Innovation Lab for Food Security Policy
Working Paper No.C3-3

Drivers of Micronutrient Policy Change in Zambia: An Application of the Kaleidoscope Model

By

Steven Haggblade, Suresh Babu, Jody Harris,
Elizabeth Mkandawire, Dorothy Nthani and Sheryl L. Hendriks

February15, 2016

AUTHORS

Steven Haggblade (blade@msu.edu) is a professor of International Development in the Department of Agricultural, Food and Resource Economics at Michigan State University, East Lansing, MI, US.

Suresh Babu (s.babu@cgiar.org) is head of capacity strengthening in the Director General's Office of the International Food Policy Research Institute (IFPRI), Washington, DC.

Jody Harris (J.Harris@cgiar.org) is a Ph.D. candidate at the University of London's School of Oriental and African Studies and a Senior Research Analyst at the International Food Policy Research Institute (IFPRI).

Elizabeth Mkandawire (elimka23@gmail.com) is a Ph.D. candidate in the Department of Agricultural Economics and Rural Development at the University of Pretoria, South Africa.

Dorothy Nthani (dnthani@gmail.com; dorothy.nthani@unza.zm) is a Lecturer in the Department of Food Science and Nutrition in the School of Agricultural Sciences at the University of Zambia in Lusaka, Zambia.

Sheryl L. Hendriks (Sheryl.Hendriks@up.ac.za) is Professor and Director of the Institute for Food, Nutrition and Well-being at the University of Pretoria.

FOOD SECURITY POLICY (FSP) INNOVATION LABORATORY

The FSP Innovation Lab helps USAID-supported countries in Africa, Asia, and Latin America to fight hunger, reduce poverty and improve nutritional outcomes through better food policy. Funded through the U.S. Agency for International Development's Feed the Future initiative, Michigan State University's Food Security Group leads implementation, partnering with the International Food Policy Research Institute (IFPRI) and the University of Pretoria in South Africa. Together, the consortium will work with governments, researchers and private sector stakeholders in as many as 19 Feed the Future focus countries in Africa, Asia and Latin America to increase agricultural productivity, improve dietary diversity and build greater resilience to challenges, like climate change, that affect livelihoods.

International Food Policy Research Institute (IFPRI). IFPRI, established in 1975, provides evidence-based policy solutions to sustainably end hunger and malnutrition and reduce poverty. IFPRI is a member of the CGIAR Consortium.

Michigan State University (MSU). Established in 1855, MSU is the oldest of the US Land Grant (agricultural) universities with a long history of faculty research on agricultural and food policy in developing countries.

University of Pretoria (UP). UP was established in 1908 and is one of the oldest universities in South Africa. The University has a strong history of engagement in agricultural policy and capacity building in Africa

ACKNOWLEDGMENTS

The authors wish to thank members of the National Food and Nutrition Commission (NFNC) of Zambia and their advisory board who provided key documents as well as detailed insights into the evolution of micronutrient policies in Zambia. Harry Ngoma and Helen Khunga Chirwa of USAID/Zambia likewise provided valuable support in framing the study and helping the team to identify and contact knowledgeable key informants. To the key informants whom we interviewed from a variety of public agencies, private sector business groups, research institutions and civil society groups we offer our sincere thanks for the time and careful reflection they brought to bear in helping us to understand how micronutrient policies have changed over time. We wish to acknowledge helpful input from Edson Matsonda, Oyinkan Tassie and Stephen Morgan in conducting field work, assessing legal statutes and securing reference materials. Financial support for this study comes from the US Agency for International Development (USAID) under the Food Security Policy Innovation Laboratory, contract number AID-OAA-L-13-00001. The views expressed in this paper remain the sole responsibility of the authors.

ABSTRACT

This review of the micro-nutrient policy process in Zambia serves as a companion piece to two parallel studies in Malawi and South Africa. All three studies employ the Kaleidoscope Model of policy change to trace the causal forces leading to key micro-nutrient policy decisions in each of the three countries.

After outlining the overall micro-nutrient policy process in Zambia, the study focuses on policy decisions affecting three micro-nutrients – iodine, iron and Vitamin A. Although iodine deficiency has dropped precipitously as a result of Zambia's salt iodization mandate, progress in combatting iron and Vitamin A deficiencies has proven more difficult. As a result, micro-nutrient policies have changed over time, in an effort to find effective tools for combatting these lingering micro-nutrient deficiencies and the considerable health risks they impose. The analysis in this paper traces the evolution of policies adopted through multiple iterations beginning in 1978 and running through to the present time. To supplement the voluminous published and grey literature on micro-nutrient status and policies in Zambia, the research team conducted semi-structured interviews with several dozen policy stakeholders in Zambia in June and July 2015 using a standardized interview guide.

Together, these data permitted the team to formally assess 16 Kaleidoscope hypotheses about factors driving policy change at each of five key stages in the policy process: agenda setting, design, decision making, implementation and monitoring and reform.

Agenda setting. To successfully get micro-nutrient policies onto Zambia's crowded policy agenda required effective advocates armed with strong empirical evidence of both deficiency levels as well as the human costs these impose on productivity and health. Frequently, in addition, a focusing event – such as an international conference, or a recent local study – proved decisive in enabling advocates to gain the necessary attention of key decision makers.

Design. At the design stage, most of Zambia's micro-nutrient policies (whether involving supplementation, fortification or bio-fortification) drew on existing global best-practice, adjusted where necessary by local particularities of diet and incidence. These preferred designs broadly aim to achieve high impact at low cost.

Decision making. Decision-making outcomes revolve around the relative power of proponents and opponents. Donors, in particular, have served as powerful proponents of Zambia's micro-nutrient policy agenda, particularly when they offer to finance necessary nutrients and delivery systems. Opponents have emerged infrequently in Zambia's micro-nutrient policy debates, generally from the private sector and from consumer protection groups who object to the high cost of certain proposed fortification mandates.

Implementation. While public agencies assume responsibility for implementing micro-nutrient supplementation programs, fortification and bio-fortification depend heavily on private sector agribusinesses to execute micro-nutrient mandates. In the public sphere, budgets for supplements, manpower and logistics have depended on GOZ and donors. In the private sector, commercial interests triggered initial resistance from the maize millers, who saw fortification as a competitive disadvantage to those who complied. In contrast, the oligopolistic sugar industry has embraced vitamin A fortification as a means of limiting import competition and sustaining higher domestic prices and profits. To the extent micro-nutrient policy moves toward private

sector dominated fortification and bio-fortification, private businesses become de facto veto players at the implementation stage.

Monitoring, evaluation and reform. Policy reform has occurred regularly in Zambia, driven primarily by changing conditions (such as rising levels of iodine intake) and by empirical information about these changes.

Zambia's record on micronutrient policy both mirrors and contrasts with those of its neighbors. Zambia has led in some respects, mandating iodine fortification of salt 20 years earlier than Malawi (in 1978 rather than 1998) and 16 years earlier than South Africa (in 1994). Despite Illovo's ownership of sugar mills in all three countries, Zambia mandated vitamin A fortification of sugar in 1998, 17 years before Malawi did (in 2015). South Africa, in contrast, has considered but declined to mandate sugar fortification. Future work comparing micronutrient policy evolution across these three countries aims to explore reasons for the differing policy timing and outcomes. By comparing policy responses and chronologies, we hope to learn more about what's required to place micronutrient policies on the agenda and successfully implement them.

CONTENTS

Acknowledgments iii
Abstract iv

1. Introduction 1

2. Overview of Micronutrient Policies in Zambia
    2.1. Major micronutrient deficiencies 3
    2.2. Micronutrient policies 4
    2.3. Policy institutions and policy processes 8

3. Methods
    3.1. The Kaleidoscope Model 14
    3.2. Data 15
    3.3. Empirical testing of the model's hypotheses 16
    3.4. Validation and counterfactuals 17

4. Drivers of Policy Change: A Formal Test of the Kaleidoscope Hypotheses
    4.1. Iodine 19
    4.2. Vitamin A 27
    4.3. Iron 47
    4.4. Vitamin D 51

5. Conclusions
    5.1. Summing up key hypotheses about what drives policy change 54
    5.2. Common factors influencing the effectiveness of micronutrient policy advocates .. 56
    5.3. Shifting phases in Zambia's micronutrient policies 57
    5.4. Regional contrasts among Zambia, Malawi and South Africa 59

References 60

Annexes

A. Zambian Policy Institutions 68
B. Legislation Shaping Micronutrient Policies 70
C. Key Informant Interview Guide 71
D. List of Persons Interviewed 74
E. Data Matrices for Kaleidoscope Hypothesis Testing 78

LIST OF TABLES

1. Trends in major micronutrient deficiencies in Zambia 4
2. Snapshot of micronutrient policies in Zambia, 2015 5
3. Summary chronology of key micronutrient decisions in Zambia 6
4. Institutional roles and responsibilities for micronutrient policies 12
5. Kaleidoscope model hypotheses: key variables affecting policy change 15
6. Zambia's evolving salt fortification mandate 19
7. Iodine policy chronology 21
8. Iodine policy stakeholder inventory 23
9. Kaleidoscope policy hypothesis testing: iodine 26
10. Vitamin A policy chronology 30
11. Government's perspective on the pros and cons of alternative vitamin A interventions 39
12. Vitamin A stakeholder inventory 42
13. Kaleidoscope hypothesis testing: vitamin A policy 46
14. Kaleidoscope hypothesis testing: iron policies 50
15. Kaleidoscope hypothesis testing: vitamin D fortification of margarine 53
16. What drives micronutrient policy change? 55

LIST OF FIGURES

1. Micronutrient policy process 13
2 The Kaleidoscope Model of Food Security Policy Change. 14
3. Circle of Influence: Iodine Fortification of Salt 24
4. Four waves of vitamin A interventions 29
5. Circle of influence: vitamin A fortification of sugar 40
6. Circle of influence: vitamin A supplementation 41
7. Vitamin A sugar fortification policy schematic 44
8. Circle of influence: mandatory maize meal fortification 48
9. Circle of influence: iron supplementation 49

LIST OF ACRONYMS

ACF	African Competition Forum
ANC	Ante Natal Care
CCPC	Competition and Consumer Protection Commission
CDC	Centers for Disease Control
CHW	Child Health Week
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Research Institute
CIP	International Potato Center
CUTS	Consumer Unity and Trust Society, International
FDCL	Food and Drugs Control Laboratory
FTF	fortification task force
GAIN	Global Alliance for Improving Nutrition
IAPRI	Indaba Agricultural Policy Research Institute
ICCIDD	International Control Committee for Iodine Deficiency Disorders
IDA	Iron Deficiency Anemia
IDD	Iodine Deficiency Disorders
IMCI	Integrated Management of Childhood Illness
MAL	Ministry of Agriculture and Livestock
MCDMCH	Ministry of Community Development, Mother and Child Health
MOE	Ministry of Eduction
MOH	Ministry of Health
NAZ	Nutrition Association of Zambia
NFNC	National Food and Nutrition Commission
NISIR	National Institute for Scientific and Industrial Research
NRDC	Natural Resources Development College
TDRC	Tropical Diseases Research Center
VAD	Aitamin A Deficiency
SABRN	Southern Africa Bean Research Network
SCCI	Seed Certification and Control Institute
SI	Statutory Instrument
UNICEF	United Nations Children's Fund
UNZA	University of Zambia
USAID	United States Agency for International Development
UTH	University Teaching Hospital
WHO	World Health Organization
ZABS	Zambia Bureau of Standards
ZARI	Zambia Agricultural Research Institute

1. INTRODUCTION

Micronutrient policies differ considerably across countries, particularly over time. In order to understand what drives policy change in any given setting a team of colleagues from the Food Security Policy (FSP) Innovation Lab[1] is conducting a series of three case studies comparing micronutrient policies and associated policy processes in Zambia, Malawi and South Africa (FSP 2015).

These comparative case studies aim to provide an understanding of national policymaking processes and identify key drivers of policy change. In addition, the three-country cluster enables a comparison of differences in institutional architecture and in micronutrient policy outcomes across the three countries. Some countries have moved earlier and more effectively than others, and so the authors hope that a clearer understanding of factors driving policy change may help to provide insights into how policy processes, policy advocacy and policy implementation might be improved more generally. Following completion of the initial country case studies, the analytical team will formally compare differences in the content, timing, design, transmission mechanisms and implementation of micronutrient policies in a second stage of analytical work.

This paper focuses on Zambia's micronutrient policies and explores how and why they have changed over time. Specifically, the Zambia case study aims to address the following two objectives:

1. Map nutrition policy institutions and policy processes. What key stakeholders and institutions drive nutrition policy decisions? How do nutrition policy institutions and stakeholders interact? How has the institutional architecture for nutrition policy changed over time? How has that institutional framework affected policy outcomes?

2. Assess key drivers of change for specific micronutrient policies. Zambia has instituted a broad range of micronutrient policies -- iodine fortification (mandated since 1978), Vitamin A fortification and bio-fortification, vitamin-mineral multi-mix fortification (mandated for maize meal in 2006 and then rescinded in 2007) and iron supplementation and fortification. How did each of these interventions get onto the policy agenda initially? Who championed the policies? Who opposed them? Who financed them? How have they been implemented, monitored and modified over time?

In order to provide a framework for understanding policy processes, the FSP team has developed a model of policy change building on existing operational hypotheses within the international donor community and drawing on academic scholarship from public administration and political science. The resulting Kaleidoscope Model offers testable hypotheses covering the five key stages of the policy cycle: agenda setting, design, adoption, implementation, and evaluation and

[1] The FSP partner institutions include Michigan State University (MSU), the International Food Policy Research Institute (IFPRI) and the University of Pretoria (UP).

reform (Resnick et al. 2015). Section 3 below provides further details on the analytical and field research methods used.

To set the stage, Section 2 below describes Zambia's micronutrient policy institutions and processes as well as major changes over time. Following the Kaleidoscope Model description in Section 3, the paper proceeds to test key hypotheses about drivers of micronutrient policy change in Zambia. Section 4 formally tests these hypotheses for four sets of micronutrient policies: iodine, iron, vitamin A and vitamin D. Section 5 sums up the major conclusions emerging from this country micronutrient policy review.

2. OVERVIEW OF MICRONUTRIENT POLICIES AND POLICY PROCESSES IN ZAMBIA

2.1. Major micronutrient deficiencies

Worldwide, three major micronutrient deficiencies dominate public health concerns. Iron deficiency affects over two billion people worldwide, leading to high levels of anemia, increased risk of maternal bleeding and mortality, reductions in cognitive performance and physical endurance, as well as impaired iodine and vitamin A absorption (Allen et al. 2006). Though iron deficiency can affect all population groups, it becomes especially serious during pregnancy and infancy, when iron needs become most acute. Second in terms of numbers affected are iodine deficiency disorders (IDD) which affects nearly two billion people, leading to abnormal thyroid functioning, visible neck enlargements known as goiters and serious cognitive dysfunction including cretinism (Allen et al. 2006). Pregnant women and infants under two years of age are most at risk, since iodine plays a critical role in early brain development and since deficiencies in the fetal stage through the third month after birth result in irreversible mental impairment (WHO 2004). Hence iodine deficiency in utero and in the first years of life, when brain development occurs most rapidly, can lead to permanent mental stunting. Third is vitamin A deficiency which affects an estimated quarter of a million pre-school children (Allen et al. 2006). Vital to the functioning of the immune system, vitamin A deficiency leads to increased risk of infection, elevated rates of mortality in infants and pregnant women, impaired vision and night blindness.

Iodine. Efforts to address these micronutrient deficiencies, by the international nutrition and public health community, focused first on iodine. Building on early evidence from the 1920s about the effectiveness and low cost of iodine fortification of salt, many countries adopted salt fortification standards in the 1940s, 1950s and 1960s (UNICEF 2013). Iodine fortification efforts accelerated considerably in the developing world following the 1990 the International Summit on Children which produced global agreement on Universal Salt Iodization (USI) with the goal of eliminating iodine deficiencies by 2000 (UNICEF 1990).

Vitamin A. By the early 1990s, a growing global consensus on the importance of vitamin A for effective immune system functioning led to broad promotion of bi-annual supplements of vitamin A megadoses, which the liver can store (Horton et al 2008). Interest in vitamin A and immune system interactions with HIV/AIDS has spurred additional research on vitamin A, which broadly recommends vitamin A supplementation in HIV-positive children, though not in HIV-positive pregnant women (Mehta and Fawzi 2007).

Iron. Iron supplementation has long featured in clinical responses to maternal anemia during pregnancy. Because the body cannot store iron easily, bi-annual megadoses are not feasible, and so effective prevention of iron deficiency requires improved diets or regular supplementation. Both are expensive and complex undertakings. Hence, progress in combatting iron deficiencies has proven the most difficult micro-nutrient problem to remedy (Berhman et al 2004, Horton et al 2008).

In Zambia, these same three micronutrients dominate micronutrient policy concerns. Iodine deficiency among schoolchildren has fallen from 72% in the early 1990s to 14% in 2011.

Against this major success, iron and vitamin A deficiency rates in children remain above 50% (Table 1).

Table 1. Trends in major micronutrient deficiencies in Zambia

	Children						Women			
	1993	1997	1998	2002	2003	2011	1997	1998	2003	2011
Iodine (< 100 ug/L)	72%			4%		14%				
Iron										
anemia ((Hb<11g/dL)			65%		53%	58%				
anemia, pregnant women (Hb<11g/dL)								47%		36%
anemia, non-pregnant women (Hb<11g/dL)								38%	29%	28%
Vitamin A (serum retinol < 20 ug/dl)		66%			54%		22%		13%	

Sources: Lumbwe et al (1995, 2003), MOST et al. (2003), NFNC (1999, 2005, 2012b), Stevens et al. (2013), WHO (2015).

2.2. Micronutrient policies

In Zambia, as globally, micronutrient policies and interventions have focused primarily on three major micronutrient deficiencies: iodine, vitamin A and iron. While iodine deficiency disorder (IDD) has declined rapidly following mandated iodization of salt and its effective enforcement, vitamin A and iron deficiencies remain significant public health concerns (Table 1; NFNC 2012a).

As outlined in the National Micronutrient Policy (2005-2011), Zambia's current policy efforts involve food based approaches – primarily fortification, bio-fortification, promotion of breast feeding and diet diversification – as well as supplementation of iron, folate and vitamin A for vulnerable groups, particularly pregnant and lactating women and infants under 5 years of age. Table 2 summarizes current policy and programs while Table 3 describes the broad chronology of international and domestic policy actions taken over the past 50 years.

Table 2. Snapshot of micronutrient policies in Zambia, 2015

No.	Micronutrients	Targets	Which delivery mechanism		
			Supplements	Fortification	Bio-fortification
1	Iodine	general public	-	Salt fortification mandated since 1978, modified 1994, 2001.	-
2a	Iron, folate	pregnant women	Provided through antenatal care (ANC). Compliance challenges persist.	-	Bean breeding for improved iron content. No releases yet of locally bred bio-fortified beans.
		adolescent girls	Distributed in selected schools as school health and nutrition (SHN) programme.	-	-
2b	Vitamin-mineral multi-mix (Iron, vitamin A, folic acid, Zinc)	general public	-	Mandatory fortification of commercial maize flour supported by NFNC and Global Alliance for Improved Nutrition (GAIN) in 2006 but rejected by President's Office on national security grounds.	-
3	Vitamin A	children 6 – 59 months	Bi-annual mega-doses distributed through child health weeks (CHW)	Margarine fortification mandated 1978. Sugar fortification mandated 1998.	Bio-fortification of orange-fleshed sweet potatoes and orange maize with vitamin A. Releases in 2003, 2012, 2015.
		post-partum women	Distributed bi-annually through child health weeks (CHW).		
4	Zinc	children with diarrhea	Distributed through IMCI but with limited coverage.	-	-
5	Vitamin D	general public	-	Margarine fortification mandated 1978.	-

Table 3. Summary Chronology of Key Micronutrient Policies in Zambia

	International Events	Zambian Policy Environment	Iodine	Vitamin A	Iron
1960s		• 1964-1991 Kaunda'a UNIP government • 1967 National Food and Nutrition Act • 1967 NFNC established			
1970s		• 1972 Food and Drugs Act • 1975 National Food and Nutrition Act amended	• 1972 national goiter study • 1978 legislation mandating salt fortification, not enforced	• 1978 mandatory margarine fortification	• supplementation for pregnant women at ANC
1980s		• 1987 external review of NFNC performance reports "a state close to collapse"	• 1985 TDRC study links night blindness to VAD		
1990s	• 1990 UN World Summit for Children • 1992 International Conference on Nutrition • 1994 UNICEF-WHO endorse universal salt iodization (USI)	• 1991 new constitution • 1991-2008 Chiluba's MMD government • 1993 Micronutrient Task Force established	•1993 IDD baseline survey • 1994 mandatory fortification of domestic and imported salt	• 1990 supplementation begins • 1997 national VAD survey • 1998 mandatory sugar fortification; simultaneous ban on sugar imports • 1999 expanded supplementation through CHW	• 1998 national baseline study on anemia survey • expanded supplementation programs (MOH, MCDMCH, MoE SHN) • expanded efforts in food fortification and diet diversification
2000s	• 2000 OAU Abuja summit Rolling Back Malaria • 2002 UN General Assembly on Children sets goal of IDD elimination by 2005 • 2006 Pemba iron study documents danger of iron supplementation in high-malaria zones (Sazawal et al. 2006)	• 2001-2008 Mwanawasa's MMD government • 2005 National Micronutrient Policy 2005-2011 • NFNC Strategic Plan 2005-2010 • 2006 National Food and Nutrition Policy • 2008-2011 Rupiah Bandas MMD government • 2009 $7M embezzlement at MoH triggers donor aid reductions (Taylor 2012)	• 2001 fortification levels reduced to prevent hyper-thyroidism • 2002 IDD Impact Survey	• 2001 smuggling of imported sugar from neighboring countries accounts for 10% to 25% of national sugar consumption • 2003 national VAD and anemia survey • 2003 two light orange sweet potato varieties released • 2008 sugar price spikes • 2009 Parliamentary Committee on Economic and Labor Affairs calls for change in sugar fortification	• 2003 VAD survey finds malaria significantly increases iron deficiency • 2003 mosquito bed net distribution included in CHW • 2006 mandatory maize meal fortification standards developed (iron, folic acid, vitamin A, zinc); statehouse stops implementation

				policy to improve competitiveness of sugar industry	
2010s		• 2010 Zambia joins SUN movement • 2011-2015 Sata's PF government • 2011 National Food and Nutrition Strategic Plan 2011-2015 • 2015 Lungu's PF government	• 2011 IDD monitoring survey	• 2010 CCPC investigates complaints of high sugar prices •2010-2014 multiple studies of high sugar prices • 2012 bio-fortified maize released (3 varieties) • 2015 bio-fortified sweet potatoes (4 varieties) released	• bio-fortified bean breeding begins with support from CIAT and Harvest Plus

Sources: Field interviews, Serlemitsos and Fusco 2001, Greiner et al 1988, Harris and Drimie 2012, Taylor 2012.

2.3. Policy institutions and policy processes

Three broad groups of actors -- government, donors and the private sector -- interact to design and implement micro-nutrient policies in Zambia. A multiplicity of distinct institutions and individuals operate within each group. Their roles, responsibilities, resources and priorities often differ, resulting in a complex web of interactions within and among groups as the policy process plays out (Figure 1).

Government actors

Government actors include the Ministry of Health (MOH), charged with implementing food and nutrition policy, the Ministry of Agriculture and Livestock (MAL), charged with food policy in general and in the case of micro-nutrients with incorporation of bio-fortification in national breeding programs, the Ministry of Community Development, Mother and Child Health (MCDMCH), charged since 2011 with delivery of health and nutrition services at community level, and the Ministry of Education (MoE), charged with implementing the School Health and Nutrition (SHN) program for adolescent girls in selected schools (Table 4).

The statutory instruments (SI) required to implement micro-nutrient fortification mandates under the Food and Drugs Act fall within the purview of the Minister of Health. In practice, however, the minister requires Cabinet approval before issuing SIs. Parliament has the power to enact laws and review the government budget, though in practice the Zambian constitution provides for a strong executive, under which Statehouse plays a dominant role in setting and implementing national policies (Africa Lead 2014). Zambia's extensive use of statutory instruments serves as one mechanism for delegating power from the legislature to the executive branch (Africa Lead 2014).

The National Food and Nutrition Commission (NFNC) provide technical input and coordinates nutrition policy within the public sector camp. An autonomous body established in 1967 within the MOH, the NFNC's mandate calls on it to promote, coordinate, monitor and evaluate food and nutrition policies in Zambia. Twenty years after inception, an external review identified key structural and financial weaknesses at NFNC, recommending major upgrading efforts as well as consideration of alternative institutional homes for NFNC (Greiner et al. 1987). A more recent review by Harris and Drimie (2012) provides a detailed assessment of current staffing, budgeting and coordination issues that have arisen at NFNC and associated ministries involved in food and nutrition policy.

The key functional issue that recurs in food and nutrition policy debates concerns the appropriate institutional home for NFNC. Currently based in MOH, NFNC enjoys good lines of communication with its major implementing partners. At the same time, this placement within a single line ministry limits NFNC's ability to coordinate across ministries. Alternate options include placement at the Cabinet Secretariat, the Office of the Vice President, or in the Office of the President, as the Malawians have done (Babu et al. 2015).

Donors

Donors play a leading role in priority setting, financing and implementing micro-nutrient policy in Zambia. The policy chronology in Table 3 identifies key points at which major donor actions have influenced Zambia's micro-nutrient policy agenda. UNICEF has played a leading role, particularly since sponsoring the UN World Summit for Children in 1990. This UN General Assembly session devoted to child welfare and nutrition lead to a series of high-profile global conferences on nutrition and micro-nutrients (notably iodine) which, in turn, have translated into scaled up donor funding for a series of international micro-nutrient priorities. Chronologically, global donor interest in micro-nutrients focused first on iodine, through universal salt iodization, then on iron and most recently on Vitamin A (Horton et al 2008).

In Zambia, nutrition sector donors and technical agencies (including DfID, UNICEF, Irish Aid, USAID, World Bank, SIDA, WFP, WHO and the European Union) organized, first as an informal group, and then formally in 2011 as the SUN donor group (Grutz et al. 2014). Through the power of the purse, they play a key role in setting priorities, simply by making known to key government decision-makers which micro-nutrient policies they are willing to fund. At the design and implementation phase, donors play a similarly decisive role through a legion of consultants, project entities and NGOs. Chapter 4 below, for example, describes USAID's decisive role, through a series of consultants and projects, in instituting Zambia's mandatory Vitamin A fortification of sugar.[2]

Most recently, the SUN initiative has helped to mobilize donor support from DfID, Irish Aid and SIDA for community nutrition and public health programs through the newly constituted MCDMCH. Zambia signed the SUN initiative in 2011, the same year in which they split off primary health care from MOH to the newly constituted MCDMCH, which in turn has become the key vehicle for implementing SUN initiatives in its 14 pilot districts.

Private sector

Zambia's private sector plays an increasingly important role in micro-nutrient policy design, primarily because of growing interest in fortification and bio-fortification. Both require increasingly active engagement of agribusiness firms and farmers in the micro-nutrient policy arena. Fortification requires that private milling and food processing firms modify their food products to comply with specified norms prior to packaging, distribution and sale. Bio-fortification requires that private seed companies produce certified seeds that comply with varietal release specifications and that trading, milling, and distribution companies properly package and label the bio-fortified foods.

Given the need for private sector cooperation in both fortification and bio-fortification initiatives, NFNC has courted agribusiness firms through a series of fortification task force discussions, workshops and retreats at the agenda setting, design and decision-making stages of the policy process. Maize millers have been prominent targets of policy makers' affection, through a series

[2] A UNICEF consultant played a similarly crucial role in designing and instituting Malawi's Vitamin A fortification mandate (Babu et al. 2015).

of ongoing interactions through which NFNC and its donor partners aim to sensitize industry and persuade firms to embrace maize meal fortification. The discussion below, in Chapter 4, details how Zambia's maize millers initially rebuffed NFNC's fortification overtures in 1996 and then came around to support maize meal fortification in 2006 only to have the emerging consensus standards vetoed by the Office of the President. Following the initial active disinterest by maize millers in micro-nutrient fortification, NFNC and its donor partners approached Zambia's sugar company, which agreed to participate. Currently Zambia's sugar companies, salt companies, margarine manufacturers, and millers of orange (bio-fortified) maize all form part of the micro-nutrient policy process. These agribusiness firms and farmers dominate implementation of the fortification and bio-fortification mandates (Figure 1).

Through a series of task forces, workshops and direct communications with government and Statehouse, these agribusiness interests have shaped the design, decision-making and implementation of key micro-nutrient policies – particularly a series of fortification (maize meal, sugar, salt) efforts and marketing and processing of bio-fortified maize. The discussion in Chapter 4 describes their involvement in detail.

Figure 1 outlines schematically Zambia's micro-nutrient policy process. At the agenda-setting stage, NFNC and donors play a leading role in determining micro-nutrient policy priorities. In practice, donors frequently play a decisive role since external resources dominate funding decisions. A series of local research institutes and individual researchers at TDRC, UNZA, UTH and IAPRI contribute local empirical knowledge to the large and growing body of international nutrition research provided by international community.

Once a particular micro-nutrient has made it onto the policy agenda, the design phase orchestrated by NFNC typically revolves around an evolving set of task forces involving key stakeholders who review technical options that shape the final line ministry recommendations to decision-making authorities in Cabinet and Statehouse.

The implementation stage involves an array of public and private actors. The supplementation programs (iron, folate, Vitamin A), all financed by public money, are likewise implemented by line ministries (MOH, MCDMCH and MOE) who deliver supplements to designated vulnerable groups. In contrast, private agribusiness firms implement fortification programs, while consumers finance them through higher food prices. Once enacted, the public role in fortification policy remains confined to monitoring and evaluation. The Food and Drugs Control Laboratory (FDCL) tests fortification levels, while the Competition and Consumer Protection Commission (CCPC) monitors pricing and costs borne by consumers. Bio-fortification efforts begin with public sector breeding at MAL, which often require 5-10 years of crossing, testing and trials. Following release of approved new varieties, private seed companies begin production of commercial seed which they sell to farmers following certification by MAL's Seed Certification and Control Institution (SCCI).

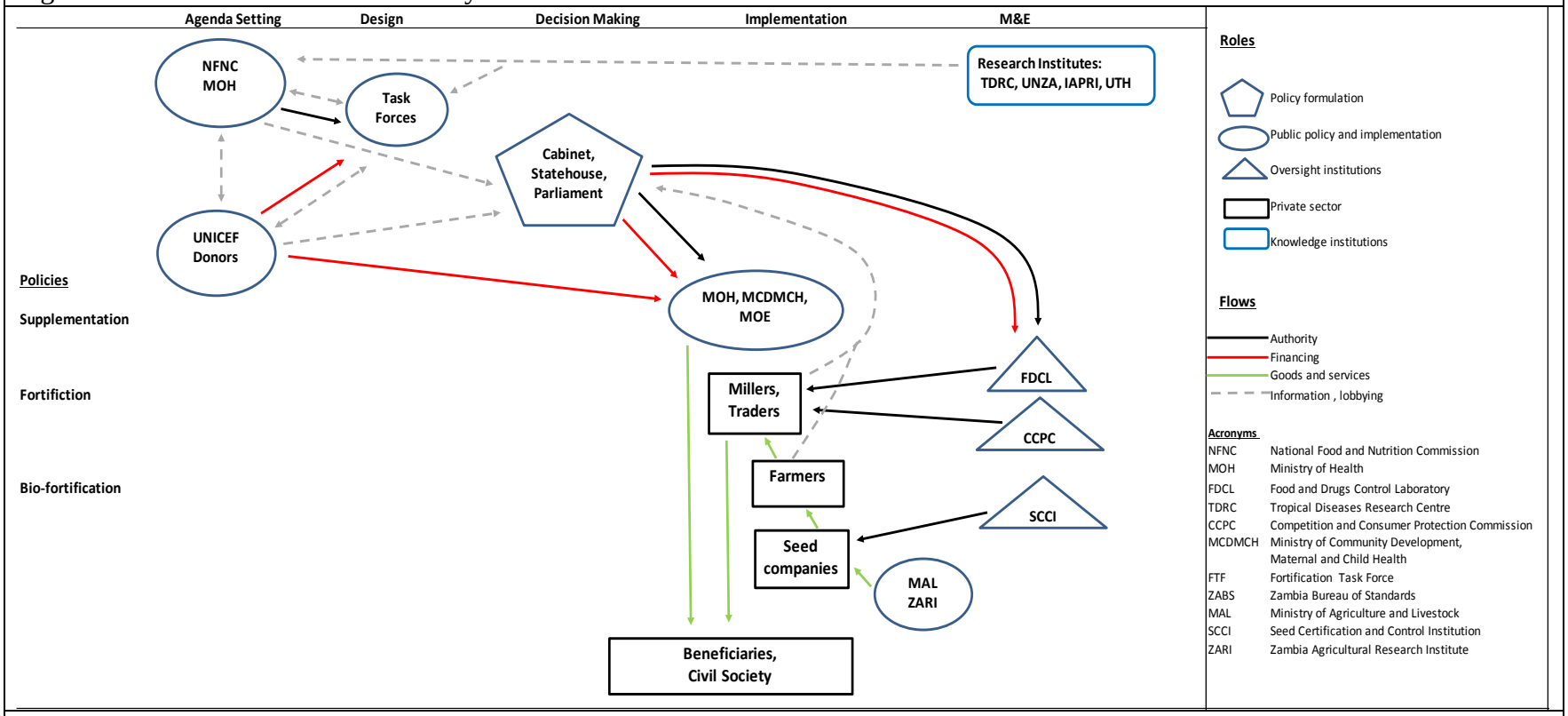
Monitoring and evaluation of micro-nutrient policies involves a large number of actors. Typically, donors finance local research institutes to conduct baseline and monitoring surveys of major micro-nutrient deficiencies. These feed into NFNC and ongoing consultative processes to review, assess and modify policies in response. For example, salt iodization standards, initially

established in 1978 have been modified twice since then, in 1994 and 2001, in response to evolving evidence on iodine deficiencies and iodine levels in retail salt. The discussion in Chapter 4 below describes these policy iterations and interactions in detail.

Table 4. Institutional Roles and Responsibilities for Micronutrient Policies in Zambia

Institution	Legal Mandate	Roles and Responsibilities
Office of the President	• Constitution of Zambia, 2015, Cap 1	
Ministry of Health (MOH)	• Public Health Act CAP 295 basis for enforcement of food fortification regulations •	• provide health services • advise on health and nutrition policy • issue regulations • enforce food fortification regulations
Local Governments, Departments of Public Health	• Local Government Act Cap 289	• enforce food fortification regulations in townships
Ministry of Community Development, Mother and Child Health (MCDMCH)	• Presidential decree of September 2011, Gazette No. 183, 23 March 2012	• provide social protection and primary health care
National Food and Nutrition Commission (NFNC)	• National Food and Nutrition Commission Act CAP 308 of 1967, amended 1975, 2015 undergoing review process	• promote food and nutrition activities • coordinate, monitor and evaluate implementation of food and nutrition policies • reports to Minister of Health • register community nutrition groups
Food and Drugs Control Laboratory (FDCL)	• public health Act CAP 295	• tests food and drugs for compliance with national standards
Zambia Bureau of Standards (ZABS)	• Standards Act CAP 416 • Food and Drug Act 1972, 2006	• formulate national standards and testing procedures • set standards and enforcement mechanisms for foods
Ministry of Agriculture and Livestock (MAL)	• Presidential proposal approved by Parliament under Article 44(2)(e) of the Constitution of the Republic of Zambia	• breeding research • agricultural extension
Seed Control and Certification Institute (SCCI)	• Plant Variety and Seeds Act (CAP 236) • Plant Breeder's Right Act (No. 18 of 2007)	• testing and release of new seed varieties • seed certification • department under MAL
Competition and Consumer Protection Commission (CCPC)	• Fair Trading Act 1994 • Competition and Consumer Protection Act 1994, amended 2010	• investigate cartels, collusion and price fixing • ensure consumer protection from unfair trading practices • reports to Minister of Commerce, Trade and Industry
Tropical Diseases Research Center (TDRC)	• World Health Assembly 1997	• conduct research on tropical diseases and public health, including micro-nutrient deficiencies • joint collaboration between WHO and MOH

Figure 1. Zambia's Micronutrient Policy Processes



Source: field interviews.

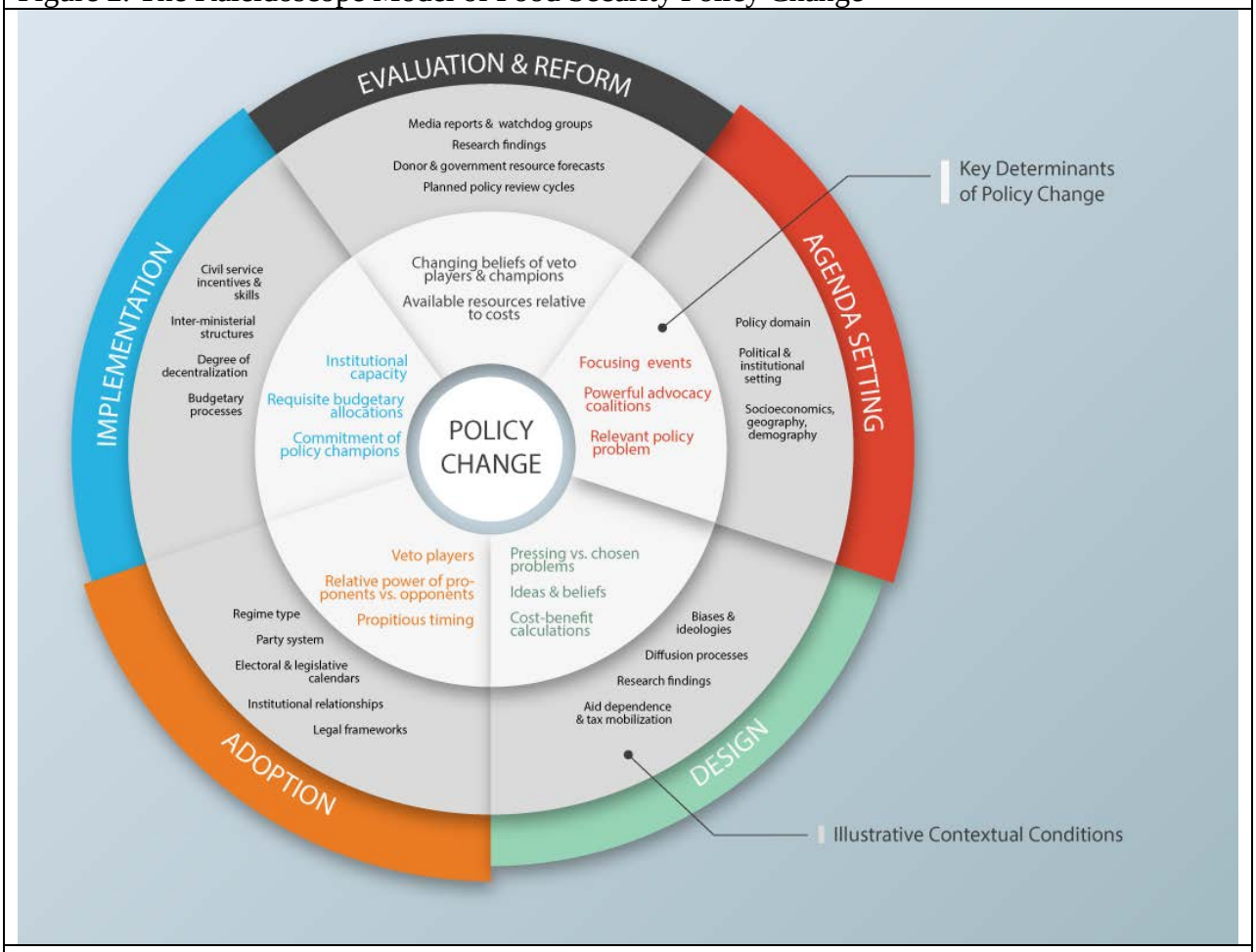
3. METHODS

3.1. The Kaleidoscope Model

What triggers policy change – in nutrition policy, agricultural policy or indeed any other policy arena? A wide array of researchers, donors and policy makers has explored this question in an effort to understand how to better shape policy processes and improve policy outcomes (Babu 2013, USAID 2013, Chhoker et al. 2014).

Drawing on theoretical and empirical research in political science, public administration and political economy, the Kaleidoscope Model aims to identify key hypotheses about factors driving policy change (Resnick et al. 2014). At each of five stages in the policy process, the model aims to identify key variables that define the necessary and sufficient conditions for policy change to occur. Identified in the inner core of the Figure 2, these variables serve as key hypotheses for empirical testing. Table 5 below lays out the resulting 16 key hypotheses in tabular form to facilitate summary in the empirical testing that follows.

Figure 2. The Kaleidoscope Model of Food Security Policy Change



Source: Resnick et al. (2014).

Table 5: Kaleidoscope Model Hypotheses: Key Variables Affecting Policy Change

Policy Stages Key variables affecting policy change
1. Agenda setting
1.1. Powerful advocates
1.2. Focusing event
1.3. Recognized, relevant problem
2. Design
2.1. Pressing vs chosen problem
2.2. Ideas and beliefs
2.3. Cost-benefit calculations
2.4. International design spillovers
3. Adoption
3.1. Propitious timing
3.2. Veto players
3.3. Relative power: proponents vs opponents
4. Implementation
4.1. Institutional capacity
4.2. Requisite budgetary allocations
4.3. Commitment of policy champions
5. Evaluation, Reform
5.1. Changing conditions
5.2. Changing information or beliefs
5.3. Resource availability relative to cost

Source: Resnick et al. (2014).

3.2. Data

Data used in testing the Kaleidoscope hypotheses come from published documentation as well as from semi-structured interviews with key stakeholders. In practice, the collection of written and oral data becomes an iterative process, with initial information triggering new leads and demands for additional data and additional interviews with newly identified key informants.

Background documentation includes a wide range of grey literature, policy documents and a smaller set of published research. Empirical data on micronutrients comes from a variety of

sources – some collected under local funding by national researchers and others collected on a larger scale with donor funding and often with assistance from agencies such as UNICEF, WHO, TDRC and the CDC.

Semi-structured interviews with key stakeholders provide critical insights into the policy process and interactions among the various stakeholders. The stakeholder mapping exercise provided us with a list of key informants, which grew over time as our understanding of the issues, processes and outcomes improved over time. The interview guide in Annex C provides the template used in conducting these interviews. It served as the backbone for each interview as well as a checklist to make sure we addressed each of the Kaleidoscope hypotheses. In addition, most interviews included very specific questions about the micronutrient of interest to individual stakeholders and about specific key junctures in the policy process.

As any homicide detective will attest, eye witness accounts may vary, sometimes quite considerably, among different people who witnessed the same event. Differences in perspective, background and attentiveness influence what information they retain, while their individual stake in the process may color their framing of both process and outcomes. To help in accurately interpreting the broad range of qualitative input received from key informants, we explicitly sought multiple accounts of each major policy episode in order to cross-check and verify the various eye witness accounts. For the more contentious policy events – such as the failed 2006 maize meal multi-mix fortification mandate and the successfully imposed but highly controversial sugar fortification mandate of 1998 – we ended up interviewing over half a dozen participants in the various technical trials, policy reviews and implementation. In each of these cases, the respondent accounts provided surprisingly consistent readings of key events, enabling us to paint what we consider an accurate account of the interactions that led to the "yes" decision in one case and the "no" decision in the other.

The research team conducted semi-structured interviews with several dozen policy stakeholders in Zambia in June and July 2015. In addition, we followed up via email, phone and field interviews during the months of August and September. In all, the team interviewed three dozen stakeholders in order to test the 16 hypotheses embodied in the Kaleidoscope Model. Annex D provides a list of the persons interviewed.

3.3. Tools for testing of the model's hypotheses

Hypothesis testing using the Kaleidoscope model revolves around three sets of analytical tools:
a. Policy Chronology
b. Stakeholder Mapping
- stakeholder inventory
- policy system schematic
- circle of influence

c. Hypothesis Testing Template.

The Policy Chronology outlines in detail the sequence of policy decisions and resulting implementing actions involved in the specific policy cycle under review. As an illustration, Table 7 below provides an example tracing the evolution of Zambia's iodine policy over time.

In this case, the policy emerged on the policy agenda three separate times -- in 1978, 1994 and 2001. The chronology serves as a means of focusing stakeholder interviews, and it evolves over time as the researcher's understanding of the specifics of the policy interactions improve.

The Stakeholder Mapping begins with the identification of key interest groups involved in any specific policy formulation or implementation. Table 8 below provides the stakeholder inventory for the iodine policy system. It summarizes their role, their resources, their position and how they interact with other stakeholders to produce policy outcomes. Two schematics portray visually how the various stakeholders interact to produce the sequence of observed policy outcomes. Figure 1 above provides the policy system schematic for the full suite of micronutrient policies reviewed in this paper, while Figure 3 below maps out the circle of influence graphic for iodine policy.

Hypothesis testing focuses on the tabular representation of the 16 specific Kaleidoscope hypotheses about factors driving policy change (Table 5). Using the sum total of available documentary and oral evidence reviewed, the research team assigns an initial qualitative score in the hypothesis table under each of the 16 hypotheses. A "+" indicates a significant, positive impact of that particular variable, while a "indicates a significant, negative impact. A blank cell indicates no impact of that particular variable on the policy outcome.

The authors submitted this initial assessment as well as a full draft write-up to all stakeholders interviewed for this study for their comment and review. Follow-up phone interviews with key stakeholders served to help identify and iron out lingering areas of disagreement and agreement among the key participants.

3.4. Validation and counterfactuals

Validation matters. Since success has many fathers, the qualitative interview data recorded by the research team embody the inherent biases of individual respondents, each of whom has different information, perspectives, objectives and stakes in the policy outcomes. For this reason, the Kaleidoscope research protocol calls for verification of each policy hypothesis from multiple respondents. Written documentation, in both gray and published literature, frequently provides additional testimony about the factors affecting policy change. The detailed hypothesis testing summaries in Annex E provide full details of the respondent numbers and written sources supporting each of the hypotheses tested. Stakeholder feedback on the initial research hypotheses serves to validate the formal assessment of the Kaleidoscope hypotheses.

Counterfactuals rarely exist in social science research, particularly in complex, interactive processes involving multiple stakeholders. The Kaleidoscope Model addresses this problem in two ways. First, multiple iterations of similar, individual policy events come close to providing repeated testing within the same framework conditions. The three reviews of iodine fortification legislation, for example, enable paired assessments of the same policy issues by the same institutions and involving the same actors. Similarly, we find multiple occurrences of similar fortification policies (margarine, salt, maize meal) with differing outcomes and different private sector stakeholders. These comparisons help to reveal the key variables driving the differing outcomes.

Second, the cross-country comparisons – to be undertaken in a second phase of analysis – enable the research team to compare differences in conditions, institutions and outcomes for the same policies in different policy systems. Why, for example, did Zambia mandate iodine fortification of salt 20 years before Malawi and 17 years before South Africa? Why did the same sugar company (Illovo) support vitamin A fortification of sugar in Zambia but fight against it a decade later in Malawi? Why is it that recommendations from the same international conferences – such as the World Summit for Children in 1990 – produced different policy responses in different receiving countries? The cross-country comparisons among Malawi, South Africa and Zambia offer prospects for testing hypotheses about international evidence and policy spillovers in multiple policy settings.

4. DRIVERS OF POLICY CHANGE: A FORMAL TEST OF THE KALEIDOSCOPE HYPOTHESES

4.1. Iodine

4.1.1. Policy Chronology

Zambia's iodine policy has rolled out in three successive waves, each centered around an evolving salt fortification mandate (Table 6). The first round of policy action occurred in 1978 when Zambia's Minister of Health issued Statutory Instrument 133 of September 1978 mandating[3] iodine fortification of all salt sold in Zambia. Given limited local salt supplies, domestic salt production takes place only on a very small scale in Zambia, in the districts of Kasempa and Kaputa. As a result, imports, primarily from Botswana and Namibia, account over 90% of Zambia's salt consumption (NFNC 2012a). During the 1970s, a government parastatal, National Milling, imported most of the salt consumed in Zambia. The company imported non-iodized salt from neighboring countries and then fortified it locally before packaging and selling it to domestic retailers. After a while, the mechanical mixers they had purchased for fortification corroded and National Milling did not replace them. Instead, they stopped iodizing the salt they imported and sold. Possibly, Ministry of Health monitoring officers may have found it difficult to regulate a parastatal reporting to a different ministry, in this case the Ministry of Agriculture. Whatever the reason, the enforcement of the salt fortification lapsed during the 1980s.

Table 6. Zambia's Evolving Salt Fortification Mandate

Year	1978	1994	2001
Statutory Instrument	SI 133	SI 97	SI 90
Requirement	Mandatory	Mandatory	Mandatory
Point of inspection	Retail	Import Retail	Import Retail
Fortification level (ppm potassium iodate)	Retail: 50	Factory: 135-168 Port: 84-135 Retail: 50-84	Factory: 25-66
Enforcement agency	• MOH Environmental Health Officers, • FDCL, • Town Councils	• MOH Environmental Health Officers, • FDCL, • Town Councils, • Customs Services	• MOH Environmental Health Officers, • FDCL, • Town Councils, • Customs Services
Enforcement level	Negligible	Highly active	Intermittent

[3] Given the nearly 40 year time span since the introduction of Zambia's 1978 salt fortification regulations, none of the stakeholders we interviewed had first- hand involvement with the 1972 goiter study or the setting of the 1978 salt fortification standards. Some current stakeholders, as well as Katongo (2012) and NFNC (2012), indicate that SI 133 provided for only voluntary salt fortification. In contrast others, including NFNC (2005b), Chintu (2007) and those who have dealt most closely with the iodine fortification program, maintain that SI133 technically imposed a mandatory salt fortification requirement. Lawyers we consulted confirm that the legal language used in SI133 stipulates mandatory fortification. Despite these differing recollections, all written sources and key informants agreed that no serious enforcement of the salt fortification mandate occurred during the 1970s and 1980s.

In a second round of policy formulation, high-level international discussion of iodine deficiency disorders (IDD) at the 1990 World Summit on Children led to a UN General Assembly resolution calling for concerted global efforts to eliminate IDD by 2000. Follow-up technical work by the WHO and UNICEF resulted in high-level endorsement of universal salt iodization (USI) as the preferred global vehicle for eliminating iodine deficiencies (Table 7). Given universal salt consumption, the low cost of fortificants and the simple equipment required, cost estimates range between 2 and 9 cents per child per year, making salt fortification with iodine the internationally recognized most cost-effective vehicle for reducing IDD (WHO 2004). Domestically, international attention translated into ramped up donor support for training, equipment, monitoring, test kits and education. The NFNC Fortification Task Force (FTF) established to review fortification opportunities and options proposed a revision of the iodine fortification regulations, primarily to stipulate fortification of salt imported into Zambia. Issued in 1994, SI97 amended fortification requirements by specifying fortification levels at the factory (in Botswana), at the port of entry into Zambia and at the retail level. Financial support from UNICEF and other donors enabled MOH Environmental Health Officers and Ministry of Trade Customs Officials to collect samples of salt at the border and in retail establishments and deliver them to FDCL for testing. These resources enabled, for the first time, regular monitoring of salt fortification levels. As one recent study put it, "In 1995, NFNC with support from UNICEF commenced enforcement of the USI law and salt monitoring was intensified especially in border areas, but also at wholesale, retail and households levels." (Katongo et al. 2015, p.11). These concerted efforts to enforce salt fortification requirements led to a rapid decline in IDD. Iodine deficiency levels in school children fell from 72% in 1993 to 14% in 2011 (Table 1) prompting the NFNC to conclude that "iodine deficiency is no longer a problem of public health significance in Zambia."(NFNC 2012, p.15).

In recent years, excessive iodine intake has become a concern following reports of over-iodization in over one-third of salt samples tested and reports of hyperthyroidism in surrounding countries (WHO/UNICEF/ICCIDD 1997, Lumbwe et al. 2003, NFNC 2012). These concerns led to a third round of policy action in which SI90 of 2001 reduced mandated fortification levels by two-thirds (Table 6). The 2011 IDD monitoring survey reports sums up the current situation as follows: "… like other countries in Eastern and Southern Africa, a trend of excessive iodine intake has been observed …. The challenge in sustaining IDD elimination in Zambia is now twofold: to improve coverage of iodized salt where iodine intake is insufficient and to reduce iodine intake where it is excessive." (NFNC 2012, p.15).

4.1.2. Stakeholder Mapping

Four broad sets of stakeholders drive iodine policies in Zambia (Table 8). Government formulates and enforces the iodine fortification mandate, with NFNC and FTF leading the design efforts, while ZABS manages the technical review committee that defines the standards and testing methods. Enforcement relies on MOH Environmental Health Officers, Town Council officers and MOT Customs Officers to collect salt samples at the ports of entry and in various retail markets and deliver them to FDCL for testing.

Table 7. Iodine Policy Chronology

Date	External Influences	Domestic Policy Events
1972		• national goiter study (Nwokolo 1972, 1974) • 1972 Food Act lays the legal foundation for food standards
1973-77	• international standards reviewed by ZABS likely influenced the salt iodization standard adopted by the ZABS technical review committee	• ZABS conducts large-scale review of food standards in preparation for issuance of the first comprehensive set of food standards under the Food Act
1978		• SI 133 mandates iodine fortification of salt sold in Zambia
1990	• UN World Summit for Children endorses goal of eliminating IDD through salt fortification	
1992	• strong donor support(UNICEF, USAID) becomes available to promote fortification efforts	• NFNC establishes a Fortification Task Force (FTF) to review micronutrient requirements and fortification options for meeting them
1993	• IDD survey financed by UNICEF and USAID	• IDD baseline survey (Lumbwe et al. 1995)
1994	• UNICEF-WHO endorse universal salt iodization (USI)	• SI 97 increases fortification levels and imposes a mandate on imported salt as well as domestic sales, making border monitoring necessary for the first time
1994	• UNICEF funds equipment for FDCL and training and rapid test kits for MOH Environmental Health Officers, Customs Officers	• vigorous enforcement of iodization requirement begins
1997	• regional IDD study documents excessive iodine intake (hyperthyroidism) in neighboring countries	
2001		• SI 90 reduces iodization levels mandated, in response to fears of hyperthyroidism
2002	• UN General Assembly Special Session on Children adopts goal of eliminating IDD by 2005 • donor funding for survey	• IDD impact survey (Lumbwe et al. 2003)
2011	• donor funding for survey	• IDD monitoring survey (NFNC 2012)

As with most fortification mandates, the private sector implements the policy in that they purchase the fortificants, add them to the food product, package, label and distribute the fortified foods to consumers. In Zambia's case, 90% of the salt comes from outside the country and so, since 1994, fortification has taken place outside of Zambia, mostly at Sua Pan in Botwana. This reliance on imported salt has posed some practical problems in the past in communicating

shifting standards to foreign firms. In discussing the 2001 changes, for example, Lumbwe et al. 2003, p.44) note that "The salt manufacturers were not told of this change and have continued to iodate salt at the old recommended levels of 135-168 ppm." Subsequent reviews continue to recommend improved communication with these external suppliers (NFNC 2011 2012).

Researchers constitute the third major group of stakeholders. They include medical and public health researchers at Zambia's various universities, teaching hospitals and research institutes. Early work by Nwokolo (1972) at University Teaching Hospital first flagged the magnitude of the IDD problem in Zambia when his study of schoolchildren reported 50% rate of goiter nationally, with incidence ranging from 26% to 81% (Nwokolo 1974).

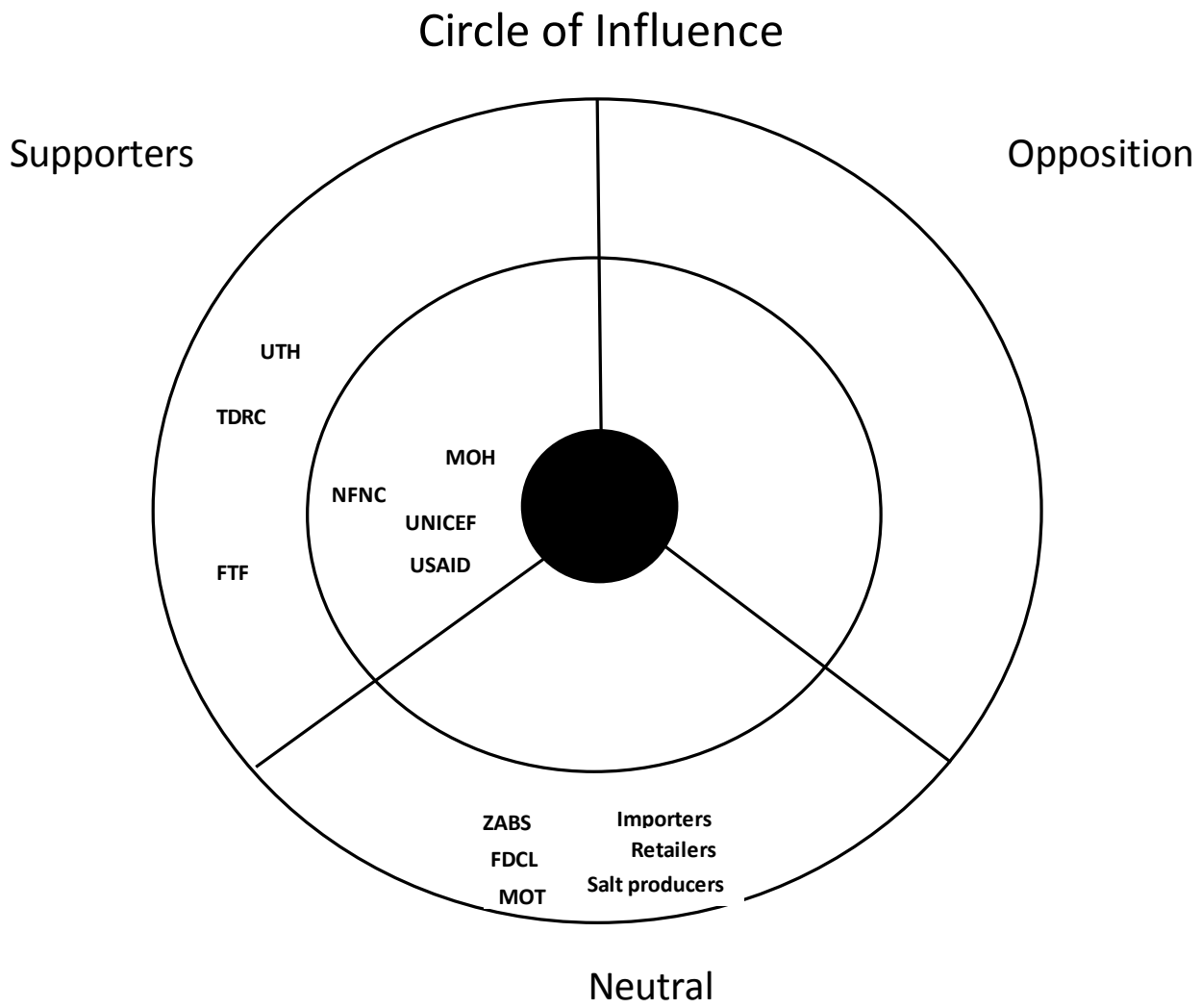
Donors constitute the fourth major stakeholder group. Since 1990, they have strongly supported fortification efforts through educational campaigns, testing equipment and implementation of salt fortification mandates around the world. In Zambia, this increased international visibility translated into rapidly ramped up funding from UNICEF, USAID and other donors to support baseline studies, fortification task force activities, training, education and test kits used by various government monitoring agencies.

Figure 1 above shows how these various stakeholder groups interact, while Figure 3 below summarizes the advocacy roles and relative influence of each major stakeholder group.

Table 8. Iodine Policy Stakeholder Inventory

Institution	Category	Role	Resources	Influence	Policy Stance
MOH	Government	• issue regulations • enforcement • education	• limited	• large	Advocate
NFNC	Government	• identify key issues and policy options • monitor implementation • advise MOH and GOZ	• limited	• large	Champion
FTF	Government	• identify fortification opportunities	• mostly donor-supplied	• large	Champion
ZABS	Government	• set standards & testing protocols	• limited	• large	Neutral
MOT	Government	• Customs Officers collect samples of imported salt			
FDCL	Government	• tests samples	• limited	• limited	Neutral
Importers	Private sector	• import			Neutral
Local salt producers	Private sector	• fortify salt	• small	• limited	Neutral
Retailers	Private sector	• retail salt to consumers	• small	• limited	Neutral
UNICEF	Donors	• fund studies • fund testing • fund education • technical assistance	• large	• large	Champion
USAID	Donors	• ditto	• large	• large	Advocates
UTH	Researchers	• empirical research	• limited	• large	Advocates
TDRC	Researchers	• empirical research • inform policy makers	• limited	• large	Advocates

Figure 3. Iodine Fortification Circle of Influence



Source: Field interviews.

4.1.3. Hypothesis Testing

Agenda setting. Iodine fortification of salt has formally appeared on the policy agenda at Cabinet level three successive times (Table 9). The first time, in the late 1970s, domestic focusing events drove the policy agenda. Nwokolo (1972) published his national study documenting the high prevalence of goiter at the same time that the Food and Drugs Act of 1972 laid the framework for formal gazetting of food standards. As a result, ZABS led a broad effort, in the mid-1970s, to establish formal standards for all major foods consumed in Zambia. It appears that the large-scale ZABS standards review served as the key focusing event placing salt (and all other food) standards on the policy agenda. As that discussion unfolded, Nwokolo's

work highlighted the importance of iodine deficiency. The stakeholders we interviewed considered it likely that the ZABS technical review committee adapted Zambia's initial salt iodization standards from international sources. Along with over a hundred other food standards, MOH gazetted standards for fortified salt through SI133 of September 1978.

In 1994 and 2001, during the second and third rounds of formal policy review of salt fortification standards, international advocates strongly shaped the agenda. As convener of the UN World Summit for Children in 1990, UNICEF became the powerful international voice for combatting IDD among children. Broad international support for universal salt iodization (USI) resulted in large infusion of donor technical and financial support for salt iodization around the globe, including in Zambia. UNICEF and other donors supported NFNC and its various task forces to assess iodine deficiency levels, review salt fortification standards, ensure proper enforcement and rectify the shortcoming of the 1978 mandate by requiring imported salt to be fortified before it could enter into Zambia. The 2001 review focused on reducing iodization levels, given growing concern about hyperthyroidism in the region. In this case, too, regional studies by WHO/UNICEF flagged the potential problem and so once again international advocates championed the policy reforms.

The ZABS standards review appears to have served as the key focusing event placing salt standards on the policy agenda in 1978, while in 1994 UNICEF's World Summit for Children played the catalytic role. The 1997 regional WHO/UNICEF study documenting growing problems of excess iodine intake triggered interest in reducing fortification levels, as Zambia did in 2001.

In all three rounds of policy debate, credible empirical information documenting the magnitude of the IDD problem played a key role in strengthening the hand of the fortification advocates. The key studies documenting the incidence of IDD in Zambia include Nwokolo (1972, 1974), Lumbwe et al. (1995, 2003) and WHO/UNICEF/ICCIDD (1997) and NFNC (2012b).

Design. Longstanding work on iodine fortification of salt, beginning in the US and Switzerland in the 1920s has established salt fortification as the most practical, low-cost solution available for addressing IDD (WHO 2004, Horton et al. 2008, UNICEF 2010). WHO and the ICCIDD have established norms for USI and so many countries refer to WHO or regional standards in setting their domestic fortification levels.

Adoption. The 1978 Cabinet-level decision to issue the SI mandating salt fortification appears to have resulted from the fortuitous confluence of the 1972 ZABS mandate to establish food standards and the simultaneous appearance of the Nwokolo report. In the second and third rounds of standard revision, strong champions drove the policy reform efforts, with UNICEF, USAID and other donors providing strong support for NFNC, FTF and MOH. Indeed, our mapping of the key stakeholders reveals a striking absence of opposition (Figure 3). Given passionate advocates and no opposition, GOZ adopted and refined the salt fortification mandates over time, without contention.

Table 9. Iodine Policy Hypothesis Testing

Policy Stages			
Policy actions:	Iodine Fortification of Salt		
Kaleidoscope Hypotheses	1978	1994	2001
1. Agenda setting			
1.1. Powerful advocates		++	+
1.2. Focusing event	+	++	+
1.3. Recognized, relevant problem	+	++	−
2. Design			
2.1. Pressing vs chosen problem			
2.2. Ideas and beliefs			
2.3. Cost-benefit calculations	+	+	+
2.4. International design spillovers	+	+	+
3. Adoption			
3.1. Propitious timing	+		
3.2. Veto players			
3.3. Relative power: proponents vs opponents		+	+
4. Implementation			
4.1. Institutional capacity	−		
4.2. Requisite budgetary allocations	−	++	−
4.3. Commitment of policy champions		++	
5. Evaluation, Reform			
5.1. Changing conditions	+	+	+
5.2. Changing information or beliefs	+	+	+
5.3. Resource availabilty relative to cost		+	

Legend
+ significant positive impact of this variable on policy process
− significant negative impact of this variable on policy process

Source: Field interviews, Nwokolo (1972, 74), Lumbwe et al. (1995, 2003), NFNC (2012b), Katongo et al (2015). See Annex Table E.1 for details.

Implementation. Because private sector traders and food processors implement fortification mandates, government's role becomes one of monitoring and enforcement. The 1978 mandate revealed the weak monitoring capacity and inadequate budget support for this purpose. The major difference in 1994 revolved around the strong financial support from donors to provide

testing equipment, training, rapid test kits and education to government agencies involved in the monitoring – MOH Environmental Health Officers, Customs Officers, Township officials and the Food and Drugs Control Laboratory (FDCL). After the big push to monitor iodine levels and enforce fortification mandates in the 1990s, IDD levels fell across Zambia, and so too did donor support for monitoring. As a result, budgets required for testing kits, materials and transport have atrophied as GOZ has failed to fill the gap left by the reduction in donor support (Lumbwe et al. 2003, NFNC 2012b). Today, enforcement and monitoring of fortification levels remains intermittent and scattered.

Evaluation and Reform. Changing conditions clearly triggered the 2001 reduction in mandated fortification levels. Monitoring of iodine deficiency levels domestically and regionally resulted in emerging evidence of excessive iodine levels in salt and early indicators of hyerpthyroidism (WHO/UNICEF/ICCIDD (1997). By 2011, IDD monitoring revealed excessive urinary iodine levels (above 300 mg/L) in 39% of Zambian schoolchildren (NFNC 2012b, Table 4). As a result, the reassuring evidence of broadly declining IDD levels (Table 1) has been tempered by emerging concerns about possible overshooting of the target. Because of these changing conditions, and the survey evidence documenting them, Zambia's most recent reforms have focused on reducing mandated levels of iodine fortification.

4.2. Vitamin A

4.2.1. Policy Chronology

Domestically, medical researchers have known for some time about the serious health risks posed by vitamin A deficiency (Table 10). Early work in Luapula District documented 56% VAD levels among school children in the vicinity of Mansa, then called Fort Rosebery (Friis-Hansen and McCollough 1962). Work in the mid-1980s by medical researchers from TDRC definitively established vitamin A deficiency, rather than onchocerciasis (a river-borne parasite), as the root cause of night blindness in the Luapula Valley, thus raising interest in VAD among Zambian nutrition and public health professionals (see Taylor and West 1983, TDRC 2015).

Internationally, large-scale efforts to combat vitamin A deficiency began in the 1990s, following the UNICEF World Summit for Children held at the UN in 1990. Horton et al. (2008) describe the sequencing of international attention on micro-nutrient deficiencies as follows:

> "International attention was first focused on iodine deficiency, which thanks to iodized salt has been considerably reduced as a global problem. …. In the early 1990's meta-analyses indicating the importance of vitamin A in reducing severity of infection and mortality led to concerted efforts to undertake mass-dose vitamin A supplementation of children 6-24 months, often in conjunction with immunization campaigns. …. Iron is the third of the "big three" micro-nutrients and progress has been harder to make than for the other two. Unlike the other two, single annual or semi-annual mass doses are not feasible. Iron supplementation programs have had mixed results and although iron fortification is currently taking off in developing countries, coverage of many vulnerable populations remains problematic." (Horton et al. 2008, pp.7-8)

Beginning in the 1990s, large scale donor resources became available for vitamin A programs which is when Zambia's efforts began.

Zambia's vitamin A interventions have proceeded in four broad waves (Figure 4). Unlike iodine, for which a single silver bullet (in the form salt fortification) hit the targeted deficiency squarely, vitamin A deficiency has proven far more difficult to address. Early efforts in Zambia focused on vitamin A supplementation for vulnerable groups (children 6-59 months and lactating women). Later, given the logistic challenges of ensuring full national coverage of the supplements, a subsequent softening of donor funding for supplements and emerging evidence suggesting that VAD deficiency remained widespread in spite of the supplementation programs (Table 1), efforts quickly expanded into a shotgun, all-of-the-above strategy encompassing four major types of intervention.

Supplementation

The first wave of Zambia's vitamin A interventions focused on supplementation targeted at children under 5 years of age and post-partum women. Following a formal commitment in 1990, government ante-natal clinics began providing vitamin A supplements to women and young children who visited the clinics, starting in 1992 in drought-prone regions and expanding gradually thereafter to health centers nationally (Serlemistos and Fusco 2001). Supplementation efforts ramped up considerably from 1998 onwards, following the results of the 1997 national VAD survey which documented vitamin A deficiency in 66% of children 6 months to 59 months of age (NFNC 1997). The same survey found that vitamin A supplements reached only 28% of under-five children. In response, UNICEF and other donors pledged financial support for expanded campaigns to improve coverage of vitamin A supplements. With their support, NFNC launched bi-annual "vitamin A supplementation week" in February 1998. Through a concerted campaign of social mobilization, they advertised and actively sought out children and post-partum mothers at clinics, schools and community centers. Renamed Child Health Weeks (CHW) in 1999, these bi-annual campaigns provide vitamin A supplements, deworming medicine, family planning, growth monitoring and immunization. Because humans can store vitamin A in their liver for four to six months, the CHW campaigns deliver bi-annual mega-doses of vitamin A supplements in February and August (MOST 2004). By 2014, coverage of vitamin A supplements had reached 77% of under-five children (CSO 2015).

Despite increasing coverage, the impact of supplementation programs has proven difficult to establish. Statistical analysis of the 2003 VAD survey results found no significant link between vitamin A supplementation and VAD levels. Of the variables considered, only rates of malaria infection produced a statistically correlation with levels of VAD, higher rates of malarial infection being correlated with significantly higher rates of VAD (MOST/UNICEF/CDC/NFNC 2003, pp.42-45).

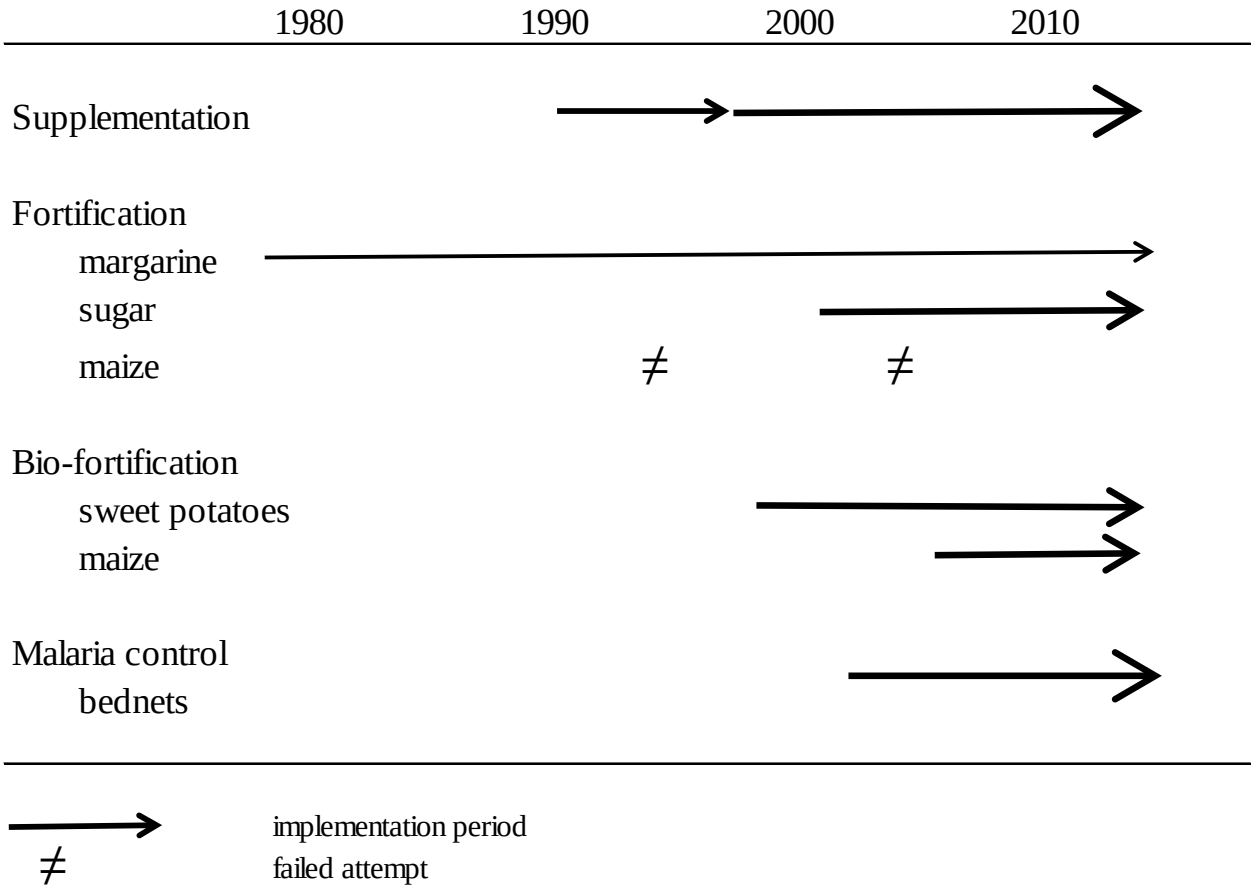
Recent concerns have likewise emerged over possible over-dosing on vitamin A. Because both supplementation and fortification provide preformed vitamin A (in the form of retinol), they can lead to overdosing. Though considered benign, excessive levels of hypercarotenodermia does turn children's skin orange (Tanumihardjo et al. 2015). Biofortification approaches, in contrast, provide provitamin A caretenoids that the body converts to retinol as needed. This self-

regulation of vitamin A stores has led to increasing interest in biofortification of sweet potatoes and maize.

Fortification of margarine

Since 1978, SI 133 has mandated margarine fortification with both vitamin A and D. However, the margarine mandate does not seem to have been actively enforced or very effective. The authors of the 2003 VAD survey summarize this early experience as follows, "The fortification of margarine with vitamin A began in Zambia in 1978, but because consumption was low, especially among the poorer groups of the population, it had little impact on national vitamin A status." (MOST/UNICEF/CDC/NFNC 2005, p.4). Reiterating this view, none of stakeholders we interviewed in 2015 considered margarine fortification particularly useful for combatting VAD, given the low levels of margarine consumption by vulnerable groups.

Figure 4. Four Waves of Vitamin A Interventions



Source: Field interviews, Serlemitsos and Fusco (2001), MOST (2004), NFNC (2011).

Table 10. Vitamin A Policy Chronology

Date	External Influences	Domestic Policy Events
1958		• VAD study in Luapula (Friis-Hansen & McCollough 1958)
1978		• SI 133 mandates vitamin A fortification of margarine
1985		• TDRC research links night blindness to VAD rather than to onchocerciasis (Taylor and West 1983, TDRC 2015)
1990	• UNICEF World Summit on Children	• MOH begins VA supplementation
1993		• NFNC establishes Micronutrient Task Force
1995	• Zambia Sugar purchased by Tate and Lyle	• Zambia Sugar privatized
1996		• DHS survey finds 68% VAD • NFNC convenes vitamin A workshop; considers maize fortification first, but millers object
1997	• USAID funds national survey on VAD • USAID funds visit by Dr. Omar Dary, a specialist with experience in Guatemala, to examine prospects for sugar fortification in Zambia • USAID provides $250,000 in equipment, chemicals and training	• national survey on VAD (NFNC 1997) • Zambia Sugar expresses willingness to fortify sugar; requests $1 million in donor funding for equipment and one-year supply of fortificant
1998	• FTF members visit Guatemala to investigate sugar fortification	• SI 155 mandates sugar fortification • sugar imports banned simultaneously
1999		• Zambia Sugar threatens to discontinue fortification if illegal sugar imports continue • MOH agrees to improve enforcement of import ban on unfortified sugar • VA supplementation expanded to a national campaign with biannual mega-doses delivered through CHW campaigns • Kalungwishi Estate begins commercial sugar production, with under 1% market share
2000	• UNICEF supports testing and enforcement of sugar fortification • USAID MOST project sponsors training workshop for VA inspectors • NFNC expresses concern about advertising sugar as a « healthy » product • OAU summit Roll Back Malaria	• MOH begins enforcement of sugar fortification mandate • NFNC establishes Sugar Fortification Technical Committee • Zambia Sugar complains that Kalungwisihi Sugar's fortificant does not comply with fortification regulations
2001	• CIP launches its Vitamin A for Africa (VITAA) partnership among sweet potato breeders in Eastern and Southern Africa	• widespread smuggling of unfortified sugar from surrounding countries accounts for 10% to 25% of national consumption • ZNFU and Zambia Sugar protest lack of controls on sugar imports
2001	• Ilovo, a South African company, purchases Zambia Sugar	
2003	• UNICEF and other donors support VAD survey	• national survey on VAD (MOST,UNICEF,CDC, NFNC 2005) • ZARI releases 2 light orange sweet potato varieties • Kafue Sugar enters sugar market as 3rd producer with 7% market share
2003		

2006	• British Foods buys controlling interest in Ilovo, and hence in Zambia Sugar • GAIN comes to Zambia to help NFNC promote maize meal fortification with vitamin mineral multi-mix	• CCPC investigates complaints of high sugar prices by large sugar users • ZABS works with fortification task force and industry to prepares standards for maize meal fortification • Office of the President orders MOH to stop work on maize meal fortification standards
2007	• HarvestPlus approaches ZARI about breeding vitamin A rich maize	• ZARI begins breeding for vitamin A traits in maize, using varieties supplied by CIMMYT through HarvestPlus
2008		• sugar prices spike by 150%, triggering widespread public awareness of high domestic sugar prices
2009		• Parliamentary Committee on Economic and Labour Affairs calls for policy change (dropping vitamin A fortification mandate) to improve sugar market competition • NFNC defends fortification policy (Lusaka Times 2009)
2010	• ODI study of oligopoly in Zambian sugar market concludes that oligopoly combined with lack of import competition enables excessively high domestic sugar prices (Ellis et al. 2010)	
2011		• ZARI submits 4 varieties of bio-fortified sweet potatoes for SCCI review
2012	• ACF regional study concludes that Zambia Sugar exerts monopoly power to raise sugar prices (Chisanga et al. 2014)	• ZARI releases 3 varieties of bio-fortified “orange” maize • UNZA study concludes that sugar fortification mandate constitutes a non-tariff barrier, reduces competition and enables local sugar oligopoly to charge high prices for sugar (Kalinda and Chisanga 2012)
2013		• President’s Office phones ZARI to ask if orange maize is GMO
2014		• IAPRI study concludes that sugar fortification limits imports, enabling local sugar producers to charge excessively high prices (Chisanga et al. 2014)
2014		• CUTS study examines reasons for Zambia’s high sugar prices (CUTS 2014) • CCPC indicates that lack of competition leads to excessively high sugar prices (Chanda 2014) • NFNC convenes breakfast briefing session to discuss sugar pricing and VAD; defends sugar fortification policy to the press (Chanda 2014)
2015		• ZARI releases 4 varieties of orange fleshed sweet potatoes

Fortification of sugar[4]

Early concerns about low supplementation coverage motivated a series of additional efforts to promote vitamin A fortification of various foods, beginning in the mid-1990s. Launching these fortification efforts, NFNC and UNICEF hosted a joint workshop on food fortification in May 1996 to explore options for vitamin A fortification. Initially, the workshop organizers focused on maize meal as the most likely food vehicle for fortification. However, several major millers objected to mandatory fortification of maize meal on the grounds that it would increase their production costs, they feared it might affect taste and it would likely put the large millers at a competitive disadvantage compared to Zambia's thousands of small, neighborhood hammermills where enforcement would prove problematic. Following rejection by the maize millers, NFNC began to seek alternate food vehicles for vitamin A fortification (Serlemitsos and Fusco 2001).

Drawing inspiration from experiences in Central America, the NFNC fortification task force (FTF) expanded its search for fortification candidates to include sugar. In October of 1996, the FTF visited Zambia Sugar, then Zambia's sole sugar producer and recently privatized parastatal struggling to regain profitability under new, private sector management. Zambia Sugar's new management team proved receptive and discussed the possibilities of project funding for equipment and fortificants. To move the discussion forward, USAID brought in a consultant, Dr. Omar Dary, in May 1997 to explain how the Guatemala sugar fortification efforts has worked and to assess prospects for successful sugar fortification in Zambia. The following January 1998, USAID financed travel for a five-member Zambian team to visit Guatemala to study sugar fortification efforts there. Ultimately, Zambia Sugar agreed to cooperate with the fortification program. Tate and Lyle, the British sugar company that had recently purchased Zambia Sugar from the government of Zambia, agreed to test the sugar fortification process and ultimately agreed to implement the mandate on several conditions: • that donors fund the initial equipment and one year supply of fortificants; • that donors provide staff training and public education campaigns; and • that GOZ ban imports of unfortified sugar, which at the time accounted for between 10% and 25% of national sugar consumption. Given that no countries in the region fortified sugar at the time, this requirement effectively banned the sale of imported sugar in Zambia. An early review of the sugar fortification mandate summarizes Zambia Sugar's decision as follows, "Business incentives led Zambia Sugar to support fortification legislation, which it hoped would bring a reduction in smuggling and an increase in domestic sales that would offset the cost of fortifying sugar."(Serlemitsos and Fusco 2001, p.ix)

Zambia Sugar formally launched fortified Whitespoon sugar in May 1998. Later that year, in December, the MOH issued SI 155 mandating fortification of all household sugar sold in Zambia, though not industrial sugar.

The early implementation years proved tense and contentious. Some of the equipment donors had promised failed to arrive, and so Zambia Sugar purchased necessary machinery and sought reimbursement. Given the severe cash-flow problems associated with privatization, Zambia Sugar requested $1 million from USAID to cover the cost of fortificants.

[4] This discussion draws heavily on an early review of the sugar fortification mandate by Serlemitsos and Fusco (2001).

> "USAID rejected this request in January 1998, citing its prior provision of equipment, chemicals, training and protectionist regulation. USAID support exceeded $250,000 in addition to the nearly $100,000 spent on the 1997 baseline VAD survey. USAID did agree to clear the first shipment of vitamin A fortificaant, thus exempting it from duty." (Serelemitsos and Fusco 2001, p.11).

Zambia Sugar likewise claimed that the donors had failed to provide adequate publicity for the new fortified sugar. Most important, the company complained about the continued widespread smuggling of unfortified sugar imports into Zambia from surrounding countries and the lack of border enforcement by authorities. Zambia's National Farmers Union (ZNFU) placed additional pressure on government to improve border patrols in order to prevent farmgate price erosion as a result of low-cost imports of unfortified sugar. GOZ responded with stricter border controls, while USAID's micronutrient program (MOST) provided training for sugar health inspectors and drug enforcement officers. In March 1999, Kalungwishi Estate began production as Zambia's second sugar producer, supplying 1% of national production.

Testing of fortification levels in retail and household sugar samples has proven erratic and problematic since imposition of the vitamin A mandate. The first samples tested by FDCL from Zambia Sugar's Mazabuka mill in 1998 ranged between 0 and 13.6 mg/kg, roughly half of the levels measured by Zambia Sugar and with most samples falling below the mandated 10 mg/kg. After technical discussions, Zambia Sugar adjusted their fortification procedures. Two years later, at the end of 2000, USAID's MOST project tested household sugar samples in a variety of locations. Amid wide variation, most samples again fell below the mandated 10 mg/kg. After further consultation, Zambia Sugar shifted fortificant suppliers to improve adhesion (Serlemitsos and Fusco 2001). Three years later, the 2003 VAD monitoring survey, which tested household sugar supplies from across Zambia, found only 18% of sugar samples above the minimum 10 mg/kg, with 37% between 2.5 and 10 mg/kg and 45% below 2.5 mg/kg. Results from retail shops produced similar results, with 50% below 2.5 mg, 41% between 2.5 and 10 mg and 9% above the mandated 10 mg/kg (MOST/UNICEF/CDC/NFNC 2005, pp.34-37).

In 2015, our team visited the FDCL laboratory to enquire about testing frequency and results. Following procedures spelled out in the Food and Drugs Control Act, FDCL does not collect samples but instead conducts tests on samples brought to them by various enforcement agencies and stakeholders -- traders, local sugar companies, township officers, customs officials and MOH Environmental Health Officers. Pulling two volumes at random from the FDCL test records confirmed the paucity of samples delivered to FDCL. During June to December 2006, the FDCL records listed four batches of sugar received for testing with an average of vitamin A content of 3.4 mg/kg. The second ledger book we reviewed, covering the calendar year 2011, recorded 5 batches of sugar received with an average vitamin A content of 3.9 mg/kg. At the same time, Zambia Sugar's quality control team indicates that they test every batch of sugar hourly at their mill in order to ensure that all shipments from the mill test out at regulation vitamin A levels. Given the potential for losses during shipment and storage, vitamin A content normally differs between the factory and household level. In the end, our stakeholder interviews mirror concerns expressed by most major reviews of Zambia's vitamin A sugar fortification policy -- about actual fortification levels at household level and about weaknesses in the current monitoring system.

Beginning in 2006, a variety of consumer groups have complained about Zambia's high sugar prices (Lusaka Times 2009, Ellis et al. 2010, CUTS 2014, Chanda 2014). In response, a series of studies has examined the structure of Zambia's sugar industry, its pricing patterns, price trends and possible explanations for Zambia's high domestic sugar price (Ellis et al. 2010, Kalinda and Chisanga 2014, Chisanga et al. 2014a, 2014b, CUTS 2014a, 2014b). The various parties -- including Zambia Sugar -- generally agree that Zambia's sugar prices are higher than those in surrounding countries. They also agree that the cost of fortification, at only 1% of production costs, cannot explain the price differential (Serlemitsos and Fusco 2001).

Disagreements arise over the remaining possible explanations for Zambia's high sugar prices. On one side of the debate, Zambia Sugar maintains that high sugar prices stem from the high cost of doing business in Zambia, where they face high value added taxes, high labor costs, high electricity costs and a generally high cost of conducting business locally. Others counter that Zambia Sugar faces very low corporate tax rates and that, compared to other African sugar producers Zambia is, in fact, a low-cost sugar producer (Ellis et al. 2010, Action Aid 2013). Most independent research studies conclude that high sugar prices result from the monopolistic structure of Zambia's domestic sugar industry coupled with an absence of price competition from imports since around the year 2000 when enforcement of import restrictions required by the vitamin A fortification mandate began (Ellis et al. 2010, Chisanga et al. 2014a, 2014b). A regional comparative study by the Africa Competition Forum (ACF) summarizes the situation as follows:

> "Zambia Sugar has embraced fortification, which has also served to control the influx of cheap imported sugar to the Zambian market …. This (fortification) legislation does not generally exist in most countries and this effectively blocks potential imports from entering Zambia. … Within Zambia, millers therefore have the ability to price domestic sugar at the highest price with high margins, even when Zambia is a low-cost sugar producer. … this signifies some abnormal pricing in the domestic market whereby millers, wholesalers and retailers are probably overpricing sugar in the domestic market despite having comparative advantage and surplus production. This is possibly a function of protectionism and significant market power." (Chisanga et al. 2014b, pp19-20)

Structurally, Zambia's sugar industry resembles a classic monopoly. Its two small producers account for only 8% of national sugar production, while Zambia Sugar holds a 92% market share (Kalinda and Chisanga 2014). Production has grown rapidly since privatization in 1995, and today Zambia exports roughly 60% of national sugar production (Kalinda and Chisanga 2014, Chisanga et al. 2014). Paradoxically, despite Zambia's export competitiveness in external markets, domestic prices frequently exceed those in neighboring countries (Chulu 2009, Chisanga et al 2014, Ellis et al. 2010, CUTS 2014).

Formal complaints began in 2006, when several large commercial sugar users (confectionary and brewing companies) complained to Zambia's Competition and Consumer Protection Commission (CCPC) about Zambia's high sugar prices. In response, CCPC staff launched a review of sugar pricing and produced an internal report detailing their findings. Though CCPC has declined to make their findings public, press reports quote CCPC researchers as concluding

that an absence of competition -- from imports and domestic producers -- enables Zambia Sugar to exercise monopoly of power and charge high prices domestically (Ellis et al. 2010, Chanda 2014).

A second major complaint emerged several years later following a sharp spike in sugar prices – a doubling of sugar prices in 2008 following large-scale flooding in the cane fields -- which punctuated a steady rise in sugar prices since 2000. This price spike focused the attention of not only consumers but also parliament. In 2009, Zambia's Parliamentary Committee on Economic and Labour Affairs requested that MOH change government's vitamin A fortification policy in order to foster competition in Zambia's sugar industry and lower prices. NFNC, however, rejected their request, asserting that they would continue to enforce the vitamin A fortification mandate (Lusaka Times 2009).

More recently, in 2014, high sugar prices again made the news following publication of a sugar market scoping study by the Consumer Unity Trust Society (CUTS 2014, Chanda 2014). Throughout these public debates, Zambia Sugar has consistently maintained that domestic sugar prices are high, not because they exercise monopoly power, but because of high taxes, high labor, high electricity costs and generally high costs of doing business in Zambia.

In public, the NFNC has continued to staunchly defend the vitamin A fortification mandate (Lusaka Times 2009, Chanda 2014). However, in private, many nutrition and public health specialists we consulted expressed concern about the efficacy of sugar fortification mandate, given the low reported vitamin A levels in household sugar and possible exclusion of vulnerable groups as a result of Zambia's high sugar prices. A regional study by ODI summarizes this tension as follows:

> "The government argues that a large part of the Zambian population suffers from vitamin A deficiency, and since sugar is a staple commodity, it is a good medium through which to provide vitamin A to the people. However, many stakeholders outside the Government and the sugar industry consider fortification to be a mechanism for protecting the Zambian sugar market from foreign competition." (Ellis et al. 2010, p.5).

Throughout these debates, firm data on sugar consumption patterns remain elusive. The FAO reports results of a Food, Health and Nutrition Information System (FHANIS) survey indicating that 53 percent of urban household consumed sugar while only 29% of rural households did. In both zones, higher income groups consumed more than the poor (FAO 2006). The 2003 VAD survey similarly reports that 50% to 60% of households interviewed had no sugar available on the day of the survey (MOST/UNICEF/CDC/NFNC 2005, p.34). A 2014 consumption study by NFNC, though yet to be released, may shed light on the important questions of income and price responsiveness of different household groups as well as the resulting differences in consumption levels.

Currently, the latest available impact data (though dated from 2003) found no statistically significant link between access to adequately fortified household sugar and vitamin A deficiency levels (NFNC 2005, p.45). A recent IAPRI study of sugar markets and pricing behavior concludes as follows:

> "Although the vitamin A (fortification) policy was meant to achieve health objectives, its implementation could be viewed as a Non-Tariff Barrier to trade, preventing imports and thus concentrating the market further. …. Prior to the legislation, imports (originating from Malawi) had reached almost 25% of total domestic consumption. Following the legislation, imports declined significantly and domestic prices began to rise, diverging from world prices. …. Thus, the legislation may have contributed to escalating prices of sugar, working against the initial objective of making vitamin A accessible to the wider population." (Chisanga et al. 2014, p.11).

TBC

Aborted efforts to fortify maize meal

Zambian nutrition policy makers have tried multiple times to introduce maize meal fortified with vitamin A as well as iron and a mix of various B vitamins. In May of 1996, as described above, the NFNC-UNICEF fortification workshop convened in Siavonga to seriously review options for food fortification. As the Country's most widely consumed food staple, maize attracted early attention as the preferred vehicle for delivering micronutrients to the population. Prior experiments by some large millers with voluntary fortification led them to resist a government mandated effort. In part, they feared consumer rejection of a new product. During the early voluntary efforts, rumors began to circulate about food safety, unusual taste and possible loss of fertility from consuming fortified meal. Moreover, Zambia's 45 large millers feared a competitive disadvantage if government imposed a fortification mandate on them. Since government monitoring agencies did not have the capacity to enforce a fortification mandate on Zambia's many thousand small hammer mills, these small producers would easily undercut the large millers on price and thus erode their market share and profit margins. Fortification did not make good business sense, and so the large millers rejected overtures from NFNC to fortify maize meal. As a result, the first round of mandated vitamin A fortification ultimately focused instead on sugar.

In the face of lingering high levels of VAD, NFNC continued to explore prospects for expanding food fortification. They enlisted outside support from the Global Alliance for Improving Nutrition (GAIN) to help design, test and market a maize meal fortification standard for Zambia. In 2004, GAIN agreed to support maize meal fortification efforts in Zambia. GAIN provided funding for equipment and premix stocks for 30 millers. GAIN likewise provided technical support and training for the millers, bringing in fortification consultant Omar Dary once again to work with local industry. Domestically, NFNC worked with MOH and MAL to launch a Food Fortification Alliance, which included the millers, over their initial objections. Sensory trials, GAIN's financial and technical support and NFNC's indication that mandatory fortification would enable all large millers to compete on an even basis ultimately led the large millers to agree to cooperate (Madamombe 2007). ZABS established a technical standards review committee, including the millers, to formally set fortification requirements. The standards and testing procedures had advanced to the final stage of the mandated ZABS technical committee assessment and were ready for public review.

At the last minute, the President's Office phoned to instruct MOH and ZABS to stop all work on the maize meal fortification standards. During the course of our interviews, we asked over half a dozen participants from the private sector and from various branches of the public sector about

reasons for the failed effort to introduce mandatory maize meal fortification standards in 2006. Despite their differing technical and institutional backgrounds, the stakeholders reported a strikingly consistent set of three major objections raised by the political leaders at Statehouse. The first concerned national security and food safety. The politicians worried about the potential risk of widespread poisoning given that fortificants would have to be imported from outside of Zambia. Secondly, they raised concerns about ensuring national food security in drought years. Mandatory standards, they feared, would prevent rapid emergency imports of maize meal from outside of Zambia. Third, they raised concerns about the rumors and perceptions of a possible impact on fertility. In short, the maize fortification proposal became highly politicized. Even today, the nutrition and milling communities remain puzzled about why the political leaders intervened to stop this proposed mandate while continuing to endorse other forms of mandatory fortification with imported fortificants.

Biofortification

Zambian sweet potato breeders received pro-vitamin A rich breeding lines from the International Potato Center (CIP) in the early 2000s as part of CIPs Vitamin A for Africa (VITAA) partnership program to support breeding of orange-fleshed sweet potatoes in Eastern and Southern Africa. Zambia's main root and tuber crops breeding station outside of Mansa sits adjacent to the district capital of Luapula Province, where medical research on night blindness and vitamin A deficiencies over many decades have made breeders well aware of the problems of VAD in Zambia. Given this clear need, the sweet potato research team quickly realized that several key properties of sweet potatoes -- segregation, heterosis and vegetative propagation -- made sweet potato an excellent vehicle for introducing vitamin A-rich traits. [5] As a result, the root and tuber team quickly integrated pro-vitamin A characteristics into their breeding program. As early as 2003, they released two light orange varieties of sweet potato, Lalungwishi and Lukusashi, from their own breeding lines. In addition to high yield, good dry matter content, good taste and narrow leaves preferred by consumers, they produced 4-5 mg/gram of betacarotine.

With the new CIP sweet potato varieties, the root and tuber team aimed to attain 15 mg/gram in their new lines. In 2011, after nearly a decade of breeding work, the research team in Mansa produced four new orange-fleshed sweet potato varieties. Formal review and release by the Seed Certification and Control Institute (SCCI) took several years, leading to their formal release in 2014. On average, the four new varieties provide 12 mg/kg of pro-vitamin A. In addition, in 2010, the root and tuber team began breeding for vitamin A rich "yellow" cassava using 26 breeding lines from IITA to cross with local clones.

Zambian maize breeders have likewise become engaged in biofortification efforts, beginning in 2007 when HarvestPlus breeders approached ZARI about incorporating vitamin A properties in their breeding program. Early experiments with biofortification by the International Maize and Wheat Research Center (CIMMYT) had concluded that vitamin A, unlike iron and zinc, could be easily incorporated into conventional maize breeding programs. Given high levels of VAD in Zambia, ZARI's maize breeders quickly agreed to incorporate the pro-vitamin A rich CIMMYT

[5] High segregation means that a single cross produces a wide diversity of offspring. High heterosis means that offspring generally outyield their parents. Vegetative propagation means that small farmers can reproduce identical genetic clones from one year to the next without needing to purchase seeds annually.

varieties into their breeding lines. By 2009, it became clear that the initial target of 15 ppm would be difficult to achieve quickly, so Harvest Plus recommended that the breeders instead aim for 7.5 initially, in order to show rapid results. By 2012, ZARI released three varieties of vitamin A fortified "orange" maize, one to each of three different seed companies. Because these varieties are hybrids, farmers will need to purchase seeds annually from the seed companies. Early results suggest strong farmer interest.

Education, marketing and work with local seed companies and millers constitute important components of the Harvest Plus support for Zambia's maize breeding team. Zambian consumers, who have consumed local "white" maize varieties for many generations, reacted strongly to a heavily fumigated batch of "yellow" food aid maize imported as a drought relief measure during the early 1990s. As a result, "yellow" maize conjured up bad memories and considerable consumer resistance. To avoid that problem with the biofortified varieties, ZARI and Harvest Plus have carefully branded the new maize as "orange" maize, to distinguish it from "yellow" maize. They have conducted extensive tasting trials with farmers, consumers and millers and have worked to help brand the "orange" maize, which sells out immediately when reaching the shops. That local farmers produce the maize helps to avoid the fears of contamination by outsiders that capsized the maize meal fortification efforts in 2006. Nonetheless, sensitivities remain. In 2013, just after the release of these new varieties, ZARI received a call from the President's Office asking if these new "orange" varieties were GMOs. Breeders assured the Statehouse that these varieties have been breed through conventional crossing and not mechanical cross-species gene transfers.

Complex Interactions

Despite the broad range of efforts Zambia has introduced to improve vitamin A intake (Figure 4), this panoply of vitamin A interventions appears to have achieved only very modest results. Comparison of Zambia's two national monitoring surveys, in 1997 and 2003, indicate that VAD among young children fell from 66% to 54% over this period (MOST/UNICEF/CDC/NFNC 2003). Nevertheless, results from the statistical analysis of the 2003 survey indicate that neither vitamin A supplements nor fortified sugar consumption significantly influenced VAD levels. Malaria infection rates, however, did significantly correlate with VAD levels, higher levels of disease burden being associated with higher levels of VAD (NFNC 2005, p.42). According to the report,

> "Part of the apparent failure of the children to respond to the vitamin A supplementation programme may be attributable to the high levels of sub-clinical infection present in the population, and asymptomatic malaria may have the biggest effect." (NFNC 2005, p.xii).

MOH began distributing insecticide-treated bed nets during Child Health Weeks (CHW) in December 2003 and has continued to do so as part of overall efforts to reduce the malaria disease burden, child mortality and relieve pressure on immune systems:

> "The widespread use of bed-nets, especially for women and their pre-school children may help reduce the number of mosquito bites they may be exposed to, which in turn could lead to a reduction in symptomatic and asymptomatic malaria. As a consequence, there would be a reduction in the number of acute phase reactions, which would allow plasma retinol and

haemoglobin concentrations to increase, hence improving the overall vitamin A and haematological status of the population. " (NFNC 2005, p.xii).

This explicit link by NFNC between disease control and nutrition demonstrates the complexity of finding remedies for major micro-nutrient deficiencies, particularly vitamin A and iron deficiencies. Together with the encouraging early bio-fortification efforts, it further demonstrates the importance of inter-ministerial and inter-department coordination in formulating and implementing micro-nutrient policies. The table below outlines, from the government's perspective, the pros and cons as well as the potential interactions among the various vitamin A policy interventions currently under way in Zambia (Table 11).

Table 11. Government Perspective on the Pros and Cons of Alternate Vitamin A Interventions

	Pros	Cons
Supplements	• direct delivery to vulnerable groups	• all costs borne by government and donors • heavy manpower costs • delivery of pure retinol leads to potential over-dosing
Fortification mandates	• consumers pay for the program • sugar companies implement • government needs only monitor	• monopoly structure of local market may contribute to high sugar prices • import ban reduces competition and risks pricing poor out of market • price inflation leads to possible exclusion of rural and poor vulnerable groups
Bio-fortification	• one-time research cost to government • minimal recurrent cost of seed certification continues after initial release of new varieties • involves ministries other than MOH in nutrition policy • provides pro-vitamin A which body converts to retinol as required; avoids over-dosing	

4.2.2. Stakeholder Mapping

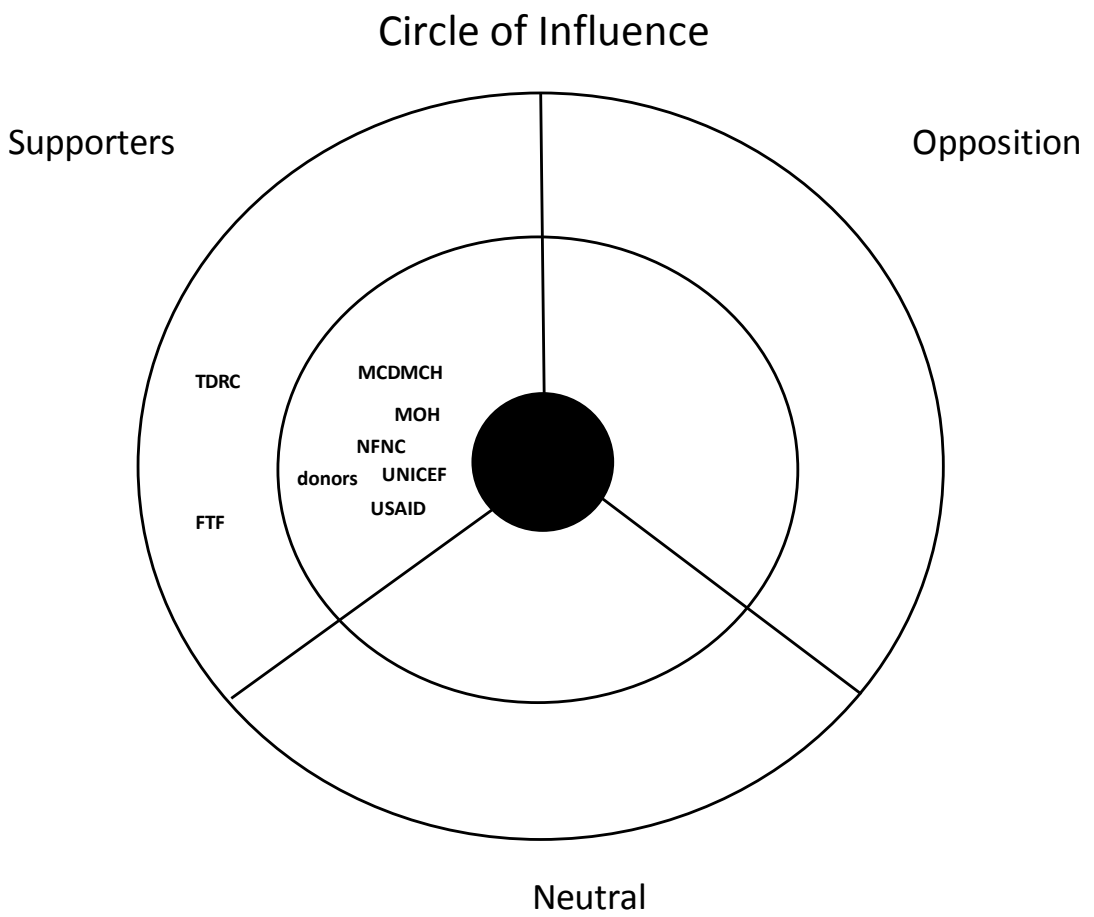
A broad array of government agencies formulate and implement the bulk of Zambia's vitamin A policies (Table 12). MOH and MCDMCH deliver vitamin A supplements and insecticide-treated bed nets to under-five children and lactating women. MAL's breeding programs at ZARI implement the bio-fortification policies through their research stations. To a large extent, these public sector programs depend on steady infusions of donor funding. As a result, public sector leads in the design and implementation of three out of four of the main vitamin A policies in Zambia – supplementation, bio-fortification and bed net distribution.

Fortification, in contrast, relies on the private sector to implement and on consumers to finance the program over the long term through higher prices. Government's role remains one of

formulating standards, educating consumers and enforcing the fortification mandates and associated trade laws across Zambia's various mills and markets.

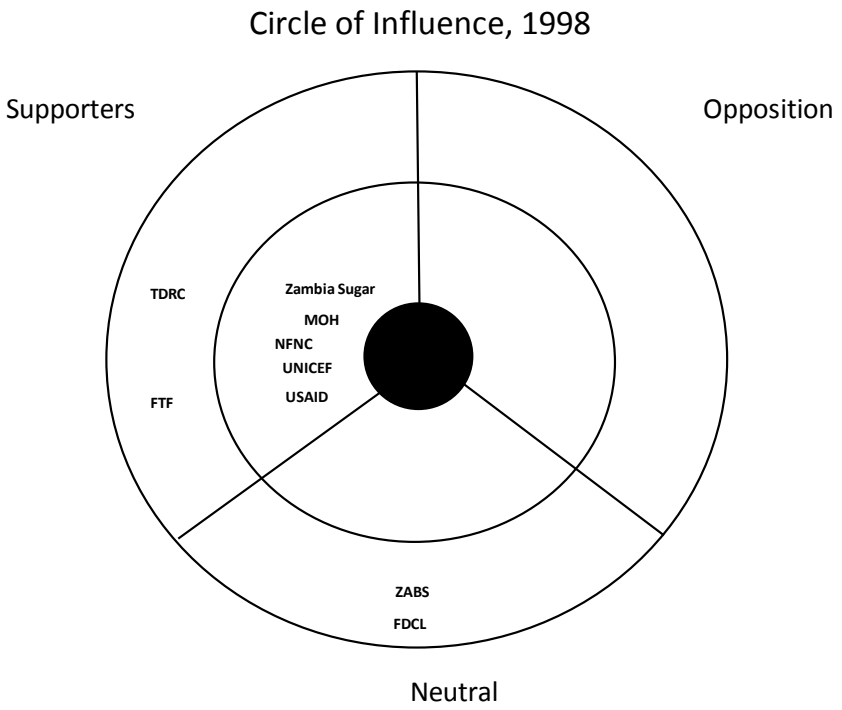
Though vitamin A fortification programs impose the least cost to government (Table 11), they have proven easily the most controversial. In stark contrast to Zambia's salt fortification mandate, sugar fortification has unleashed a stream of complaints from consumer groups, industrial users of sugar, researchers and even from parliament. Donors, who helped to design, finance and monitor the sugar fortification mandate, remain strong allies of NFNC. Unlike maize meal fortification, which maize millers see as a threat to their profitability, sugar producers have embraced fortification, along with the direct financial benefits that accrue to their corporate bottom line. A comparison of the stakeholder maps below demonstrates the absence of opposition to Vitamin A supplementation programs (Figure 5) as well as the array of opponents that has emerged to contest sugar fortification (Figure 6a and 6b).

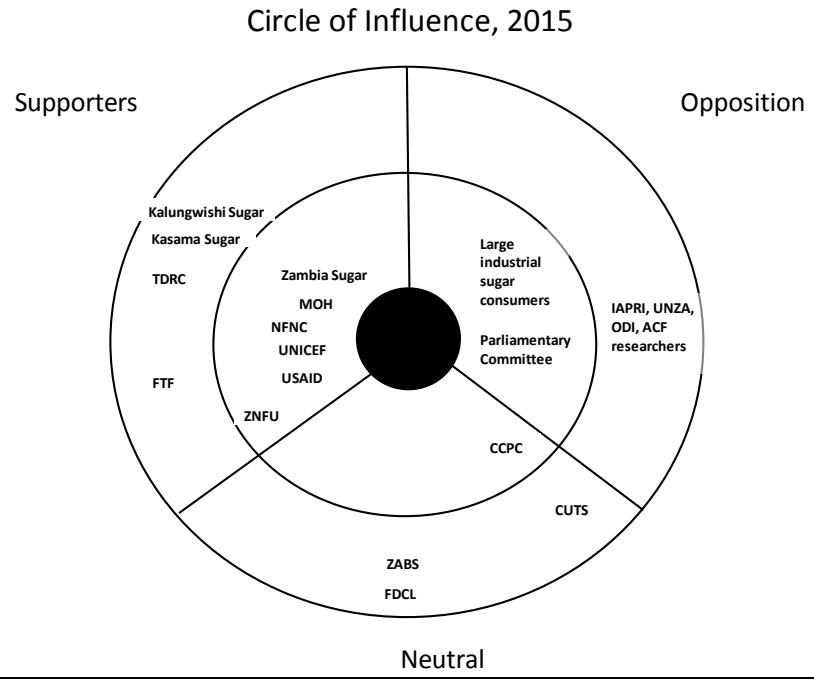
Figure 5. Vitamin A Supplementation Circle of Influence



Source: Field interviews.

Figure 6. Vitamin A Fortification, Changing Circles of Influence





Source: Field interviews.

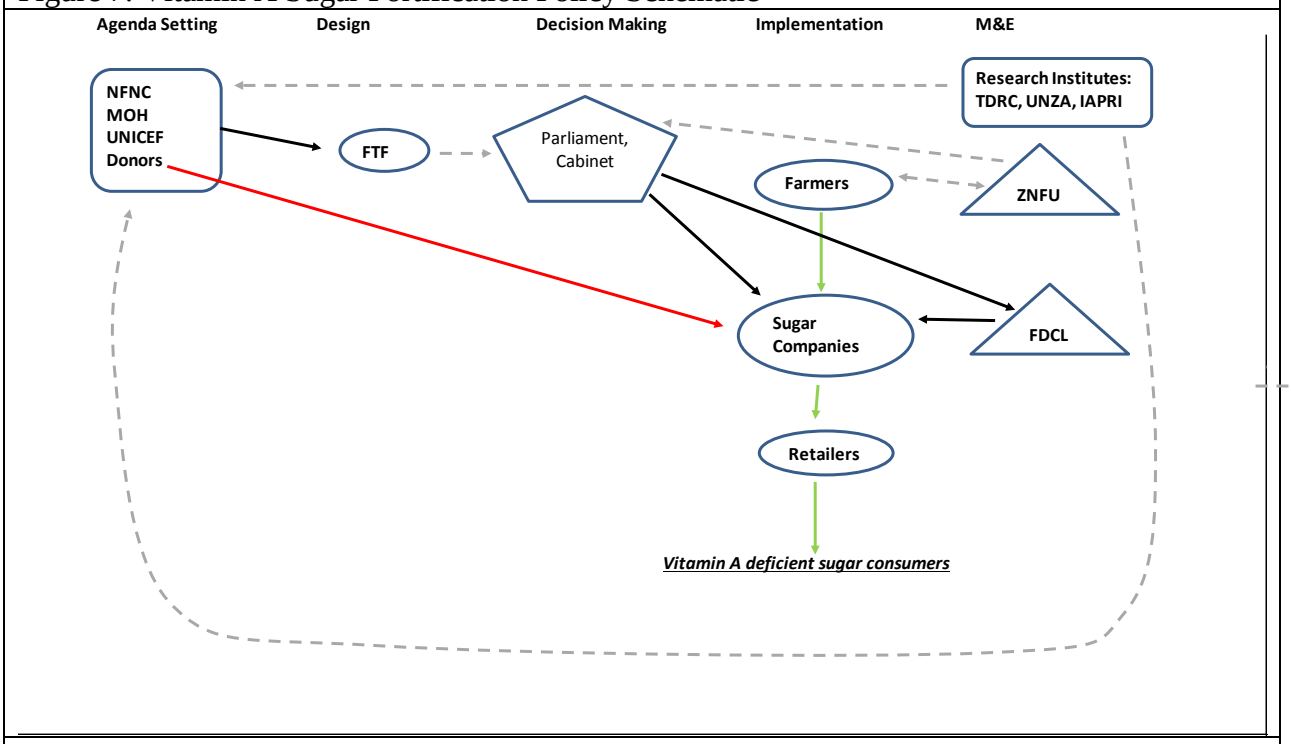
Researchers have played an important role in all of these policies. While the standard public health interventions (supplementation, bed nets) have drawn strong conceptual and empirical contributions from the medical and academic research community, sugar fortification has attracted keen interest from consumer groups, local and pan-African competition commissions and local scholars. A series of academic studies by ODI, ACF, UNZA and IAPRI point to the importance of sugar market concentration and the import ban resulting from the vitamin A fortification mandate in pressuring sugar prices contributing to what appear to be abnormally high sugar prices in Zambia. Consumer groups such as CUTS and competition watchdogs in Zambia (CCPC) and outside (ACF) have contributed to the sugar fortification debates. The process through which this constellation of stakeholders interacts is described in Figures 1 (above) and Figure 7 (below).

Table 12. Vitamin A Stakeholder Inventory

Institution	Category	Role	Resources	Influence	Policy Stance
MOH	Government	• issue regulations • enforcement • education • manage public health campaigns	• limited	• large	• champions all forms of VA fortification, supplementation and bio-fortification
MCDMCH	Government	• implement public health programs (supplementation, CHW, bed nets, immunizations)	• limited	• large	• pro VA promotion
NFNC	Government	• identify key issues and policy options • monitor implementation • advise MOH and GOZ	• limited	• large	• champions all forms of VA fortification, supplementation and bio-fortification
FTF	Government	• identify fortification opportunities	• mostly donor-supplied	• large	• champions fortification
ZABS	Government	• set standards & testing protocols	• limited	• large	• neutral
FDCL	Government	• tests samples	• limited	• limited	• neutral
MOT	Government	• enforces import ban on sugar	• limited	• large	• intervened to stop CCPC inquiry into sugar market oligopoly
MAL	Government	• crop breeding for biofortification • enforces import ban on sugar	• limited	• large	• champions bio-fortification
CCPC	Government	• monitors competition levels in local industries	• limited	• limited	• neutral

Parliament	Legislature	• passes legislation • monitors competition	• limited	• large	• questions competitiveness of sugar market
Zambia Sugar	Private sector	• produces over 90% of Zambia's sugar • fortify sugar	• large	• large	• strongly supports VA fortification
Small sugar producers	Private sector	• fortify sugar	• small	• limited	• support VA fortification
ZNFU	Private sector	• represents farmer interests • protest illegal sugar imports	• moderate	• large	• support import ban on sugar
CUTS	Civil society	• protect consumer interests	• limited	• moderate	• questions VA fortification and its resulting restraint on competition
UNICEF	Donor	• fund studies • fund testing • fund education • technical assistance	• large	• large	• champions all forms of VA supplementation, fortification and bio-fortification
USAID	Donor	• ditto	• large	• large	• ditto
ODI	Donor	• conduct sugar market study	• moderate	• limited	• questions VA fortification and its resulting restraint on competition
TDRC	Researchers	• empirical research • inform policy makers	• limited	• large	• promotes all programs that reduce VAD
IAPRI	Researchers	• empirical research on sugar markets	• moderate	• limited	• opposes sugar fortification
UNZA	Researchers	• empirical research on sugar markets	• limited	• limited	• research suggests VA fortification confers monopoly advantages and raises prices
ACF	Researchers	• promote competition	• moderate	• limited	• question VA fortification and its resulting restraint on competition

Figure 7. Vitamin A Sugar Fortification Policy Schematic



Source: Field interviews, Serlemitsos and Fucos (2001).

4.2.3. Hypothesis Testing

Agenda setting. **Advocates** of vitamin A supplementation and fortification policies include an influential consortium of domestic and international partners – including TDRC, NFNC, WHO, UNICEF, USAID and other donors. Early key **focusing events** centered on empirical evidence from localized medical studies conducted in Luapula Province, by WHO researchers in the 1960s and later by TDRC in the 1980s, which established the importance of VAD as a cause of night blindness and led to early small-scale supplementation efforts by MOH in the late 1980s. TDRC's early studies proved particularly influential (TDRC 2015). Internationally, UNICEF's 1990 World Summit for Children served as a signal event focusing world-wide attention on VAD and unleashing a large new wave of donor funding for VAD prevention efforts. Medical researchers have **recognized** VAD as a **serious public health problem** in Zambia, particularly since the TDRC research of the 1980s. Subsequently, the 1997 national baseline VAD survey (NFNC 1999) served to highlight the extent of Zambia's VAD problem and to galvanize domestic and donor support for national supplementation and fortification programs. The 2003 follow-up monitoring survey (NFNC 2005) provided a second wake-up call, raising concerns about the limited coverage of supplements, the low levels of vitamin A in fortified sugar and the absence of a statistically significant impact of either program on VAD levels.

Bio-fortification efforts similarly benefitted from all three agenda-setting triggers, though the key advocates and focusing events differed from the supplementation and fortification programs. The key initial **advocates** of vitamin A bio-fortification breeding programs included two international agricultural research centers -- CIP in the case of orange-fleshed sweet potatoes and Harvest Plus together with CIMMYT in the case of vitamin A enriched orange maize. ZARI breeders, who report to the Ministry of Agriculture, rather than MOH, nonetheless readily agreed to cooperate in these bio-fortification efforts. **Focusing events** similarly revolved around external stimuli – the launch of CIP's Vitamin A for Africa (VITAA) Partnership program in 2001 and the CIMMYT maize breeding conference convened by Harvest Plus in Addis Ababa in 2005 to evaluate technical options for incorporating micronutrient traits into maize breeding programs in Africa (Table 13).

Malaria control as a means of combatting vitamin A (and iron) deficiency became **recognized as a relevant problem** during analysis of the 2003 national VAD monitoring survey, which concluded that malaria burden contributed significantly to high levels of both VAD and IDD, compromising both fortification and supplementation efforts (NFNC 2005, p.42). As a result, the 2003 VAD monitoring survey served as a **focusing event**, galvanizing support for including the insect-treated bed nets as part of the CHW program from December 2003 onwards. **Advocates** included the same alliance of international and domestic nutrition and public health agencies promoting supplementation programs, led by NFNC and UNICEF.

Design. **Design spillovers** from existing international practices shaped the design of all four VAD prevention interventions. Bi-annual supplementation, linked to immunization and other child health services, grew out of standard international best practices in combatting VAD (Horton et al. 2008). Standards for fortification of margarine came directly from international industry practice. Vitamin A fortification of sugar, though not widely adopted elsewhere, drew directly on early efforts in Central America, with direct design support financed by donors using consultants who had worked in Guatemala. Bio-fortification programs, objectives and breeding materials came directly from the international agricultural research centers promoting these efforts. In most instances, these international best practices draw on lowest-cost methods for treating specific problems (Horton et al. 2008, MOST 2004).

Adoption. By definition, the adoption of specific policies requires that proponents exert greater influence over decision-makers than do their opponents. Unlike many policy decisions, most micronutrient policies attract only proponents. In Zambia, vitamin A supplementation, bio-fortification and malaria control efforts garnered no opposition. Adoption depended not on the power of the proponents but on the depth of their conviction in eliciting financial contributions to finance these activities.

Only fortification efforts have generated serious opposition. While maize millers refused to participate in the 1996 fortification effort, the sugar industry agreed and hence at decision time, no opponents existed, only proponents from industry, government and donors. Large-scale opposition to sugar fortification emerged only later, after adoption of the policy and evidence of its impact became felt by consumer groups and competition watchdogs

Table 13. Vitamin A Policy Hypothesis Testing

Policy Stages	Supplementation	Fortification		Bio-fortification	
Kaleidoscope Hypotheses	children (6-59 mos); lactating mothers	margarine (1978)	sugar (1998)	sweet potatoes	maize
1. Agenda setting					
1.1. Advocates	+		++	+	+
1.2. Focusing event	+	+	+	+	+
1.3. Recognized, relevant problem	+		+	+	+
2. Design					
2.1. Pressing vs chosen problem					
2.2. Ideas and beliefs					+
2.3. Cost-benefit calculations			+	+	+
2.4. Design spillovers (best practices)	+	+	+	+	+
3. Adoption					
3.1. Propitious timing		+			
3.2. Veto players					
3.3. Relative power: proponents vs opponents	+		no opponents initially	+	+
4. Implementation					
4.1. Institutional capacity	+		–		
4.2. Requisite budgetary allocations	–				+
4.3. Commitment of policy champions	+		++	+	+
5. Evaluation, Reform			strong		
5.1. Changing conditions			opponents emerge	+	+
5.2. Changing information or beliefs	+		+	+	+
5.3. Resource availabilty relative to cost					

Source: Field interviews, See Annex Table E.2 for details.

Implementation. Implementation of all of these programs depends on the strong commitment of policy champions, led by NFNC, UNICEF and other donors, who ensure funding required to execute the specific micronutrient policies. Donors such as USAID played a strong role in promoting and funding sugar fortification and bio-fortification.

Evaluation, reform. Empirical evidence about existing conditions (such as high levels of VAD) and changing conditions (such as rising sugar prices and availability of vitamin A rich plant varieties) have driven expansion of supplementation programs and increasing calls for reform of sugar fortification regulations. Funding for empirical research and monitoring has relied largely on donor resources, which ebb and flow, leading to over a decade gap since last VAD monitoring study in 2003.

4.3. Iron

4.3.1. Policy Chronology

Medical researchers and public health specialists have long recognized the importance of maintaining high iron levels, particularly among pregnant and menstruating women and newborn babies whose iron requirements are most acute. For this reason, Zambia's ante-natal clinics have routinely provided iron supplements, since at least the 1970s, to pregnant women visiting MOH and MCDMCH clinics (Table 3).

Following the 1998 national survey documenting anemia among 65% of children (NFNC 1999), NFNC, UNICEF and other key stakeholders have advocated a broadening of strategies for improving iron accessibility, through food fortification (focused particularly on maize meal), diet diversification and bio-fortification aimed at improving dietary iron intake.

In the late 2000s, ZARI began incorporating high-iron traits into bean breeding lines, using improved varieties supplied by CIAT and with support from Harvest Plus and the Southern Africa Bean Research Network (SABRN). In 2013, ZARI released one high-iron bean variety from among the materials received from CIAT. However cross-breeding with local varieties remains ongoing.

Zambia's two major national anemia surveys, in 1998 and 2003, have tracked trends in IDD, which despite some progress remain stubbornly high (Table 1). Findings from the VAD monitoring survey of 2003 indicates that 53% of children were anemic, compared with 65% in 1998 (NFNC 2005). Evidence on access to iron and folic acid supplements suggests improvement in availability over time, though compliance remains an issue raised repeatedly in our stakeholder interviews. Data from the 2007 DHS indicate that although 98% of pregnant women made at least one ANC visit, slightly over 80% of women pregnant women first attended in their second (73%) or third (8%) trimester. Equally disconcerting, over 90% of women receiving supplements consumed less than the proper dosage (Fielder 2014). The latest monitoring data, from Zambia's 2013-14 DHS, indicate that 59% of pregnant women took iron tables daily for 90 or more days.

In 2006, findings from Tanzania have caused public health officials to reconsider iron supplementation programs in high-malaria zones. The now-famous Pemba study documented higher rates of hospital admissions and mortality among subjects receiving iron supplements, a result attributed to high-levels of endemic malaria and simultaneous benefits of supplementation for both malaria parasites and human hosts (Sazawal et al. 2006).

4.3.2. Stakeholder Mapping

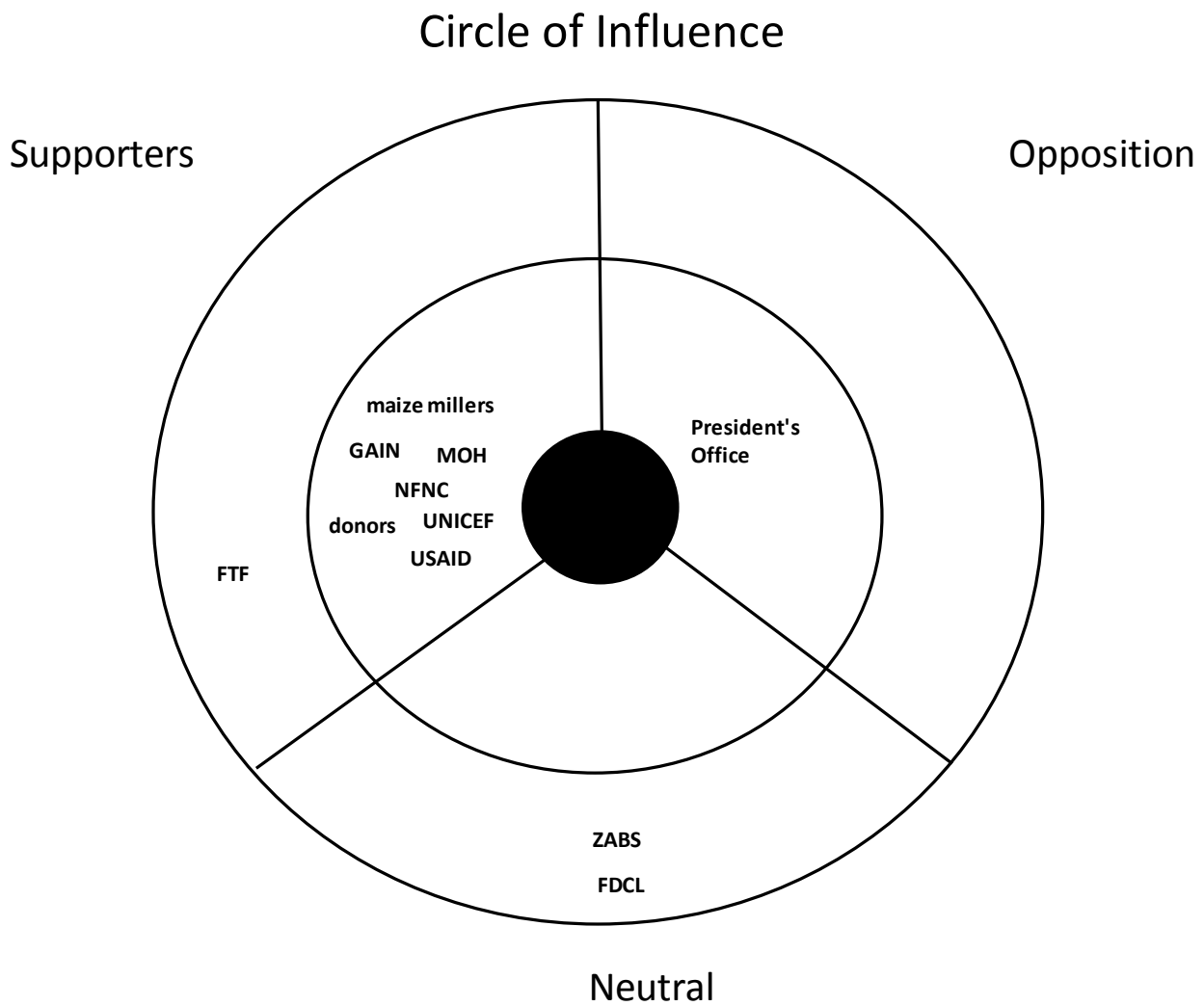
Stakeholders overlap to a considerable degree between iron and vitamin A policies, as do the specifics of interventions, which as with vitamin A run the gamut from supplementation for vulnerable groups (in the case of iron, pregnant women and adolescent girls), aborted efforts to mandate fortification of maize meal, ongoing breeding work to bio-fortify beans, and common embrace of insect-treated bed nets to control malaria and thereby reduce pressure on iron and

vitamin A levels. The sole addition to the stakeholder inventory in Table 12 involves the MoE's School Health and Nutrition program, which delivers iron supplements to adolescent girls in selected schools.

Similarly, data collection efforts sometimes combine iron and vitamin A deficiency tracking, as with the national VAD survey of 2003 (2005). Since assessment of both micronutrient deficiencies relies on blood testing, joint tracking of deficiency levels and progress offers considerable economies.

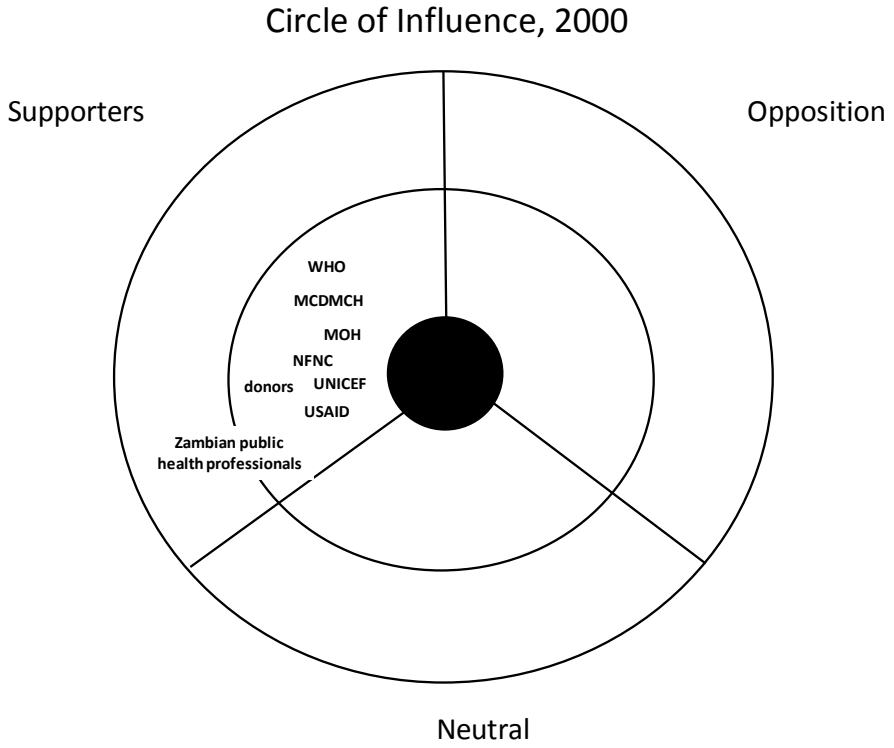
As with vitamin A, mapping of stakeholder positions on various policies reveals strong opposition to maize meal iron folate multi-mix fortification (Figure 8). While vitamin A supplementation programs have proven largely non-controversial (Figure 6), support for iron supplementation has wavered in recent years in Zambia due to concerns about non-compliance among pregnant women and possible adverse consequences of supplementation in the presence of heavy malaria disease loads (Figure 9).

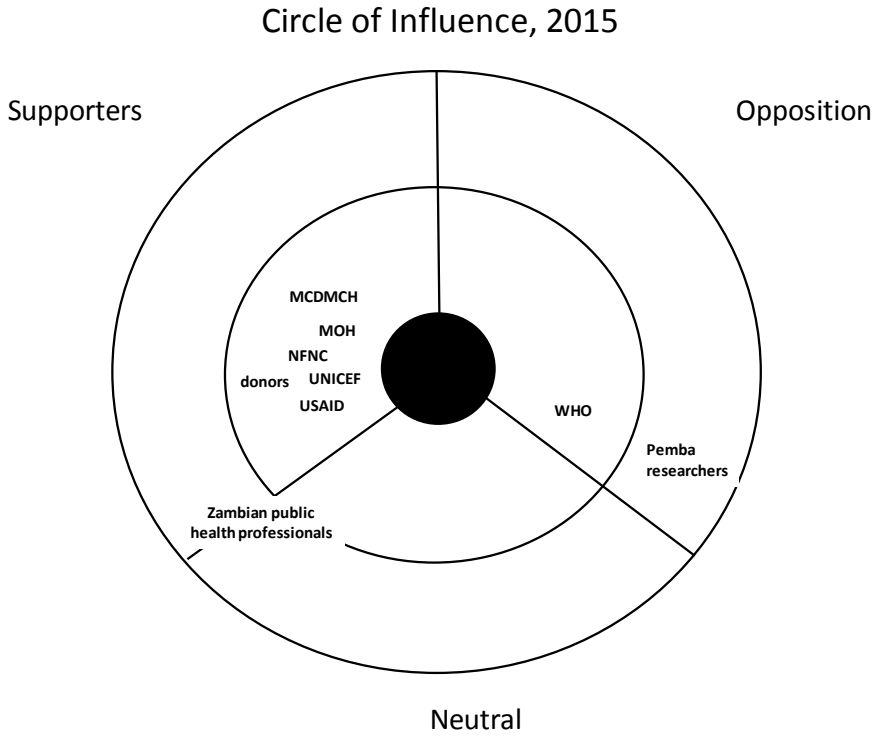
Figure 8. Circle of Influence: Mandatory Iron Folate Multi-mix Fortification of Maize Meal



Source: Field interviews.

Figure 9. Circle of Influence: Iron Supplementation





Source: Field interviews.

4.3.3. Hypothesis Testing

Agenda setting. As with vitamin A, the UNICEF World Summit on Children in 1990 served as a signal **focusing event** raising awareness on a global level and mobilizing the additional donor resources that enabled planning, design and implementation of expanded iron supplementation programs in Zambia (Table 14). The iron anemia baseline survey of 1998 provided further ammunition and motivation for domestic policies promoting increased iron consumption.

Design. As with iodine and vitamin A, policies addressing iron deficiency disorders (IDD) drew on **international best practices**, which in turn combine information on efficacy and cost to identify the generally accepted lowest cost options for achieving a given result.

Table 14. Kaleidoscope Hypothesis Testing: Iron

Policy Stages	Supplementation		Fortification	Bio-fortification
Kaleidoscope Hypotheses	pregnant women	adolescent girls	multi-mix maize meal	beans
1. Agenda setting				
1.1. Advocates	+	+	+	+
1.2. Focusing event	+		+	
1.3. Recognized, relevant problem	+	+	+	+
2. Design				
2.1. Pressing vs chosen problem				
2.2. Ideas and beliefs			–	
2.3. Cost-benefit calculations	–	–	+	+
2.4. International design spillovers	+		+	+
3. Adoption				
3.1. Propitious timing				
3.2. Veto players			–	
3.3. Relative power: proponents vs opponents	+	+		+
4. Implementation				
4.1. Institutional capacity	–			
4.2. Requisite budgetary allocations	–	+		
4.3. Commitment of policy champions	+			+
5. Evaluation, Reform				
5.1. Changing conditions				
5.2. Changing information or beliefs	–			
5.3. Resource availabilty relative to cost	+	+		

Source: Field interviews.

Adoption. **Proponents dominate** micro-nutrient debates, since these typically elicit little opposition. As with other micronutrient policies, an alliance of domestic advocates (NFNC, MOH, medical researchers, ZNA), international groups (UNICEF, WHO, CGIAR research centers) and donors (USAID, DfID, Irish Aid, and others) has collaborated to promote policies that address IDD. In most cases, financial constraints, rather than opponents, constitute the main brake on micronutrient policies.

One major veto play, however, did emerge to squash the GAIN-led maize meal fortification effort of 2006. As described in the vitamin A policy chronology above, the President's Office emerged at the last minute, as ZABS was about to release the official mandated standards for maize fortification for public comment, to squash the mandate. They invoked various concerns, including national security, food safety, possible complications of emergency relief efforts during drought years and difficulties monitoring hammermills.

Implementation. The **commitment of policy champions**, particularly among the donor groups, has proven key to scaling up of iron supplementation programs, given the need for external funding in the face of chronic difficulties eliciting adequate **financial support** from GOZ. Implementation capacity at MDCMCH and MOH remain constraints, while the high cost of flavored supplements makes compliance a recurring problem among pregnant women.

Evaluation and reform. **Changing information** about iron fortification in the presence of heavy malaria burden has caused a rethinking of iron supplementation programs in Africa. A global rethinking has followed on the heels of the Pemba iron study in Tanzania, documenting increased risk of malaria deaths among children receiving iron and folic acid supplements; it appears that iron supplements can, in some instances benefit the malaria parasite more than its host (Sazawal et al. 2006, Schumann and Christ 2007, Prentice 2008). The embrace of insect-treated bednets also clearly benefited from early evidence about the important effect of malaria disease burden on IDD (NFNC 2005).

Beliefs and misinformation also matter. In the case of the aborted maize meal fortification, mis-information about the safety of externally supplied fortificants and malicious rumors about possible impact on fertility contributed to political leaders' unwillingness to proceed with mandatory fortification of a sensitive food commodity.

4.4. Vitamin D

4.2.1. Policy Chronology

Since 1978, Zambia has mandated vitamin D (and vitamin A) fortification of margarine under SI 133. Nutrition policy makers today have difficulty explaining this vitamin D mandate, given an absence of vitamin D deficiency and 5 to 8 hours of sunshine per day (Weather and Climate 2015). They surmise that ZABS imported this standard from a temperate climate where an absence of winter sunlight led to longstanding fortification of dairy products with vitamin D.

4.2.2. Stakeholder Mapping

The stakeholders involved in setting this standard include the same cast of characters involved in assisting ZABS to implement the broad set of food standards instituted in 1978 under the Food and Drugs Act. Key players include ZABS, FDCL, MOH, and NFNC, the National Institute for Scientific and Industrial Research (NISIR) and industry stakeholders. It appears that the margarine fortification standards, like many others, emerged as part of the omnibus effort in the mid-1970s spearheaded by ZABS to establish standards for all major foods as required by the Food and Drugs Act.

4.2.3. Hypothesis Testing

Agenda setting. Unlike most micronutrient policies, the vitamin D fortification mandate emerged on Zambia's policy agenda despite the absence of a recognized deficiency and without a clear public health advocate (Table 15). Instead, it appears that the newly established Food and Drugs act of 1972 served as a focusing event motivating ZABS to institute standards for all major foods consumed in Zambia, which they did through an omnibus statutory instrument in September 1978.

Design. This accidental micronutrient policy appears to have resulted from a design spillover. It seems most probable that ZABS modeled this fortification requirement based on standards in force elsewhere and consulted during the ZABS review. In what must have been massive effort to prepare a full set of standards for all food products under SI 133 of 1978, the various ZABS technical committee's would have referred then (as they still do today) to existing standards in force elsewhere. The vitamin D fortification mandate appears to be a replica of standards adopted elsewhere, where an absence of sunlight made vitamin D fortification important. Processing equipment and producers would be well familiar with these international standards and, when consulted, would likely have endorsed a common standard.

Adoption. The adoption of this policy by the Minister of Health (following Cabinet approval) through the issuance of SI 133 of 1978 occurred as part of the wholesale introduction of food standards into Zambia at that time.

Implementation. The food industry implements this mandate. Government's role is to ensure inspection. However, it does not appear that MOH Environmental Health Officers actively enforce this mandate.

Evaluation, reform. We found no evidence of any effort to evaluate this margarine fortification mandate. Given that vitamin D deficiency does not seem to be a problem in Zambia, the nutrition and public health community have little incentive to assess what appears to be an unnecessary policy.

Table 15. Kaleidoscope Hypothesis Testing: Vitamin D Fortification of Margarine

Policy Stages Kaleidoscope Hypotheses	Vitamin D Fortification of Margarine 1978 to present
1. Agenda setting	
1.1. Advocates	
1.2. Focusing event	+
1.3. Recognized, relevant problem	
2. Design	
2.1. Pressing vs chosen problem	
2.2. Ideas and beliefs	
2.3. Cost-benefit calculations	
2.4. Design spillovers	+
3. Adoption	
3.1. Propitious timing	+
3.2. Veto players	
3.3. Relative power: proponents vs opponents	
4. Implementation	
4.1. Institutional capacity	
4.2. Requisite budgetary allocations	
4.3. Commitment of policy champions	
5. Evaluation, Reform	
5.1. Changing conditions	
5.2. Changing information or beliefs	
5.3. Resource availabilty relative to cost	

Source: Field interviews.

5. CONCLUSIONS

5.1. Summing Up Key Hypotheses about What Drives Micronutrient Policy Change

The micronutrient policies reviewed in this paper have made their way onto Zambia's policy agenda 13 different times (see Tables 9, 13, 14 and 15). Table 16 below tabulates the number of times each of the Kaleidoscope Model's key hypothesized variables emerged as a significant cause of policy change.

Agenda setting. International and domestic advocates drove Zambia's micronutrient policy agenda nearly 80% of the time, at moments when they proved able to focus the attention of busy policy makers on micronutrient deficiencies of vulnerable populations. Only in the three largely accidental fortification policies of 1978 -- when the ZABS mandate to establish food standards motivated broad review of all food standards -- did someone other than nutrition advocates take a leading role in setting the micronutrient policy agenda. Empirical evidence documenting acute micronutrient deficiencies – including Nwokolo (1972), NNFC (1997, 1999, 2005) -- and a series of international conferences such as the 1990 World Summit for Children in 1990s served as focusing events helping advocates to generate the energy and enthusiasm required to push micronutrients onto the policy agenda.

Design. International design spillovers contributed to over 90% of the design options selected. In general, these best-practice international norms derive from comparison of alternatives and selection of the perceived lowest-cost options for attaining a specific objective. Local fine-tuning, of course, occurs based on the particularities of local diet and health conditions.

Adoption. By definition, the power of proponents relative to their opposition drives the successful adoption of micronutrient (or any other) policy decisions. Only in the case of the failed maize meal fortification mandate of 2006 did the President's Office emerge at the last minute as a surprise veto player, squelching the GAIN-inspired design supported by a broad array of domestic industry, government and donor stakeholders.

Propitious timing, rather than raw political power, governed the adoption of the three 1978 fortification mandates (iodized salt and margarine fortification with vitamins A and D). These three mandates came into effect as part of an omnibus ZABS effort to institute food standards across the full range of food commodities consumed in Zambia.

Implementation. Institutional capacity and adequate budgets proved critical to the implementation of government-delivered micro-nutrient policy interventions such as supplements and insect-treated bed nets. The commitment of policy champions typically served to remedy existing resource deficiencies, in terms of manpower or budget.

Fortification and bio-fortification efforts rely primarily on private sector implementation and consumer financing. Government's role remains limited to development of the initial standards and new plant varieties and subsequent monitoring.

Evaluation and reform. Information on existing and changing conditions drove reform in all of the micronutrient policies studied. Emerging information on excessive iodine intake (WHO/UNICEF/CDC 1999) triggered modification in salt fortification levels, while evidence documenting the ineffectiveness of vitamin A and iron supplements in the face of high malaria burdens (NFNC 2005) led to a broad consensus about the importance of incorporating distribution of insect-treated bed nets into Child Health Week programs.

Table 16. What drives micronutrient policy change?

Policy Stages Kaleidoscope Hypotheses	Percent significant cases	Significant cases	Total cases
1. Agenda setting			
1.1. Advocates	77%	10	13
1.2. Focusing event	85%	11	13
1.3. Recognized, relevant problem	85%	11	13
2. Design			
2.1. Pressing vs chosen problem	0%	0	13
2.2. Ideas and beliefs	15%	2	13
2.3. Cost-benefit calculations	77%	10	13
2.4. Design spillovers	92%	12	13
3. Adoption			
3.1. Propitious timing	23%	3	13
3.2. Veto players	8%	1	13
3.3. Relative power: proponents vs opponents	69%	9	13
4. Implementation			
4.1. Institutional capacity	31%	4	13
4.2. Requisite budgetary allocations	54%	7	13
4.3. Commitment of policy champions	54%	7	13
5. Evaluation, Reform			
5.1. Changing conditions	46%	6	13
5.2. Changing information or beliefs	62%	8	13
5.3. Resource availabilty relative to cost	23%	3	13

Source: Tables 9, 13, 14 and 15.

5.2. Common factors influencing the effectiveness of micronutrient advocates

Advocates typically drive micronutrient policy change by helping to shape the agenda, evaluate design options, lobby for affirmative decisions, monitor implementation and signaling the need for reform. The power and influence of micronutrient advocates at each stage in the policy process depends on three major factors – information, resources and the nature of the opposition.

Information. Credible empirical information has repeatedly proven crucial in providing ammunition for micronutrient policy advocates in Zambia. Unlike many policy arenas in which credible evidence and counterfactuals remain elusive, a growing body of medical research provides powerful testimony on the human costs of major micronutrient deficiencies. Early work in Zambia by Nwokolo (1972, 1974) and NFNC (1992) on iodine deficiencies, by WHO (Mccullough 1962), TDRC (2015) and NFNC (1997, 1999, 2005) on vitamin A and iron deficiencies have served to persuade Zambia's cabinet as well as agribusiness firms, farmers and plant breeders of the importance and potential gains offered by micronutrient supplementation, fortification, bio-fortification and malarial control efforts.

Increasingly, international literature reviews have helped to consolidate peer-reviewed evidence assessing the magnitude of micronutrient deficiencies, the effectiveness of various design options and the impact of various micronutrient policies over time. Many of the stakeholders we interviewed outside of government and outside the public health community specifically highlighted the persuasive nature of the medical evidence provided by the research community in shaping and in some cases moderating their views.

Resources. For micronutrient polices such as supplementation and bed net delivery, public resources clearly define the realm of feasible policy action. Even concerned governments face resource constraints. In Zambia's case, acute pressure on government health and nutrition budgets mean that donors frequently drive agendas simply by indicating which micronutrient activities they are willing to fund.

Donors, therefore, have played an outsized role in shaping micronutrient policy agendas, designs and implementation. In the fortification and bio-fortification efforts, donors brought in a stream of consultants, paid for initial equipment and testing, study tours, training, enforcement and monitoring. The documentary evidence as well as our stakeholder interviews suggest, for example, that without the strong and sustained push from donors, Zambia's sugar fortification mandate would never have become policy. The heavy donor influence has also served to encourage the international flow of evidence from around the world by making it available to local decision makers.

Resource pressures, which magnify donor influence, likewise underlie the drive to diversify programs outside of supplementation and into private-sector financed and implemented policies such as fortification and bio-fortification.

Nature of the opposition. In the abstract, no one we interviewed opposes efforts to combat micronutrient deficiencies. However, some of the specific methods proposed elicit strong opposition. In the case of fortification mandates, the monopolistic sugar industry embraced the

fortification mandate, seeing it as an opportunity to stifle competition from low-priced sugar imports. In contrast, the maize milling industry refused to support early maize meal fortification efforts in the mid-1990s, since fortification posed a clear competitive disadvantage for the implementers in a situation where enforcement seemed both difficult and unlikely. These early experiments with maize meal fortification gave rise to a series of rumors, possibly started by competing millers disinterested in fortification, about possibilities of poisoning and reductions in fertility. Despite an absence of evidence, these rumors gained widespread currency and proved highly damaging to maize meal fortification efforts. Ultimately, they contributed to the decision by the President's Office to veto the mandatory fortification of maize meal, seeing it as a highly charged, politically dangerous move.

Zambia's experience with orange maize provides a valuable lesson on how to co-opt potentially lethal opposition. Given widespread experience with heavily fumigated yellow maize during drought relief programs of the 1990s, Zambian consumers have long preferred white maize. Strong fear of GMOs as well as conspiracy theories about outside plots to poison Zambians or to use them as experimental guinea pigs, made introduction of bio-fortified orange maize a potentially very delicate sales job. Recognizing these potential pitfalls, Harvest Plus has provided funding for not only breeding, but also for a multi-year program of work with local farmers and millers to assess taste and to empirically monitor the high vitamin A content of orange maize. Harvest Plus has funded an extensive education and social marketing campaign that appears to have successfully positioned orange maize as a premium brand. This achievement required early recognition of the potential resistance from consumers and competitors and significant investment in outreach, education, marketing and empirical research on vitamin A content and impact on consumers. The contrast between GAIN's aborted efforts with maize meal fortification and that of Harvest Plus and ZARI's orange maize breeding proves highly instructive. In one case, the power of opposition rumors blindsided GAIN and its local collaborators. Only a few years later, with the benefit of GAIN's highly publicized failure, Zambia's orange maize research, testing and marketing program provides a good example of how early anticipation and careful planning can serve to neutralize potentially lethal opposition.

5.3. Shifting phases in Zambia's micronutrient policies

From silver bullets to shotguns. Zambia's early success with a single-intervention strategy for dealing with IDD through fortification of salt has given way to recognition that other micronutrients require more complex, multiple-pronged efforts. As a result, shotguns rather than single silver bullets have become the instruments of choice in combatting vitamin A and iron deficiencies (Figure 4).

Rapid success in combatting IDD through salt fortification has helped to motivate policy makers to tackle other, equally severe micronutrient deficiencies like vitamin A and iron deficiencies. But these problems have proven far more complex and consequently more difficult to solve. As a result, the initial rapid success of iodized salt fortification has given way to generally lackluster performance in other areas (Table 2).

Shifting costs to the private sector. Multi-faceted interventions raise government's management, monitoring and evaluation costs. Nonetheless, two of the four major tools for combatting micro-

nutrient deficiencies -- fortification and bio-fortification – offer governments the financial advantage of shifting costs from the public treasury to consumers and shifting implementation responsibilities from government agencies to the private sector. The two food-based approaches, fortification and bio-fortification, offer greater prospects for financial sustainability than supplementation and promise less reliance on long-term donor support.

Viewed from its flip side, increasing reliance of private sector delivery systems favors the emergence of new opposition. Consumer groups object when prices increase abruptly, as has Zambia's sugar price. Agribusiness groups object when fortification mandates place them at a competitive disadvantage and depress their earnings. Thus, growing focus on fortification and bio-fortification complicate the task of policy makers and advocates, who must increasingly navigate and harmonize a broad range of pecuniary industry interests.

Biofortification. Over the past decade, interest in bio-fortification has surged in Zambia, for two principal reasons. In part, growing international support and experience has triggered new opportunities, new resources and new awareness among Zambian breeders. In addition, increasing domestic and regional evidence on micronutrient over-dosing – of both iodine and vitamin A – makes bio-fortification a more interesting vehicle for addressing micro-nutrient deficiencies than either fortification or supplementation. Because both fortification and supplementation deliver preformed retinol to human subjects, they can result in hypervitaminosis. In contrast, bio-fortification delivers proto-vitamin A beta-carotenoids which the body converts to retinol as needed. This biological self-regulation makes vitamin A-rich orange-fleshed sweet potatoes and orange maize versatile vehicles suitable for delivering vitamin A to both deficit and over-dosed, "orange-fleshed" consumers (Tanumihardjo et al. 2015). Support from Harvest Plus and the major international agricultural research centers (the CGIAR group) has helped to identify feasible bio-fortification opportunities and supply the breeding lines and testing equipment necessary to launch these endeavors. In turn, these efforts, have mobilized human resources at the Ministry of Agriculture into more active support for micro-nutrient policies. This also raises the level of cross-ministerial coordination required to harmonize various micronutrient policy initiatives.

Dealing with complexity. Complex interactions among micronutrient deficiencies and various diseases makes it difficult to treat them in isolation. Zambia's 2003 VAD and iron monitoring survey sounded a wake-up call, signaling the statistically insignificant impact of sugar fortification and iron and vitamin A supplementation. In contrast, the survey results documented the clear importance of malaria on both VAD and IDD. International evidence from Tanzania's Pemba iron supplementation study reinforces concerns about the importance of malaria control prior to major iron supplementation interventions (Sazawal et al. 2006, Prentice 2008). Nutrition and health interventions, therefore, require careful coordination. Bio-fortification offers an additional tool for addressing micronutrient deficiencies but at the same time demands further improvement in inter-ministerial coordination and monitoring.

Ongoing debates about coordination structures reflect the institutional implications of addressing complex micronutrient problems. Zambia's Food and Nutrition act of 1967 established the National Food and Nutrition Commission (NFNC) within the Ministry of Health to serve this coordinating role. As more actors have become involved, current discussions include the option

of placing a new NFNC in a higher political access level – reporting possibly to the President's Office, to Cabinet or possibly to the Ministry of Finance. Neighboring countries have approached these same issues with evolving institutional coordinating mechanisms from which Zambia might usefully learn.

5.4. Regional contrasts among Zambia, Malawi and South Africa

Zambia's record on micronutrient policy both mirrors and contrasts with those of its neighbors. Zambia has led in some respects, mandating iodine fortification of salt 20 years earlier than Malawi (in 1978 rather than 1998) and 16 years earlier than South Africa (in 1994). Despite Illovo ownership of sugar mills in all three countries, Zambia mandated vitamin A fortification of sugar in 1998, 17 before Malawi did so (in 2015). South Africa, in turn, has declined to mandate sugar fortification. Future work comparing micronutrient policy evolution across these three countries aims to explore reasons for the differing chronologies. By comparing policy responses and chronologies, we hope to learn more about what is required to place micronutrient policies on the agenda and successfully adopt them.

The three countries likewise face the common institutional challenge of how to coordinate, manage and monitor complex policies that require action and interactions across ministries in addition to an appreciation of the interactions among micro-nutrients deficiencies and various diseases. Zambia's current debates about where to locate its NFNC mirror those same debates in Malawi and South Africa. Since both its neighbors have opted for different coordinating systems over time, policy makers in each of the three countries may welcome the chance to learn about the strengths and weaknesses of alternate coordination models.

REFERENCES

ActionAid. 2013. Sweet Nothings: The Human Cost of a British Sugar Giant Avoiding Taxes in Southern Africa. London: ActionAid.

Africa Competition Forum. 2014. Competition in the regional sugar sector: the case of Kenya, South Africa, Tanzania and Zambia. Background Document for the Fifth Meeting of the UNCTAD Research Partnership Platform. Fifth Meeting of Geneva: UNCTAD.

Africa Lead. 2014. Zambia Food Security Policy Assessment: Institutional Architecture for Food Security and Policy Change. Washington, DC: Development Alternatives, Inc.

Alaofe, Halimatou, Kohler, Lindsay, Taren, Douglas, Mofu, Musonda J., Chileshe, Justin and Kalungwana, Ngandwe. 2014. Zambia food consumption and micronutrient status survey report. Lusaka: National Food and Nutrition Commission. DRAFT

Allen, Lindsay, de Benoist, Bruno, Dary, Omar and Hurrell, Richard. 2006. Guidelines on food fortification with micronutrients. Geneva: World Health Organization.

Babu, Suresh Chandra. 2013. Policy process and food price crisis: A framework for analysis and lessons learned from country studies. UNU-WIDER Working Paper 70. Helsinki: United National World Institute for Development Economics Research.

Behrman, J., H. Alderman, and J. Hoddinott. 2004. "Hunger and Malnutrition". In B. Lomborg (ed.) Global Crises, Global Solutions. Cambridge (UK): Cambridge University Press.

Central Statistical Office (CSO). 2015. Zambia Demographic and Health Survey 2013-14. Lusaka: CSO and Ministry of Health.

Chanda, Gift. 2014. CCPC links high sugar prices to lack of competition. Zambia Post. September 3, 2014.

Chiona, Martin. 2011. Report for FSRP crop cuts. IAPRI, ZARI.

Chiona, Martin. 2012. Cassava and sweet potato yield assessment. ZARI, IAPRI.

Chisanga, B., Meyer, F.H., Winter-Nelson, A. and Sitko, N.J. 2014. Does the current sugar market structure benefit consumers and sugarcane growers? IAPRI working Paper 89. Lusaka: IAPRI.

Chisanga, B., Gathiaka, J., Nguruse, G., Onyancha, S. and Vilakazi, T. 2014. Competition in the regional sugar sector: the case of Kenya, South Africa, Tanzania and Zambia. Afircan Competition Forum. Geneva: Fifth Meeting of the UNCTAD Research Partnership Platform.

Chulu, Kabanda. 2009. Sugar Producers Association of Zambia (SPAZ) justifies high sugar prices. http://maravi.blogspot.com/2009/09/spaz-justifies-high-sugar-prices.html

Chintu, Chifumbe and Lumbwe, C.M. 2007. Iodine deficiency disorders – the Zambian experience. Presentation at the 2007 Toronto Workshop on Disease and Development. http://www.sickkids.ca/PGPR/Symposia-and-Workshops/May-2007-Toronto-Disease-and-Development/Iodine-Deficiency-Disorders/index.html

Chhokar, Jagdeep S., Babu, Suresh Chandra, and Kolavalli, Shashidhara. 2014. Improving the food policy process: lessons from capacity strengthening of parliamentarians in Ghana. IFPRI Discussion Paper No.1401. Washington, DC: IFPRI.

Consumer Unity and Trust Society (CUTS). 2014a. An assessment of the structural and political economy issues in the Zambia sugar industry. Lusaka: CUTS International.

Consumer Unity and Trust Society (CUTS). 2014b. Why are sugar prices so high in Zambia? *Briefing Paper No 1*. Lusaka: CUTS International.

CSO-SUN (2013) 'Nutrition in Zambia's 2014 Budget: An Analysis of Zambia's funding to Nutrition', Lusaka, Zambia.

De Souza, Sabrina, Katherine Pittore and Lloyd Handongwe (2014) Nutrition Advocacy in Zambia: Challenges and Opportunities, Results UK, London, UK; www.results.org.uk

Drimie, Scott, Chakrabarty, Subrata Kumar, Dube, Christopher, Smit-Mwanamwenge, Majroliein, Rawat, Rahul and Harris, Jody. 2014. Intersectoral coordination for nutrition in Zambia. *IDS Special Collection* (September 2014):72-77.

Ellis, K., R. Singh and S. Musonda. 2010. Assessing the Economic Impact of Competition: Findings from Zambia. Westminster Bridge, London: Overseas Development Institute (ODI). Can be accessed at http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/6066.pdf

Food and Agriculture Organisation (FAO). 2007. Sugar fortification in Zambia. Annex to Lesson 1: Food Security Information Systems. Rome: FAO Food Security Information for Action Unit.

Food and Agriculture Organisation (FAO). 2009. Nutrition country profile: the Republic of Zambia. Rome: FAO.

Fielder, Jack, D'Agostino, Alexis and Sununtnasuk, Celeste. 2014. Nutrition Technical Brief:. A rapid initial assessment of the distribution and consumption of iron-folic acid tablets through antenatal care in Zambia. Arlington, Virginia: USAID/Strengthening Partnerships, Results and Innovaitons in Nutrition Globally (SPRING).

Friis-Hansen, Bent and McCullough, Fergus S. 1962. Vitamin A deficiency in African children in Northern Rhodesia. *Tropical Pediatrics* 60(1):114-121.

FSP (Food Security Policy Innovation Lab). 2015. Conceptualizing drivers of agriculture and nutrition policy change through the Kaleidoscope Model." FSP Policy Brief. http://fsg.afre.msu.edu/fsp/Resnick_RISE_2015.pdf

Gannon, Bryan, Kaliwile, Chisela, Arscotrt, Sara A., Schmaelzle, Samantha, Chileshe, Justing, Kalungwana, Ngandwe, Mosonda, Mofu, Pixley, Kevin, Masi, Cassim and Tanumihardjo, Sherry A. 2014. Biofortified orange maize is as efficacious as a vitamin A supplement in Zambian children even in the presence of high liver reserves of vitamin A: a community-based, randomized placebo-controlled trial." *American Journal of Clinical Nutrition* xxxxx.

Greiner, T., Antonsson-Ogle, B., Kaunda, J. and Kazilimani, B. 1988. An assessment of the nutrition sector in Zambia and the role of the National Food and Nutrition Commission : November 15-December 4, 1987. Uppsala: Swedish University of Agricultural Sciences.

Grütz, Silke Seco, Sadlier, Maurice and Brunet, Dominique. 2014. "Reflections on the Role of Donors in Scalling Up Nutrition in Zambia from 2010 to 2013: Successes, Challenges and Lessons Learnt." *IDS Special Collection* (September) Brighton, UK: Institute of Development Studies.

Haddad, Lawrence. 2014. Politics, stature and status: The Lusaka GNR Roundtable. February 27. http://globalnutritionreport.org/2015/02/27/politics-stature-and-status-the-gnr-lusaka-roundtable/

Harris, J. and Drimie, S. 2012. Toward an integrated approach for addressing malnutrition in Zambia: a literature review and institutional analysis. IFPRI Discussion Paper 01200. Washington, DC: IFPRI.

Harris, J; Seco, S; Masi, C and Haddad, L (eds) (2014) Turning Rapid Growth into Meaningful Growth: Sustaining the Commitment to Nutrition in Zambia, Brighton, Institute for Development Studies, United Kingdom, Brighton.

Harriss, J. 2015. Stories of change in nutrition: Zambia protocol. Mimeo.

HarvestPlus. 2015. Zambia launches widespread sales of vitamin A maize. (August 12, 2015). http://www.harvestplus.org/content/zambia-launches-widespread-sales-vitamin-maize

Hetzel, Basil S. 1983. Iodine deficiency disorders (IDD) and their eradication. *The Lancet* (November 12) 1126-1129.

Hetzel, Basil S. 1993. The control of iodine deficiency. *American Journal of Public Health* 83(4):494-495.

Horton, Sue, Alderman, Harold and Rivera, Juan A. 2008. Copenhagen Consensus 2008 Challenge Paper: Hunger and Malnutrition. Copenhagen: Copenhagen Cionsensus Center.

Horton, Sue, Mannar, Venkatesh and Wesley, Annie. 2008. Micronutrient fortification (iron and salt iodization). Best Practice Paper: New Advice from CC08. Working Paper October 2008. Copenhagen: Copenhagen Consensus Center.

Illovo Sugar. 2014. Zambia socio-economic impact assessment: internal management report. Lusaka: Illova sugar.

Kalinda, Thomson and Chisanga, Brian. 2014. Sugar value chain in Zambia: an assessment of the growth opportunities and challenges. *Asian Journal of Agricultural Sciences* 6(1):6-15.

Katongo, C. 2012. Iodine deficiency disorders impact survey: 2011 report. Lusaka: NFNC.

Katongo, Cyprian, Siulapwa, Nathan, Njunju, Eric and Chileshe, Justin. 2015. Iodine nutrition status of vulnerable pregnant women of Zambia. Technical Report. Lusaka: University of Zambia.

Kaunda, Danstan. 2010. Fortified sweet potatoes developed in Zambia. August 10. http://newsciencejournalism.com/08/2010/fortified-sweet-potatoes-developed-in-zambia/

Leung, Angela M., Braverman, Lewis E. and Pearce, Elizabeth No. 2012. History of US iodine fortification and supplementation. *Nutrients* 4(11):1740-1746.

Lumbwe, C.M., Chowa, V., Maonde, N., Nyirongo, W., Gutekunst, R., (1995). Iodine Deficiency Disorders In Zambia: 1993 Baseline Survey funded by UNICEF. Lusaka: National Food and Nutrition Commission.

Lumbwe, C.M. Siamusantu, W., Habulembe, R., Mwanza, M., Nyirongo, W. and Campbell, J. 2003. 2002 Iodine Deficiency Disorder (IDD) Impact Survey. Volume 1: IDD Indicators. Lusaka: National Food and Nutrition Commission of Zambia and UNICEF.

Luo, C., Mwela, C. and Campbell, J. 1999. National baseline survey on prevalence and aetiology of anaemia in Zambia: A random cluster community survey involving children, women and men. Lusaka: National Food and Nutrition Commission.

Lusaka Times. 2008. Sugar crisis forces Kafue to resume production. June 5.

Lusaka Times. 2009. Food commission defends sugar fortification policy. Lusaka Times. April 1, 2009.

Madamombe, Itai. 2007. Combatting Zambia's "hidden hunger". *Africa Renewal Magazine* (January). http://www.un.org/africarenewal/magazine/january-2007/combating-zambia%E2%80%99s-%E2%80%98hidden-hunger%E2%80%99

Mason, John, Greiner, Ted, Shrimpton, roger, Sanders, David and Yukich, Joshua. 2014. Vitamin A policies need rethinking. International Journal of Epidemiology 10(1093):1-10.

Mehta, S. and Fawzi, W. 2007. Effects of vitamins, including vitamin A, on HIV/AIDS patients. *Vitamins and Hormones* 75:355-383.

Ministry of Health, Republic of Zambia. 2012. Iodine deficiency disorders control programme. Lusaka: National Food and Nutrition Commission.

MOST, USAID Micronutrient Program. 2004. Cost Analysis of the National Vitamin A Supplementation Program in Zambia. Arlington, Virginia, USA

MOST, UNICEF, Centers for Disease Control and Prevention, & Food and Nutrition Commission of Zambia. 2003. Report of the national survey to evaluate the impact of vitamin A interventions in Zambia, July and November 2003. Zambia, Micronutrient Operational Strategies and Technologies, United States Agency for International Development (USAID) Micronutrient Program.

National Food and Nutrition Commission (NFNC). 1997. National survey on vitamin A deficiency in Zambia: A random cluster study for children (0-5 years) and mothers attending national immunization days in August 1997. Report prepared by C. Luo and C. Mwela. Lusaka: NFNC.

National Food and Nutrition Commission (NFNC). 1999. National baseline survey on prevalence and aetiology of anemia in Zambia: A random cluster community survey involving children, women and men. National Food and Nutrition Commission. Lusaka.

National Food and Nutrition Commission (NFNC). 2005a. 2003 National Survey to Evaluate the Impact of Vitamin A Interventions in Zambia. Lusaka: National Food and Nutrition Commission.

National Food and Nutrition Commission (NFNC). 2005b. Zambia national micronutrient operational strategy 2005-2009. Lusaka: NFNC.

National Food and Nutrition Commission (NFNC). 2011. National Food and Nutrition Strategic Plan for Zambia 2011-2015. Lusaka: National Food and Nutrition Commission.

National Food and Nutrition Commission (NFNC). 2012a. Iodine deficiency disorders control programme: strategic plan (2012-2016). Lusaka: Ministry of Health.

National Food and Nutrition Commission (NFNC). 2012b. Iodine deficiency disorders impact survey: 2011 report. Lusaka: Ministry of Health.

National Food and Nutrition Commission (NFNC). 2012c. Zambia zeroes in on IDD elimination. IDD Newsletter (August 2012).

Nwokolo U. (1972). Endemic Goitre in Zambia. National Council for Scientific Research, Medical Research Report CR2, Lusaka, Zambia.

Nwokolo, U. 1974. Endemic goiter in Zambia. Journal of Tropical Medicine and Hygiene. 77:233-8.

Organization of African Unity (OAU). 2000. The Abuja Declaration on Roll Back Malaria in Africa. African Summit on Roll Back Malaria, 25 April 2000, Abuja, Nigeria.

Prentice, Andrew M. 2008. Iron metabolism, malaria and other infections: What is all the fuss about? The Journal of Nutrition 138:2537-2581.

Resnick, D., Babu, S.C., Haggblade, S., Hendriks, S. and Mather, D. 2015. Conceptualizing drivers of policy change in agriculture, nutrition, and food security: The kaleidoscope model. IFPRI Discussion Paper 1414. Washington, DC: International Food Policy Research Institute. http://www.ifpri.org/publication/conceptualizing-drivers-policy-change-agriculture-nutrition-and-food-security

Sablah, Mawuli, Grant, Fred and Fiedler, John L. 2013. Food fortification in Africa: progress to date and priorities moving forward. Sight and Life 27(3):18-24.

Sazawal, Sunil, Black, Robert D., Ramsan, Mahdi, Chwaya, Hababu M., Stoltzful, Rebecca J., Dutta, Arup, Shingra, Usha, Kabole, Ibrahim, Deb, Saikat, Othman, Mashavi I. and Kabole, Fatma M. 2006. Effects of routing prophylactic supplementation with iron and folic acid on admission to hospital and mortality in preschool children in a high malaria transmission setting: community-based, randomized, placebo-controlled trial. Lancet 367:133-143.

Schellenberg, J.R.M.A., Abdulla, S., Nathan, R., Mukasa, O., Marchant, T.J., Kikumbih, N., Mushi, A.K., Mponda, H., Minja, H., Mshinda, H., Tanner, M. and Lengeler, C. 2001. Effect of large-scale social marketing of insect-treated nets on child survival in rural Tanzania. *Lancet* 357:1241-47.

Schuman, Klaus and Christ, Frank. 2007. Did the “iron age” end in Pemba? Sight and Life Magazine Issue 3/2007.

Serlemitsos, J. and H. Fuscos. 2001.Vitamin A Fortification of Sugar in Zambia 1998–2001. Arlington, VA: MOST. The USAID Micronutrient Program.

Somer, A., Djunaedi, E., Loeden, A.A., Tarwotjo, I., West, K.P., Tilden, R. and Mele, L. 1986. Impact of vitamin A supplementation on childhood mortality: a randomized controlled community trial. *The Lancet* (May 24)8491:1169-1173.

Stevens, G.A., Finucane, M.M., De-Regil, L.M. et al. 2013. Global, regional and national trends in hemoglobin concentration and prevalence of total and severe anemia in children and pregnant and non-pregnant women for 1995-2011 : a systematic analysis of population-representative data. *The Lancet Global Health* 1(1):e16-e25.

Stoltzful, R.J. and Dreyfuss, M.L. 1998. Guidelines for the use of iron supplements to prevent and treat iron deficiency anemia. International Nutritional Anemia Consultative Group (INACG). Washington, DC: International Life Sciences Institute.

Sweet Potato Profit and Health Initiative (SPHI). 2012. Integrating orange: combatting vitamin A deficiency in maize-based food systems in Zambia. Washington, DC: USAID.

Tanumihardjo, S.A., Gannon, B.M., Kaliwile, C. and Chileshe, J. 2015. Hypercarotenodermia in Zambia: which children turned orange during mango season? *European Journal of Clinical Nutrition* (2015):1-4.

Taylor, Hugh R. and West, Keith P. Jr. 1983. Trip report: Zambia (September 14-23, 1983). Washington, DC: USAID.

Taylor, Linnet. 2012. A second chance: Focusing Zambia's nutrition sector in the context of political change. Brighton: IDS.

Tropical Diseases Research Center (TDRC). 2015. Vitamin A supplements – TDRC's success story. http://www.tdrc.org.zm/?p=2874

UNICEF. 2003. Micronutrients – Iodine, Iron and Vitamin A. http://www.unicef.org/nutrition/index_iodine.html

UNICEF. 1990. UNICEF Annual Report 1990. New York: United Nations Children's Fund.

UNICEF, 2006: Progress for children: A report card on nutrition. UNICEF, New York.

UNICEF. 2010. Sustainable Elimination of Iodine Deficiency: Progress since the 1990 World Summit for Children. New York: UNICEF.

UNICEF. 2013. Iodizing Salt: A Health Policy: The Costa Rica Experience. San José, Costa Rica: Ministry of Health.

USAID (United States Agency for International Development). 2013. Feed the Future Guide to Supporting Sound Policy Enabling Environments. Washington, DC: USAID.

WHO/UNICEF/ICCIDD. 1997. Review of findings from seven country study in Africa on levels of salt iodation in relation to iodine deficiency disorders, including iodine-induced hyperthyroidism. WHO/AFRO/NUT/97.2.

World Health Organization (WHO). 2004. Iodine status worldwide: WHO global database on iodine deficiency. Geneva: WHO.

World Health Organization (WHO). 2015. Global anemia prevalence and trends 1995-2011. Geneva: WHO.

Zambia Bureau of Standards (ZABS). 2009. Draft Zambian Standard: Maize Meal Specification Part 2: Fortified Maize Meal. Lusaka: ZABS.

ANNEX A. KEY MICRONUTRIENT POLICY INSTITUTIONS

Civil Society Scaling Up Nutrition Movement: (CSO-SUN): The CSO-SUN alliance of civil society partners is a donor-funded group that champions nutrition programs in Zambia in alignment with international best practices.

Competition and Consumer Protection Commission (CCPC): CCPC is a statutory body established to ensure competition and protect consumers. The CCPC was established in 1997 as the Zambia Competition Commission (ZCC). Its name changed in 2010 to Competition and Consumer Protection Commission (CCPC) following revisions to the Competition and Consumer Protection Act (CCPA) No. 24 of 2010. In the micronutrient policy arena, CCPC has formally investigated complaints from large sugar buyers and consumer groups that Vitamin A fortification mandate has reduced competition, increased the monopoly power of Zambia Sugar and enabled the firm to artificially inflate domestic sugar prices.

Food and Drugs Control Laboratory (FDCL): FDCL is mandated, under the Food and Drugs Act (2006) to monitor food quality, safety, labeling, and marketing. The lab serves as government's regulator to ensure that food, drugs and water consumed in Zambia conform to standards as stipulated in The Food and Drugs ACT CAP 303 of the Laws of Zambia and The Food and Drugs Regulations of 2001.

Ministry of Community Development, Mother and Child Health (MCDMCH): Formed in 2011, the MCDMCH provides social protection, community development and primary health care services to district and local communities, with a focus on maternal and child health.

Ministry of Health (MoH): Zambia's MoH manages health and nutrition policy formulation and implementation. Its specific objectives include the following:

- To effectively provide essential drugs to all Government health facilities in order to facilitate provision of the basic health services.
- To provide quality health services in order to achieve the 2009 national and MDGs health targets and improve the overall health status.
- To integrate and harmonize operations of statutory boards, training institutions and others institutions under the Ministry of Health within the mainstream service delivery structures in order to attain better health outcomes.
- To mobilize adequate resources for financing the provision of Health Services.
- To provide a comprehensive legal and policy framework for effective coordination, implementation and monitoring of health services.
- To implement an effective planning and budgeting system at all Levels of the health care delivery system in order to strengthen programme co-ordination and ensure optimum allocation and efficient utilisation of resources.
- To provide effective systems for plant, transport, equipment and infrastructure in order to improve health service delivery.

National Food and Nutrition Commission (NFNC): Established under the Food and Nutrition Act (Zambia 1967), Zambia's NFNC serves as government's coordination body for promoting food and nutrition activities and advising the government on nutrition policies. The National Food and Nutrition Act was amended in 1975 to include provision for the setup of community nutrition groups and their registration with the NFNC. NFNC reports to Minister of Health.

Nutrition Association of Zambia (NAZ): NAZ is a voluntary professional organization grouping together nutrition professionals in Zambia. NAZ provides professional input into the national nutrition research and policy agenda.

Tropical Diseases Research Centre (TDRC): TDRC was founded in 1975 by the World Health Organization, in collaboration with the Zambian government, as one of three international centers for research in tropical diseases. Based in Ndola, with offices at the Ndola Central Hospital, TDRC simultaneously serves as a national institute for research and training on issues of importance to public health in Zambia. Since the 1980s, TDRC has conducted research on vitamin A deficiencies in collaboration with a wide range of international partners.

Zambia Bureau of Standards (ZABS): Formulates and publishes standards; provides testing laboratories.

ANNEX B. KEY LEGISLATION AND REGULATIONS SHAPING MICRONUTRIENT POLICIES IN ZAMBIA

Key Regulations

Legal foundation document
• Constitution of Zambia, 1991

Nutrition policy formulation
• National Food and Nutrition Act (Zambia 1967).
• National Food and Nutrition Act (1975): amended to include provision for setup of community nutrition groups and their registration.

Competition
• Fair Trading Act (1994)
• Competition and Consumer Protection Act (2010)

Food fortification
• Food and Drugs Act cap 303 of the laws of Zambia (1972, 2006)
• Standards Act, Cap 416 of 1994 of the laws of Zambia,
• Statutory Instrument 133 (September 1978): mandates fortification of salt and margarine sold in Zambia
• Statutory Instrument 97 (July 1994): mandates fortification of imported and domestically sold salt
• Statutory Instrument No. 90 (2001): lowers fortification levels mandated for salt
• Statutory Instrument No.55 (1998): mandates vitamin A fortification of sugar

Bio-fortification
• Plant Variety and Seeds Act (CAP 236)
• Plant Breeder's Right Act (2007)

Key Policy Documents

• National Food and Nutrition Policy (NFNP) (Zambia 2008)
• National Food and Nutrition Strategic Plan 2011–15 (NFNSP) (Zambia, Ministry of Health 2011)
• Micronutrient Operational Strategy (2004–09)

ANNEX C. KEY INFORMANT INTERVIEW GUIDE

Interview Guide:
Policy Institutions

Who takes the key micronutrient policy decisions? Parliament? Cabinet? MOH?

Who is responsible for implementation, monitoring, assessment of micronutrient policies?

- iodine
- VAD
- iron
- multi-mix fortification of maize flour
- others (calcium, B vitamins)

Who finances Zambia's major micronutrient interventions?

What venues exist for engaging stakeholder comment, suggestions and preferences?

What policy frameworks exist to legislate accountability?

Why so many individual task forces (VAD, IDD, IDA)? Who funds them? Initiates them?

What legal/moral standing do they have? What human and financial resources?

When did Zambia's key micro-nutrient interventions get onto the policy agenda?

- iodine
- VAD
- iron
- multi-mix fortification of maize flour
- others (calcium, B vitamins)

How did they get onto the policy agenda when they did?

- iodine
- VAD
- iron
- multi-mix fortification of maize flour
- others (calcium, B vitamins)

Interview Guide
for Specific Micronutrient Interventions (VAD, iron, iodine, mixed)

1. <u>Agenda-setting</u>

How did this micronutrient policy (iodine, VitA, iron, Vit-min mix) get on the agenda when it did?

K1.1. What advocates?
K1.2. What focusing events?

Who championed this cause?
- domestic advocates
- international advocates

Who opposed it?

K1.3. Why was this considered a priority issue? (relevant problem)

2. <u>Design</u>

Who designed the policy intervention?

What design options were considered?

Why did designers choose: a) supplementation; b) fortification (of what?); c) biofortification?

What is the annual cost?

Who finances the cost?

K2.3. How cost-effective are the various alternatives?

K2.1. Was this a pressing or a chosen problem?

K2.2. What ideas and beliefs underlie the chosen design?

3. <u>Decision making</u>

Who made the final decision?

Who lobbied in favor?

Who opposed it?

K3.1. What factors led to a favorable decision? (propitious timing?)

K3.2. What veto players exist?

K3.3. Evaluate the relative power of the proponents and opponents.

4. <u>Implementation</u>

Who implements?

What regulatory and legislative changes took place to implement the policy decision?

What institutional oversight is there?

Did this policy require setting up new institutions?

Any policy changes since introduction? When? Why?

K4.1. institutional capacity of implementing institution

K4.2. commitment of policy makers

K4.3. Budget resources: what cost? Who pays? Are the resources sustainable?

5. <u>Evaluation and reform</u>

Who monitors the impact of this policy (iodine, VitA, iron, Vit-min mix)?

Any other relevant research bearing on this policy?

K5.1. Did changing conditions lead to policy change?

K5.2. Changing beliefs? Did understanding or awareness change?

K5.3. Did resource constraints trigger reform?

ANNEX D. LIST OF PERSONS INTERVIEWED

Agnes Aongola
Senior Nutritionist
Ministry of Health (MOH)

Harrison Banda
Executive Director
Millers Association of Zambia

Japhet Banda
Head of Communication and Corporate affairs
Zambia Sugar

Phoebe Bwembya
Board member and former chair
National Food and Nutrition Commission (NFNC)

Mary Chibambula
Team Leader – Sun Fund Project
Care International in Zambia

William Chilufya
Executive Director
CSO-SUN

Martin Chiona
Head, Root and Tuber Programme
Zambia Agricultural Research Institute (ZARI)

Helen Chirwa
Nutrition Advisor
USAID/Zambia

Brian Chisanga
Research Associate
Indaba Agricultural Policy Research Institute (IAPRI)

Vincent Chowa,
Iodine Specialist
National Food and Nutrition Commission (NFNC)

Gladys Kabaghe
Coordinator for IDD
Senior Nutritionist, Food Quality

National Food and Nutrition Commission (NFNC)

Mwansa Kabamba
Lead Maize Breeder,
Zambia Agricultural Research Institute (ZARI)

Mr. Y. Kakusa
Chief Planner, Department of Planning and Information
Ministry of Community Development, Mother and Child Health (MCDMCH)

Thompson Kalinda
Professor, Agricultural Economics
University of Zambia (UNZA)

Ng'andwe Kalungwana
Acting Head, Nutrition Unit
Tropical Diseases Research Center (TDRC)

Kondwani Kaonga
Investigator – Mergers and Monopolies
Competition and Consumer Protection Commission (CCPC)

Mwisa P. Kapukanya
GOZ Gazette Editor
Government Printer

Sumbukeni Kowa
Head of Department
Food and Drugs Control Laboratory

Matongo Matamwandi
Head of Marketing
Zambia Sugar

Musonda Mseteka
Research Officer, Head of Sugar Study
CUTS International

Fred Mubanga
Unit head of quality control, coordinator of SUN
National Food and Nutrition Commission (NFNC)

Kennedy Muimui
Bean breeder
Zambia Agricultural Research Institute (ZARI)

Davies Mukuka
Senior Documentation and Information Officer
Zambia Bureau of Standards (ZABS)

Paul Mumba
Deputy Director for Policy
Ministry of Health

Mofu Musonda
Deputy Director
National Food and Nutrition Commission (NFNC)

Thelma Musonda
Investigator
Competition and Consumer Protection Commission (CCPC)

Simonda Muyunda
Head of Quality Control
Zambia Sugar

Derrick Mwanakatwe
Food and Drugs Control Laboratory

Harry Ngoma
Food Security Specialist
USAID/Zambia

Simon Ng'ona
Centre Coordinator
CUTS International

Chewe Orbrie
Principal Epidemologist
Ministry of Community Development, Mother and Child Health (MCDMCH)

Nelly Phiri
CSO-SUN

Kelvin Saili
Standards Officer
Zambia Bureau of Standards (ZABS)

Prisca Shapole
Senior Standards Officer
Zambia Bureau of Standards (ZABS)

Annie M. Siame
Assistant and Programme Officer
CUTS International

Ruth Siyandi
Chief Nutritionist
UNICEF

ANNEX E. KALEIDOSCOPE HYPOTHESIS TESTING DETAILS AND DATA MATRICES

Table E.1. Iodine – Data Matrix for Kaleidoscope Hypothesis Testing

	1978	1994	2001
Date:	September 1978	July 1994	September 2001
Actor:	Minister of Health	Minister of Health	Minister of Health
Policy Action:	SI 133 mandating fortification of salt sold in Zambia: • no mandate for imported salt, only domestic sales • mandated level: 50 ppm potassium iodate	SI 97 mandating fortification of imported and domestically sold salt • Enforcement becomes serious • Iodate levels stratified: Factory (135-168) Port (84-135) Retail (50-84)	SI 90 lowers mandatory salt fortification level: • Factory (25-66 ppm iodate = 15-40 ppm iodine)
1. Agenda setting			
1.1. Powerful advocacy coalitions		• broad external support emerges (UNICEF, WHO, ICCIDD, donors) • NFNC, MOH become energized and resourced • micronutrient task force established 1991 **+ IR: 14, 15, 18**	• same advocacy coalition continues, though donor funding atrophies after initial success in reducing IDD **+ IR: 14, 15, 18**
1.2. Focusing events	• 1971 national IDD survey finds 50% goiter rate (Nwokolo 1972) • 1972 Food & Drugs Act; ZABS sets standards for a broad range of foods • NFNC 2012a, p.4 • NFNC 2012b, p.1 **+ IR: 18**	• 1990 UNICEF World Summit for Children sets goal of eliminating IDD by 2000 • 1993 IDD survey (Lumbwe et al. (1995) **+ IR: 11, 14, 15, 18**	• WHO/UNICEF/ICCIDD (1997) survey of 7 countries reveals high iodine levels; recommends downward revisions in fortification levels **+ IR: 15, 16, 18**
1.3. Recognized, relevant policy problem	• high incidence of goiter (26%-80%) among school-age children nation-wide provides visible indicator of IDD **+ IR: 18, 14**	• 1993 IDD survey finds 72% IDD among school children (Lumbwe et al (1995) **+ IR: 11,15,16,18,21**	• regional study (WHO/ UNICEF/ICCIDD 1997) • 2002 IDD survey (Lumbwe et al. 2005) • 2011 IDD survey (NFNC 2012) **+ IR: 15, 16, 18**
2. Design			
2.1. Pressing vs chosen problems			
2.2. Ideas and beliefs	• IDD poses critical cognitive and health risks (Hetzel 1983)	• IDD poses critical cognitive and health risks (UNICEF/WHO 1990; WHO 2004)	• overdosing may lead to hyperthyroidism (IIH)
2.3. Cost-benefit	• Fortification viewed as	• Fortification viewed as	• Fortification viewed as the

calculations	the cheapest alternative; •salt widely established as best vehicle • Hetzel (1983, 1993) **+ IR: 5, 18**	the cheapest alternative; •salt widely established as best vehicle • WHO (2004) • NFNC 2012a **+ IR: 5, 11, 18**	cheapest alternative •salt widely established as best vehicle • Horton et al. (2008) • UNICEF (2010) **+ IR: 5, 11, 18**
3. Adoption			
3.1. Propitious timing	• ZABS drafts comprehensive set of food standards as mandated by the 1972 Food and Drugs Act • many standards imported **+ IR: 18**		
3.2. Veto players			
3.3. Relative power of proponents vs. opponents		No serious opponents **+ IR: 18**	No serious opponents
4. Implementation			
4.1. Institutional capacity	• National Milling (parastatal) is country's major importer of unfortified salt, they iodized, packaged and sold it domestically • weak enforcement by MOH • little interest in MOH enforcing rules at MoAg's parastatal **+ IR: 18**	• no enforcement previously by MOH, Customs or FDCL • vigorous educational campaign for importers, retailers and consumers • NFNC 2012b, p.1 **+ IR: 16, 18, 21**	• Enforcement atrophies • rapid test kits out of stock; • donor support wanes; • GOZ fails to finance the test kits • NFNC 2012a, pp. 5,11 • NFNC 2012b, p.2 Kabugo 2015, p.12 **+ IR: 18, 24**
4.2. Requisite budgetary allocations	• little funding for education or enforcement **+ IR: 18**	• UNICEF funded IDD campaign (NFNC 2012a, p.4) **+ IR: 14, 15, 18, 23**	• decline in donor funding for IDD programs (education, rapid test kits) • NFNC 2012a, pp.11,14 • Lumbwe et al 2003, p.46
4.3. Commitment of policy champions		• NFNC and micronutrient task force become energized **+ IR: 11, 18**	
5. Evaluation and reform			
5.1. Changing conditions	• 1990 World Summit on Children makes donor resources available for studies and enforcement **+ IR: 11, 14, 15, 18**	• IDD levels fall significantly between 1993 and 2002 (Lumbwe et al. 2003) • NFNC 2012a, p.4	• by 2011, IDD no longer poses a significant public health problem (NFNC 2012b, p.15) • excessive intake in some areas (NFNC 2012a,b; Lumbwe 2003 p.42) **+ IR: 15, 18, 24**
5.2. Changing	• 1992 IDD survey reveals continued high	• 1996 WHO/UNICEF/ ICCIDD (1997) survey of	• 2003 survey documents possible overdosing of

information or beliefs of veto players and champions	levels of IDD in Zambia: Lumbwe et al. (1995) **+ IR: 11, 14, 15, 18**	7 countries reveals high iodine levels in Zimbabwe; • UNICEF recommends downward revisions in Zambia **+ IR: 16, 18**	iodine, with 64% of hh salt above upper limit of 40 ppm (Lumbwe et al. 2003) • 2011 IDD survey confirms fall in IDD, but continued high levels (27%) of over-iodized salt and 39% pupils with excessive iodine intake (NFNC 2012, Table 4) **+ IR: 15, 18, 24**
5.3. Available resources relative to cost		• UNICEF and USAID/MOST provide technical and financial support • NFNC 2012a, p.5 **+ IR: 11, 14, 15, 18**	

Legend: **IR** = interview respondent number.

Table E.2. Vitamin A – Data Matrix for Kaleidoscope Hypothesis Testing

	Supplementation	**Fortification: margarine**	**Fortification: sugar**	**Bio-fortification: sweet potatoes**	**Bio-fortification: maize**
Date:	1990	1978	1998	2002	2007
Actor:	• MOH •MCHCD • NFNC	• ZABS • MOH	• MOH • NFNC • ZABS • NFDCL • UNICEF • USAID	• MAL • ZARI • CIP	• MAL • ZARI • HarvestPlus • CIMMYT
Policy Action:	• capsules to children 6-59 months • post-partum women	• mandatory fortification of margarine	• mandatory fortification of sugar from 1998	• sweet potato breeding incorporates VA traits • release of two light orange varieties in 2003 • release of 4 new orange-fleshed varieties in 2015	• maize breeding incorporates VA traits • release of three orange maize varieties in 2012 • release of 2 more expected 2015
1. Agenda setting					
1.1. Influential advocates	• UNICEF (1990) • WHO • NFNC **+ IR: 5, 6, 11, 14, 15, 24**		• UNICEF supports mandate, testing • USAID support research, design, and implementation **+ IR: 6,11,14,15,24**	• CIP • USAID • SPHI 2012 **+ IR: 2, 5, 6, 25**	• Harvest Plus • CIMMYT • USAID **+ IR: 4, 6, 12, 25**
1.2. Focusing events	• 1990 UNICEF World Summit for Children • NFNC 2011 **+ IR: 5,11,14,15**	• 1972 Food Act requires ZABS to set food standards **+ IR: 18**	• 1997 VAD survey (NFNC 1997) **+ IR: 5, 6, 11, 14, 15, 24**	• 2001 CIP launches its Vitamin A for Africa program (VITAA) • breeding lines become available **+ IR: 25**	• 2006 failure of maize meal fortification mandate **+ IR: 4**
1.3. Recognized, relevant policy problem:	• Somer et al. 1986 • Horton et a. 2008 • NFNC 2011 **+ IR: 4, 5, 6, 8, 9, 11, 14, 15, 24, 25**		• VAD surveys 1997, 2003 (NFNC 1997, 2005) **+ IR: 2, 5, 6, 11, 12, 14, 15, 17, 20,**	• 1980s TDRC research on VAD in Luapula (West 1983) • 1990s FAO work on palm oil in Luapula • VAD surveys 1997,	• VAD surveys 1997, 2003 (NFNC 1997, MOST et al. 2005)

			21, 24	2003 (NFNC 1997, MOST et al. 2005) **+ IR: 5,14,15,20,25**	**+ IR: 4,5,14,15,25**
2. Design					
2.1. Pressing vs chosen problems					
2.2. Ideas and beliefs					• fear of GMOs • bad reputation of yellow maize **+ IR: 4,6,9**
2.3. Cost-benefit calculations			• private sector and consumers pay under the fortification model **+ IR: 14, 20**	• bio-fortification requires one-time public cost, after which farmers and traders deliver vitamin enriched diet **+ IR: 5, 20, 25**	• bio-fortification require one-time public cost, after which farmers and traders deliver vitamin enriched diet **+ IR: 5, 20**
2.4. Design spillovers	• supplementation recommended by WHO, UNICEF for vulnerable groups • links to CHW immunization campaigns emulated • Horton et a. 2008 **+ IR: 14,15,24**	• Standard was apparently imported, possibly from Britain **+ IR: 18**	• Guatemala example invoked repeatedly • Serlemitsos and Fusco (2001) **+ IR: 3, 6, 8, 14, 15, 20, 24**	• CIP promotes bio-fortification breeding • bio-fortification prevents hyper-vitaminosis • Kaunda 2010 **+ IR: 6, 20, 25**	• Harvest Plus, CIMMYT breeding protocols • bio-fortification prevents hyper-vitaminosis **+ IR: 4, 6, 20**
3. Adoption					
3.1. Propitious timing		• 1972 food act required standards; international standards reviewed include fortification **+ IR: 18**			
3.2. Veto players					
3.3. Relative power of proponents vs. opponents	• no opponents initially		• no opponents initially • maize millers decline to fortify • monopolist sugar	• no opponents • ZARI breeders empowered to set priorities	• no opponents, after Statehouse reassured about conventional, non-GMO breeding

	+ IR: 5, 6, 11, 12, 14, 15, 20, 24		company enthusiastic about preventing import competition • Serlemitsos & Fusco 2001 • Lusaka Times 2009 • Ellis et al. 2010 • Chisanga et a. 2014a,b **+ IR: 1, 17, 19, 26**	**+ IR: 25**	• ZARI breeders empowered to set priorities **+ IR: 4**
4. Implementation					
4.1. Institutional capacity	• CHW programs provide infrastructure • MCDMCH strengthened **+ IR: 5, 6, 11, 14, 15, 21, 22, 23, 24**		• poor monitoring capacity • Serlemitsos and Fusco 2001 • MOST et al 2003 **+ IR: 8, 10, 11, 24**		
4.2. Requisite budgetary allocations	• donor support fluctuates • GOZ meager funding **+ IR: 5, 6, 11, 14, 15, 24**				• Harvest Plus supports promotion and expensive testing • USAID supports trials **+ IR: 4,6**
4.3. Commitment of policy champions	• NFNC • UNICEF • CSO-SUN **+ IR: 2, 5, 6, 11, 12, 14, 15, 24**		• USAID and UNICEF strongly support fortification mandate • Serlemitsos 2001 • NFNC 2011 **+ IR: 6,8,10,11,21**	• CIP supplies breeding lines • ZARI funds research; Luapula station makes VAD a priority • SPHI 2012 **+ IR: 25**	• Harvest Plus (2015) • CIMMYT • ZARI **+ IR: 4,6**
5. Evaluation and reform					
5.1. Changing conditions			• strong opponents emerge (Parliament, CCPC, academics, CUTS) • Lusaka Times 2009 • Ellis et al. 2010 • Chisanga et al.	• hyper-vitaminosis emerges in some groups • reduced donor funding for supplements • Tanumihardjo et al 2015	• hyper-vitaminosis emerges in some groups • reduced donor funding for supplements • Tanumihardjo et al 2015

			2014a,b • CUTS 2014, 2015 • Chanda 2014 **+ IR: 1, 5, 8, 17, 26**	**+ IR: 6, 20**	**+ IR: 6, 9, 20**
5.2. Changing information or beliefs of veto players and champions	• evidence of limited impact of supplementation programs • disease burden reduces impact of supplements • MOST et al. 2003 • Mason et al. 2014 **+ IR: 5,6,11,24**		• limited reductions in VAD observed from supplementation • NFNC feels need to expand avenues for increasing VA intake • limited sugar testing; low levels in reported tests • Serlemitsos & Fusco 2001 • NFNC 2005 • Mason et al. 2014 **+ IR: 10, 11, 24**	• limited reductions in VAD from supplementation • bio-fortification offers: a) an additional VA conduit; b) protection against over-dosing • SPHI 2012 • Gannon et al. 2014 • Tanumihardjo et al 2015 **+ IR: 5, 20**	• limited reductions in VAD observed from supplementation • bio-fortification offers: a) an additional VA conduit; b) protection against over-dosing • Gannon et al. 2014 • Tanumihardjo et al 2015 **+ IR: 5, 20**
5.3. Available resources relative to cost					

Legend: **IR** = interview respondent number.

Table E.3. Iron – Data Matrix for Kaleidoscope Hypothesis Testing

	Supplementation Pregnant women	**Supplementation Adolescent girls**	**Fortification Maize meal 2006**	**Bio-fortification Beans**
Actor:	• MOH ante-natal clinics (ANC) • MCDMH • donors	• MOH ANC • MOE SHN • donors	• NFNC • GAIN • MOH • maize millers • Statehouse	• MAL (ZARI) • CIAT • HarvestPlus • SABRN
Policy Action:	• iron and folic acid supplements for pregnant women through ante-natal clinics (ANC)	• adolescent girls in selected schools through school health and nutrition (SHN) programs at MOE	• mandatory maize meal fortification: trials conducted, standards prepared • President's Office vetoes mandate at the last minute, during standards review	• bean breeding with CIAT lines high in Fe and Zn • 20 lines evaluated • NUA45 released in 2013
1. Agenda setting				
1.1. Powerful advocates	• MOH • NFNC • WHO **+ IR: 5,6,11,12, 14,15,21,24**	• NFNC • MOH • UNICEF	• NFNC, MOH • GAIN • maize millers • donors **+ IR: 3,4,5,6,9, 11,14,15**	• HarvestPlus • CIAT • USAID **+ IR: 6, 7**
1.2. Focusing events	• 1990 UNICEF World Summit for Children • 1998 national anemia study (NFNC 1999) • Lancet series on micronutrients **+ IR: 2, 14,15**	• 1997/8 survey showing poor compliance and impact of supplementation	• 1998 anemia survey shows poor compliance with supplements (NFNC 1999) • 2003 VAD survey showing limited impact of iron supplements (MOST et al. 2003) • Fielder 2014 **+ IR: 14, 15**	
1.3. Recognized, relevant policy problem	• anemia is a widely recognized problem,	• 1997 VAD study (NFNC 1997)	• 1997 VAD study (NFNC 1997)	• 1997 VAD study (NFNC 1997)

	particularly among pregnant women **+ IR: 5,6,11,12, 14,15,21,24**	• 1998 Anemia study (NFNC 1999) **+ IR: 5,6,11,12, 14,15,21,24**	• 1998 Anemia study (NFNC 1999) **+ IR: 5,6,11,12, 14,15,21,24**	• 1998 Anemia study (NFNC 1999) **+ IR: 5,6,11,12, 14,15,21,24**
2. Design				
2.1. Pressing vs chosen problems				
2.2. Ideas and beliefs			• rumors about fertility impact, food safety **+ IR: 3,4,5,6,9,14, 24**	
2.3. Cost-benefit calculations	• high cost • uncertain impact because of low compliance and high malaria prevalence **+ IR: 5,11,15,24**	• cost high **+ IR: 5,11,15,24**		• one-time breeding investment makes high-iron varieties available to farmers and food industry **+ IR: 5,6,7,20**
2.4. Design spillover	• standard supplementation protocols • Horton et al 2008 • NFNC 2011			• CIAT breeding lines supplied • SABRN (regional research network) support **+ IR: 5,6,7**
3. Adoption				
3.1. Propitious timing				
3.2. Veto players			• Statehouse vetoes mandatory fortification **+ IR: 3,4,5,9,11, 14,15**	
3.3. Relative power of proponents vs. opponents	• no opponents initially • cost and budget constraints limit adoption **+ IR: 5,11,24**	• no opponents initially • cost and budget constraints limit adoption **+ IR: 5,11,24**		• no opponents • ZARI breeders set priorities **+ IR: 5,6,7,11,20**
4. Implementation				
4.1. Institutional	• manpower limits • health care system			

capacity	challenges of staffing, funding, distance and delays • Harris and Drimie 2012 • NFNC 2011 **+ IR: 11,24**			
4.2. Requisite budgetary allocations	• costly • GOZ budget limited **+ IR: 11,24**	• donor support drives program levels **+ IR: 11,24**		
4.3. Commitment of policy champions	• donor support essential for financing **+ IR: 2,11,24**			• HarvestPlus • USAID **+ IR: 6,7**
5. Evaluation and reform				
5.1. Changing conditions				
5.2. Changing information or beliefs of veto players and champions	• supplementation challenges: low but growing compliance, limited impact • Pemba iron study finds supplements in high malaria zones harmful • Sazawal et al 2006 • Prentice 2008 **+IR: 5, 11,24**			
5.3. Available resources relative to cost	• UNICEF reduces funding for supplements **+IR: 5,6,24**	• donor support drives program levels **+ IR: 11,24**		

Legend: **IR** = interview respondent number.

Table E.4. Vitamin D Fortification of Margarine – Data Matrix for Kaleidoscope Hypothesis Testing

	1978	Comments
Date:	September 1978	
Actor:	Minister of Health	
Policy Action:	SI 133 mandates margarine fortification • A: 26-33 intl units/gram • D: 3-4 IU/gram	
1. Agenda setting		
1.1. Focusing events	• 1972 Food and Drugs Act leads ZABS to establish standards for a broad range of food commodities. **+ IR: 18**	This looks like an accidental policy, a good example of "contagion inoculation". No evidence of Vitamin D deficiency. No urgent need. As ZABS issued standards, their ZABS technical people apparently borrowed from elsewhere.
1.2. Powerful advocacy coalitions		Who promoted this fortification mandate?
1.3. Recognized, relevant policy problem:	NO. **+ IR: 11, 14, 15, 18**	Is Vitamin D deficiency a problem in Zambia? All interview respondents say NO.
2. Design		
2.1. Pressing vs chosen problems		
2.2. Ideas and beliefs		
2.3. Cost-benefit calculations		• Margarine in not widely consumed by vulnerable groups. MOST et al. 2005, p.4 **+ IR: 25**
2.4. Design spillovers	• Standard was apparently imported, possibly from Britain. **+ IR: 18**	
3. Adoption		
3.1. Propitious timing	Timing appears accidental. ZABS needed standards, so they appear to have imported off-the-shelf standards from abroad. **+ IR: 18**	Contagion inoculation hypothesis.
3.2. Veto players		
3.3. Relative power of proponents vs. opponents		No obvious proponents. VAD is not a problem in Zambia
4. Implementation		
4.1. Institutional capacity		

4.2. Requisite budgetary allocations		
4.3. Commitment of policy champions		Nobody in the public health community indicates vitamin D is a problem. We found no champions of vitamin D fortification during our interviews.
5. Evaluation and reform		
5.1. Changing conditions		
5.2. Changing information or beliefs of veto players and champions		
5.3. Available resources relative to cost		

Legend: **IR** = interview respondent number.