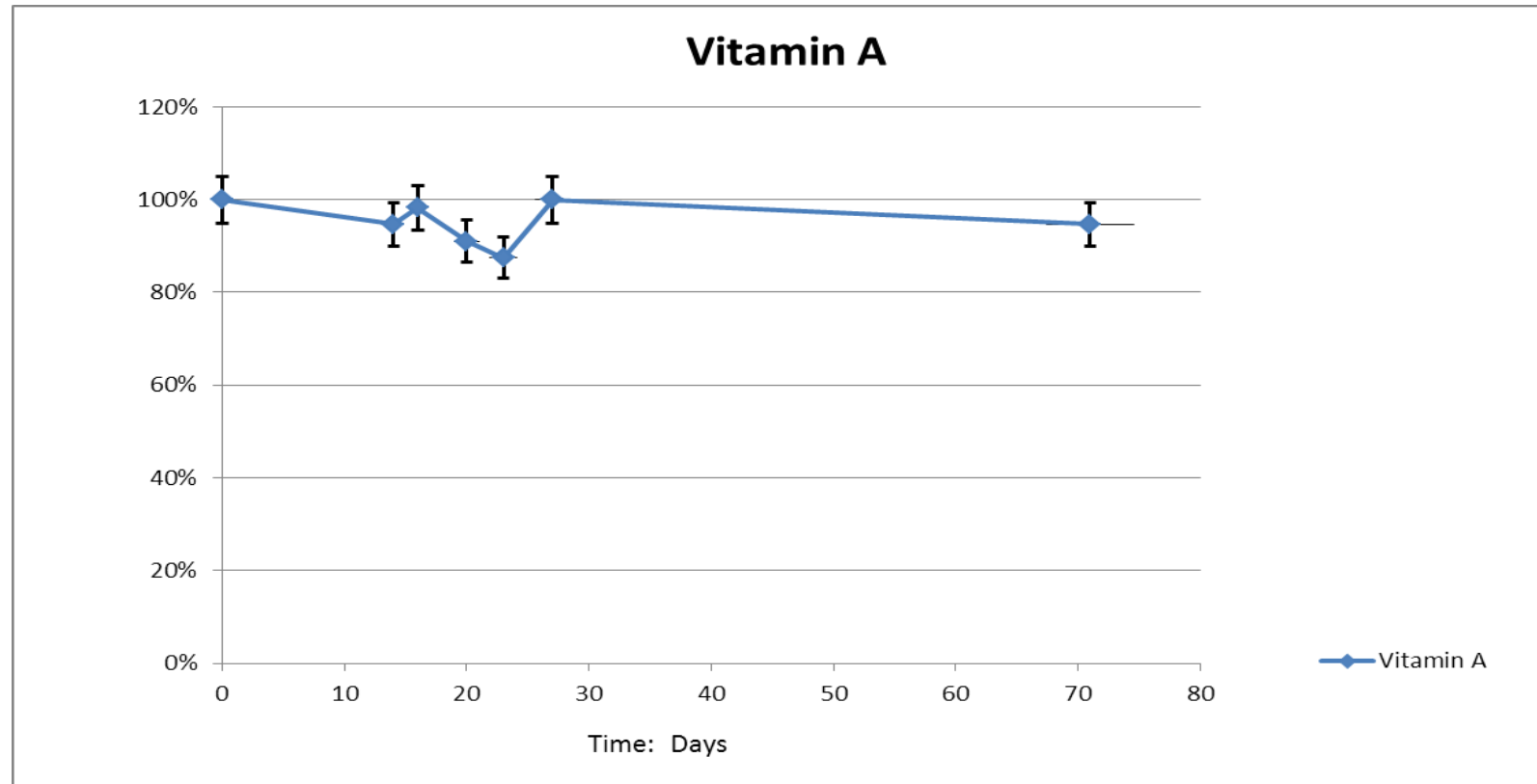
GOAL of pilot

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

Pilot study results – Oil quality findings



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

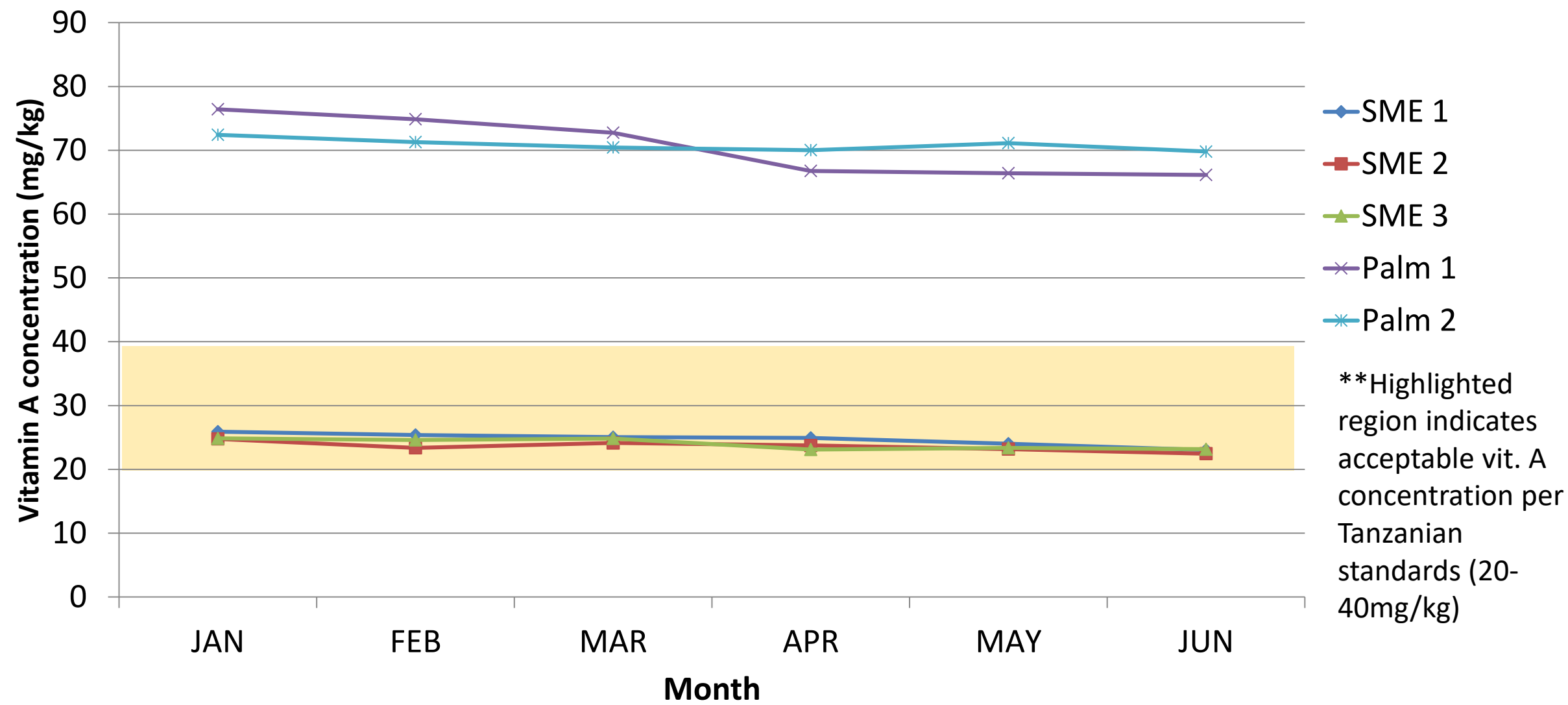
1. Can unrefined sunflower oil be fortified by Small and Medium Enterprises (SMEs) for local consumption
2. Can the business model be sustainable
3. Can electronic vouchers (eVouchers) succeed in promoting consumption of fortified oil
4. Can the fortified product reduce micronutrient deficiencies in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



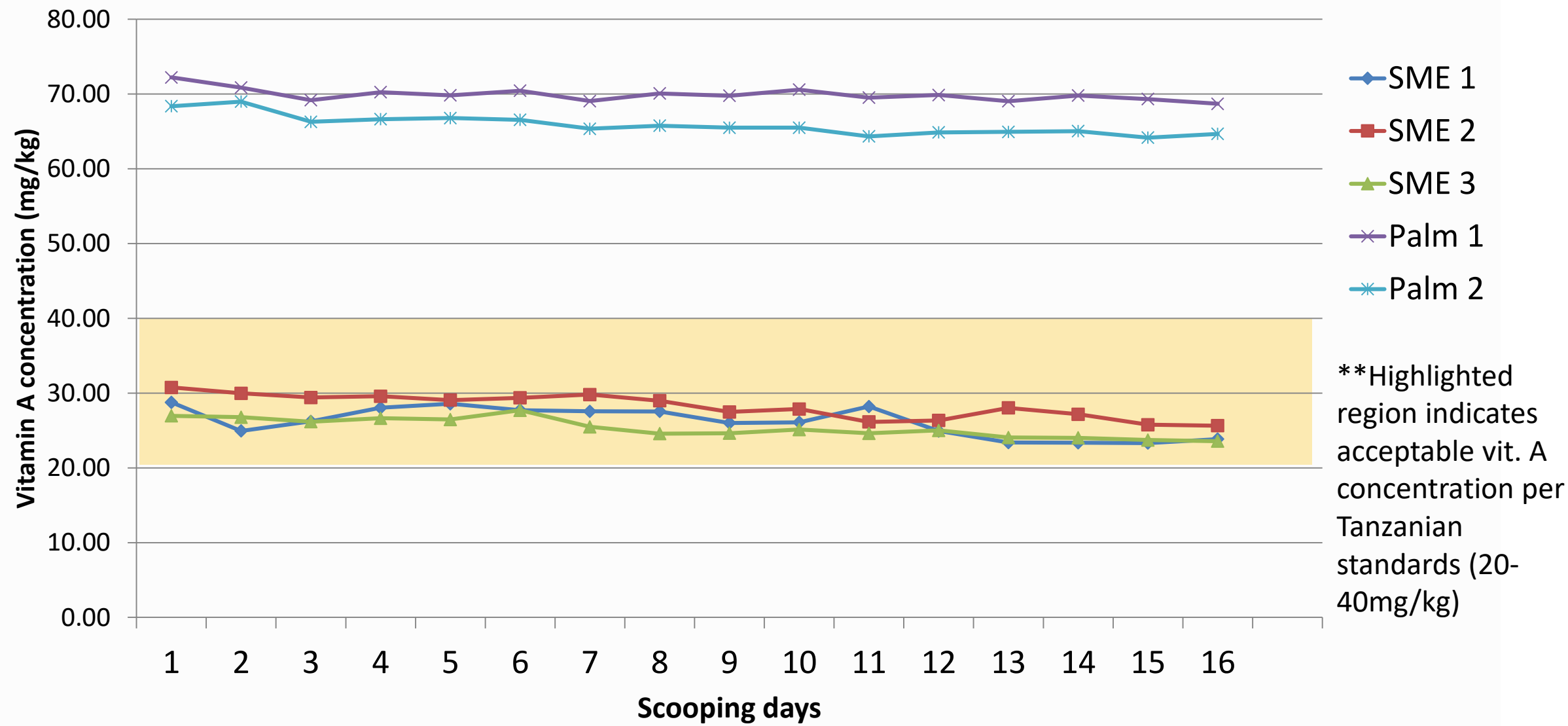
Current Project Facts

- **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)



Vit. A concentration in scooped fortified sunflower oil (over 16 days)



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



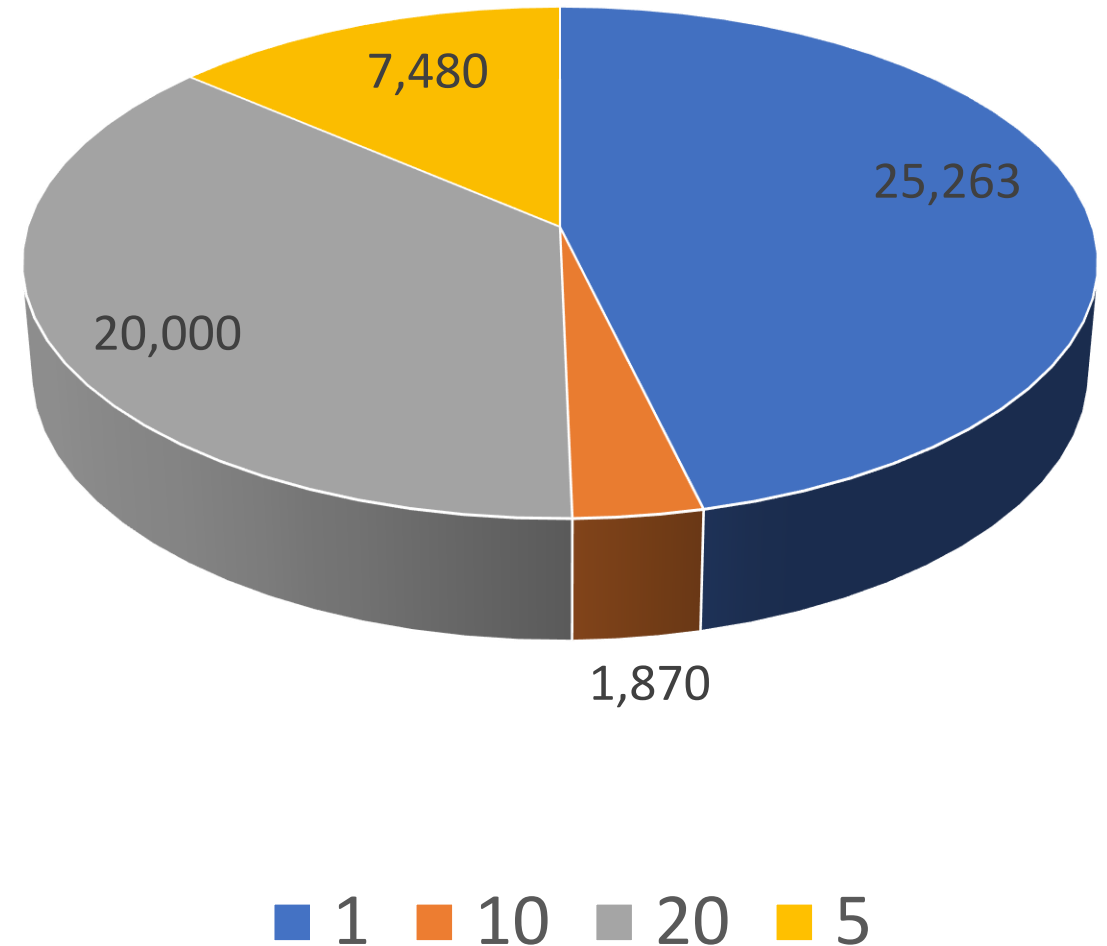
Can eVoucher discounts stimulate demand?

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

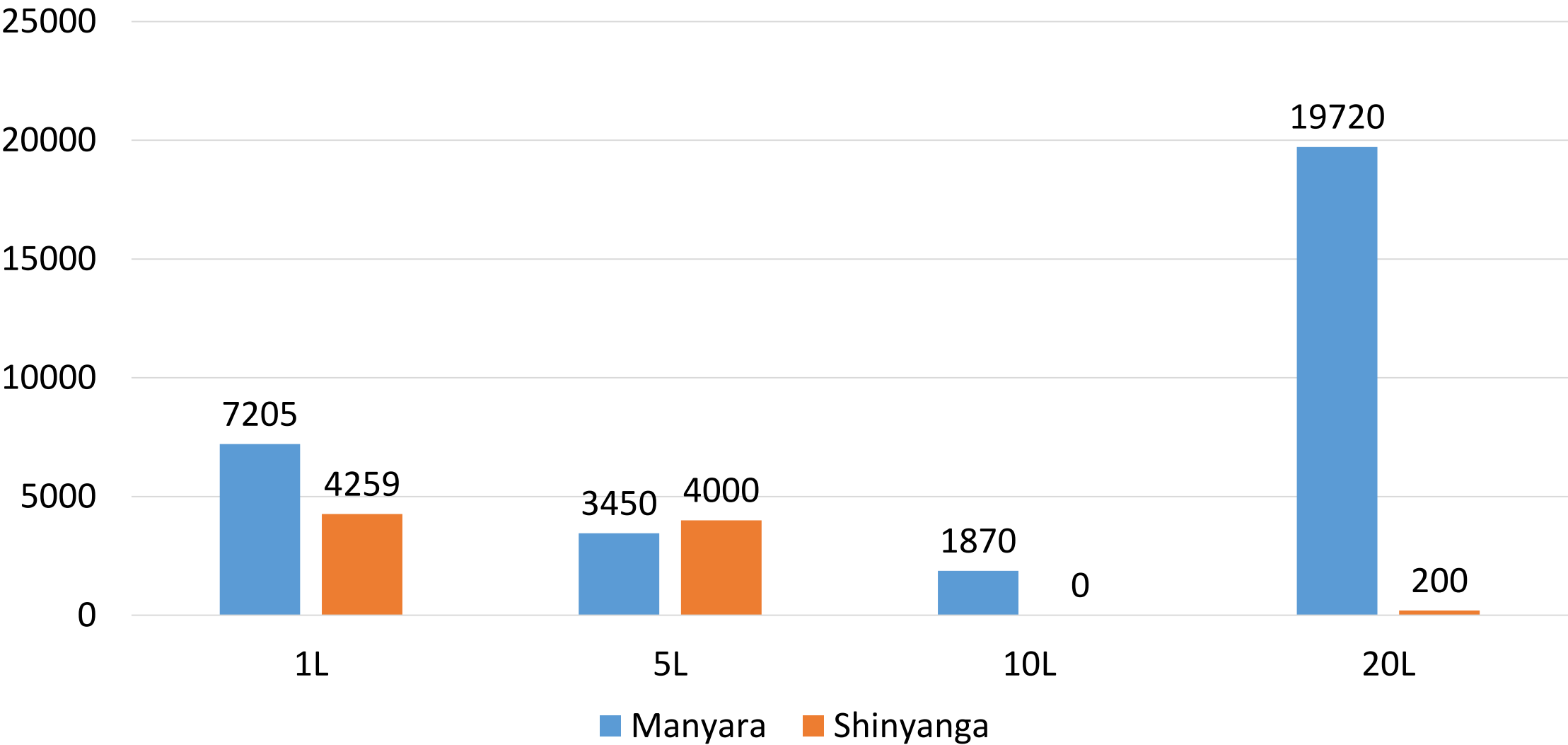


Comparison of volumes sold in litres (October 2015 – June 2017)

- 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)



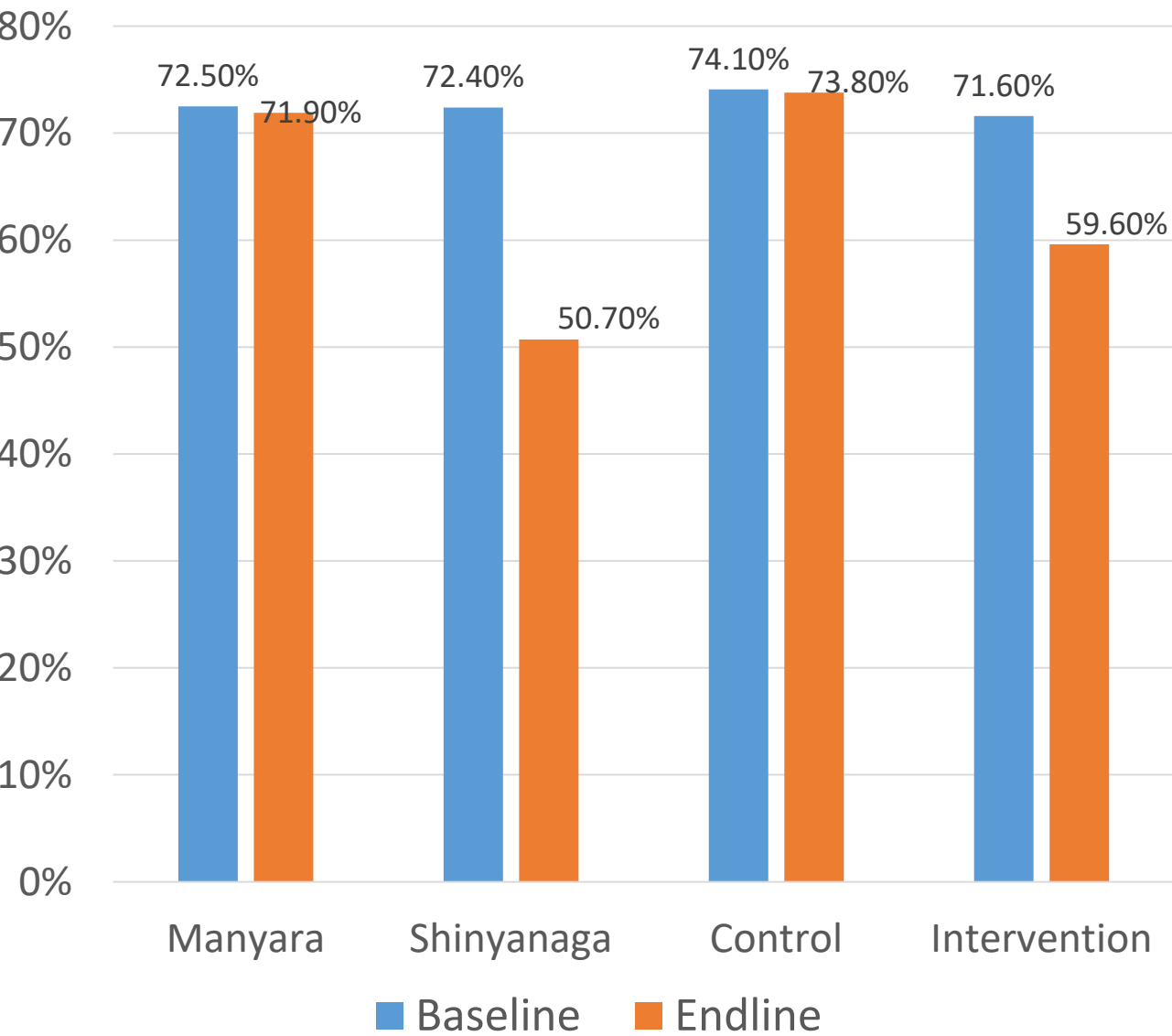
Result: estimated reach ending June 2017

Variable	Total
Production (overall impact of fortified oil)	110, 677 L
Sales to distributors (Oil which is still in the chain to target areas)	82,541 L
eVoucher/eWallet redemptions (by individuals or retailers – indication of oil to households in target areas)	54,613 L

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



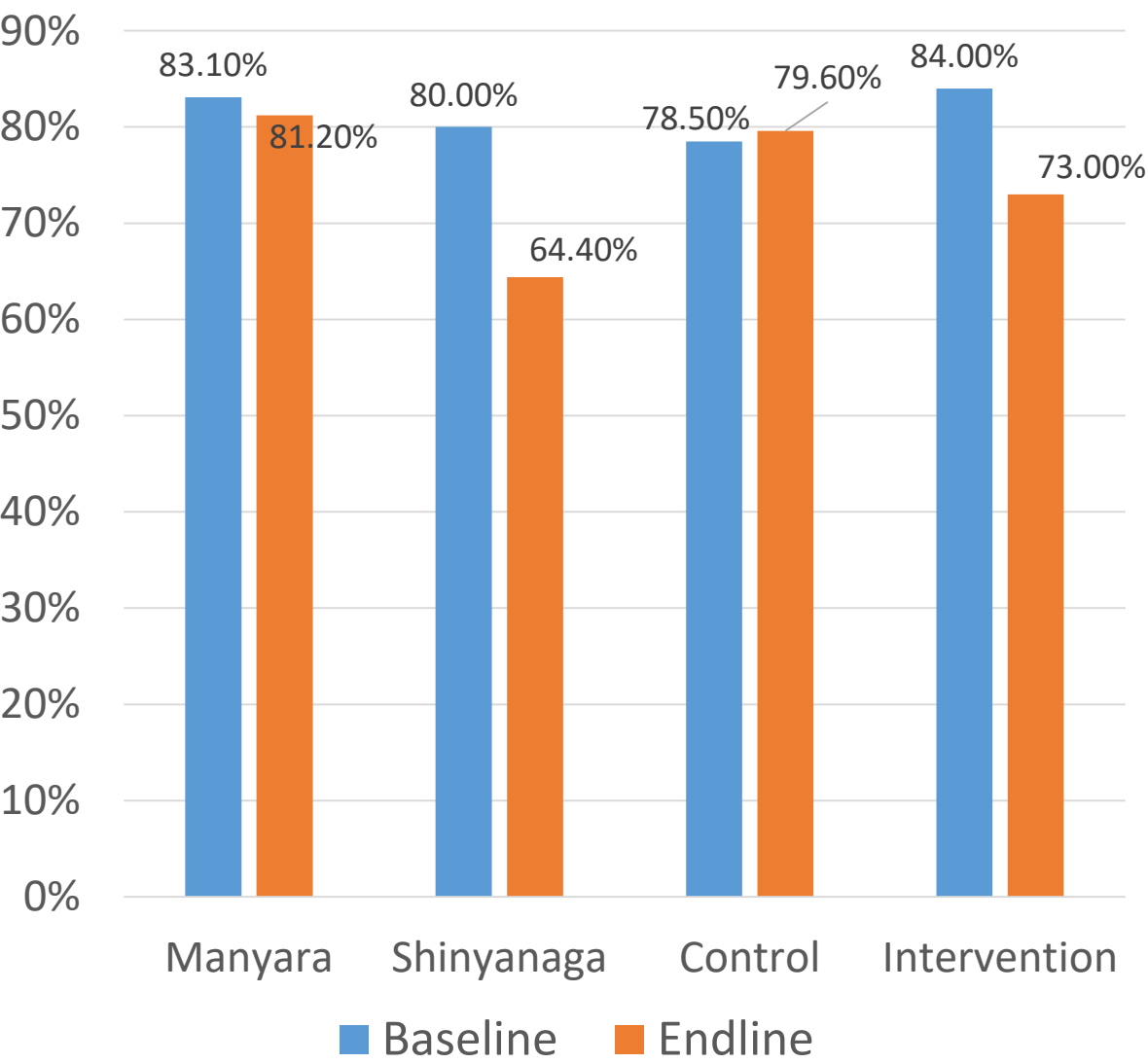
	Baseline Mean RBP mg/mL	Endline Mean RBP mg/mL
Manyara	14.85	15.04
Shinyanga	14.71	18.42*
Intervention	14.83	17.20**
Control	14.74	14.37

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



	Baseline Mean RBP mg/mL	Endline Mean RBP mg/mL
Manyara	20.21	19.06
Shinyanga	20.32	23.05**
Intervention	19.72	20.41
Control	21.21*	20.48

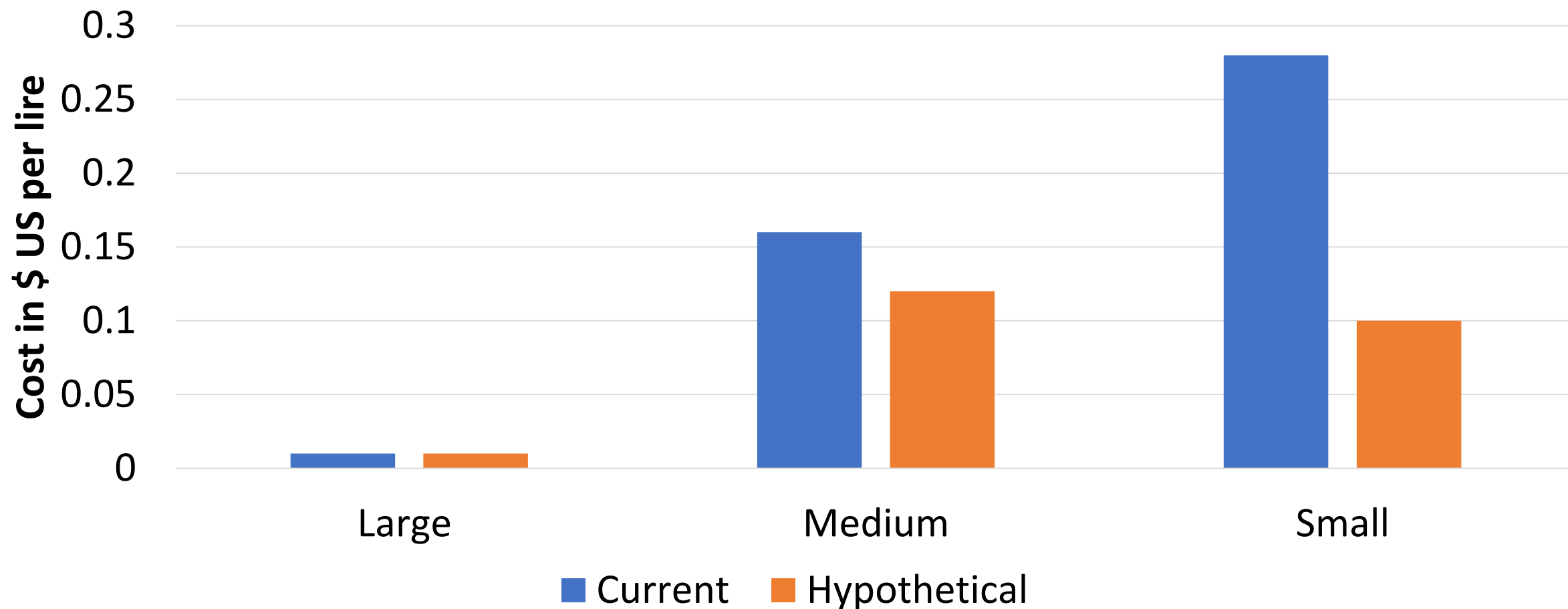
*Significant difference in mean RBP level between Intervention and Control at baseline (F(1,533)=5.267,p=0.005).

**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)



Project conclusion

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



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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:

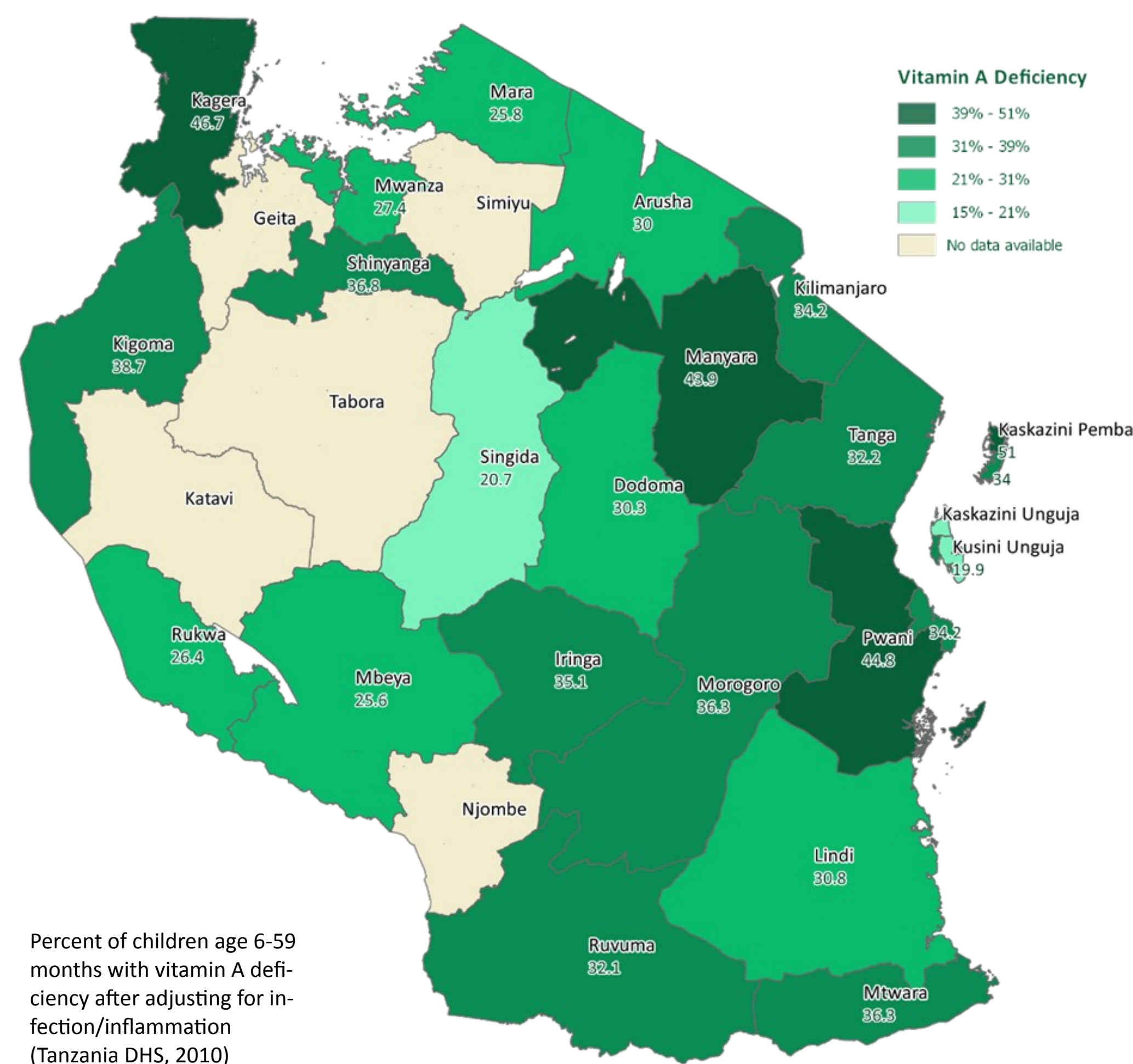
This poster presents results on stability of retinol in oil from the initial trial, and results on consumption of type of oil, and of foods containing vitamin A, from the household baseline survey.

IDRC Project Number 107790

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Challenge: vitamin A deficiency



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 (SME) 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

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

Saleh, Nadira, MEDA Canada; Guo, Victor, University of Waterloo; Phiri, Thoko, University of Waterloo

Unrefined fortified oil stability

Two trials were conducted; both by fortifying 100 L freshly produced unrefined sunflower oil. Fortification level was set to 40-50 IU/g of vitamin A using a vitamin A concentrate "Vitamin A Palmitate 1.0 Mio IU/g, stabilized with BHT". In both cases 4.5 g of vitamin A concentrate was weighed and diluted it into 1 L of unfortified oil. Samples were taken directly from the drum and brought to BASF Denmark for analysis sealed in PET bottles. Samples were tested at 0, 1, 2, 3, 4, 5 and 9 weeks for vitamin A, the results of which are highlighted in **Figure 1**.

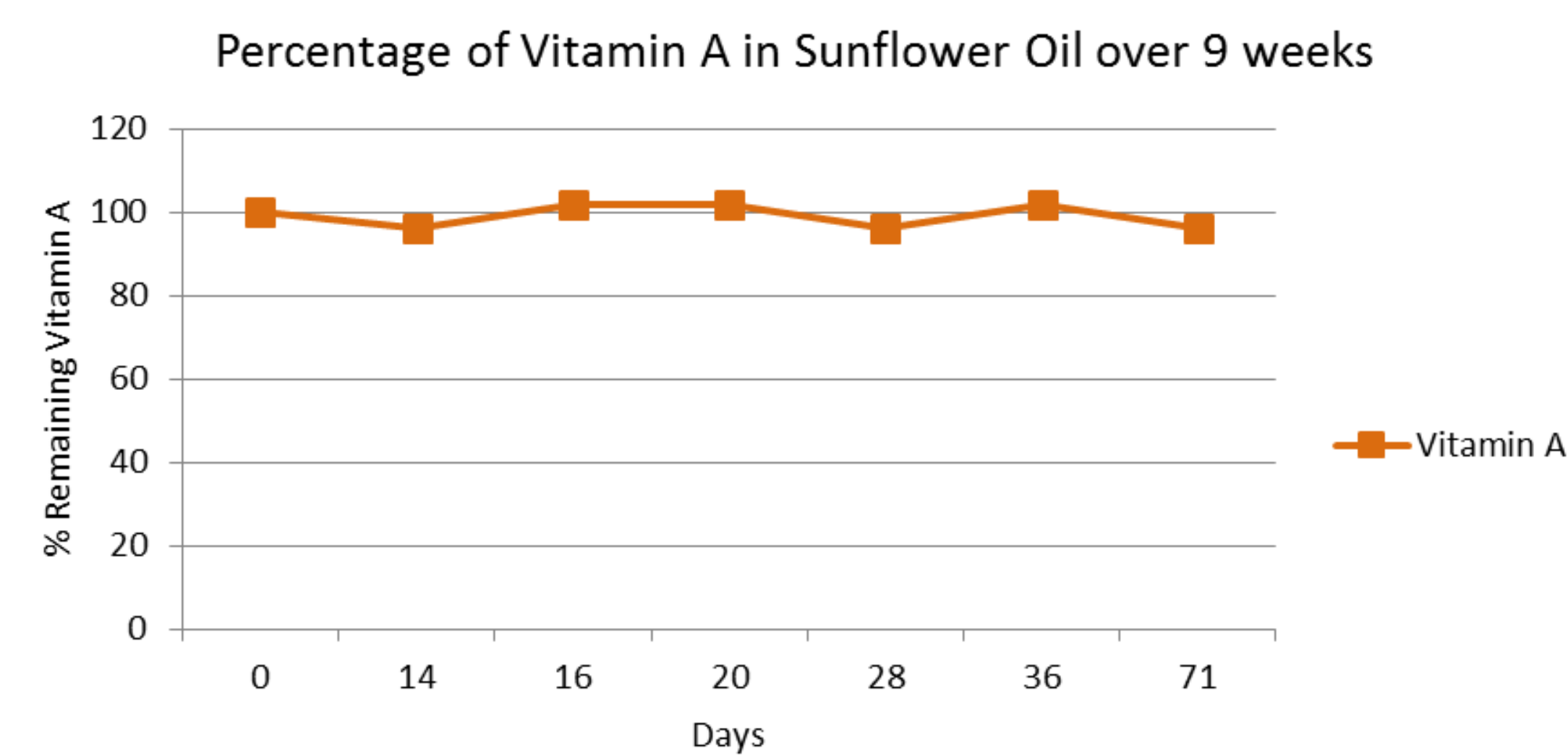


FIGURE 1: PERCENTAGE OF VITAMIN A IN SUNFLOWER OIL OVER 9 WEEKS: Vitamin A content is almost unchanged after 9 weeks storage at 30°C (without light exposure)

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.

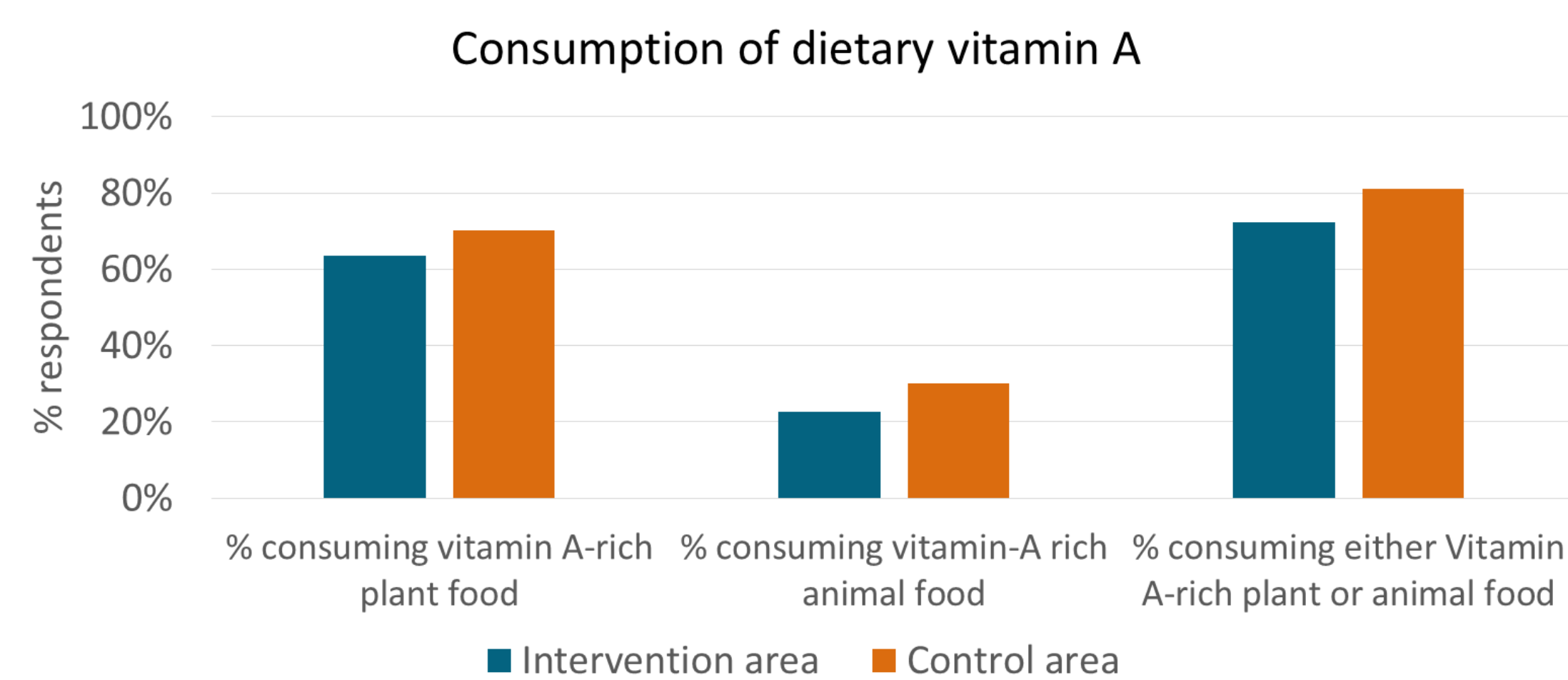


FIGURE 2: DIETARY DIVERSITY, CONSUMPTION OF VITAMIN-A RICH FOODS: Percentage of respondents reporting having consumed vitamin A from plant or animal sources in the previous 24 hours

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**.

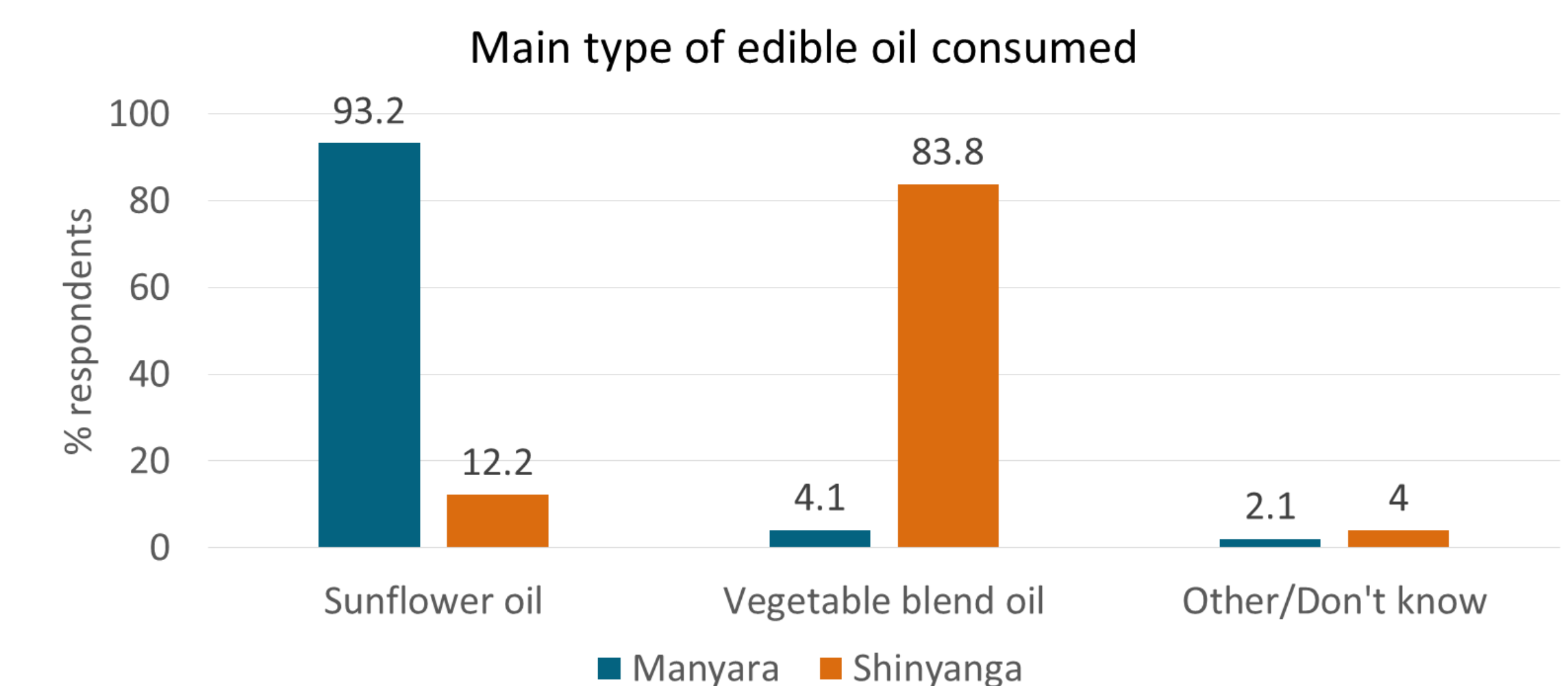


FIGURE 3: TYPE OF OIL CONSUMED: Percentage of respondents having reported to consume various types of edible oil as the predominant variety in their household

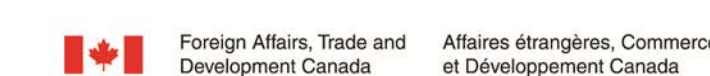
Conclusion and upcoming results

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 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.



WEBSITE: www.masava.org
CONTACT: info@masava.org

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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Presenter:
Dylan Walters

Abstract: #0029

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

Dylan Walters¹, Edna Nda², Elina Maseta³, Nadira Saleh⁴, Dr. Theobald Mosh⁵, and Dr. Susan Horton⁶



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SUMMARY

- The **MASAVA project** aims to reduce VAD through fortification of vegetable oil 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 and possibly due to stoppage of VA 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 child samples by regions,

- intervention/control sites, age group, dietary diversity score, nor receipt of VA supplement.
- There was a significantly higher mean RBP level in children who were breastfed at time of survey versus not.
- The majority of cooking oil possessed by households had below recommended quantities of retinol (60.4%).
- These regions are in high need of sustainable interventions for increasing access to vitamin-A fortified foods.

INTRODUCTION

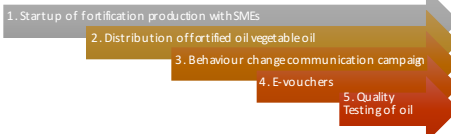
Vitamin A Deficiency (VAD) is attributed with 157,000 child deaths (6-59 months) globally each year (1). In Tanzania, VAD is considered a severe public health problem responsible for a high burden of the child mortality and morbidity. The Tanzania DHS 2010 estimated that the rate of VAD is 38% in children (2).

Hunger, lack of food diversity, consumption of vitamin-A rich foods and poverty are main determinants of VAD. In Tanzania, Vitamin A is found naturally in breast milk, other milks, liver, eggs, fish, butter, red palm oil, mangoes, papayas, carrots, pumpkins, and dark green leafy vegetables.



Fortifying staple foods with vitamins and minerals can be an effective vehicle for improving dietary consumption of deficient micronutrients but is often limited to foods produced and distributed through large food manufacturers and retailers, which may not serve vast number of poorer and rural households most in need.

The **MASAVA project**, in the Manyara and Shinyanga regions of Tanzania, is an attempt to work with small and medium-sized enterprises (SMEs) 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 Manyara and Shinyanga regions, 48% and 42% in 2010 respectively (2) by developing and implementing a sustainable business model for vitamin A fortification in these regions between 2014 and 2017.



RESEARCH QUESTION

Is the delivery of locally-fortified vegetable oil through the market of small & medium-sized enterprises effective in reducing Vitamin A deficiency in children?

RESEARCH OBJECTIVES

Using baseline data, the research objectives of this study presented are:

- To understand the household SES, health, and nutrition characteristics of the study sample.
- To compare the determinants of child Vitamin A status at baseline prior to start of intervention by region, district and intervention/control sites.



METHODS

Research Design

A quasi-experimental non-equivalent control group research study design. There will be 3 intervention districts and 1 control district in each of the two regions of study. In Shinyanga, Kishapu is the control district (in red), and Shinyanga urban, Shinyanga rural, and Kahama are intervention districts. In Manyara, Mbulu is the control district (in red), and Babati Rural, Babati Urban, Hanang are intervention districts.

Baseline Data Collection (May–July 2015)

Data collection was based on the DHS methodology of household survey with the mother of an index child in each household. Eligible mothers, living in either urban or rural locations, were stratified by age groups, geographic areas, and incomes. Then mothers were randomly selected from within the strata in order to obtain a crudely representative sample. The mother's oldest child below the age of five years was selected into the study sample in order to obtain a varied sample of children with a range of ages under five. Blood samples were drawn using the fingerprick method from index child then stored and analyzed by the Tanzania Food and Nutrition Centre.

Measures

The primary outcome of interest in this study is mean Retinol Binding Protein (RBP) levels, a proxy for serum retinol and vitamin-A, in children under the age of five. The RBP cut-off points for presence of VAD in children 6-59 months is below 17.325 mg/mL (or 0.824 $\mu\text{mol/L}$) (23). **Independent variables** for this analysis include 1) Household location by intervention/control district, where vegetable oil is fortified/unfortified, and by region/district, 2) Socio-economic status using wealth index score and maternal education level, 3) Maternal knowledge of vitamin-A, 4) Dietary diversity scores for mother and child, and 4) Household oil retinol content.

Sample size

Baseline data was collected from 568 households total, including 366 in intervention districts and 203 in control districts.

FUNDING SUPPORT

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

AUTHOR AFFILIATION

- PhD candidate, Canadian Centre for Health Economics, IHPME, University of Toronto, Canada
- PhD student, Sokoine University of Agriculture, Tanzania
- PhD student, Sokoine University of Agriculture, Tanzania
- Project Manager, MEDA, Canada
- Professor, Sokoine University of Agriculture, Tanzania
- Professor and Chair, Global Health Economics, CIGI, University of Waterloo, Canada

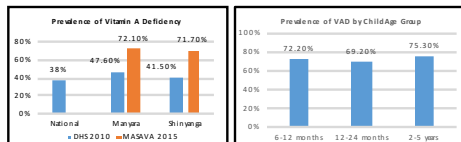
KEY BASELINE RESULTS

Household characteristics

The mean age of index child in this study was 1832 months ($N=568$, $SD=9.42$, $Min=3$, $Max=46$) at time of survey. Mean age of mother was 2967 years ($N=568$, $SD=7.22$, $Min=17$, $Max=58$). The majority, 79.4%, of mothers reported completing primary education (7 years), the remainder were split between less or more than primary. Between intervention and control sites, there was neither any significant difference in mean age of child or mother nor maternal education and wealth. However, the Manyara region sample was significantly wealthier than the Shinyanga sample ($F(1,566)=34.82$, $p<0.001$). Majority of households (60.4%) use cooking oil with below guideline levels of 20–40 μg /mg of retinol. Households in Shinyanga have more adequately fortified oil (35%) compared to Manyara (18%).

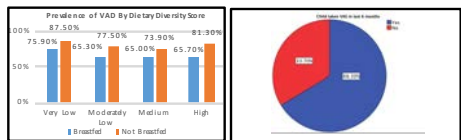
VAD Prevalence & RBP Levels

This study found VAD prevalence rates of 72.1% and 71.7% in Manyara and Shinyanga respectively. There was no significant difference, tested using independent samples t-test with a p -value = 0.05, in mean RBP level between Shinyanga ($u=14.87$, $SD=4.99$) and Manyara ($u=14.80$, $SD=5.88$) nor between intervention ($u=14.87$, $SD=5.37$) and control sites ($u=14.79$, $SD=5.23$). While the 2–5 year age group of children had the highest VAD prevalence at 75.3%, there was no significant difference in mean RBP levels with younger age groups, tested in the whole sample, by region or by intervention/control.

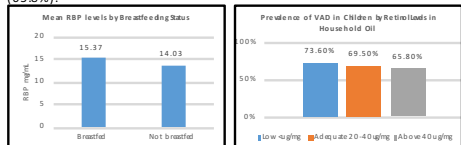


Determinants of VAD

VAD prevalence was higher in children with lowest dietary diversity score (DDS). However, there was no significant difference in mean RBP levels between children with a very low ($u=14.18$, $SD=5.04$), moderately low ($u=15.01$, $SD=5.51$), medium ($u=15.05$, $SD=5.4$), and high ($u=14.94$, $SD=5.00$) DDS. Children who took a VA supplement in the last 6 months has a higher mean RBP level ($u=14.88$, $SD=5.13$), but insignificant, compared to children who did not ($u=14.78$, $SD=5.69$).



VAD prevalence was higher and mean RBP level significantly higher in children who were breastfed ($u=15.31$, $SD=5.50$) compared to children who were not ($u=14.03$, $SD=4.90$), ($F(1,525)=8.037$, $p=0.005$). Children who lived in households using oil with retinol levels below WHO fortification guideline levels had higher VAD prevalence (73.6%) compared to those with adequate (69.5%) and above recommended levels (65.8%).



DISCUSSION

Analysis prior to fortification found that VAD is greater for (*denotes significant):

- Children 2–5 years old compared to younger children,
- Children with lower Dietary Diversity Scores,
- Children who did not receive a VA supplement in last 6 months,
- Children whose mother is also deficient,
- Children who are not breastfed*,
- Children living in households that use cooking oil with retinol levels below WHO fortification guideline levels.



Limitations/Challenges

- During the program implementation, some households expected that program would deliver oil to directly to houses, and initial distribution was not in a small enough container size for the context.
- During data collection, researchers faced negative perceptions from households/families in some instances regarding surveys and IDBS collection.

Conclusion

Results of baseline data analysis emphasize the both the high need for action to reduce micronutrient deficiencies in children in the study regions as well as the potential for fortification to make an impact. Fortification efforts through SMEs will have to balance efforts to ascertain technical efficacy of processes and fortificants with the public health program effectiveness that considers feasibility, costs, and local perceptions and behaviors cultures and communities.

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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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Presenter:
Edna Ndaui

Abstract: #0030

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

Edna Ndaui¹, Dylan Walters², Daphne Wu³, Nadira Salehi⁴, Dr. Susan Horton⁵ and Dr. Theobald Moshaf⁶



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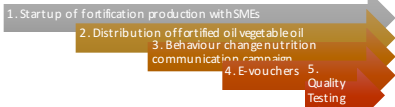
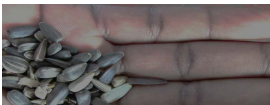
International Development Research Centre
Centre de recherches pour le développement international

SUMMARY

- MASAVA project** intends to reduce VAD through fortification of vegetable oil in collaboration with SMEs as part of the Government's PPP (private-public-partnership)
 - The prevalence of VAD was high among breastfeeding women in the two regions surveyed (regions than in the previous reported reports (DHS 2010)). The prevalence was 83.9% in Manyara and 78.9% in Shinyanga (78.9%). This could be attributed to the fact that deficiency is higher in lactating women (as measured in our survey) compared to all reproductive age women (DHS).
 - Mean retinol levels among women by regions was neither significant with intervention/control areas, age group, education, Household cooking oil, dietary diversity score, nor receipt of VA supplement and knowledge about vitamin A.
- Cooking oil used in most households had retinol levels below the recommended levels
 - Mothers had good knowledge on vitamin A but practising was poor
 - Information of food consumption for lactating mothers showed limited dietary diversity
 - Consumption of vitamin A rich animal source foods was minimal
 - These regions are in high need of sustainable interventions for increasing access to vitamin-A fortified foods.

INTRODUCTION

- Vitamin A Deficiency (VAD) is a major problem that the world is facing today and more prevalent in low income countries like Tanzania (1).
- The main underlying cause of it is diet, which is chronically insufficient with Vitamin A
- In Tanzania, VAD is a public health problem among children under the age of five years and lactating mothers due to increased risk of morbidity and mortality
- Micronutrient deficiencies including vitamin A cost the country over US\$ 51.8 million, which is about 2.65% of the country's GDP (World Bank, 2012).
- According to DHS (2010), about 37% of women of reproductive age are VAD. Among them, 39% of pregnant women and 33% of lactating women have VAD. However, prevalence of VAD for lactating mothers in Shinyanga and Manyara (53.5% and 43.4% respectively) was higher than the national average (37%).
- Potential interventions to combat VAD among lactating mothers in Tanzania include Vitamin-A supplementation, dietary diversity, nutritional education and food fortification
- In Tanzania, fortified foods do not reach all households (households in more remote rural areas do not typically consume centrally-processed cereal foods due to limited foods produced and distributed through large food manufacturers and retailers, who can serve a vast number of poor rural households)
- Sunflower oil is the best vehicle for carrying vitamin A, more reliable and accessible in both regions
- MASAVA** project in Manyara and Shinyanga regions is working with small and medium-sized entrepreneurs involved in sunflower oil processing and oil trades to fortify and distribute the sunflower oil fortified with Vitamin-A to households with lactating women and young children.



RESEARCH QUESTION

- Is the delivery of locally-fortified Sunflower oil produced by small & medium-sized entrepreneurs effective in reducing Vitamin A deficiency among lactating women?

RESEARCH OBJECTIVE

- Research objective
 - To determine retinol status of lactating mothers prior to start of intervention



RESULTS

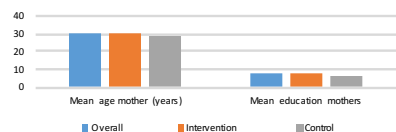


Fig. 1. Age and education levels among mothers in the intervention and control districts. No significant difference ($p < 0.05$) was observed in the mean age and education levels of the mothers.

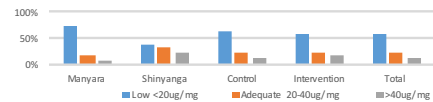


Fig. 2. Level of retinol in household cooking oil. No significant difference ($p < 0.05$) was observed in mean retinol level in household cooking oil.

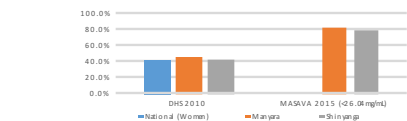


Fig. 3. VAD Prevalence in lactating mothers. No significant difference ($p < 0.05$) was observed. Higher levels of deficiency are likely because our sample is all lactating women, whereas those in the DHS survey are of reproductive age.

Dietary diversity Score (DDS)

VAD prevalence was higher in mothers with lowest dietary diversity score (3 DDS), however, there was no significant difference in mean RBP levels of mothers with a higher score dietary diversity (DDS > 5).

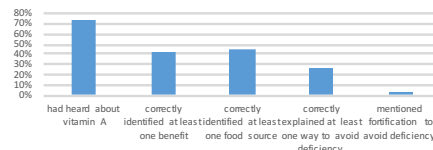


Fig. 4. Knowledge about vitamin A. No significant difference ($p < 0.05$) was observed in mean RBP levels and knowledge about Vitamin A of the mothers. Also no significant difference was observed in mean by consumption of vitamin A rich plant or meat.

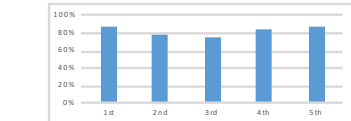
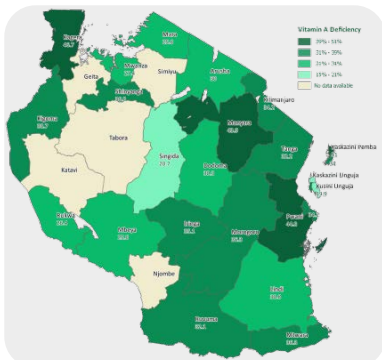


Fig. 5. VAD Mothers by Wealth quintile. No significant difference ($p < 0.05$) in the means of RBP levels was observed in mothers by wealth quintile.

METHODS

Research location



Research Design

An experimental study design has been integrated in this study.

Sample size

This study involved a total of 568 households, including 366 in intervention districts and 203 in control districts.

Baseline Data Collection (May–July 2015) and analysis

Subjects were randomly selected by assigning numbers and drawing at random from each social group. Blood samples were drawn using the fingerpick method. DBS was analyzed at TFNC Labs, Dar es Salaam. Data were analyzed by SPSS ver. 20.

Ethical clearance

Ethical approval was attained from the National Institute of Medical Research, Tanzania and the University of Waterloo.

DISCUSSION

Analysis of baseline data prior to fortification and distribution of fortified Sunflower oil by SMEs indicated that VAD was greater for (but not significantly different):

- Women's retinol status and dietary diversity scores
- Women's retinol status and education level
- Women's retinol status and SES
- Women's retinol status and knowledge about Vitamin A
- Women's retinol status living in households that use cooking oil with retinol levels below WHO fortification guidelines.

Limitations/Challenges

There were challenges experienced during each phase of the study

- Dried Blood Spot collection from children was cumbersome
- Household expectations that the project would bring oil directly to the households
- During data collection, researchers faced negative perceptions from households/families in some instances regarding surveys and DBS collection.
- Some DBS samples were too small for analysis

Conclusion

Results at baseline highlights that, both regions require immediate action to minimize VAD among under-five children and lactating mothers in Manyara and Shinyanga regions of Tanzania. This can be achieved through Vitamin A fortification of Sunflower oil by SMEs because they are numerically the largest number of distributors/suppliers of cooking oil, and their products disproportionately reach poor and remote populations in Tanzania.



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).

AUTHOR AFFILIATION

- PhD student, Sokoine University of Agriculture, Tanzania
- PhD candidate, Canadian Centre for Health Economics, IHPME, University of Toronto, Canada
- Masters student, University of Waterloo, Canada
- Project Manager, MEDA, Canada
- Professor and Chair, Global Health Economics, CGI, University of Waterloo, Canada
- Professor and PI, Sokoine University of Agriculture, Tanzania

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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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Addressing inequities in access to fortified sunflower oil: Costs of small, medium & large-scale fortification in Tanzania

Dylan Walters¹, Edna Ndau², Elina Maseta³, Nadira Saleh⁴, Dr. Theobald Mosha⁵, and Dr. Susan Horton⁶



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SUMMARY

- 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.

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 A supplement 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.

1. Startup of fortification production with SMEs
2. Distribution of fortified oil vegetable oil
3. Behaviour change communication campaign
4. E-vouchers
5. Quality Testing of oil

RESEARCH QUESTION

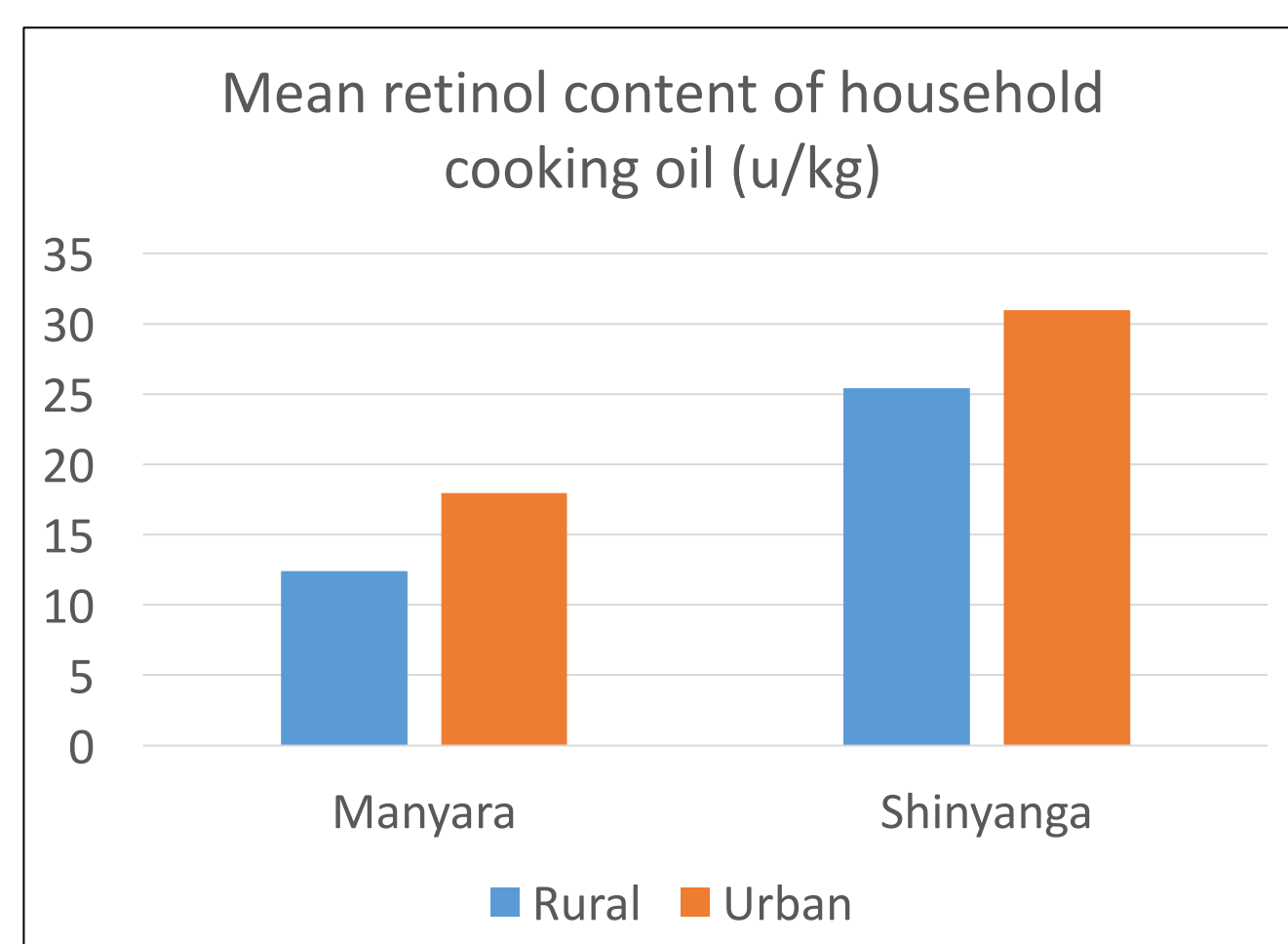
What are the private sector incremental costs (IC) and cost drivers of locally-produced edible sunflower oil fortified with Vitamin A by SMEs compared to large-scale producers?

METHODS

- Fortification trial was a quasi-experimental non-equivalent control group research study design. There were 3 intervention districts and 1 control district in each of the two regions of study. Data collected using baseline and endline household and retailer surveys.
- Using the vitamin A fortification costing framework from Fiedler and Afrida 2010 (4), this costing analysis model used an ingredients approach to estimate the hypothetical costs of fortification for each of a hypothetical small, medium and large-scale enterprise – a low-cost-small-scale scenario - using cost data collected during the retailer and SME surveys (5,6, 7) and data from literature and project reports.

RESULTS

- The baseline data on retinol levels in household cooking oil showed: 1) The retinol content was lower in Manyara compared to Shinyanga and 2) within each region, rural districts had lower content than urban districts (but only significant for Manyara.)
- As well, in Manyara, only 8% of households reported purchasing a known fortified brand of oil that, whereas in Shinyanga 76% of rural and 96% of urban households did.



FUNDING SUPPORT

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

AUTHOR AFFILIATION

1. PhD candidate, Canadian Centre for Health Economics, IHPME, University of Toronto, Canada
2. PhD student, Sokoine University of Agriculture, Tanzania
3. PhD student, Sokoine University of Agriculture, Tanzania
4. Project Manager, MEDA, Canada
5. Professor, Sokoine University of Agriculture, Tanzania
6. Professor and CIGI Chair, Global Health Economics, University of Waterloo, Canada

RESULTS (Continued)

- The modelled incremental cost (IC) of fortification is estimated at \$0.01, \$0.16 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 22.21% 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%).

Type/scale of sunflower oil production	IC per litre	IC per capita/yr	Avg. Household Cost /Yr	% Increase
Unfortified (min.)			\$34.72	
Large-scale fortified (20L)	\$0.01	\$0.04	\$34.95	0.66%
Medium-scale fortified (20L)	\$0.16	\$0.87	\$39.15	12.78%
Medium-scale fortified (1L)	\$0.39	\$2.11	\$45.47	30.97%
Small-scale fortified (20L)	\$0.28	\$1.51	\$42.43	22.21%
Small-scale fortified (1L)	\$0.51	\$2.75	\$48.74	40.40%
Low-cost medium-scale fortified (hypothetical)	\$0.12	\$0.62	\$37.90	9.17%
Low-cost small-scale fortified (hypothetical)	\$0.10	\$0.53	\$37.41	7.75%

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 “scoop”.
- 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

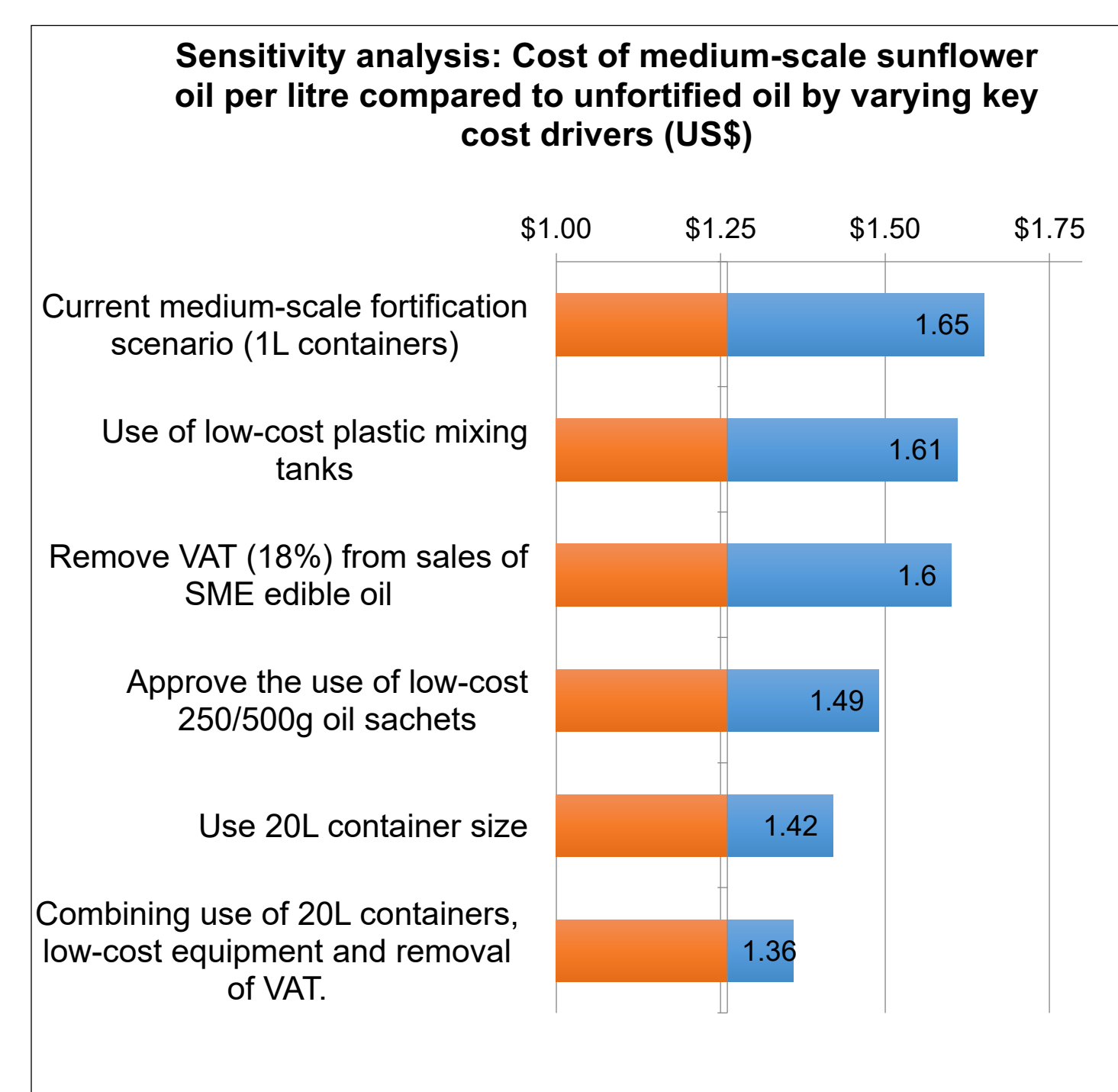
- This costing model is preliminary and relies on cost data and assumptions about the production based on project reports and literature. Work underway on costs components and prices of oil and equipment/materials would improve the accuracy. This does not include public sector costs of fortification for advocacy, social marketing, QA and MNE, 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.



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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.

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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, CGI 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

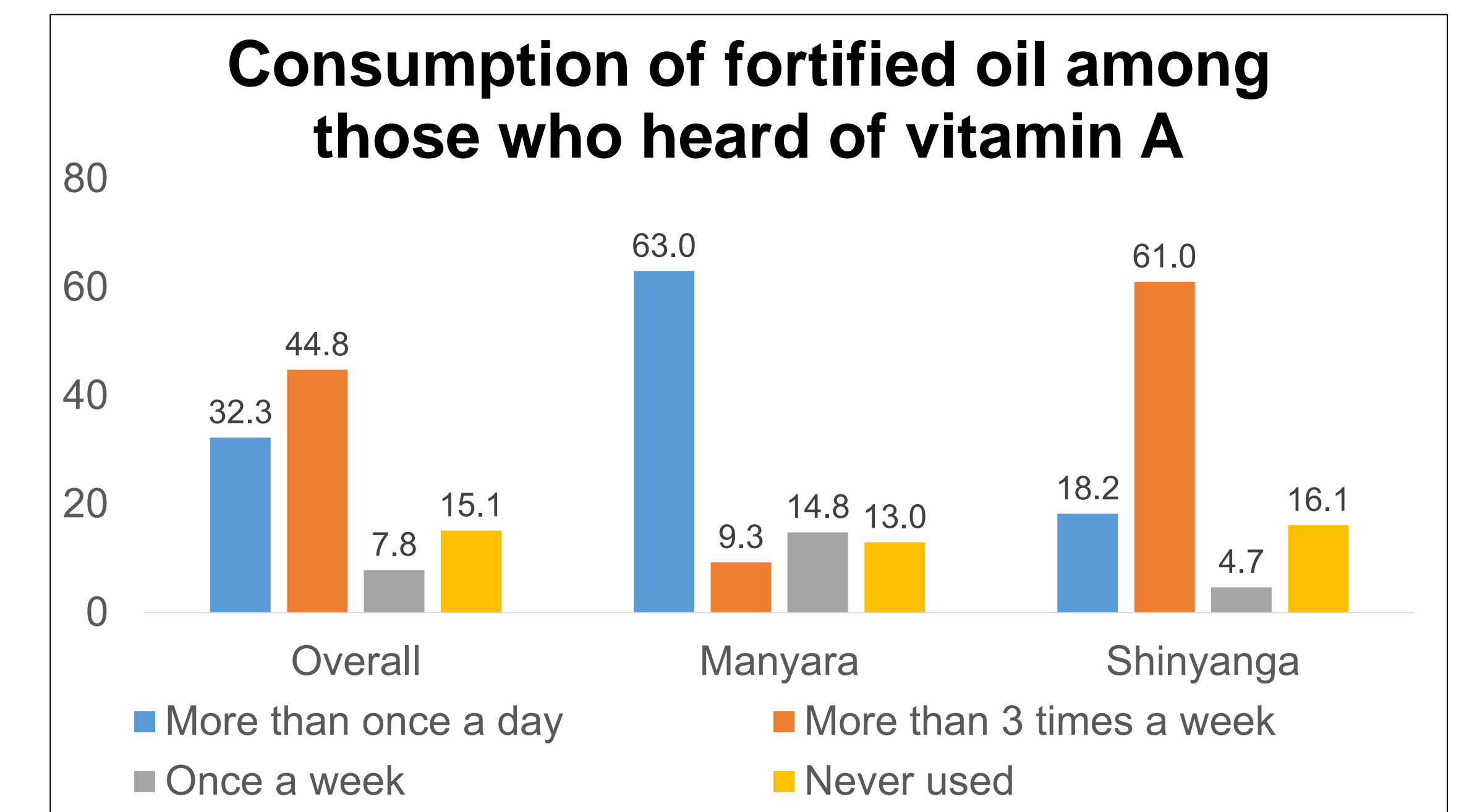
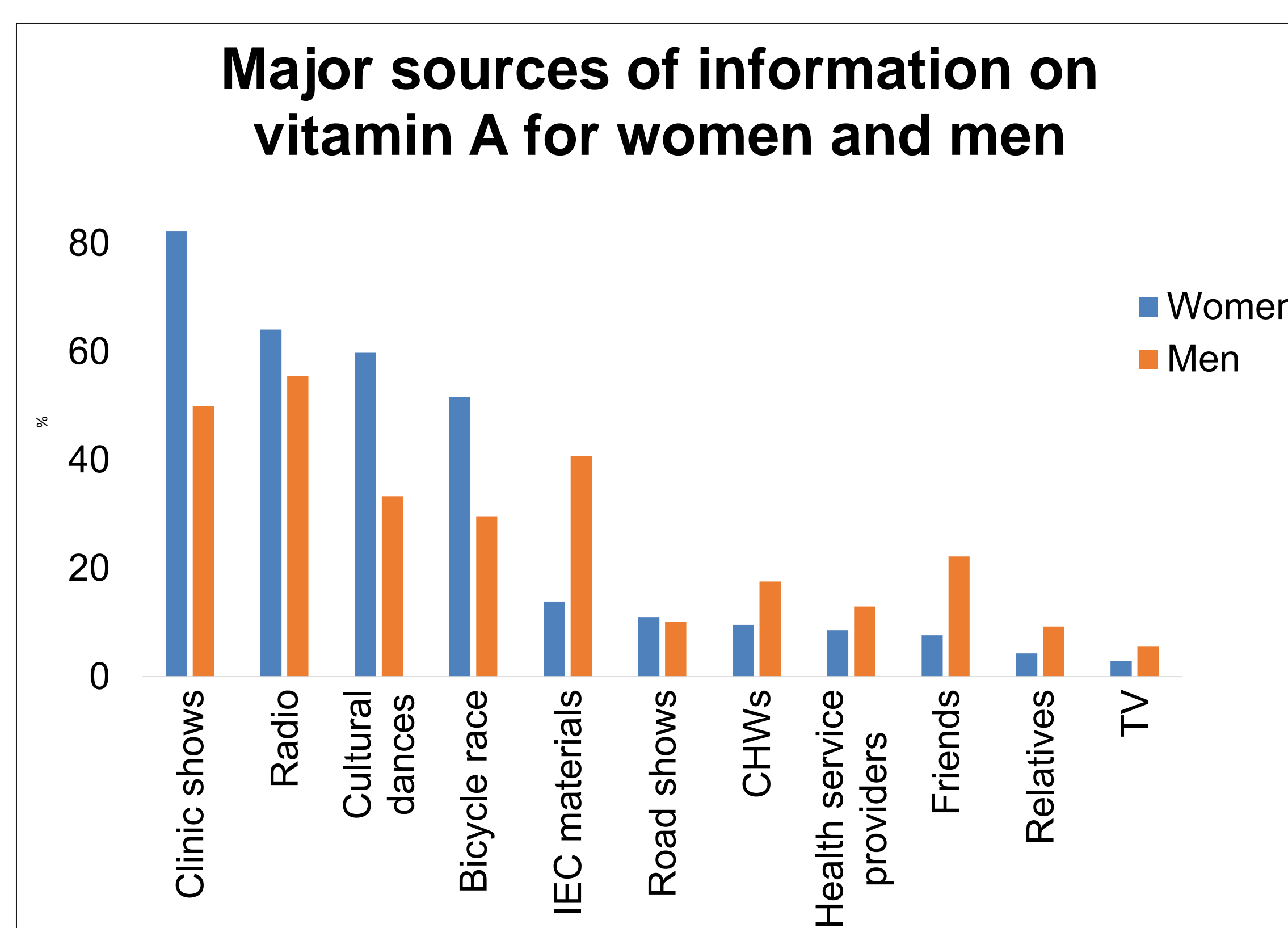
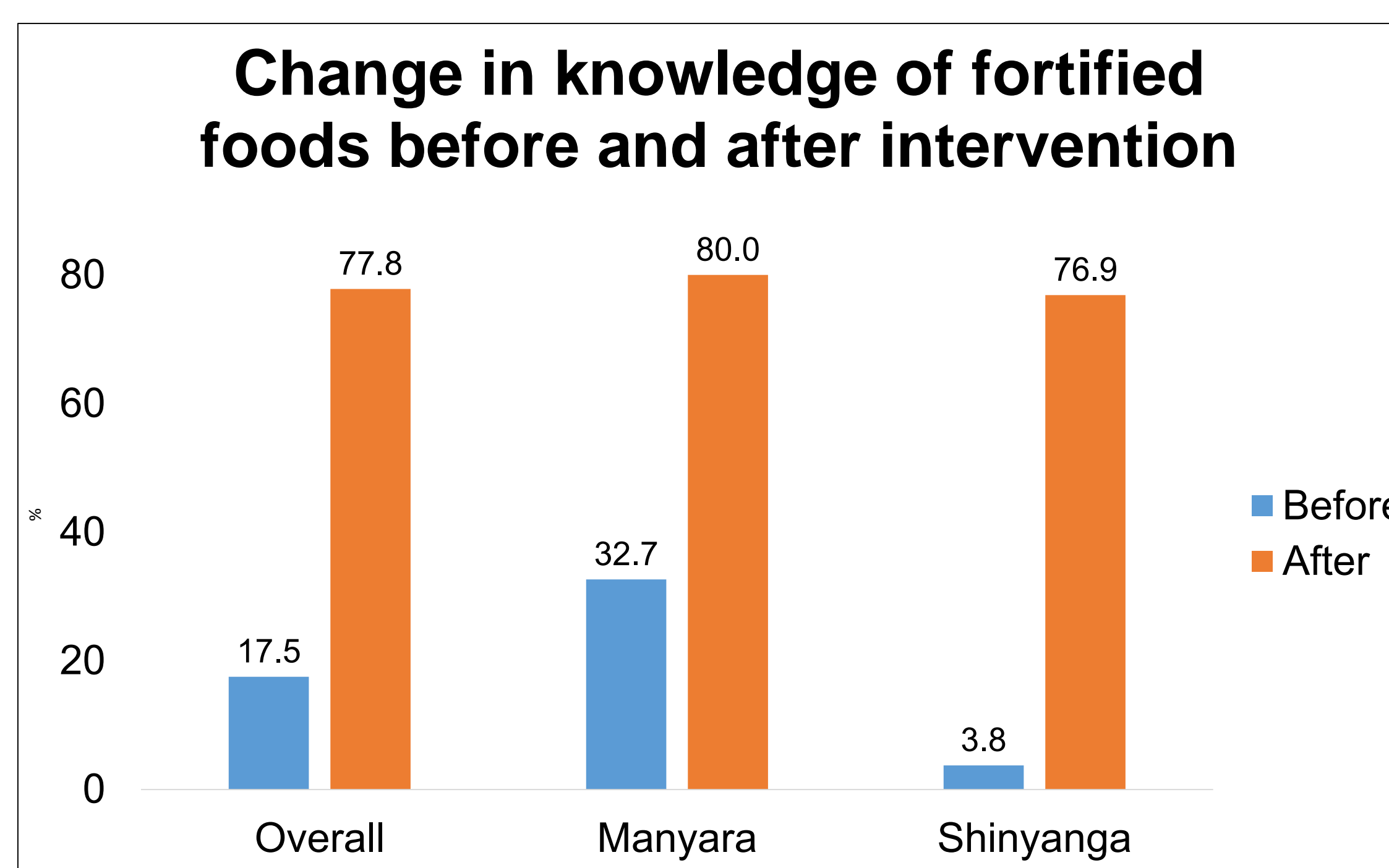
Objective: To evaluate the impact of the BCC interventions on knowledge, attitude and practices of consumers of the vitamin A-fortified oil.

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



IDRC | CRDI

International Development Research Centre
Centre de recherches pour le développement international



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Annex 2.9.

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

Susan Horton. PhD. Professor. School of Public Health and Health Systems. University of Waterloo. Canada.

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

Nadira Saleh. MSc. Project Manager. Mennonite Economic Development Associates Canada. Waterloo. Canada.

John Belt. MSc. Senior Advisor. Sustainable Economic Development. Royal Tropical Institute (KIT). Netherlands.

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?.

By: Katherine Wihry, Nadira Saleh, Kenneth Nchimbi. Daniel O’Kelly, TCE Mosha, Susan Horton..

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.

Annex 2.13.

Title: Association between social marketing interventions and knowledge, attitudes and practise towards onsumption 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.

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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.

Annex 2.14.

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.

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

Ndau, E. L, Walters, D, Wu., D., , Saleh, N., Mosha, T. C. E., Horton, S. and Laswai , S. H.

***Corresponding author e-mail: ndauedna@yahoo.com**

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.

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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 oi 9.5380 ± 3.1956 , 3.36 ± 0.767 , 2.82 ± 1.4832 , 31.996 ± 5.37 and 1.496 ± 0.038 while those of palm oil was 6.73 ± 1.5391 , 4.7 ± 1.65529 , 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

Correspondence Author: Edna Ndau

Email address: ndauedna@yahoo.com

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.

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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