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Full Length Research Paper

Adoption of orange-fleshed sweetpotato varieties by urban consumers in Maputo, Mozambique

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Biofortified orange-fleshed sweetpotato (OFSP) cultivars are being promoted in Sub-Saharan Africa as a strategy to reduce vitamin A deficiency among young children. Several studies have addressed the adoption of OFSP by farmers. This paper addresses the level of adoption of OFSP by urban consumers of Maputo in Mozambique by comparing survey data from 2014 and 2017. Adoption is analyzed in four steps: having knowledge about OFSP, consuming OFSP, consuming OFSP by choice and using it to feed young children. It assesses the role of social economic status, supply and quality changes in adoption and looks at the extent at which the promotion of OFSP for supplementary feeding has been successful. It concludes that the percentage of the population of Maputo who eat OFSP has increased significantly in particular in the city's wealthier district, proving that OFSP is now an accepted source of vitamin A by all strata in society.

Keywords: Biofortification, sweetpotato, urban consumers, innovation, inequality, Maputo, Mozambique.

INTRODUCTION

Deficiencies of micronutrients such as vitamin A have important impacts on people's health. Most vulnerable are pregnant and lactating women and young children. The consequences of micronutrient deficiencies during the first thousand days after conception can be felt throughout the individuals' lifetime (WHO and UNICEF 2003). There are two basic solutions to micronutrient deficiencies: supplementation and food-based approaches (Bouis, et al. 2011) (Ruel, Alderman e The Maternal and Child Nutrition Study Group 2013). Food-based approaches are used in many low-income countries to address poverty-related micronutrient malnutrition (Demment, Michelle M. Youngy e Sensenig 2003). Biofortification supports food-based approaches by improving the nutritional quality of food crops through agronomic practices, conventional plant breeding, or modern biotechnology (Bouis, et al. 2011; WHO 2016).

Orange-fleshed sweetpotato (OFSP) roots are a good example of successful biofortification (Ruel, Alderman and The Maternal and Child Nutrition Study Group 2013). In Sub-Saharan Africa sweetpotato is widely produced but the available varieties are typically white or yellow-fleshed. Conventional breeding has resulted in orange-fleshed cultivars. These are rich in beta-carotene, a pre-cursor for vitamin A. Consuming them on a regular basis improves one's retinol level in the blood (Low, et al., 2007). Therefore, they are an effective option to reduce vitamin A deficiency (Global Panel 2015; WHO 2016).

In Mozambique, the effort to promote OFSP farming and consumption started in the mid-1990s. In the early 2000s the results of a pilot study in Central Mozambique provided a proof of concept (Low, et al. 2007; Jenkins, Byker Shanks e Houghtaling 2015). Initially, imported cultivars were used but these appeared not fully adjusted to local conditions. In 2011, 15 new, locally bred, cultivars were released. These are better adapted to the local climate and thanks to a higher dry-matter content to local taste preferences (Andrade et al. 2017). Their release was accompanied by dissemination campaigns and by efforts to raise awareness of the importance of vitamin A and OFSP for pregnant and lactating women and young children.

The incorporation of orange-fleshed cultivars in agricultural production requires also the development of markets of fresh and processed OFSP roots so that demand can match production (Low, et al. 2007). A good example of processed OFSP is 'golden' bread (Low and van Jaarsveld 2008; Awuni et al. 2018). Moreover, the development of markets creates the possibility to supply OFSP roots and products to urban consumers, among whom in particular the poor are also affected by food insecurity and micro-nutrient deficiencies (Crush and Frayne, 2010; Daboné et al. 2011; Crush et al. 2012). Providing them with OFSP can help to improve their nutrition status.

Sweetpotato biofortification is an example of technological innovation. Jenkins et al. (2018) analyze the factors that determine adoption of orange-fleshed (OFSP) varieties by farmers using Rogers' (2003) five-step model of innovation: knowledge, persuasion, decision, implementation, and confirmation. The benefits and costs of Innovation are frequently not equally distributed across society (Cozzens and Thakur, 2014). Brito et al. (2012) argue that sweetpotato by its nature is easily accessible for small-scale and resource-poor producers. Contrary to seed propagated crops such as maize, sweetpotato is vegetatively propagated. As a result, the improved genetic characteristics are retained from one generation to the next. As farmers do not rely on seed suppliers at each production cycle, sweetpotato contributes to 'seed sovereignty' (Adhikari, 2014). Further, sweetpotato is mostly grown and eaten by the poorer strata, which means that these easily reap the nutritional benefits of biofortified cultivars (Mitra 2012; Jenkins et al., 2015). However, research shows that access of urban dwellers to nutritious food is often skewed according to where people live, their socio-economic status and the transformations of the food system (Dixon, et al. 2007; Vlismas et al. 2009; Vearey, et al., 2010).

Work has been done on the adoption of healthy food by consumers in western countries focusing on social marketing within a behavioral perspective model (Al Kurdi, 2016), health literacy and neophobia (Luis and Luis 2016). Work on dietary change in non-western urban contexts focuses often on socio-economic and cultural factors (Monge-Rojas et al., 2005; Puoane et al., 2006). In the case of OFSP the emphasis has been on the adoption among rural populations (Low et al. 2007; Jenkins et al. 2015), and associated with nutrition education (Caeiro and Vicente 2013; Mutiso et al. 2018). Naico and Lusk (2010) investigated the willingness of consumers in Mozambique to consume OFSP using data from a choice experiment with rural and urban sweetpotato shoppers. Their results point at the importance of dry matter for consumer acceptance of new sweetpotato cultivars.

This paper studies the adoption of OFSP by urban consumers. It focuses on Maputo City, the capital of Mozambique. With more than one million inhabitants, it is the country's largest city (INE 2010a). In 2014 it became target of OFSP promotion through a project financed by the government of the United Kingdom called SUSTAIN – Scaling-Up Sweetpotato Through Agriculture and Nutrition. This project aimed at (1) scaling out biofortified OFSP varieties by distributing planting material among rural households; (2) improving nutrition conditions of women and children under five in these households by nutrition education and the incorporation of OFSP in their diets; and (3) scaling up into urban markets through the development of fresh and processed roots value chains linking smallholders, processors and urban consumers (Heck 2015). The paper wants to answer three questions: Have urban consumers adopted OFSP as part of their diet? Do the poorer strata in society have preferential access to the benefits of biofortified sweetpotato varieties? And is OFSP used for complementary feeding of young children?

METHODOLOGY

The study analyses data collected in 2014 and 2017. Trained female and male university students and recent graduates interviewed pedestrians at different locations across six urban districts (DU1-DU6) collecting data about the socio-economics of the respondents' households and sweetpotato consumption and production. The 2014 and 2017 questionnaires are slightly different. The sequence of some questions in the 2017 questionnaire was modified to improve ease of flow during the interview and two new questions were added to address the perception of changes in availability and quality of OFSP. There is no reason to believe that these changes have affected the results.

Data were collected through street interviews. This method is cheap and fast as there is no need to use a costly and complex sampling frame such as household listings. Non-response is low as people are relatively accessible; the few people refusing to take part can easily be substituted by the next available person. Finally, there is evidence that during street interviews people may disclose more sensitive information than during telephone and household interviews (Akbar Haghdoost et al. 2013; Nasirian et al. 2018). By the same token, people who are forced to stay at home have a lower probability to be interviewed. Moreover, the selection of interviewees is basically left to the enumerators, who may unconsciously choose respondents they can easily relate to (Katz 1942). Enumerators interviewed 712 pedestrians in 2014 and 761 in 2017. Out of the 2017 interviews, 32 were rejected. These interviews had been carried out at the entrance of the city's main university and tilted the sample towards younger and higher educated respondents.

After this correction, differences between the 2014 and 2017 samples with regard to the respondents' gender ($Chi^2(1, 1441)=2.210$, p=0.137) and age (Mann-Whitney U Test, p=0.089) were no longer significant. For subsequent data analysis, only residents of Maputo City's six urban districts were selected (656 for 2014 and 572 for 2017). To control for selection bias population means were weighted according to the proportions of the populations of the six urban districts in the total population (Duflo et al., 2007). Population data were obtained from the 2014 and 2017 projections by Mozambique's National Bureau of Statistics (INE 2010b).

Analysis focuses on seven variables: three describing the respondent's socio-economic position and four describing adoption. Socio-economic status variables covered are gender of the head of household (Kennedy e Peters 1992), education (Wedgewood 2005; Luis and Luis 2016), occupation (Vlismas et al. 2009) and the area of residence (Vearey et al. 2010). In the case of Maputo, people who live in the city's central district DU1 are generally better-off than those in the other areas (INE 2010a; Tvedten et al., 2013). The group of variables describing adoption consists of eating sweetpotato, having heard or knowing about OFSP, eating OFSP, eating OFSP by choice and using OFSP to feed a young child. These variables correspond to three of the five steps of adoption proposed by Rogers (2003): knowledge, decision and confirmation.

Table 1 compares the socioeconomic variables for 2014 and 2017 after weighting. There is no significant difference regarding the gender and the area of residence of the respondents between the samples and the general demography. There are significant changes in the level of education. These changes match with the growth of post-primary education in Mozambique reported by UNESCO (UIS 2018). Changes in the source of income are probably the result of the increase in enrolment in education combined with the economic crisis triggered by the discovery of 'hidden debts' late 2015 (Ballard, 2018). This discovery led to a depreciation of the national currency, price hikes in essentials such as transport and bread (Deutsche Welle, 2017), the closure of businesses and unemployment (Deutsche Welle, 2016). This crisis may also explain the reduction of the percentage of female headed households as people opt to share living arrangements to cope with economic hardship (Wiemers, 2014).

RESULTS AND DISCUSSION

Eating orange

The figures in Table 1 show that between 2014 and 2017 there are statistically significant changes in the consumption of sweetpotato in general and of orange-fleshed roots in particular. There is a decrease in the percentage of households not consuming sweetpotato by 2.8%. This decrease is not statistically significant ($Ch^2(1, 1217)=2.201$, p=0.138). Significant are changes in the proportion of respondents eating sweetpotato all year and eating the crop seasonally (p=0.000), probably due to an increase in the seasonality of supply. There are also significant changes in the frequency of sweetpotato consumption (p=0.000). The percentage who consume sweetpotato less than once a month decreased by 11.2% and those eating it up to once a day increased by 9.3%.

The percentages who are aware OFSP and who consume OFSP increased by about 13% and 21% respectively. The percentage of households who consume OFSP in at least two-thirds of the meals containing sweetpotato increased from 12.3% to 30.4%. This shows that orange-fleshed have successfully replaced white-fleshed sweetpotato roots in the diet of Maputo City's residents: orange has become the new root.

There are two factors contributing to consumers substituting OFSP for white-fleshed roots: supply and quality of OFSP roots. In the 2014 survey, 36.3% of those (26.2%) who didn't buy OFSP indicated that it was not available on the market. In 2017, only 11.0% of those (26.4%) who didn't buy OFSP gave the same reason. Of those consuming OFSP in 2017 more than one-third (38.4%) believed that OFSP was more available than three years earlier (in 2014). An appraisal at five markets in Maputo City confirms that the number of sweetpotato retailers and the percentage selling OFSP have increased (Table 2). About 35% of those consuming OFSP in 2017 felt that its quality had improved. This matches with the release and dissemination of varieties with a higher dry matter content (Andrade et al., 2017).

Table 1 presents also the usage of OFSP for young child feeding. The percentage of households who use OFSP for complementary feeding declined by 13% from 44% in 2014 to 31% in 2017. The percentage of households with a young child using OFSP deceased from 68% in 2014 to 44% in 2017. This change is highly significant ($Chi^2(1, 800)=44.333$, p=0.000). Thus, despite the overall increase in OFSP consumption and the emphasis on the use of OFSP for complementary feeding, the use of OFSP for child nutrition has declined.

Orange and equality

The above results show that OFSP has penetrated the Maputo food-system replacing part of white-fleshed roots in the urban diet. But is the level of penetration equal across society? Table 4 summarizes the results of Spearman's correlation test for 2014 and 2017. It presents the association between socio-economic factors (area of residence, gender of the head of household, level of education and employment status) with indicators of adoption: eating sweetpotato, knowing about OFSP, eating OFSP and using OFSP to feed a young child.

Table 1. Comparison of key sample descriptors for 2014 and 2017 (weighted).

Sample	2014		2017		Change	Significance	
	N	%	N	Valid %	%	Chi^2	p
Sample size (Maputo City)	656	100.0	572	100.0	0.0	-	-
Gender of respondent	641	100.0	561	100.0	0.0	0.982	0.322
- Female	305	47.6	283	50.4	2.8		
- Male	336	52.4	278	49.6	-2.8		
Respondent goes to school	654	100.0	570	100.0	0.0	25.359	0.000
- Yes	225	34.3	277	48.6	14.3		
- No	429	65.7	293	51.4	-14.3		
Gender of household head	654	100.0	569	100.0	0.9	20.190	0.000
- Male	480	73.4	478	83.9	10.5		
- Female	174	26.6	91	16.1	-10.5		
Area of residence	656	100.0	572	100.0	0.0	2.250	0.814
- DU1	70	10.7	50	8.8	-1.9		
- DU2	90	13.7	71	12.4	-1.3		
- DU3	127	19.4	109	19.1	-0.3		
- DU4	174	26.6	160	27.9	1.3		
- DU5	183	27.9	171	29.8	1.9		
- DU6	12	1.8	11	1.8	0.0		
Level of education	649	100.0	567	100.0	0.0	139.035	0.000
- None	23	3.6	15	2.7	-0.9		
- Can read and write	83	12.8	52	9.2	-3.6		
- Primary	263	40.6	92	16.2	-24.4		
- Secondary	213	32.8	231	40.8	8.0		
- Technical	30	4.6	76	13.4	0.0		
- Higher	34	5.2	84	14.9	9.7		
- Vocational training	2	0.4	16	2.9	2.5		
Main source of income	635	100.0	567	100.0	0.0	361.444	0.000
- None	22	3.5	33	5.9	2.4		
- Unemployed - Student	69	10.9	156	27.5	16.6		
- Unemployed –Sick	2	0.3	1	0.2	-0.1		
- Self-employed	303	47.7	185	32.5	-15.2		
- Employed (private)	101	15.9	117	20.6	4.7		
- Civil servant	138	21.7	75	13.2	-8.5		

The 2014 data show a very weak positive statistically significant correlation between area of residence and eating OFSP suggesting that fewer residents of urban districts with a lower number such as DU1 ate the crop than those in the districts with higher numbers. For the 2017 data, this correlation is significant but negative, which indicates that in 2017 OFSP was more widely consumed in the lower numbered districts. The figures for 2014 suggest that gender of the head of household and education and main source of income of the respondent do not influence adoption. In 2017, education and eating white and orange-fleshed varieties are positively and using them to feed a child negatively correlated.

Spearman's correlation test assumes that the variates are in a ranked order. This is true for gender (as there are only two), education and employment, but not for area of residence: the sequence of the districts is administrative. For this non-ordinal variable, a Chi-square analysis has been carried out crossing the area of residence with the adoption variables. The results are summarized in Table 3. They confirm that the area of residence is significantly correlated with eating sweet potato in general (in 2017) and with the use of OFSP for complementary feeding (in 2014 and 2017). It does not seem to influence the consumption of OFSP in 2014 and 2017 and knowing about OFSP in 2017. It appears that the influence of the area of residence on OFSP adoption decreased between 2014 and 2017 except for using it to feed a child.

To better understand the results in Table 3 the data for the wealthiest urban district (DU1) are compared with those of the other five districts. Only one statistically significant difference is observed. In 2014 the percentage of households eating OFSP was higher among respondents from outside DU1 (70.9% against 52.1%). This difference in OFSP consumption has disappeared in 2017. However, in 2017, the percentage of households in

Table 1. Sweetpotato adoption descriptors for 2014 and 2017 (weighted).

Sample	2014		2017		Change	Significance	
	N	%	N	Valid %	%	Chi^2	p
Sample size (Maputo City)	656	100.0	572	100.0	0.0	-	-
Eats sweetpotato (SP)	652	100%	565	100.0	0.0	33.430	0.000
- Yes, all year	175	26.9	83	14.7	-12.2		
- Yes, during the season	382	58.6	416	73.6	15.0		
- No	95	14.5	66	11.7	-2.8		
Number of meals with SP	628	100.0	537	100	0.0	22.111	0.000
- Less than one per month	221	35.2	129	24.0	-11.2		
- Less than oneper week	216	34.5	187	34.8	0.3		
- Up to one per a day	138	21.9	168	31.2	9.3		
- More than one per day	53	8.5	54	10.0	1.5		
Knows about OFSP	655	100.0	568	100.0	0.0	68.621	0.000
- Yes	559	85.3	560	98.6	13.3		
- No	96	14.7	8	1.4	-13.3		
Eats OFSP	639	100.0	565	100.0	0.0	78.443[a]	0.000[a]
- Yes, by chance	441	69.0	298	52.7	21.0		
- Yes, by choice			210	37.3			
- No	198	31.0	57	10.0	-21.0		
% of SP meals with OFSP	560	100.0	526	100.0	0.0	116.850	0.000
- Less than 1/3	395	70.6	214	38.6	-32.0		
- Less than 2/3	87	15.5	149	27.0	11.5		
- More than 2/3	69	12.3	168	30.4	18.1		
- All	9	1.7	22	4.0	2.3		
Uses OFSP to feed a child	632	100.0	550	100.0	0.0	47.883	0.000
- Yes	279	44.2	171	31.0	-13.2		
- No, there was no child	219	34.6	163	29.6	-5.0		
- No, there was a child	134	21.2	216	39.3	18.1		

[a] Two x two table.

Table 2. Number of sellers of sweetpotato(SP) and OFSP on five selected markets in Maputo City in 2015 and 2018 (headcount).

Market	2015			2018			Change	
	SP	OFSP	% OFSP	SP	OFSP	% OFSP	SP	OFSP
Central	13	7	54%	29	26	90%	123%	271%
Fajardo	8	2	25%	15	13	87%	88%	550%
Janete	6	3	50%	10	6	60%	67%	100%
Xiquelene	17	1	6%	28	24	86%	65%	2300%
Zimpeto	7	5	71%	36	25	69%	414%	400%
Sum	51	18	35%	118	94	80%	131%	422%

Table 4. Results of Spearman's correlation test for selected variables in the 2014 and 2017 surveys (unweighted).

Variable		Consumes SP		Aware of OFSP		Consumes OFSP		Feeds OFSP to child	
		2014	2017	2014	2017	2014	2017	2014	2017
Area of residence	Rho	-0.091	-0.163	-0.039	0.111	0.122	-0.084	0.080	-0.008
	p	0.020	0.000	0.324	0.008	0.002	0.045	0.044	0.853
Gender Head of Household	Rho	-0.014	0.026	0.064	0.058	-0.001	0.010	0.016	0.051
	p	0.726	0-535	0.104	0.163	0.977	0.813	0.689	0.230
Education	Rho	0.000	0.151	-0.006	-0.012	-0.062	0.205	0.140	-0.132
	p	0.997	0.000	0.881	0.767	0.118	0.000	0.729	0.002
Main source of income	Rho	-0.018	0.047	-0.111	-0.023	-0.024	0.038	-0.028	-0.089
	p	0.646	0.263	0.005	0.590	0.540	0.367	0.490	0.036
Consumes SP	Rho	-	-	0.098	0.086	0.403	0.130	-0.091	0.106
	p	-	-	0.012	0.041	0.000	0.002	0.020	0.013

DU1 using OFSP for complementary feeding (68.0%) is significantly higher than in the rest of the city (41.9%) (Table 4).

The figures in Table 4 indicate that in 2014 sweetpotato and OFSP were more accepted in the poorer districts, supporting the general notion of 'sweetpotato as a poor

Table 3. Results of Chi-square tests for district of residence against adoption indicators (unweighted).

	Eats SP		Knows OFSP		Consumes OFSP		Uses OFSP for child	
	2014	**2017**	**2014**	**2017[a]**	**2014**	**2017**	**2014**	**2017**
Chi^2	9.080	15.186	20.643	14.326	8.870	8.565	36.745	54.986
Degrees of freedom	5	5	5	5	5	5	10	10
Significance (p)	0.169	0.019	0.001	0.014	0.181	0.200	0.000	0.000
N	561	570	655	575	636	572	630	556
% of cells less than 5	0	0	0	50	0	0	0	0

[a]Only 13 respondents didn't know OFSP. Chi square does not produce a valid result.

Table 4. Adoption of OFSP by residence in 2014 and 2017 comparing DU1 with the rest of the city (unweighted).

	2014				2017			
	N	**%**	**Chi^2**	P	**N**	**%**	**Chi^2**	**P**
	Eats sweetpotato							
DU1	38	76.0	4.007	0.045	52	86.7	0.417	0.518
Other	519	86.4			456	89.5		
	Knows OFSP							
Du1	40	80.0	Fisher	0.417	60	100.0	Fisher	0.380
Other	512	84.6			502	97.4		
	Eats OFSP							
DU1	25	52.1	7.427	0.006	55	91.7	0.161	0.688
Other	417	70.9			461	90.3		
	Feeds OFSP to young child[1]							
DU1	12	57.1	0.533	0.466	34	68.0	11.957	0.001
Other	254	65.0			143	41.9		

[1] Households without young children excluded.

man's food'(Mitra 2012). This has totally changed in 2017. The percentages eating either sweetpotato in general or OFSP among the respondents from DU1 do not differ anymore from those from the other districts. There is however a difference in the drivers of adoption. There are basically two possible explanations for eating OFSP. The first is that people eat it by chance (i.e., without intending to). This is because producers and traders often mix varieties. Hence a person who buys sweetpotato may find that some of them are white and others orange-fleshed (Tedesco and Brouwer, 2016). In this case the growth of consumption is the result of the increase in supply. The second reason is by choice: people eat OFSP because they actively decide to do so. Table 7 compares these explanations across the city's districts. It shows that the percentage of respondents from DU1 who ate OFSP by choice is almost 25% higher than that from the other districts ($Ch^2(2)=14.945$, $p=0.001$). Thus, while the increase in OFSP in most parts of the city results primarily from a higher availability, in DU1 it is more the result of a conscious decision: for many in DU1 eating orange has become the favourite choice.

CONCLUSIONS

The paper answers three questions: Have consumers accepted or rejected OFSP? Do the data confirm that the poorer strata in society have – preferential – access to the benefits of biofortified sweetpotato varieties? And does biofortification reach its targeted populations in the sense that it is used to improve the nutritional status of the most vulnerable to vitamin A deficiency (VAD)? In other words, is there an increase in its use for complementary feeding of young children?

The data show that between 2014 and 2017 the percentages of the Maputo population who know about OFSP and eat it have grown significantly. Moreover, many now consciously choose orange-fleshed roots. This indicates that OFSP is progressively adopted by the consumers. Adoption is driven by increased availability, improved quality and consumer preference. Poorer strata – notably those residing outside DU1 – do have access to OFSP. However, any predilection towards poorer urban districts that existed in 2014 and matched with the pro-poor bias postulated by Brito et al. (2012) has disappeared over the 2014-2017 period. Apparently, OFSP's pro-poor bias no longer exists. To the contrary, OFSP is now the preferred option of many of those who live in the city's wealthier district. Lastly, it appears that the role of OFSP as a complementary food item for young children has decreased in particular in the poorer sections of the city. Thus, while the OFSP innovation has been successful as to adoption for consumption it has been less successful in contributing to the improvement of the nutritional status of the children most vulnerable to vitamin A deficiency.

Table 7. Motive for eating OFSP in 2017 (unweighted).

	Eats OFSP by chance		Eats OFSP by choice		Does not eat OFSP		Total	
	n	%	n	%	n	%	n	%
DU1	21	35.0	34	56.7	5	8.3	60	100.0
Others	298	58.2	163	31.8	51	10.0	512	100.0
All	319	55.8	197	34.4	56	9.8	572	100.0

Declaration of interest

The author declares that there are no conflicts of interest.

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REFERENCES

Adhikari, Jagannath. "Seed Sovereignty: Analysing the Debate on Hybrid Seeds and GMOs and Bringing About Sustainability in Agricultural Development." *Journal of Forest and Livelihood* 12, no. 1 (October 2014).

Akbar Haghdoost, A, M. Reza Baneshi, S. Eybpoosh, and R. Khajehkazemi. "Comparison of three interview methods on response pattern to sensitive and non-sensitive questions." *Iranian Red Crescent MedicalJournal* 15, no. 6 (2013): 500-506.

Al Kurdi, Barween Hikmat. *Healthy Food Choice and Purchasing Behaviour Analysis: An Exploratory Study of Families in the UK.* Durham: Durham University, 2016.

Andrade, M., et al. "Release of orange-fleshed sweetpotato (Ipomoea batatas (l.) Lam.) cultivars in Mozambique through an accelerated breeding scheme." *Journal of Agricultural Science*, 2017.

Annunziata, Azzurra, and Paola Pascale. "Consumers' behaviours and attitudes toward healthy food products: The case of organic and functional foods." *Paper prepared for presentation at the 113th EAAE Seminar "A resilient European food industry and food chain in a challenging world", September 3 - 6, 2009.* Chania, Crete, Greece, 2009.

Awuni, Victoria, Martha Wunnam Alhassan, and Francis Kweku Amagloh. "Orange-fleshed sweet potato (*Ipomoea batatas*) composite bread as a significant source of dietary vitamin A." *Food Science & Nutrition* 6, no. 1 (2018): 174-179.

Ballard, Barclay. "Mozambique's dramatic economic reversal." *World Finance*, July 2018.

Blasbalg, Tanya L., Bram Wispelwey, and Richard J. Deckelbaum. "Eco-nutrition and utilization of food-based approaches for nutritional health." *Food and Nutrition Buletim* 32(1) suppl (2011): 1 S4-S13.

Bouis, H.E., C. Hotz, B.V.J. McClafferty, and W.H. Pfeiffer. "Biofortification: A New Tool to Reduce Micronutrient Malnutrition." *Food and Nutrition Bulletin* 32, no. 1_suppl1 (2011): S31–S40.

Brito, Lídia, Roland Brouwer, and Mário Falcão. "Sweetpotato—Biotechnology in different guises on a broad range of scales." *Technological Forecasting & Social Change* 79, no. 2 (2012): 204–212.

Burry, Betty J. "Evaluating Sweet Potato as an Intervention Foodto Prevent Vitamin A Deficiency." *ComprehensiveReviewsinFoodScienceandFoodSafety* 10, no. 2 (2011): 118-130.

Caeiro, Rute, and Pedro C. Vicente. *Vitamin A Deficiency and Training to Farmers: Evidence from a Field Experiment in Mozambique. OVAFRICA Working Paper Series No. 1305.* 2013.

Cozzens, Susan, and Dhanaraj Thakur. "Chapter One: Introduction." In *Innovation and Inequality: Emerging Technologies in an Unequal World*, by Susan Cozzens and Dhanaraj Thakur (eds.), 3-22. Cheltenham (UK) and Northampton (USA): Edward Elgar, 2014.

Crush, J., and B. Frayne. "The Invisible Crisis: Urban Food Security in Southern Africa." *Kingston, ON and Cape Town: African Food Security Urban Network. Urban Food Security Series No. 1.*, 2010: 1-48.

Crush, Jonathan, Bruce Frayne, and Wade Pendleton. "The Crisis of Food Insecurity in African Cities." *Journal of Hunger & Environmental Nutrition* 7 (2012): 271–292.

Daboné, Charles, Hélene F. Delisle, and Olivier Receveur. "Poor nutritional status of schoolchildren in urban and peri-urban areas of Ouagadougou (Burkina Faso)." *Nutrition Journal* 10 (2011): 34.

Demment, Montague W., Michelle M. Michelle M. Youngy, and Ryan L, Sensenig. "Providing Micronutrients through Food-Based Solutions: A Key to Human and National Development." *The Journal of Nutrition*, 2003: 3879S-3885S.

Deutsche Welle. "Criseem Moçambique: Greve dos transportadores e aumento do preço do pão." 03 04 2017.

https://m.dw.com/pt-002/crise-em-moçambique-greve-dos-transportadores-e-aumento-do-preço-do-pão/a-38275751 (accessed 10 30, 2018).

—. "Empresasmoçambicanasenfrentamdificuldadesdevido a crise." 16 07 2016. https://m.dw.com/pt-002/empresas-moçambicanas-enfrentam-dificuldades-devido-a-crise/a-19395936 (accessed 10 30, 2018).

Dixon, Jane, Abiud M. Omwega, Sharon Friel, Cate Burns, Kelly Donati, and Rachel Carlisle. "The Health Equity Dimensions of Urban Food Systems." *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 84, no. 1 (2007): 1118-1128.

Duflo, Esther, Rachel Glennerster, and Michael Kremer. *Using Randomization in Development Economic Research: A Toolkit. Discussion Paper No 6059.* London: Centre for Economic Policy Research, 2007.

Global Panel. *Biofortification: An Agricultural Investment for Nutrition. Policy Brief No. 1.* London: Global Panel on Agriculture and Food Systems for Nutrition, 2015.

Heck, Simon. "SUSTAIN - Scaling Up Sweetpotato Through Agriculture and Nutrition - Program Overview." *Presentation to SUSTAIN Management Team.* Kigali: Not published, 2015.

IFPRI. *2014 Nutrition Country Profile - Mozambique.*www.globalnutritionreport.org, 2014.

Imai, Tomoko, Mieko Nakamura, Fujiko Ando, and Hiroshi Shimokata. "Dietary Supplement Use by Community-living Population in Japan: Data from the National Institute for Longevity Sciences Longitudinal Study of Aging (NILS-LSA)." *Journal of Epidemiology* Vol. 16, No. 6 (November 2006): 249-260.

INE. *III recenseamento geral da população e habitação , 2007 : resultados definitivos.* Maputo: Instituto Nacional de Estatística, 2010a.

—. *Projecções da População dos Distritos: Maputo Cidade 2007-2040.*Maputo: Instituto Nacional da Estatística, 2010b.

Jenkins, M., C. Byker Shanks, and B. Houghtaling. "Orange-fleshed sweet potato: Successes and remaining challenges of the introduction of a nutritionally superior staple crop in Mozambique." *Food Nutr Bull.* 36, no. 3 (2015): 327-353.

Jenkins, Mica, Carmen Byker Shanks, Roland Brouwer, and Bailey Houghtaling. "Factors affecting farmer willingness and ability to adopt and retain vitamin A-rich varieties of orange-fleshed sweet potato in Mozambique: A qualitative approach." *Food Security*, 10, no. 6 (2018): 1501-1519.

Katz, Daniel. "Do interviewers bias poll results?" *Public Opinion Quarterly* 6, no. 2 (January 1942): 248-268.

Kennedy, Eileen, and Pauline Peters. "Household food security and child nutrition: the interaction of income and gender of household head." *World Development* 20, no. 18 (August 1992): 1077-1085.

Low, J.W, and P.J. van Jaarsveld. "The Potential Contribution of Bread Buns Fortified with β-Carotene–Rich Sweet Potato in Central Mozambique." *Food and Nutrition Bulletin* 29, no. 2 (2008): 96-107.

Low, J.W., M. Arimond, N. Osman, B. Cunguara, F. Zano, and D. Tschirley. "Ensuring the Supply of and Creating Demand for a Biofortified Crop with a Visible Trait: Lessons Learned from the Introduction of Orange-Fleshed Sweet Potato in Drought-Prone Areas of Mozambique." *Food and Nutrition Bulletin* 28, no. 2_suppl2 (2007): S258–S270.

Luis, Luis Soares, and Henrique Luis. "New food product consumer's behaviour: Health literacy and neophobia." *Global Journal of Medicine and Public Health* 5, no. 3 (2016): 1-6.

Mitra, Surajit. "Nutritional Status of Orange-Fleshed Sweet Potatoes in Alleviating Vitamin A Malnutrition through a Food-Based Approch." *Journal of Nutrition and Food Sciences* 2, no. 8 (2012): 160.

Monge-Rojas, Rafael, Carlos Garita, Marta Sanchez, and Leda Muños. "Barriers to and Motivators for Healthful Eating as Perceived by Rural and Urban Costa Rican Adolescents." *Journal of Nutrition Education and Behavior* 37, no. 1 (2005): 33-40.

Mutiso, Janet Mwence, Julius Juma Okello, Carl Johan Lagerkvist, Penina Muoki, Willis OluochKosura, and Simon Heck. "Effect of nutrition education and psychosocial factors on child feeding practices: findings of a field experiment with biofortified foods and different women categories." *Ecology of Food and Nutrition*, 57, no. 4 (July-August 2018): 346-371.

Naico, Abdul T.A., and Jayson L. Lusk. "The Value of a Nutritionally Enhanced Staple Crop: Results from a Choice Experiment Conducted with Orange-fleshed Sweet Potatoes in Mozambique." *Journal of African Economies* 19, no. 4 (2010): 536–558.

Nasirian, M., S. Hosseini Hooshyar, A. Haghdoost, and M. Karamouzian. "How and where do we ask sensitive questions: self-reporting of STI-associated symptoms among the Iranian general population." *Journal of Health Policy and Management* 7, no. 8 (2018): 738-745.

Puoane, Thandi, Princess Matwa , Hazel Bradley, and Gail Hughes. "Socio-cultural Factors Influencing Food Consumption Patterns in the Black African Population in an Urban Township in South Africa." *Human Ecology, Special Issue*, no. 14 (2006): 89-93.

Rogers, E. *Diffusion of Innovations (5th ed.).* New York: Free Press, 2003.

Ruel, Marie T, Harold Alderman, and The Maternal and Child Nutrition Study Group. "Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition?" *The Lancet* 382 (2013): 536-551.

Ruel, Marie T. *Can food-based strategies help reduce vitamin A and iron deficiencies? A review of recent evidence.* Washington DC: IFPRI, 2001.

Sommers, Alfred, and World Health Organization. Vitamin A deficiency and its consequences: a field

guide to detection and control. Geneva: World Health Organization, 1993.

Tedesco, Ilaria, and Roland Brouwer. “Sweetpotato value chain and the potential role for commercial fresh root storage in selected areas of Mozambique.” Presentation made at the 2016 Marketing, Processing and Utilization CoPMeeting in tanzania. 2016.https://www.sweetpotatoknowledge.org/files/sweetpotatovalue-chain-and-the-potential-role-for-commercial-fresh-root-storage-in-selected-areas-of-mozambique/(accessed 10 30, 2018).

Tvedten, Inge, Sandra Roque, and Bjorn EngeBertelsen. “Urban space and poverty in Maputo, Mozambique.” CMI Institute, Bergen, Norway, 2013.

UIS. *Educational Statistics - Mozambique.* UNESCO Institute of Statistics, 2018.

Vearey, Joana, Ingrid Palmarya, Liz Thomas, Lorena Nunez, and Scott Drimie. “Urban health in Johannesburg: The importance of place in understanding intra-urban inequalities in a context of migration and HIV.” *Health & Place* 16, no. 4 (2010): 694-702.

Vlismas, Konstantinos, Vassilios Stavrinos, and Demosthenes B. Panagiotakos. “Socio-economic status, dietary habits and health-related outcomes in various parts of the world: a review.” 17, no. 2 (2009): 55-63.

Wedgewood, R. Post-Basic Education and Poverty in Tanzania. Post-Basic Education and Training Working Paper Series - *Nº 1.* Country Report, Centre of African Studies, University of Edinburgh, UK., 2005.

West, K.P., and I. Darnton-Hill. “Vitamin A Deficiency.” In *Nutrition and Health in Developing Countries*, by R.D. Semba and M.W. Bloem (eds.), 377-433. Totowa, NJ: Humana Press, 2008.

WHO and UNICEF.Global Strategy for Infant and Young Child Feeding.Geneva: World Health Organization, 2003.

WHO. “Biofortification of staple crops.” *e-Library of Evidence for Nutrition Actions (eLENA).* 25 07 2016. http://www.who.int/elena/titles/biofortification/en/.

Wiemers, Emily E. “The Effect of Unemployment on Household Composition and Doubling Up.” *Demography* 51, no. 6 (December 2014): 2155–2178.