Land reform policy-induced access to agricultural land and nutritional outcomes in Zimbabwe

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Abstract

The importance of the link between nutrition and agricultural policies in developing countries has aroused interest in the study of the impact of agriculture policies on nutrition. It is against this background that this study made use of the Multiple Indicator Cluster Survey (MICS) data and applied the Generalised Linear Model (GLM) to examine the impact of land reform policy-induced access to land on nutritional outcomes. The results reveal that increasing land holding from acres to hectares for households owning agricultural land improve nutritional outcomes, in particular, reducing underweight children in rural areas. In other words, resource access policy such as land reform improves child nutrition in agricultural or rural areas. In addition, the findings show that increasing the production of domesticated birds, goats and pigs is crucial for improving nutrition. However, Zimbabwe's current livestock policy thrust puts more emphasis and support on cattle production although the results show no association between cattle ownership and nutrition. In this view, the study recommends increased access to agricultural land in rural areas for improving child nutrition and reducing under-weight children. Furthermore, nutrition, particularly in rural areas, can be improved by

reviewing the current agricultural policy thrust in livestock and allow government support to be extended to chicken, goat and pig production.

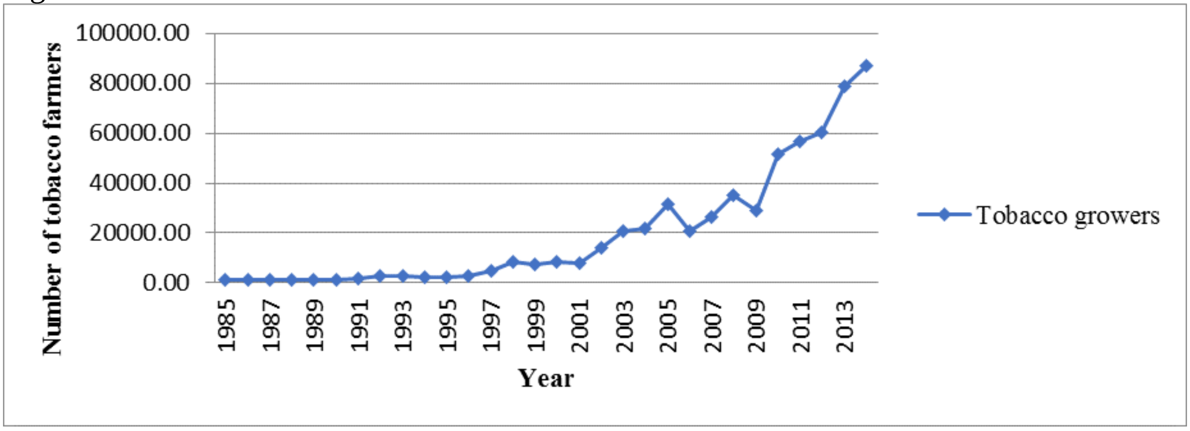
Key words: **Agriculture Policy, Land Access, Nutrition, Zimbabwe**

1. Introduction

Access to land and investment in agriculture are considered to be critical in improving food security in Africa, where over 50% of children less than 5 years are either stunted or wasted (UNICEF-WHO-World Bank, 2015; Herforth *et al*., 2012 and Quisumbing *et al*., 1995) and about one quarter of the population is unable to secure sufficient food to meet nutritional requirements (Badiane and Delgado, 1995). The importance of agricultural land ownership on food security is further accentuated by Skoet & Stamoulis (2006) who argue that reforms in the 1970s (which permitted families to lease agricultural land from the collectives and gave them long term 30-year use rights) led to a significant increase in agricultural output and household incomes. However, as in the early 2000s, Zimbabwean government instigated land reform programme that morphed into what became known as the fast track land reform (FTLR) programme, whose aim was to accelerate a land reform policy to redistribute large commercial farms to smallholder communal farmers in order to improve agricultural land access for a larger population. In other countries, for example Malawi in the 1980s, land registration was aimed at unlocking the availability of land resources across those using it rather than just be available to those owning it.

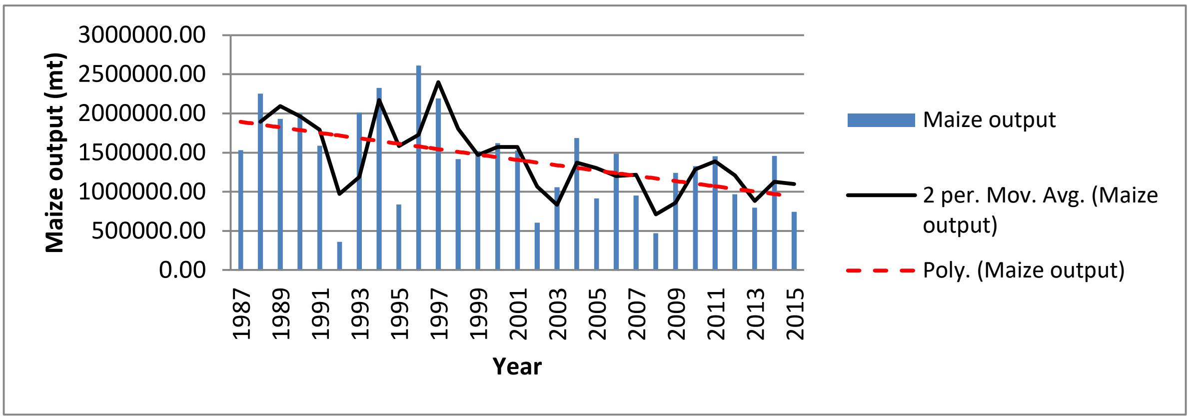
Although it is generally agreed that land distribution that boosts land sizes to otherwise land scarce communal smallholder farmers is crucial for improving food security in a nation, changes in land size may have serious consequences on food crop production and nutritional outcomes. For example, the large tracks of land gained by subsistence farmers from communal areas through the FTLR in Zimbabwe shifted their attention from food crop production to non-food cash crops, in particular, tobacco production (Scoones et al., 2011 and Zikhali, 2008). On one hand, cash crops such as tobacco and cotton can improve farmers' income, which in turn has the potential of improving their nutritional status. On the other hand, increased cash crop production at the expense of food crops can reduce the market supply of food crops thereby potentially leading to a rise in food prices. High food prices have detrimental effects on nutritional status of a nation (Webb & Block, 2012 and Haddad, 2000). Hence changes in food crop production driven by land reform-induced agricultural resource reallocations can have serious implications on food security and nutritional status of the citizens of a nation. A glance at some of the agricultural production and nutritional statistics for Zimbabwe is provided in Figures 1.1 to 1.4.

Figure 1.1: Number of tobacco farmers



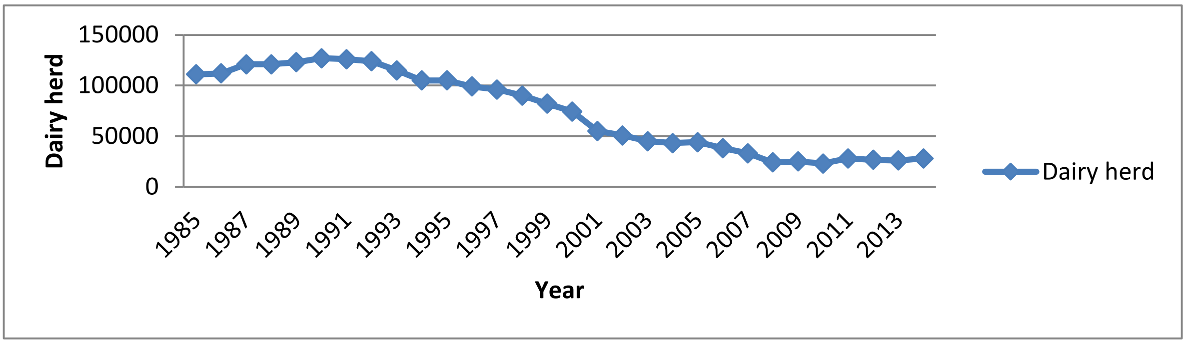
Source: Compiled by author from MAMID statistics (2014)

Figure 1.2: Maize output



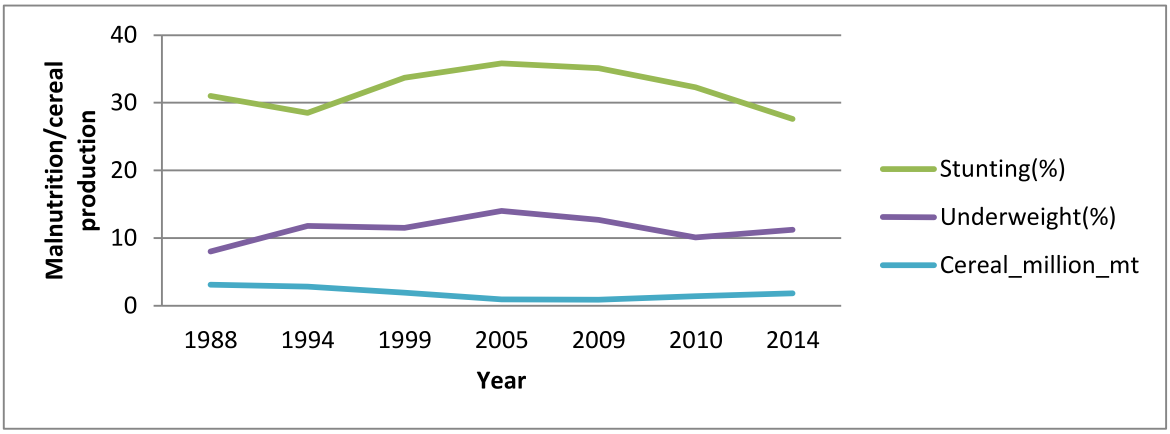
Source: Compiled by author from MAMID statistics (2014)

Figure 1.3: National dairy herd



Source: Compiled by author from MAMID statistics (2014)

Figure 1.4: Malnutrition trends in Zimbabwe



Source: Compiled by author from UNICEF and World Bank (2017) statistics

The statistics in Figures 1.1, 1.2 and 1.3 show that the number of tobacco (non-food crop) farmers has tremendously increased after FTLR while the production of maize which is the staple food crop and dairy head which is also crucial for nutritional outcomes have continued to decline. The statistics in Figure 1.4 further show that the percentage of stunted and underweight children was highest in the decade 1999 to 2009 when cereal production in the country reached its minimum levels. Although the statistics point to the potential linkages between agriculture and nutritional outcomes, there have been no Zimbabwean studies linking agricultural policies to nutritional outcomes. Zimbabwean studies on agricultural policies have mainly attempted to link these policies to agricultural productivity and efficiency. For example, Chisango & Obi (2010), Bangwayo-Skeete *et al*. (2010) and Kapuya *et al*. (2010) investigated the impact of FTLR on productivity and efficiency of farmers and maize farmers, respectively. It is, however, important to extend the investigations to nutritional and health outcomes. A good agricultural policy should improve nutritional and health outcomes of a nation. It is in this regard that this research aims to investigate the impact of land reform-driven access to agricultural land on nutritional outcomes.

The specific objectives of the research are to:

i. Evaluate how land reform driven access to agricultural land is translated into nutritional outcomes, and
ii. Investigate the impact of livestock ownership and each livestock type on nutritional outcomes.

This work therefore addresses the issue of resource access policy impacts on nutrition outcomes and aims to identify specific impact paths of access to land on nutrition. In addition, it provides useful advice to the government about the proposed livestock policy.

Production of a healthy society through improvement in nutritional outcomes is one of the objectives of all governments and a major sustainable development goal (SDG). In addition, the renewed focus on agriculture has been to encourage nutrition-sensitive agricultural policies (USAID, 2011). The knowledge of how agricultural policies, such as increasing accessibility of agricultural land through land distribution, influence nutritional outcomes is therefore crucial for government and policy makers when designing policies that are sensitive to food security and nutritional outcomes.

Land access and agricultural policy in Zimbabwe

Before independence, the distribution of agricultural land was largely skewed in favour of the white minority. Four types of land tenure were inherited by Zimbabwe at independence. These were: 1) the large-scale commercial farms wholly controlled by the white minority, 2) freehold tenure of small-scale commercial farms purchased known as African purchase areas, 3) state land reserved for national parks and other state functionaries and 4) communal areas reserved for the native people. Over 70 per cent of Zimbabweans live in communal areas. Communal areas comprise 42 per cent of Zimbabwe's land area, with as much as 75 per cent of it located in drought prone agro-ecological regions.

The skewed land distribution inherited by the Government at independence in 1980 instigated a land reform policy whose aim was to redistribute agricultural land in order to address the problems of inequality, poverty, household food security and indigenisation of the national economy (Moyo *et al*., 2003). The land policy of the period 1980-96 was characterised by a market driven approach to land reform (willing buyer and willing seller basis). The first phase of land reform has the goal to resettle 168,000 households by 1990 but only 52,000 households were resettled. In 1992, the government enacted the Land Acquisition Act which empowered the government to compulsorily acquire land for resettlement. However, the revised targets of resettling 110,000 families on 5 million hectares never materialized because the government did not commit enough resources to compensate white commercial farmers who would lose their land.

Following the rejection of the Draft Constitution in the February 2000 referendum, the government in collaboration with war veterans mobilised peasants to invade white-owned farms. A radical change in agrarian structure occurred during this period of the Fast Track Land Reform. About 170,000 households were allocated farms between 2000 and 2011. Large commercial farms were converted into villagised arrangements or small self-contained farms (referred to as A1 farms) and one focused on commercial production at a slightly larger scale (so-called A2 farms). Although land reform policy has been very popular in Zimbabwe, the country does not have a comprehensive agricultural policy framework. There is, however, a proposed comprehensive agricultural policy framework (2012 to 2032).

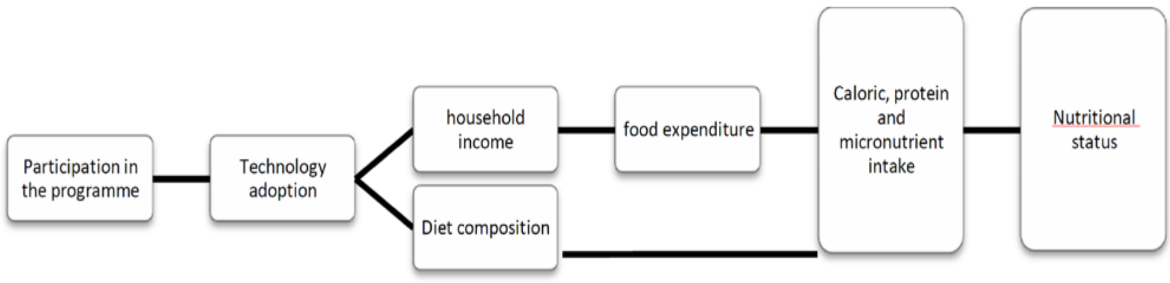
The framework falls short of land policy but has a clear policy objective for livestock production, that is, to improve production and productivity of all classes of livestock. One of the policy statements is that the government will promote preservation, improvement and expansion of existing pedigree herds, especially indigenous breeds; promote research in livestock production; and introduce livestock industry development fund. These policies oscillate ownership and holding of land and livestock. Nevertheless, a livestock industry development fund will have significant impact on household nutritional outcomes if it is directed at promoting livestock breeds whose meat is usually affordable and accessible to many households. A good example is how communal farmers more easily access goat, pig and chicken meat than beef. Cattle are rarely slaughtered for household consumption in communal areas compared to goats, pigs and chicken. This raises the policy question on which livestock industry should the government fund to promote nutritional outcomes of households or equivalently which livestock type has a greater impact on nutritional outcomes? The current policy thrust on livestock has continued to be biased towards increasing and maintaining cattle herd with less emphasis on other livestock. For instance, the government subsidises dip tank services for farmers while no such services are available for birds, goats and sheep farmers.

2. Literature review

Shrestha *et al*. (2012) argue that malnutrition was connected to food security from the 1970s. However, since Sen Amartya's publication on causes of famine in 1981, attention shifted towards improving incomes and livelihoods rather than food production. Unfortunately, changes in income failed to translate into increased calorie consumption leading to the realization that both issues needed to be addressed. Today there is a considerable volume of research on the linkages between agriculture and nutritional outcomes. The pathway through which agriculture translates into improved nutritional outcomes is well elaborated by a number of studies (UNICEF-WHO-World Bank, 2015; Gillespie *et al*., 2012; Hawkes *et al*., 2012; Chung, 2012 and Masset *et al*. 2011). For instance, Masset *et al*. (2011) demonstrate how agricultural technologies are translated into improved nutritional outcomes via improved incomes and dietary composition (Figure 2.1). Concurring with these studies, Bonnard (1999) argues that most agricultural interventions influence household's nutritional status either through improved production of subsistence food or increased agricultural incomes. The studies further recognise that some interventions may directly influence nutritional outcomes; for example, increasing production of vegetables for household consumption while other interventions may be indirect, for instance, land redistribution policy.

Bonnard (1999) suggested policies to enhance agricultural productivity and nutritional outcomes that include: increased research on indigenous food crops, research linked to direct field application, improve seasonal availability of food crops, increasing attention to crops that can be vegetatively propagated such as potatoes, intensifying extension services, improving access to credit, providing insurance schemes, providing land to marginalised households especially women and intensification of contract farming projects. The World Bank (2007) further suggests that for agricultural interventions to be effective in improving nutritional outcomes they should empower women agriculturalists and provide nutritional education.

Figure 2.1: Impact of agricultural investments on nutritional status



Source: Masset et al. (2011)

While there is a general consensus amongst many researchers that agricultural production and productivity influence household nutritional outcomes, it must be noted that productivity in agriculture can be driven by the health status of farmers. Haddad & Bouis (1991), in an investigation of the impact of nutritional status on agricultural productivity, established that better nutritional status of adults is positively associated with higher levels of productivity and wages. Other studies (Sahn & Alderman, 1988 and Strauss, 1986) also indicate the possibility of bi-directional association between agricultural productivity and nutritional status. These findings demonstrate the importance of controlling for endogeneity when modelling the impact of agricultural interventions on nutritional outcomes. However, most of the research and policy papers linking agriculture to nutritional outcomes do not take into consideration the potential endogeneity of agricultural production that may be inherently prevalent in models linking agricultural interventions to nutritional outcomes.

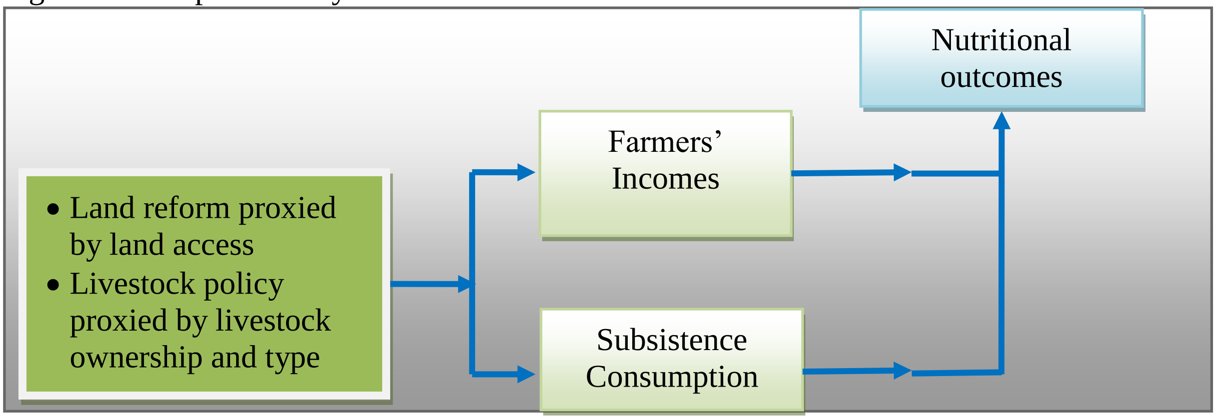
Studies on the impact of FTLR in Zimbabwe have only attempted to link the policy to productivity and efficiency of farmers (Chisango & Obi, 2010; Bangwayo-Skeete *et al*., 2010; Kapuya *et al*., 2010 and Zikhali, 2008). For instance, Bangwayo-Skeete *et al*. (2010) applied program evaluation-based probit model and established that the FTLR policy has improved technical efficiency of farmers, that is, FTLR beneficiaries were found to be more technically efficient than communal farmers. Yes, the beneficiaries could have been more technically efficient but was the improvement in efficiency translated into improved nutritional and health outcomes for the farmers? A good government policy should be in a position to improve living standards of the beneficiaries; it should reduce poverty and improve health status of the beneficiaries. It is against this background that there is need to extend the analysis of FTLR and access to land impact to cover nutritional outcomes bearing in mind that the health status indicators of these same farmers might still be well below adequate levels. The same technique applied by Bangwayo-Skeete *et al*. (2010) can be applied or modified to examine how access to land or a re-distributive land reform policy influences nutritional outcomes of the farmers.

3. Methodology and data issues

3.1 The framework

Access to and the size of agricultural land and livestock ownership are exogenous variables in nutrition models. A majority of farmers in Zimbabwe are subsistence and therefore nutritional outcomes within these farming households depend on the availability of agricultural land. Agricultural land is a key factor which drives food production and nutritional status of many farmers. The applied framework considered land access as a non-stochastic factor. Figure 3.1 illustrates the applied study framework. The framework indicates that an intervention such as land reform policy, that improves access to agricultural land, directly influences agricultural production which in turn affects nutritional outcomes via increased incomes and consumption (see Figure 3.1). Nutritional outcomes from agricultural production have a potential of improving productivity in agriculture as illustrated in the diagram. Similarly, a livestock policy such as introduction of livestock industry has a direct positive impact on meat consumption. Any policy that promotes livestock production and productivity will have a direct impact on subsistence consumption of meat.

Figure 3.1: Proposed study framework



Source: Author's compilation

3.2 Theoretical and empirical models

As in Zeng *et al*. (2014), the study applied agricultural household model in demonstrating the theoretical relationship between land access and nutritional outcomes. In the applied model, a farming household was assumed to be rational and therefore considered to be a utility maximiser. The household utility function took the following form:

$$U_i = U_i(F_i, PF_i, PNF_i, \sum_{j=1}^{N} N_{ij}) \tag{3.1}$$

where *F*, *PF* and *PNF* are the consumed food crops produced by the household, consumed food crops and non-food crops purchased by the household, respectively. The nutrition status of children is a crucial consumptive service of the household. N_{ij} therefore enters the utility function as the nutritional status of child *j* in household *i*. A summation of N_{ij} provides the overall nutritional status of children in a household with *N* children. Children nutrition, however, depends on individual-level food intake of that child, child characteristics (*CC*) and household characteristics (*HH*). The child nutrition function can be expressed as:

$$N_{ij} = N_{ij}(F_i, PF_i, PNF_i, CC_{ij}, HH_i) \quad (3.2)$$

Children consume a proportion of the overall household consumption, where the resource allocation decision within the household, a proportion α_{ij}, also depends on child and household characteristics. With λ representing consumption type (*F*, *PF* or *NPF*) of either child *j* in household *i* or household *i*, the household's allocation decision can be presented as:

$$\lambda_{ij} = \alpha_{ij}(CC_{ij}, HH_i)\lambda_i \quad (3.3)$$

The production of both food crops and non-food crops depends on the available agricultural land. Incomes generated from the sale of crops enable farming households to purchase food. Hence the variables, *F*, *PF* and *PNF*, in (3.2) depend on the land available for agricultural activities (*AL*). The household is assumed to produce food crops (*F*) using agricultural land and other inputs. The food production function of the farming household is therefore expressed as:

$$Y_i^F = Y_i^F(AL_i, Z_i) \quad (3.4)$$

where Y_i^F is the produced output of food by household *i*, AL_i is the agricultural land available for household *i* and Z_i is a vector of other inputs used by household *i* in food production. If the household receives m_i as its off-farm income (income from non-agricultural employment and transfers), then its budget constraint is:

$$p_{PF}PF + p_{PNF}PNF = p_F(Y_i^F - F_i) - p_Z Z_i + m_i \quad (3.5)$$

The farming household maximises the utility function in equation 3.1 subject to constraints from 3.2 to 3.5. Agricultural markets are imperfect in Zimbabwe; hence farmers' production and consumption decisions are inseparable. The j^{th} consumption decision that household *i* makes is given as:

$$CD_{ij} = CD_{ij}(AL_i, CC_{ij}, HH_i, p) \quad (3.6)$$

where *CD* is consumption decision for *j* = *F*, *PF*, *PNF* and *p* is a vector of food prices and non-food prices (produced and purchased). Replacing *F*, *PF* and *PNF* in equation 3.2 with information in 3.6 gives:

$$N_{ij} = N_{ij}(AL_i, CC_{ij}, HH_i, p) \quad (3.7)$$

Agricultural land (*AL*) is theoretically linked to child nutrition of the farming household as demonstrated in equation 3.7. Following Berger *et al*. (2005) and Case *et al*. (2002), the empirical model is specified as a linear function of the form:

$$N_{ij} = \beta_0 + \beta_1 AL_i + \beta_2 CC_i + \beta_3 HH_i + \beta_4 PI_i^F + \beta_5 m_i + v_{ij} \qquad (3.8)$$

where PI_i^F is the food price index facing household *i*, β s are parameters and the rest of the variables are defined as before. Agricultural land (*AL*), household characteristics (*HH*), child characteristics (*CC*) and household income (*m*) are assumed to be exogenous. Food price index enters into the nutrition meta production function in (3.8) because it is part of household constraint to utility maximization.

Child characteristics which might be endogenous, such as weight and height, are part of the dependent variable. Only exogenous factors were included in *CC*. Child and household characteristics included child gender, child age, household size, gender and marital status of household head, education of household head, household wealth index, household assets, sanitation and availability of safe drinking water. v_{ij} is the error term assumed to be independently distributed with a mean zero and constant variance. Model 3.8 was estimated using robust Ordinary Least Squares (OLS), Generalised Linear Model (GLM) and survey data analysis techniques.

Agricultural land is a vector of land and livestock ownership variables (both dummy and continuous variables). The variables consisted of two dummy variables; one taking a value of 1 if a household owned agricultural land and zero otherwise and the other taking a value of one if the household owned livestock and zero otherwise. Land ownership was also measured in acres or hectares owned while livestock was measured in terms of the number of animals owned. The data excluded rented land as renting land for agricultural purposes is not a common practice among farmers in Zimbabwe.

3.3 MICS data and variables

In Zimbabwe, there are limited national surveys combining agricultural data and nutritional data. The Demographic Health Survey (DHS) has nutritional data but does not contain agricultural data while the recent poverty, income, consumption and expenditure survey (PICES) contains agricultural productivity data but does not have nutritional data. However, the Multiple Indicator Cluster Survey (MICS) of 2014 contains a variable on agricultural land access (both land ownership and land size) and nutritional outcomes. It is in this view that the study applied land access in MICS as a proxy for land reform policies in examining how improved access to land could be translated into improved nutritional outcomes. The MICS sampled 17047 households and 97.8% of the sampled households were interviewed. From the eight different data sets collected by MICS, only two data sets (household and child) were relevant in this study. The two data sets were merged and they included child nutrition indicators, sanitation, agricultural land ownership, livestock ownership, child health, education, wealth, assets, gender, age, deviation from dietary requirements and breastfeeding, among others. Table 3.1 presents a summary of some of the variables in the MICS.

Table 3.1: Some descriptive statistics from MICS 2014

Variable	Percent of the sampled
Underweight	11.2
Stunting prevalence	27.6
Wasting prevalence	3.3
Nutritional oedema prevalence	0.2
Minimum dietary diversity	28
Minimum acceptable diet	17.3
Improved drinking water sources	76.1
Improved sanitation	53
Rural households owning agricultural land	85
Rural households owning livestock	77
Urban households owning agricultural land	31.4
Urban households owning livestock	29.5

Source: ZIMSTAT (2014)

Cluster, stratified and random sampling were applied in MICS. Clustering and stratification were done by provinces, specific area and by urban or rural. Both child and household were weighted (see *ccweight* representing child sample weight and *hhweight* representing household sample weight). Despite the data's weakness of failing to control for period-specific heterogeneity, MICS data possess sufficient attributes to effectively control for individual-specific heterogeneity. The data set contains several variables of which a handful was used in this study. Nutrition as the dependent variable was proxied by a number of child health indicators. Table 3.2 illustrates child nutrition indicators and their definitions as in MICS.

Table 3.2: Dependent variable proxies (child nutrition or health indicators)

Variable	Definition and measurement
HAP	Height for age percentile
WAP	Weight for age percentile
WHP	Weight for height percentile
BMI	Body Mass Index in kilograms per square metre

Body Mass Index (BMI) is defined as in World Health Organisation with less 18.5kg/m^2 indicating underweight, 18.5 to 25kg/m^2 normal weight, 25 to 30kg/m^2 overweight and more than 30kg/m^2 being an indication of obesity. The study considered the following child characteristics: child age in months (CAGE), child sex (HL4) taking a value of 1 for male and zero otherwise, frequency of milk consumption proxied by the number of times the child drank milk in the previous day (BD7DN), frequency of yoghurt consumption (BD8AN) proxied by the number of times the child drank yoghurt in the previous day, frequency of solid food consumption (BD11) proxied by the number of times the child ate solid or semi-solid food in the previous day and whether the child has access to vegetables (BD8F), meat (BD8J) and fruits (BD8H). The variables representing agricultural land ownership, livestock ownership and other household characteristics are presented and defined in Table 3.3.

Table 3.3: Household characteristics

Variable name	Definition and measurement
HH6	Area in which the household is situated (urban or rural)
Urban	Urban dummy taking a value of 1 for urban household and 0 for rural
HH7	Province of the household
HH11	Household size
SL1	Number of children aged 1 to 14 years
HC1A	Religion of household head
HC11	Ownership of agricultural land by any household member
HC12A	Type of agricultural land
Agland	Equals 1 if a household owns hectares of agricultural land 0 if acres
HC14A	Number of cattle including dairy cows owned by household
HC14B	Number of horses, donkeys and mules owned by household
HC14C	Number of goats owned by household
HC14D	Number of sheep owned by household
HC14E	Number of chickens owned by household
HC14F	Number of pigs owned
HC15	Bank account ownership by any household member
HHSEX	Sex of household head
helevel	Education of household head

wscore	Wealth score of the household
windex5	Wealth index quintile

The wealth index applied in this study was disintegrated to separate livestock as an independent component of wealth. One of the problems with the MICS data set is the existence of some missing observations. There are a number of missing observations for some variables. However, these missing observations do not depict any pattern that might suggest the presence of sample selection bias. As a result, the study analysed the potential impact of land access policy on child nutrition using sampling units with enough observations. The findings are presented and discussed in the succeeding section.

4. Findings

4.1 Descriptive statistics

There is a marked difference between urban and rural in terms of both child and household characteristics. Consumption patterns of rural households are significantly different from those of urban households. Despite having a normal average BMI of 18.5kg/m^2 for the country, the findings show that rural households suffer from the problem of underweight. The average BMI for rural people is below normal, that is, it is 18.28kg/m^2 while it is within the normal range for urban people, that is, 19.05kg/m^2. The information in Table 4.1 demonstrates that children nutrition indicators are better in urban areas compared to rural areas. On average rural children weigh less than urban children and are as well shorter than urban children. The differences between rural and urban children in terms of nutritional outcome indicators are illustrated in Table 4.1.

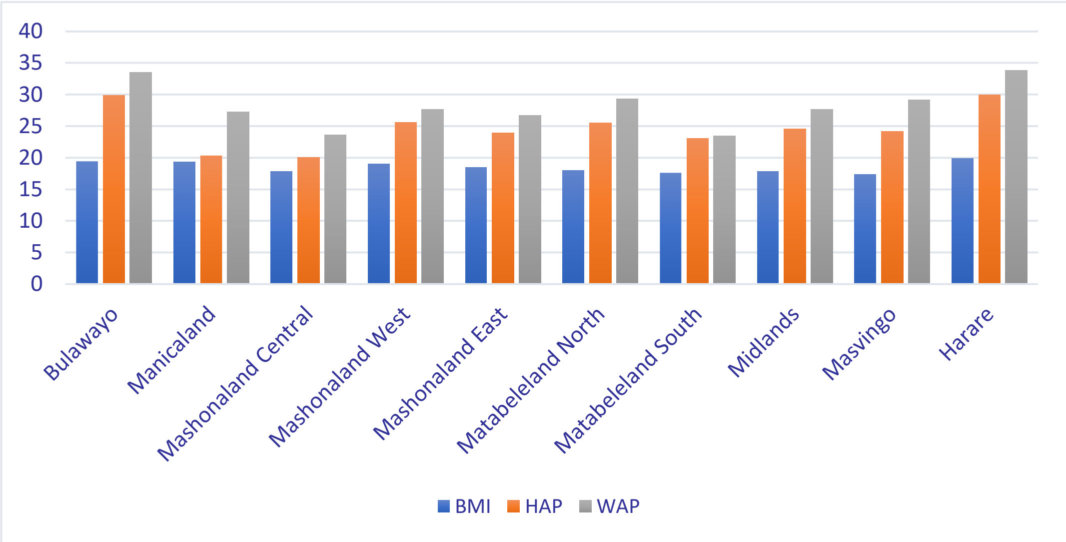
Table 4.1: Mean nutritional differences between rural and urban children

Nutrition indicator	Urban	Rural	Total	Difference
Child weight in kgs (AN3)	11.69	11.42	11.50	0.27***
Child height in cm (AN4)	86.56	84.91	85.38	1.65*
Height for age (HAP)	29.00	22.71	24.49	6.29***
Weight for age (WAP)	33.46	26.09	28.18	7.37***
Weight for height (WHP)	47.83	42.49	44.00	5.34***
Body mass index (BMI)	19.05	18.28	18.50	0.77**

***, ** and * indicate that the mean difference between urban children and rural children is statistically significant at 1, 5 and 10 percent level, respectively. Difference in means were tested using t-tests for equality of means and Levene’s test for equality of variances.

Nutritional variations are also visible amongst provinces and underweight is more pronounced in provinces which are largely rural. For instance, the results indicate that urban provinces such as Harare and Bulawayo have the largest HAP, WAP and BMI while largely rural provinces such as Masvingo, Matabeleland and Mashonaland provinces have less than normal BMI. Figure 4.1 illustrates provincial disparities in BMI, HAP and WAP.

Figure 4.1: Provincial variations in nutritional indicators



Source: Author's illustration from MICS data

Although there are noticeable differences in nutritional indicators between rural and urban areas and amongst provinces, such differences are not visible between households with large and small pieces of agricultural land. The differences in BMI, AN4 and HAP between households with large pieces of agricultural land (hectares) and households with small pieces of land (acres) are statistically insignificant. But households with larger agricultural land have children with larger weight (AN3), weight for height (WHP) and weight for age percentile (WAP). In addition, the larger tracks of agricultural land allow these households to keep larger stocks of livestock compared to those without land. Table 4.2 illustrates the mean differences in nutritional indicators and livestock between households owning hectares of land and those with only acres.

Table 4.2: Mean nutritional and livestock differences between small and large farm holders

Nutrition indicator/ Livestock	Small farms (Acres)	Large farms (Hectares)	Total	Difference

Child weight in kgs (AN3)	11.46	11.62	11.53	-0.16**
Child height in cm (AN4)	85.02	85.86	85.40	-0.84
Height for age (HAP)	23.41	23.65	23.52	-0.24
Weight for age (WAP)	26.33	27.83	27.00	-1.49**
Weight for height (WHP)	41.95	44.58	43.13	-2.62***
Body mass index (BMI)	18.22	18.50	18.34	-0.28
Milk consumption (BD7DN)	1.95	2.27	2.10	-0.32**
Cattle and dairy (HC14A)	2.70	4.05	3.34	-1.35***
Donkeys and horses (HC14B)	0.56	0.33	0.45	0.24***
Goats (HC14C)	2.99	3.28	3.13	-0.29***
Sheep (HC14D)	0.23	0.22	0.23	0.01
Chickens (HC14E)	5.88	7.40	6.60	-1.51***
Pigs (HC14F)	0.20	0.38	0.29	-0.18**

***, ** and * indicate that the mean difference between households with small pieces of agricultural land (acres) and households with large pieces of agricultural land (hectares) is statistically significant at 1, 5 and 10 percent level, respectively. Difference in means were tested using t-tests for equality of means and Levene's test for equality of variances.

The mean number of chickens, goats, pigs and cattle is larger for households owning hectares of agricultural land compared to smallholders. Consequently, children from households owning hectares of agricultural land consume milk more frequently than those from small farms. Children from households owning only acres of agricultural land consume 0.32 times less milk than those from households with hectares of agricultural land. Large land holding is therefore an important factor in livestock rearing which in turn facilitates milk production. In addition, the statistics in Table 4.2 reveal a statistically significant difference between children from households with larger farms and those from households with smaller farms in terms of their weight (AN3, WHP and WAP).

Meat, fruits and vegetables play an important role in the provision of children nutrients. However, the results show that frequent access to these food staffs by children is problematic, particularly in the rural areas. Only 18 per cent of children in rural areas frequently access meat (BD8J), 23 per cent have frequent access to fruits (BD8H) and about 47 per cent have frequent access to vegetables (BD8F). In contrast, about 40 per cent of urban children frequently access fruits and 47 per cent frequently access meat. It is only vegetables which is more accessible by rural children than urban children (34 per cent). The average age for children investigated for nutritional deficiency in this study is 2 years.

With regards to household characteristics, about 64.8 per cent of the sampled households are male-headed while only 35.2 per cent are female-headed. The average household size (HH11) is 6 members with a standard deviation of 2 members and the average number of under 5 children in a household is 2 with a standard deviation of 1 child. Household size for rural households is larger than the urban household size by one member (6 for rural and 5 for urban). For 1 to 14-year-olds (SL1), the mean number per household is 3. A majority of agricultural land owners are smallholder in rural areas, that is, 55 per cent of the households were owners of acres of land and 45 per cent are owners of hectares. What is surprising is the low financial inclusion amongst the sampled households despite the increased use of financial products in the country. Only 18.7 per cent of the households indicated that they own a bank account.

The results demonstrate a highly literacy population. Over 55 per cent of the sampled household heads have at least completed secondary education with only 3 per cent having not attended any school. The most common religion amongst households is the Apostolic sect (36.4%) followed by Pentecostal and Protestant (both 13.6%), non-religion (17.6%) and others. Despite having larger tracks of agricultural land, rural households are poorer than urban households. The overall average wealth index (windex5) was 2.95 and the average combined wealth score (wscore) was -0.15. The differences between rural and urban households in terms of wealth and household size are illustrated in Table 4.3.

Table 4.3: Mean wealth differences and household size between rural and urban households

Indicator	Urban	Rural	Total	Difference
Wealth index (windex5)	4.59	2.30	2.95	2.30***
Wealth score (wscore)	1.15	-0.66	-0.15	1.81***
Household size (HH11)	5.00	6.00	6.00	-1.00***
Children less than 5 years (HH14)	1.00	2.00	2.00	-1.00***
Children 1 to 14 years (SL1)	2.00	3.00	3.00	-1.00***

***, ** and * indicate that the mean difference between urban and rural household wealth and household size is statistically significant at 1, 5 and 10 percent level, respectively. Difference in means were tested using t-tests for equality of means and Levene's test for equality of variances.

Generally, the descriptive statistics reveal that rural households are larger than urban households and have larger pieces of agricultural land. However, they are significantly poorer than urban households and the problem of underweight is more prevalent in these rural areas than in urban areas.

4.2 Regression results and discussion

Three sets of estimated results are presented in this study. First, the study presents findings from OLS estimations using robust standard errors in Appendix A. Second, results from survey estimation technique are presented in Appendix B. Last, GLM findings are presented in Table 4.4. In all the three sets of results, four dependent variables presented and defined in Table 3.2 in chapter 3 were applied. The prevalence of heteroskedasticity makes the findings from OLS and SVY models less reliable. To correct for this, the study interprets the findings from GLM estimations (see Table 4.4).

The findings in Table 4.4 reveal that increasing agricultural land holding will increase child weight for height (WHP). However, increasing agricultural land will not have any significant impact on body mass (BMI), child weight for age (WAP) and height for age (HAP). For household owning agricultural land, pushing a household from smaller agricultural land holding (acres) into larger agricultural land holding (hectares) can significantly improve weight of children in the household. Similar findings are also shown in the other two models (OLS and SVY) in the appendices. This is, however, not the case with BMI which is a better indicator for measuring nutrition of both children and adults. In line with this, children from urban households have larger weight for age and height for age compared to those from rural households with larger tracks of agricultural land. Therefore, the results reveal that underweight is likely to be more prevalent in rural households than in urban households.

The GLM and SVY findings show that increasing the number of chickens owned by households will significantly improve body mass index (BMI). The implication of such finding is that in rural areas where BMI is below normal, agricultural policies that improve poultry production can go a long way in improving nutrition. In addition to improving BMI, increased chicken production has a positive impact on child's height (see HAP in GLM results in Table 4.4 and AN3 in OLS and SVY models in appendices). The other type of livestock with a significant impact on child nutrition indicators (WAP and HAP) is goat rearing. Chicken and goats are the main sources of meat in both urban and rural areas. Increasing the number of goats increases nutrition outcomes. Quantity of pigs is also positively associated with child weight for height in all models. These findings point to the importance of chickens, goats and pigs in improving child nutrition in Zimbabwe.

Table 4.4: GLM estimations of the impact of agricultural indicators on nutrition

VARIABLES	(1) WAP	(2) HAP	(3) WHP	(4) BMI
HH11	1.245***	0.330	1.534***	-0.142
	(0.257)	(0.247)	(0.269)	(0.130)
Urban	4.233**	3.687**	2.315	0.727
	(1.756)	(1.690)	(1.843)	(0.890)
SL1	-2.727***	-1.229***	-2.677***	0.139
	(0.366)	(0.352)	(0.384)	(0.186)
melevel	2.187***	1.196*	0.946	0.279
	(0.651)	(0.626)	(0.683)	(0.330)
HL4	1.754**	1.567**	1.368*	-0.243
	(0.742)	(0.714)	(0.778)	(0.376)
HHSEX	1.148	-0.299	2.075**	-0.0500
	(0.806)	(0.776)	(0.847)	(0.409)
windex5	0.937**	0.599	1.171**	0.206
	(0.434)	(0.417)	(0.455)	(0.220)
HC15	-1.075	-1.811*	0.430	0.585
	(1.143)	(1.100)	(1.199)	(0.579)
HC14F	0.108	-0.00264	0.259**	-0.00937
	(0.124)	(0.120)	(0.131)	(0.0631)
HC14E	0.0377	0.104***	-0.00842	0.0698***
	(0.0412)	(0.0397)	(0.0433)	(0.0209)
HC14D	-0.0899	-0.0859	0.163	0.0167
	(0.210)	(0.202)	(0.221)	(0.107)
HC14C	0.170*	0.190**	0.0514	-0.0259
	(0.0882)	(0.0848)	(0.0925)	(0.0447)
HC14A	0.00923	0.0478	-0.117	0.00500
	(0.0693)	(0.0667)	(0.0728)	(0.0352)
Agland	0.970	-0.881	2.786***	0.0235
	(0.759)	(0.730)	(0.796)	(0.385)
CAGE				
Constant	16.17***	21.01***	29.87***	16.53***
	(3.630)	(3.493)	(3.810)	(1.841)
Observations	5,670	5,670	5,670	5,670

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Although cattle are an important livestock for many households in Zimbabwe, there is no direct association between the number of cattle owned by a household and child nutrition.

This is because cattle are considered to be a symbol of wealth, hence they are rarely slaughtered by households. In fact, households with access to beef, largely purchase meat from butcheries. These findings suggest the need to change the current agricultural policy thrust in livestock production. Agricultural livestock policies in Zimbabwe are biased towards intensifying cattle production. For instance, in rural areas the government significantly subsidises cattle dipping services and no such services are given to goats, pigs and chicken keepers. In addition, the Government's command livestock programme has been mainly centred on increasing national cattle head by distributing cattle to farmers. If these subsidies are provided to chicken, goats and pigs farmers then child nutrition will significantly improve in rural areas as suggested by the findings in Table 4.4.

Other household and child characteristics with significant association with nutrition outcomes include: household size, the number of children in the household, education level of the household head, sex and age of the child, sex of household head and household wealth. Being a female child increases weight for age, weight for height and height for age. Increasing the number of children less than 14 years (SL1) reduces weight for age, weight for height and height for age while improved education of the household head increases both weight for age and height for age. The GLM results show that an increase in household wealth has a significant positive impact on child weight (WAP and WHP).

The findings show that having agricultural land alone is not enough to improve child nutrition as indicated by higher nutritional indicators for urban children whose households mainly own smaller pieces of agricultural land. The effectiveness of agricultural policies in improving child nutrition in Zimbabwe depends on the performance of specific sectors in agriculture. Child malnutrition is a serious problem in rural areas where vegetables are plenty and accessible by many households. Nevertheless, meat is the main missing nutritional food staff in rural areas. But the results reveal that child nutrition can be improved through increasing the production of chickens, goats and pigs. The implication is that child nutrition can significantly be improved in rural areas if the government's current policy thrust which emphasises increasing national cattle head is extended to chickens, goats and pigs. Subsidised programmes for cattle disease control should be extended to chickens, goats and pigs in rural areas.

5. Conclusion and policy recommendations

The study investigated the impact of resource access policy and livestock type on nutritional outcomes with the view of evaluating the current agriculture policy thrust in relation to child nutrition. Generally, the findings show that increasing land holding from acres to hectares for households owning agricultural land has a positive impact on child nutritional outcomes, in particular reducing underweight children. In other words, resource access policy such as land reform improves child nutrition in agricultural or rural areas. However, the findings demonstrate that despite having smaller agricultural land, nutritional outcomes for children from urban households are significantly better than those of rural households who own larger tracks of agricultural land. This is an indication that access to land alone is not sufficient to improve child nutrition. The results further show that chickens, goats and pigs are important sources of food in child health production. Child nutrition is strongly and positively related to these types of livestock whereas cattle are not significantly associated with child nutrition.

With regards to non-agricultural factors, nutrition indicators are improved by increased household wealth and education of household head. Child sex is also an important factor explaining nutritional outcomes. Indicators such as weight for age, weight for height and height for age are better for female children. The number of children (under 14) is negatively associated with child nutrition and household size reduces child weight while improving weight for age and height for age.

The findings point to important policy implications. First, access to agricultural land in rural areas is crucial for improving child nutrition and reducing under-weight. Second, in order to improve nutrition in the country, particularly in rural areas, the current agricultural policy thrust in livestock must be reviewed. Chickens, goats and pigs are the most important sources of meat for children in both rural and urban areas. Extension of services such as subsidies available to cattle farmers in procuring chemicals, for example dip, must be extended to chicken, goat and pig farmers. Chicken, goat and pig meat is the most accessible meat in rural areas. Hence with below normal average body mass index (BMI) for rural children, it is crucial for the government to support rural households in increasing production of these types of livestock.

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APPENDIX A: OLS RESULTS WITH ROBUST STANDARD ERRORS

VARIABLES	(1) WAP	(2) HAP	(3) WHP	(4) BMI
HH11	1.245***	0.0862	0.995***	0.599
	(0.272)	(0.256)	(0.275)	(0.390)
Urban	4.233**	3.706**	2.357	-0.829
	(1.856)	(1.733)	(1.898)	(1.049)
SL1	-2.727***	-0.821**	-1.776***	-0.864*
	(0.379)	(0.367)	(0.393)	(0.524)
melevel	2.187***	0.964	0.433	0.790
	(0.654)	(0.642)	(0.680)	(0.757)
HL4	1.754**	1.554**	1.340*	-1.653**
	(0.741)	(0.713)	(0.774)	(0.751)
HHSEX	1.148	-0.385	1.887**	0.382
	(0.811)	(0.773)	(0.847)	(0.825)
windex5	0.937**	0.625	1.228***	-0.0932
	(0.442)	(0.418)	(0.458)	(0.467)
HC15	-1.075	-2.013*	-0.0145	1.312**
	(1.145)	(1.111)	(1.194)	(0.650)
HC14F	0.108	-0.00189	0.261***	0.0242
	(0.146)	(0.112)	(0.0956)	(0.0500)
HC14E	0.0377	0.107**	-0.00343	0.0139
	(0.0436)	(0.0430)	(0.0460)	(0.0198)
HC14D	-0.0899	-0.0813	0.173	-0.0297
	(0.139)	(0.127)	(0.167)	(0.122)
HC14C	0.170*	0.198**	0.0708	0.00866
	(0.100)	(0.0981)	(0.101)	(0.0552)
HC14B	-0.147	-0.0774	-0.306	-0.0552
	(0.276)	(0.269)	(0.290)	(0.182)
HC14A	0.00923	0.0500	-0.112	-0.0728**
	(0.0798)	(0.0677)	(0.0745)	(0.0356)
Agland	0.970	-0.840	2.876***	0.172
	(0.757)	(0.728)	(0.793)	(0.835)
CAGE		-0.0938***	-0.207***	5.77e-05
		(0.0228)	(0.0246)	(0.0764)
BD7DN				-0.133*
				(0.0748)
Constant	16.17***	25.08***	38.85***	14.65***
	(3.682)	(3.759)	(3.960)	(3.150)
Observations	5,670	5,670	5,670	567
R-squared	0.033	0.023	0.033	0.029

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX B: SURVEY (SVY) ESTIMATIONS

VARIABLES	(1) WAP	(2) HAP	(3) WHP	(4) BMI
HH11	1.230***	0.0858	0.392	-0.205
	(0.290)	(0.280)	(0.412)	(0.137)
Urban	4.664**	3.369*	0.260	0.977
	(1.970)	(1.847)	(2.929)	(1.122)
SL1	-2.629***	-0.813**	-1.563**	0.256
	(0.421)	(0.403)	(0.618)	(0.181)
melevel	2.106***	0.833	-0.318	0.211
	(0.684)	(0.647)	(1.086)	(0.389)
HL4	1.767**	1.618**	-0.465	-0.293
	(0.768)	(0.778)	(1.200)	(0.412)
HHSEX	1.545*	-0.0354	2.441*	0.0547
	(0.911)	(0.837)	(1.305)	(0.468)
windex5	0.870*	0.738*	1.329*	0.126
	(0.471)	(0.431)	(0.681)	(0.234)
HC15	-1.286	-2.593**	1.573	0.524
	(1.261)	(1.296)	(1.759)	(0.635)
HC14F	0.112	0.00342	0.213***	-0.00291
	(0.146)	(0.122)	(0.0701)	(0.0368)
HC14E	0.0421	0.106**	0.107	0.0722**
	(0.0469)	(0.0456)	(0.0662)	(0.0329)
HC14D	-0.0500	-0.0452	0.273	0.0194
	(0.138)	(0.135)	(0.514)	(0.0713)
HC14C	0.173*	0.163*	-0.0426	-0.0145
	(0.102)	(0.0921)	(0.146)	(0.0717)
HC14B	-0.0771	-0.00790	-0.132	0.00711
	(0.277)	(0.283)	(0.402)	(0.159)
HC14A	-0.0155	0.0557	-0.0699	0.00559
	(0.0800)	(0.0728)	(0.120)	(0.0387)
CAGE		-0.0954***	-0.196***	-0.0117
		(0.0228)	(0.0654)	(0.0121)
Agland	1.207	-0.979	4.294***	-0.0588
	(0.900)	(0.818)	(1.215)	(0.416)
BD11			0.120	
			(0.501)	
Constant	16.02***	25.81***	37.34***	17.29***
	(3.909)	(3.858)	(5.885)	(2.424)
Observations	6,009	6,009	3,288	6,009
R-squared	0.030	0.023	0.022	0.004

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1