Measuring the Impact of Farm input Subsidy Policy on Child Nutrition in Botswana

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Bringing Rigour and Evidence to Economic Policy Making in Africa

Measuring the Impact of Farm Input Subsidy Policy on Child Nutrition in Botswana

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Abstract

This paper examines the linkage between the farm input subsidy policy (ISPAAD) and nutritional status of children in Botswana using propensity score matching and an ordinary least squares regression. Participation of the child's parent in ISPAAD, weight of child's mother, mother's education level, sex of the child, access to health facilities and type of settlement had a significant positive effect on height-for-age z-scores of children at a 5% level of significance. Total household earnings and access to medical insurance had a statistically significant negative effect on the height-for-age z-score of the child at a 5% level of significance. Agricultural policy can enhance nutritional outcomes in society if it is made more nutrition-focussed and nutrition-sensitive.

Key Words: *ISPAAD; Subsidy; Nutrition; HAZ; Botswana*

1. Introduction

Botswana displays some unique elements in Africa and the rest of the world when a comparison is made between its economic growth and development management. The country was one of the poorest countries in Africa when it gained independence in 1966. Since then, Botswana has experienced rapid economic growth and became one of Africa's success stories. This has seen it acquire the status of an upper-middle income country (World Economic Forum, 2015). Despite this tremendous economic performance, the agricultural sector's contribution to national gross domestic product (GDP) has declined over the years and is relatively low compared to other economic sectors like mining. Agriculture accounted for about 40% of country's GDP in 1966, declining to around 5% in the early 1990s, about 1.9% in 2012 and about 2.4% in 2017. The livestock sector contributed about 80% to the agricultural sector GDP, while the crop sector supplied only 18% of national demand (MoA, undated; Ministry of Trade and Industry, 2017). This led to Botswana becoming a net importer with increased reliance on imports of food and agricultural products to attain food security. More than 80% of domestic cereal requirements are satisfied by imports (Tabane, 2018). Food and agricultural products account for about 10% of Botswana's import bill (Gumbo 2016). However, significant food self-sufficiency is less likely with the country's semi-arid environment, which renders large-scale irrigation a challenge, compounded by the adverse effects of climate change (Acquah et al., 2013).

Despite its relatively low share in national GDP, agriculture remains one of the most important economic activities in Botswana. Most people in the country, approximately 70% of the population, earn their livelihood from crop production and livestock farming activities. These agricultural activities, in turn, have important backward and forward linkages with the rest of the economy. Thus, the government of Botswana identified the agricultural sector as one of the avenues for strategic and accelerated economic diversification. However, agricultural production in Botswana is predominantly done under a communal and subsistence system, characterized by the use of traditional methods of farming, meaning lower productivity. The private and commercial system is much smaller in terms of hectares planted and total output, but is characterized by modern agribusiness operations, with better access to skilled labour, new and improved farming technologies, improved management practices and higher levels of investment. The major crops grown in Botswana are rainfed and include cereals that are a major staple food (sorghum, maize and millet), pulses (cowpeas, bambara nuts and mung beans), as well as oilseeds such as groundnuts and sunflowers (MoA, undated).

The government came up with an agricultural input subsidy policy implemented through the Integrated Support Programme for Arable Agriculture Development (ISPAAD) in 2008 aimed at: (1) increasing grain production, (2) improving food and nutritional security at the household and national level, (3) commercializing agriculture through mechanization, (4) facilitating access to farm inputs and credit, and (5) improving extension outreach. However, the policy's objective of improving food and nutrition security at the household level has not been evaluated (Marumo et al., 2014). There is no documented empirical evidence on the linkage between agricultural development policies and nutrition outcomes in Botswana. The objective of this study is to measure the average treatment effect of participating in the farm input subsidy programme, ISPAAD, on the nutritional status (measured by height-for-age z-scores) of under-five children in Botswana.

2. Literature review

The literature reveals that most African nations are heavily dependent on agriculture as a source of food, employment and income at the individual, household and national levels. Therefore, the agricultural sector is an important determinant of income growth, and food and nutrition security across nations. It is very clear that the role of agriculture in terms of generating wages, goods, and own consumption, as well as a source of rural livelihoods is an important pathway to nutrition. Therefore, agricultural policies adopted in these nations and the resultant production conditions would have both a direct and indirect influence on local diets and nutrition, mostly in rural areas where agricultural economic activities are predominant. Despite various agricultural and food policies, as well as interventions that have been implemented across Africa, there is limited analytical and empirical evidence on the linkages between agriculture and food policies and nutrition outcomes in Africa.

Nutrition

Increasing food insecurity and malnutrition in Africa continue to present a very worrisome picture. Hunger is on the rise and, according to the Food and Agriculture Organization of the United Nations (FAO, 2017), the food price hikes of 2007 and 2009 plunged an additional 24 million people into hunger in sub-Saharan Africa (SSA) alone. The most affected of the population are the resource poor found across rural Africa. About 25% of African children under the age of five are underweight (FAO, 2018; FAO, 2017). The prevalence of underweight ranges from 6% in North Africa to 35% in East Africa (FAO, 2018). Underweight prevalence is closely associated with household wealth, hence children in the poorest families are twice as likely to be underweight than children in the richest families (Colleen et al., 2000; Syahrul et al., 2016). Despite the rising prevalence of undernourishment, rates of stunting continue to decline while levels of overweight and obesity continue to grow, notably in Southern Africa (FAO, 2018).

Obesity and associated non-communicable diseases that were thought to be more prevalent among wealthy nations are increasingly becoming a challenge for the Southern African population (Mollentze et al., 1995; Bourne et al., 2002). This has mostly affected poor households undergoing industrialization where underweight and obesity coexist (Kruger et al., 2005). Therefore, globalization can be seen to be

the major factor increasing the risk of obesity and overweight in Southern Africa. Botswana is no exception as urbanization has presented accelerated and unpleasant changes to diets as high fat foods are easily accessible for urban dwellers.

The African Union Commission has initiated accelerated action to ensure sustainable access to food and nutrition security, requiring that governments invest in agriculture and food production. This is expected to include all marginalized groups such as the poor, disabled persons and women (including pregnant and lactating mothers). The Government of Botswana took an initiative to put in place strategies to alleviate and/or reduce food insecurity and poverty in the country through the establishment of programmes and interventions like the Poverty Eradication Programme (PEP), Livestock Management and Infrastructure Development Programme (LIMID) and the ISPAAD, among others.

Farm input subsidy (ISPAAD)

Food insecurity remains a major challenge in Africa as about 28% of the African population is affected by malnutrition, which is the second largest number of malnourished people worldwide, especially among the rural poor (Clover, 2003; Miller, et al., 2013; Bahta et al., 2017). Although Botswana has one of the highest per capita levels of income in Africa, food security at both the household and national levels remains a challenge. Smallholder farming is the most prominent and vital source of employment in rural Botswana. However, due to punitive and erratic climatic conditions characterized by low soil fertility, frequent droughts and unpredictable weather patterns, the sector has been underperforming (Marumo et al., 2014; Bahta et al., 2017). The government, through the MoA, introduced the ISPAAD in 2008 to address the challenges of poor technology application by farmers and low productivity in the arable subsector. The primary objectives of the policy are to: increase grain production, facilitate access to farm inputs and credit, commercialize agriculture through mechanization, promote food security at the household and national levels, and improve extension outreach. Farmers are provided with free open-pollinated seeds of the varieties of major grain crops (maize, sorghum, millet and cowpeas) to plant a maximum of 16 hectares, and free fertilizer up to a maximum of 5 hectares at a rate of 200kg/ha on condition that they row plant and have access to fertilizer applicators. The government assists farmers with draught power and associated implements for arable farming, either through Agricultural Service Centres or private contractors. In addition, farmers could be assisted to plough/harrow/row plant additional hectares from the 6th to 16th ha at a 50% subsidy. Government set prices are: Pula400/ha for ploughing, Pula350/ha for minimum tillage, Pula150/ha for harrowing and another Pula150/ha for row planting. Farmers who use animal draught power also qualify for the subsidies, provided operations are carried out correctly. Citizen or resident farmers aged 18 years and above with proof of ownership or access to arable land are eligible to benefit from ISPAAD.

Factors associated with child nutrition

Given the financial resources devoted to farm input interventions and ISPAAD in Botswana, for example, often with the intended consequences for food security and nutrition in many countries, it is imperative that the impact of these interventions are measured. The MoA assessed the ISPAAD and found that more women than men invested a higher proportion of time and resources to contributing to food production at the household level. It is expected that women, as caregivers, tend to focus their energies on family welfare. From the beginning of time, women in Botswana and elsewhere in SSA, have always been gatherers, in contrast to their male counterparts. This ideology has led to women staying home as primary caregivers, while men went out to provide for the family. The woman, therefore, is left to take care of the family's nutritional needs among other household duties. It is therefore expected that female-headed households would have a better nutritional status than male-headed households.

This also translates to the woman's literacy level. More educated women are expected to have higher income, better health and nutrition knowledge, food habits, nutrient intake, health and self-concept, and less adherence to detrimental cultural practices, while the opposite is true for illiterate women (Ene-Obong et al., 2001). These factors are therefore thought to be closely tied to women's own nutritional status and that the quality of care they receive will, in turn, have a positive influence on children's birth weights as well as the quality of care they receive (Smith et al., 2003). Conversely, women in some societies have been stripped of all power, and they therefore have little or no control over household resources and are deprived of access to information and health services. This gives men control over resources (Afonja and Aina, 1995; Olayiwola, 2013). This results in women being susceptible to high levels of poverty and economic dependence, which further translates into them being nutritionally vulnerable compared to their male counterparts (Yvonne and Velkoff, 1997).

Geographical location/status of the household also contributes significantly to nutritional status. It is expected that socioeconomic status will be higher in urban than rural areas. Several studies have found that child malnutrition is more prevalent in rural than in urban areas. This could be because rural areas are characterized by poorer economic conditions, while overweight and obesity are expected to be more prevalent in urban areas (Adeladza, 2009; Islam et al., 2014). In a study by Kruger and colleagues (2005) the highest prevalence of obesity was found among urban children followed by tribal children, with the lowest prevalence in farm children.

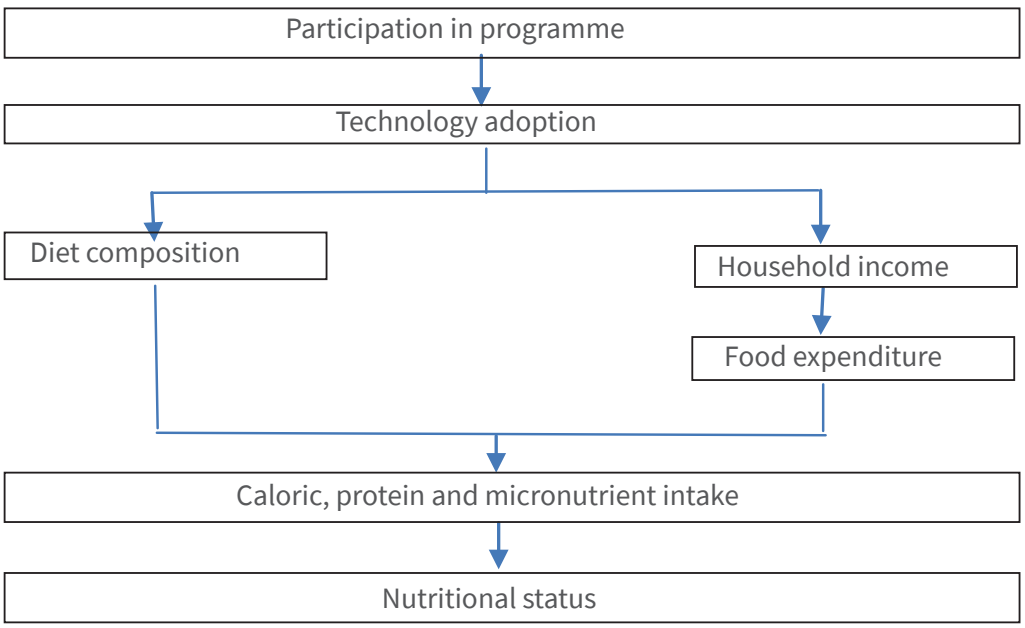
The occupation of household heads is also a vital factor influencing the level of nutritional status. It is expected that a child whose household head earns a higher income will be better nourished than a child whose household head is in a lower tax bracket. Children of farming mothers are also more likely to be less nourished compared to mothers in a different trade. This could be owing to the fact that mothers in rural areas tend to leave home to work on the farm leaving family, especially children, in the care of an older child or relatives who often do not provide the same care than the mother. Childcare is instrumental to a child's nutritional status.

3. Methodology

Conceptual framework

It is considered that food security is a situation that exists when all people at all times, have physical, social and economic access to safe and nutritious food that meets their dietary requirements and food preferences on a continued and sustainable basis (FAO, 2000). Policy makers will request the delivery of high quality products from food producers without paying particular attention to either the inputs nor what the conditions are in the industry (Walls et al., 2018). Figure 1 outlines how the farm input subsidy policy through ISPAAD is expected to affect household food security and child nutrition. It is expected that participation in a programme by producers will lead to technology adoption. Adoption of technology will increase income and change the household food basket, or the nutritional content of the already-existing basket. This will result in increased household income and enable access to a variety of nutritious foods and improve the nutritional status of the household.

Figure 1: Conceptual framework



Source: Adapted from Masset et al., 2011

Table 1 presents the indicators underlying the conceptual framework shown in Figure 1.

Table 1: Derived outcome indicators based on conceptual framework

Outcome Indicator	Description of Outcome Indicator
Programme participation	Characteristics of targeted population and participation rates (occupation, childbirth weight, food intake frequency, parental education, maternal nutrition knowledge, residence, age and gender)
Production	Own production from farm (own consumption, marketed output)
Income	Total household income (own production, wages, transfers)
Food expenditure	Total household expenditure on food
Diet diversity	Consumption of calorie, protein and micronutrient-rich food
Nutritional status	Prevalence rates of stunting, underweight and wasting among children under 5 years old.

Estimation of propensity scores

A logistic regression analysis was used to predict group assignment (beneficiary or non-beneficiary of ISPAAD) from the theoretically relevant covariates. Treatment assignment was used as the outcome variable and the selected covariates as predictors. The empirical logistic regression model is specified as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_9 X_{9i} + e_i \quad (1)$$

where

Y_i= the natural log of the odds ratio for an individual participating in the ISPAAD

β_i= Parameters to be estimated

X_1= Age of household head (years)

X_2=Sex of the head of the household (l if male, 0 otherwise)

X_3=Marital status of household head (l if male, 0 otherwise)

X_4= Household size (number of dependents in household)

X_5= Education of household head (l if attended school, 0 otherwise)

X_6= Total annual earnings of household (Pula)

X_7= Strata dummy1 (1 if city/town, 0 otherwise)

X_8= Strata dummy2 (1 if urban village, 0 otherwise)

X_9= Citizenship

e_i = Error term

Estimating Average Treatment Effects (ATE)

An ordinary least squares (OLS) regression was specified and estimated using the matched sample to estimate the impact of the farm input subsidy policy (that is, participating in the ISPAAD programme) on the nutritional status of children under five, as follows:

$$HAZ_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_{14} X_{14i} + e_i \quad (2)$$

where:

HAZ_i = Height-to-age z-score of child i
β_i= Parameters to be estimated
X_1= ISPAAD beneficiary household (l if yes, 0 otherwise)
X_2= Weight of mother (kg)
X_3= Household size (number of dependents in household)
X_4= Total annual earnings of household (Pula)
X_5= Distance to preschool (km)
X_6= Sex of child (l if male, 0 otherwise)
X_7=Education of mother (l if attended school, 0 otherwise)
X_8=Marital status of mother (l if married, 0 otherwise)
X_9= Mother is smoker (l if yes, 0 otherwise)
X_{10}= Access to health facility (l if no, 0 otherwise)
X_{11}= Household has medical insurance cover (l if no, 0 otherwise)
X_{12}= Mother drinks alcohol (l if yes, 0 otherwise)
X_{13}= Strata dummy1 (1 if city/town, 0 otherwise)
X_{14}= Strata dummy2 (1 if urban village, 0 otherwise)
e_i = Error term

4. Results and discussion

Characteristics of beneficiaries of the farm input subsidy programme

Table 2 presents the household and child characteristics of beneficiaries of the farm input subsidy programme, ISPAAD, in Botswana, with more emphasis on the variables that influence the nutritional status of children under five. The results show that the average household size was about 7 people in each household with an average total household earnings of P17,306.24 per annum. This translates to an average monthly household income of P1,442.15. Given the poverty datum line of P188.89 for Botswana (Statistics Botswana, 2018), these ISPAAD beneficiary households would be considered non-poor.

The average weight of the mothers of the children was estimated at 83.3kg, while the average weight for the children under five was about 16kg. This estimated weight of children under five fell within the World Health Organization (WHO) growth and development standards, which stipulate a weight range of 0.9–18kg for this age group (WHO, 2006). The weight of the children considered is lower than the midpoint of the international standard range. The average height recorded for children under five was 0.59 metres. This estimated average height for children under five also falls within the WHO growth and development standards, which stipulate a height in the range of 0.38–1.5 metres for this age group (WHO, 2006). Again, this height is lower than the midpoint of the international standard range for the given age group of children. The average age for children under five was 2.06 years, and the average distance between their home and the preschool facility was 0.03km. That is, these young people did not have to travel long distances to a pre-school facility for learning and other daycare services.

Table 2: Household and child characteristics of farm input subsidy beneficiaries

Variable	Measurement	Mean	Std. dev	Min	Max
Household size	Number	6.93	3.73	2	23
Total household earnings	Pula	17,306.64	12,348.35	1400.00	234,722
Weight of mother	Kg	83.33	30.15	20.06	131.64
Age of child	Years	2.06	1.42	0	5
Under-five weight	Kg	15.96	5.12	3.28	58.44
Under-five height	Metres	0.59	0.30	0.0034	0.95
Distance to preschool	Km	0.03	0.29	0.0004	8

Tables 3.1 and 3.2 present the household and child characteristics for both beneficiaries and non-beneficiaries of the farm input subsidy. The sample size comprised 3,117 households, with 1,999 ISPAAD beneficiary and 1,118 non-ISPAAD beneficiary households. The tables also present the results of the Pearson chi-square and F-tests on selected categorical variables, as well as the results of the t-tests conducted on selected continuous variables to check if there were any differences in the mean values between the two groups. The results show that there were no statistically significant differences for most variables between ISPAAD and non-ISPAAD beneficiary households. However, it is important to note that there were more children under five in the ISPAAD beneficiary households than non- ISPAAD beneficiary households. ISPAAD beneficiary households also consumed more vegetables than non-ISPAAD households. This is an important factor that would contribute towards improved nutritional status of the children in these households.

However, the two groups were found to be different in terms of weight and height of the children under five. These variables are important in the determination of nutritional outcome indicators for the children. The non-ISPAAD beneficiary households had higher average weights for both the mother and the children under five compared to the ISPAAD beneficiaries. The non-ISPAAD beneficiary households had a significantly higher average weight (16.43kg), at a 1% level of significance for children under five, compared to ISPAAD beneficiary households. The non-ISPAAD beneficiary households had a significantly lower average height (0.58m), at a 10% level of significance, for children under five compared to ISPAAD beneficiary households.

Table 3.1: Difference in characteristics of ISPAAD and non-ISPAAD beneficiaries

Variable	Program participation (N = 3117)			
	ISPAAD beneficiary (n = 1999)	Non-ISPAAD beneficiary (n =1118)	P-value	Chi² value
Categorical variables				
Children under 2 years			0.036	4.3978**
Yes	75.24	24.76		
No	85.22	14.78		
Attended preschool			0.811	0.0572
Yes	79.43	20.57		
No	78.33	21.67		
Computer access			0.605	0.2677
Yes	66.67	33.33		
No	78.93	21.07		
Child had an accident/illness before			0.628	0.2354
Yes	80.77	19.23		
No	78.19	21.81		

continued next page

Table 3.1 Continued

Variable	Program participation (N = 3117)			
	ISPAAD beneficiary (n = 1999)	Non-ISPAAD beneficiary (n =1118)	P-value	Chi² value
Categorical variables				
Had a chronic illness			0.926	0.0087
Yes	80	20		
No	78.79	21.22		
Access to health			0.765	0.0894
Yes	80	20		
No	78.42	21.58		
			F-stat	F-value
Region			0.13	0.7137
Cities/towns	15.66	15.83		
Urban villages	39.97	40.61		
Rural areas	44.37	43.56		
Consumes fruit			0.627	2.5984
Everyday	84.62	15.38		
3 to 4 times a week	80	20		
1 to 2 times a week	73.33	26.67		
Once in a while	77.59	22.41		
Never	86.67	13.33		
Consumes vegetables			0.013	12.6793**
Everyday	83.92	16.08		
3 to 4 times a week	76.12	23.88		
1 to 2 times a week	56.67	43.33		
Once in a while	78.95	21.05		
Never	100	0		
Has children below 6 years		0.094	9.4141*	
0	86.15	13.85		
1	84	16		
2	81.33	16.67		
3	73.02	26.98		
4	68.75	31.25		
5	100	0		

Note: **,* = significant at 5% and 10%, respectively.

Table 3.2: Difference in characteristics of ISPAAD and non-ISPAAD beneficiaries

Variable	Program participation (N = 3117)			
	ISPAAD beneficiary (n = 1999)	Non-ISPAAD beneficiary (n =1118)	p-value	t-value
Household size (number)	6.93	6.8	0.9386	0.0700
Total earnings (Pula)	17,286.64	17,342.39	0.9038	0.1209
Weight of caretaker (Kg)	83.3	105	0.1279	-1.5529
Age of child (years)	2.06	2.00	0.9263	0.0938
Under 5 weight (kg)	15.70	16.43	0.0001	3.8298***
Under 5 height (metres)	0.59	0.58	0.0571	-0.6634*
Distance to school (Km)	0.03	0.01	0.8546	0.1832

Note: **, * = significant at 1% and 10%, respectively.

Determinants of a child's nutritional status (measured by height-for-age z-score)

Table 4 presents the results of the estimated ordinary linear regression model to determine the effects of selected factors on nutritional status (measured by height-for-age z-score, HAZ) of children in Botswana. The table reports the selected explanatory variables, coefficients, standard errors, t-values and the associated p-values. The overall model accounts for 73% (R-squared = 0.7310) of the variations in the height-for-age z-score of the child and where the overall F-ratio was significant ($p < 0.001$). On the basis of this test, it can be concluded that the specified OLS model fitted the data rather well.

Table 4: OLS estimates of effect on height-for-age z-score of under-5 children

Explanatory variable	Coefficient	Std. error.	t	P>|t|
ISPAAD	0.6836131	0.2476362	2.76	0.006*
Weight_mother	.0167847	0.0028861	5.82	0.000*
Household size	0.009383	0.0199114	0.47	0.637
Household earnings	-0.0000175	6.34e-06	-2.75	0.006*
Distance to preschool	0.0045713	0.00307	1.49	0.137
Sex_child	-0.6178973	0.134189	-4.60	0.000*
Education_mother	0.5992724	0.1389495	4.31	0.000*
Marital status_mother	0.1312918	0.1483438	0.89	0.376
Smoker_mother	-0.1192833	0.1900333	-0.63	0.530
Access to health facility	-0.0496085	0.1603214	-0.31	0.757
Access to medical insurance	-1.249562	0.2222997	-5.62	0.000*
Alcohol_mother	-0.0685429	0.1435883	-0.48	0.633
Strata_dummy1	0.2533647	0.2217563	1.14	0.253
Strata_dummy2	-0.3765506	0.1479962	-2.54	0.011*
Intercept	2.499162	0.4032667	6.20	0.000*

Note: * = significant at 5%.

The results show that although most coefficients conform to a priori expectations, the estimated coefficients for most explanatory variables included in the model were not statistically significant. However, there were some exceptions, particularly with respect to factors such as participation in the ISPAAD, body weight of the mother, total household earnings, sex of the child, education of the mother, possession of medical insurance cover and type of settlement in which the household resides.

Participation in the farm input subsidy programme

Participation of the household (to which the child belongs) in the ISPAAD was also indicated to have an important role in the nutritional status of children in the country. The variable was found to have a statistically significant positive effect on the height-for-age z-score of the child at a 5% level of significance. A child whose household was a beneficiary of the farm input subsidy recorded an average increase of 0.68 standard deviations in their height-for-age z-scores. This result conforms to a priori expectations. We expected participation in the ISPAAD to improve food security in the household by enhancing access to own-produced nutritious food and increased farm incomes, and to improve the nutritional status of the family members.

Weight of mother

The weight of a child's mother was also found to have a statistically significant positive effect on the height-for-age z-score of the child at a 5% level of significance. On average, an increase in the weight of the mother by one more kilogram would lead to an increase in the height-for-age z-score of the child by 0.02 standard deviations. This result conforms to a priori expectations. Usually, suboptimal health and/or nutritional conditions of the mother increase the risk of the child's exposure to such adverse conditions.

Total household earnings

Total household earnings were shown to have a statistically significant negative effect on the height-for-age z-score of the child at a 5% level of significance. This does not conform to a priori expectations, as we expected high levels of income to enhance access to nutritious food and to improve the nutritional status of family members. Household income is expected to have a positive impact on child nutrition. Household consumption choices by a household depends on total income, irrespective of the source of that particular income (Kirk et al, 2018). However, the negative result in this study may be influenced by lifestyle issues or bad eating habits once people have more money to spend.

Sex of child

The sex of a child had a statistically significant effect on the height-for-age z-score of the child at a 5% level of significance. On average, a boy child was shown to have a lower height-for-age z-score (by about 0.62 standard deviations) than a girl child. This is generally expected owing to the different genetic make-up and, more often, to varying levels and intensity of physical activity that boys and girls are exposed to in the household in the Botswana.

Education of mother

The education of the mother was found to have a statistically significant positive effect on the height-for-age z-score of the child at a 5% level of significance. On average, a child whose mother had attended school (or was educated) was shown to have a higher height-for-age z-score (by about 0.60 standard deviations) than a child whose mother had no formal education. This is expected as education enhances the knowledge, skills and earning capacity of mothers to afford nutritious food, access medical services and to acquire information on proper nutrition and the health of the family. Education is perceived to improve one's thinking ability. A low education level tends to be associated with poor knowledge of nutrition (Zain et al., 2015. Therefore, education is expected to positively influence the parent's ability to make better decisions concerning the family's nutrition.

Medical insurance cover

Medical insurance cover played a very important role in the nutritional status of children. This variable was shown to have a statistically significant and negative effect on the height-for-age z-score of the child at a 5% level of significance. On average, a child whose mother had medical insurance cover was shown to have a lower height-for-age z-score (by about 1.24 standard deviations) than a child whose mother had no medical insurance cover. This finding conforms to a priori expectations as we expected medical insurance cover to enable the mother and child to access medical services with ease and therefore improve their health and nutritional status. The ability of the household to easily access health services whenever the need arises is believed to improve children's nutrition (Kirk et al., 2018). It is assumed that access to health service centres increases access to information on child nutrition, health and care.

Type of settlement

The type of settlement is divided into three strata: city/town, urban village and rural village. The type of settlement played a very important role in the nutritional status of children. A child whose household lived in a rural village had an average height-for-age

z-score of 2.50 standard deviations. This average z-score was statistically significant at a 5% level of significance. On average, a child whose household lived in an urban village was shown to have a lower height-for-age z-score (by about 0.38 standard deviations) when compared to a child whose household lived in a rural village. This variation in the height-for-age z-score between the two types of settlement was statistically significant at a 5% level of significance. However, a child whose household lived in a city or town was shown to have a higher height-for-age z-score (by about 0.25 standard deviations) when compared to a child whose household lived in a rural village. This variation in the height-for-age z-score between the two types of settlement was statistically insignificant at a 5% level of significance.

5. Conclusion and policy implications

The specific objective of this study was to measure the average treatment effect (ATE) of the farm input subsidy policy provided through the ISPAAD in Botswana on the nutritional status (measured by height-for-age z-scores) of children under five.

We conclude that there is a positive relationship between agriculture and nutritional status of children in households that are engaged in agriculture-based economic activities such as arable farming. Participation of the child's parent in the ISPAAD in Botswana had a significant positive effect on the height-for-age z-scores of children. The farm input subsidy policy has benefitted children whose parents participated in the ISPAAD programme because they were shown to be more likely to have normal nutritional status than children in non-beneficiary households. Therefore, interventions that promote arable agricultural production and consumption of own production at the household level need to be emphasized. The design of agricultural policy (and the ISPAAD programme in this case) in the future needs to be more nutrition-focussed and nutrition-sensitive. The Ministry of Agricultural Development and Food Security and the Ministry of Health and Wellness need to work together to come up with nutrition improvement strategies that increase individual farmers' or households' incomes, but also empower farmers and parents (more especially mothers) through education, knowledge and skills related to health and nutrition to create awareness and adoption of nutrition-enhancing crops, and healthy diets, eating habits and lifestyles.

However, this analysis was done on the basis of cross-sectional survey data that are capable of providing levels of nutritional status of children among ISPAAD and non-ISPAAD beneficiary households only at the point or time of survey. Although a propensity score matching technique was employed in this study to allow for causal inference, the actual average treatment effect of participating in the farm input subsidy programme on the nutritional status of children require the use of panel data to be able to investigate a change in the nutritional outcome indicator, which could be attributed solely to the implementation of the farm input subsidy policy. On the basis of this observation, further research is recommended to obtain another empirically comparable data set of a similar nature to measure the actual change in nutritional status of children attributable to the ongoing farm input subsidy policy in Botswana.

The total earnings of an individual or household play an important role in the nutritional status of children. High levels of income enhance access to nutritious

food and improve the nutritional status of family members. However, depending on the lifestyle or eating habits of the members of the household, high levels of income may not necessarily translate into an improved nutritional status of members of the household, especially children. Therefore, nutrition improvement strategies should not only focus on increasing individual or household incomes, but also create awareness and adoption of nutrition-enhancing lifestyles or healthy diets and eating habits.

Effective nutrition improvement strategies need to consider the sex of the child in a household. Boys and girls need specific tailor-made nutrition improvement interventions that take into account their genetic biological differences in terms of growth and development. Strategies that empower women as caregivers are more likely to improve the nutritional status of children in the household. The education of the mother positively relates to the nutritional status of the children in the household. Children from households with mothers who had attended school are more likely to have normal nutritional scores than children from households with mothers that have no formal education. Education enhances the productive skills, earning capacity and participation of mothers in the markets to afford food and medical services. Therefore, the education and training of mothers is essential in child nutrition improvement interventions.

Supported by medical insurance cover, access to health and nutrition services is also one of the critical factors in child nutrition improvement. A child whose parents had no medical insurance cover was less likely to have a normal height-for-age z-score than a child whose parents had medical insurance cover. The medical aid facility enabled parents and children to access medical and nutrition services with ease, and thus improve on their health and nutritional status. Public policy needs to encourage parents/caregivers to obtain medical insurance cover. Having medical insurance cover that is affordable will have a positive impact on the nutritional status of children in the country.

The nutritional status of children in the country differed according to the type of settlement in which the child's household lived. Children in urban villages had the lowest height-for-age z-scores, while those in cities/towns had the highest height-for-age z-scores. This result implies that cities/towns experience high levels of stunting in Botswana. There is a need for specific tailor-made nutrition improvement interventions that take into account the different socioeconomic conditions that prevail in the rural areas, urban areas and cities/towns in the country.

6. References

Acquah, B., S. Kapunda, A. Legwegoh, T. Gwebu, T. Modie-Moroka, K. Gobotswang and A. Mosha. 2013. "The state of food insecurity in Gaborone, Botswana". Urban Food Security Series No. 17. African Food Security Urban Network (AFSUN), Rondebosch.

Adeladza, A.T. 2009. "The influence of socio-economic and nutritional characteristics on child growth in Kwale District of Kenya". *African Journal of Food, Agriculture, Nutrition and Development*, 9(7): 1570–90.

Afonja, S. and B. Aina. 1995. *Nigerian Women in Social Change*. Ile-Ife, Nigeria: Obafemi Awolowo University Press Ltd.

Bahta, S., F. Wanyoike, H. Katjiuongua and D. Marumo. 2017. "Characterization of food security and consumption patterns among smallholder livestock farmers in Botswana". *Agriculture & Food Security*, 6:65.

Bourne, L.T., E.V. Lambert and K. Steyn. 2002. "Where does the black population of South Africa Stand on the nutrition transition?" *Public Health Nutrition*, 5(1A): 157–62.

Clover, J. 2003. "Food-security in sub-Saharan Africa". *African Security Review,* 12 (1): 5–15.

Doak, C., M., L. S. Adair, C. Monteiro, B. M. Popkin. 2000. "Overweight and underweight coexist within households in Brazil, China and Russia". *The Journal of Nutrition*, 130(12): 2965–71.

Ene-Obong, H., G. Enugu and A. Uwaegbute. 2001. "Determinants of health and nutritional status of rural Nigerian women". *Journal of Health, Population, and Nutrition*, 19: 320–30.

FAO. 2000. "Global forest resources assessment 2000 – Main report". FAO Forestry Paper No. 140. Food and Agriculture Organization of the United Nations, Rome. At www.fao.org/docrep/004/y1997e/y1997e00.html

FAO. 2017. "Hunger and Food Security in Sub-Saharan Africa". Food and Agriculture Organization of the United Nations. At http://www.fao.org/Africa.

FAO. 2018. *The State of Food Insecurity in the World: High Food Prices and Food Security – Threats and Opportunities*. Rome: Food and Agriculture Organization of the United Nations.

Gumbo, B. G. 2016. "Modernisation of arable agriculture in Chobe District: A search for food self-sufficiency through ALDEP, 1980s and 1990s". *Botswana Notes and Records*, 48: 276–287.

Islam, S., J.S. Jothi, M. Islam and A.K. Obidul Huq. 2014. "Nutritional status of rural and urban under-five children in Tangail District, Bangladesh". *International Journal of Innovation and Applied Studies*, 8(2):: 841–8.

Kirk, A., T. Kilic and C. Carletto. 2018. "Composition of household income and child nutrition outcomes Evidence from Uganda". *World Development*, 109: 452–469

Kruger, H.S., T. Puoane. M. Senekal and M.T. Van der Merwe. 2005. "Obesity in South Africa: Challenges for government and health professionals". *Public Health Nutrition*, 8(5): 491–500.

Marumo D.S., N.M. Tselaesele, U. Batlang. G. Nthoiwa and R. Jansen. 2014. "Poverty and social impact analysis of the integrated support programme for arable agriculture development in Botswana". Working Paper No. 2. UNDP-UNEP-GoB Poverty Environment Initiative (PEI). Gaborone, Botswana

Masset, E., L. Haddad, A. Cornelius and J. Isaza-Castro. 2011. "A systematic review of agricultural interventions that aim to improve nutritional status of children." London : EPPI-Center, Social Science Research Unit, Institute of Education, University of London.

Miller, J., R. Brett R. T. Cuong, B. Sean, O.L. Christina, W. Kathryn and L. Cobiac. 2013. "Seasonal variation in the nutritional status of children aged 6 to 60 months in a resettlement village in West Timor". *Asia Pacific Journal of Clinical Nutrition*, 22(3): 449.

Ministry of Agriculture. (Undated). *Guidelines for Integrated Support Programme for Arable Agriculture Development*. Government of Botswana. Gaborone,

Ministry of Trade and Industry. 2017. "Agricultural Sector Trade Statistics". At http://www.gov.bw

Mollentze, W.F., A.J. Moore, A.F. Steyn, G. Joubert, K. Steyn and G.M. Oosthuizen.1995. "Coronary heart disease risk factors in a rural and urban Orange Free State population". *South African Medical Journal*, 85(2): 90–95.

Olayiwola, I. 2013. "Coping strategy for food security among the elderly in Ogun State, Nigeria". *African Journal of Biomedical Research*, 16(2): 79–85.

Smith, M.M., M. Durkin, V.J. Hinton, D. Bellinger and L. Kuhn. 2003. "Initiation of breastfeeding among mothers of very low birth weight infants". *Pediatrics*, 111(6 Pt 1): 1337–42.

Statistics Botswana. 2018. Annual Report 2017/18. Statistics Botswana. Gaborone.

Syahrul, S, R. Kimura, A. Tsuda, T. Susanto, R. Saito, F. Ahmad. 2016. "Prevalence of underweight and overweight among school-aged children and it's association with children's sociodemographic and lifestyle in Indonesia". *International Journal of Nursing Sciences*,3(2): 169–77.

Tabane, T. 2018. "Botswana: Net Food Importer". Botswana Gazette. At http://www.thegazette.news/botswana .

Walls, H., D. Johnston, E. Vecchione, A. Adam and J. Parkhurst. 2018. "The role of evidence in nutrition policymaking in Ethiopia: Institutional structures and issue framing". *Evidence Use in Health Policy Making*: 51–73. -

WHO. 2006. "Child Growth Standards: Length/ height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development". Geneva: Multicentre Growth Reference Study Group: World Health Organization.

World Economic Forum. 2015. "The Gender Gap Report 2015". Colony, Switzerland: World Economic Forum.

Yvonne J.G. and V.A. Velkoff. 1997. Gender and Aging: Demographic Dimensions. International Programmes Centre, U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, United States of America

Zain N.F.M., S.M. Yusop and I. Ahmad. 2015. "Preparation and characterization of cellulose and nanocellulose from pomelo (citrus grandis) albedo". *Journal of Nutrition and Food Sciences*, 5: 334.

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