The Nexus of Drought Tolerant Crops and Food and Nutrition Security Among Smallholder Farmers In Kerio Valley, Elgeyo Marakwet County, Kenya

By [1]Kipyego, R & [2]Mugalavai, V.K

[1]*County Department of Agriculture and Irrigation, Elgeyo Marakwet County, Kenya*

[2]*Department of Family & Consumer Sciences, University of Eldoret, Kenya*

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ABSTRACT

With the global population expected to reach over 9 billion by 2050, there will be a continuous need to increase food production and buffer stocks to meet the growing demand and efficiently cope with volatilities in food production and prices (UNDP, 2015). In Kenya, around 3.4 million people in Arid and Semi-Arid areas are severely food insecure and droughts have historically been a serious constraint to agricultural production in rain fed agricultural systems resulting in significant reductions in both yields and area cultivated thus impacting negatively on rural livelihoods and food security (FAO, 2016). This study was undertaken in Elgeyo Marakwet County of Kenya to establish whether the drought tolerant crops which have been promoted aggressively for the last three years have had an impact on production, food and nutrition security of smallholder farm households. A descriptive cross-sectional study was carried out in Keiyo North and Keiyo South Sub counties. The study sampled 500 smallholder farmers among them being 99 mother/child pairs of 24-59-month-old children. Anthropometric data was collected on the children and analysed using ENA for SMART, 2011whereas food security status was elicited among the households and analysed using SPSS 25. Sixty three percent (63%) of the households were moderately food insecure whereas malnutrition rates were at 27% for underweight children, 67% were stunted and 9% were found to be wasted. Food insecurity had no statistical significance with child growth indicators as well as maternal demographics and socio-economic characteristics. Child malnutrition rate and food insecurity were found to be high and thus further interventions need to be done to promote the DTC for household production and utilization for enhanced all round household food and nutrition security.

Index terms: **Drought tolerant crops, household food security, nutritional status**

I. INTRODUCTION

The number of undernourished people is estimated to have reached 821 million – around one person out of every nine in the world. Nearly 151 million children under five have stunted growth, while the lives of over 50 million children in the world continue to be threatened by wasting (FAO, 2018). Agricultural growth contributes directly to reducing hunger and under nutrition by increasing farm household ability to produce and purchase more nutritious foods (IFPRI, 2014) and more effectively to the poor (World Bank, 2007). In 2018, Kenya recorded an estimated 3.4 million faced with starvation due to prolonged drought and erratic rains with populations in Semi-arid and arid counties bearing the brunt (USAID, 2018). The Sustainable Development Goals (SDG) framework includes two indicators for monitoring SDG Target 2.1: the prevalence of undernourishment (SDG Indicator 2.1.1) and prevalence of moderate or severe food insecurity based on the Food Insecurity Experience Scale – FIES (SDG Indicator 2.1.2), (FAO 2018).

People experiencing moderate food insecurity face uncertainties about their ability to obtain food and have been forced to reduce, at times during the year, the quality and/or quantity of food they consume due to lack of money or other resources. It thus refers to a lack of consistent access to food, which diminishes dietary quality, disrupts normal eating patterns, and can have negative consequences for nutrition, health and well-being. People facing severe food insecurity, on the other hand, have likely run out of food, experienced hunger and, at the most extreme, gone for days without eating, putting their health and well-being at grave risk (FAO, 2018).

Prevalence of moderate or severe food insecurity

The 2019 edition of the report introduces for the first time estimates of the prevalence of food insecurity combining moderate and severe levels. This indicator refers to an expanded range of food-insecurity severity that encompasses moderate levels. According to the latest estimates, 9.2 percent of the world population (or slightly more than 700 million people) were exposed to severe levels of food insecurity in 2018, implying reductions in the quantity of food consumed to the extent that they have possibly experienced hunger. A broader look at the extent of food insecurity beyond severe levels and hunger reveals that an additional 17.2 percent of the world population, or 1.3 billion people, have experienced food insecurity at moderate levels, meaning they did not have regular access to nutritious and sufficient food. The combination of moderate and severe levels of food insecurity

brings the estimated total to 26.4 percent of the world population, amounting to about 2 billion people (FAO, 2019).

1.1 Area of study

Elgeyo Marakwet County (EMC) covers a total area of 3,029.9 km^2 and is divided into three topographic zones namely: the Highlands, the Kerio Valley and the Escarpment. The Kerio Valley where the study was carried out is narrow, averaging 6.4 km in width and running to about 150 km in a North-South direction. This Valley has low rainfall (between 700 mm and 1000 mm) and high temperatures (up to 30 degrees Celsius) during the dry season. The rainfall is unreliable and inadequate for rain-fed agriculture and the area is prone to natural disasters such as drought and landslides (Draft CIDP, 2018-2022). The area of study covered two sub-counties namely Keiyo North and Keiyo South with a total area of 313.2 km^2. The soils in these two wards are sandy- loam with moderate fertility levels.

EMC is agricultural-based with more than 80% of the households deriving their livelihood from the sector. About 25% of the population experiences seasonal food insecurity caused by over-reliance on rain-fed agricultural production coupled with poor storage and distribution systems. According to the Demographic Health Survey 2014, Elgeyo Marakwet County's stunting rate was at 29.9% which is higher than the national rate of 26% (KDHS 2014). The stunting rates in the hanging and the lower Kerio valley were also high at 40% according to the Enhancing Nutrition Services to Improve Maternal and Child Health (ENRICH) programme baseline assessment report in 2016 (CIDP, 2018).

Various research organizations, government and NGOs (ICRISAT, World Vision International, Elgeyo Marakwet County government) have introduced drought tolerant crop varieties which include green grams, pigeon peas, groundnuts, sorghum and millet in the recent past up to 4 years, and this study was undertaken to establish whether the Drought Tolerant Crops(DTC) that have been promoted by the County Government Agriculture division have enabled households to better their food security and nutrition. The Kerio Valley is classified as a semi-arid area with unreliable rainfall (CIDP, 2018).

II. METHODOLOGY

2.1 Study design, sampling procedures and data collection methods

A cross-sectional study design was applied and the target population were the smallholder farmers in Keiyo North and Keiyo South Sub-counties, which were purposively selected from a total of five sub counties due to their semi-arid nature, and the concentration of DTC. The total target population was 5120 farmer households therefore using Fisher's formula, 10% gave a total of 512 smallholder farming households for the study. Three wards were selected from each of the sub-counties depending on the scale of adoption of DTCs. One household was randomly selected from each ward and thereafter, snow balling was used to identify households that had adopted the farming of DTC until the target population of was reached using the probability proportionate to the size technique. Interviews and structured questionnaires were administered to the head of the household after pretesting them in a similar community and modifying accordingly. The questionnaires consisted of demographic and socio economic characteristics and household food insecurity measurements. Ninety nine (99) households with mother/children pairs of 24-59 months were purposively sampled for anthropometrics to elicit the nutritional status data. Five experienced data collectors and two senior supervisors from the county department of Agriculture who were able to speak the vernacular language were used to collect data under the supervision of the PI. The data was entered in the Excel spreadsheet and analysed using SPSS version 25.

Descriptive statistics were tabulated to describe the characteristics of households in each level of food security, as well as the nutritional outcomes associated with food security. For variables expressed as percentages or proportions, chi-square test was used to assess differences between food security classifications. Multiple binary logistic regression models were used to quantify the association between household food security and nutritional outcomes among reproductive age women.

Ethical clearance was obtained from ethical review committee of College of Health Sciences, MOI University. An official clearance letter was also obtained from County Government of Elgeyo Marakwet, Agriculture and Health divisions. Similarly, written consent was obtained from the interviewee before proceeding to data collection. All information that was obtained from the individual was treated confidentially.

2.2 Measuring household food security

Household food insecurity access was measured using items from the validated Household Food Insecurity Access Scale (HFIAS) that was specifically developed for use in developing countries (Coates et al., 2007). The HFIAS consists of 9 items specific to an experience of food insecurity occurring within the last one month (one year for this study). Each respondent indicated whether they had experienced the following at household level due to lack of food or money to buy food in the last one year using the questions: (1) worried about running out of food, (2) lack of preferred food, (3) whether the respondent had limited access to a variety of food due to lack of resources, (4) forced to eat unprefered food due to lack of resources, (5) eating smaller portions, (6) skipping meals, (7) the household ran out of food, (8) going to sleep hungry, (9) going a whole day and night without food. Endorsed items were then clarified with reported estimates of the frequency of food insecurity (rarely, sometimes and often). Scores ranged from 0-27 where higher scores reflect more severe food insecurity. To determine the status of food insecurity the average HFIAS score was computed using SPSS version 25 and analysed to generate household food insecurity access

prevalence categories of food secure, mild, moderately and severely food insecure (Mulusew, 2015).

2.3 Measuring the nutritional status of children.

A face to face interview was made with the household heads and child caregivers for the anthropometric measurements using a structured questionnaire. Height of children aged 24-59 months was measured in a standing position. Children were weighed using an electronic scale with light clothes three times and averaged to the nearest 10g.

Anthropometric measurements were entered into ENA for SMART 2011. WHO Anthro version 3.0.1.2007 software was used to convert the anthropometric data into Z-scores of the indices WAZ, HAZ and WHZ. Comparisons were done for the anthropometric measurements with Z scores established by WHO. Moderate stunting (low height-for age) in children, was categorized to children that had a score of between negative two and negative three standard deviation below (-2SD/Z to-3SD/Z) of the median height-for-age established by the WHO. Severe stunting was classified to children with a Z-score of minus three standard deviation (-3SD/Z) and below from the mean established standard value.

Moderate low weight-for-age (underweight) in children was obtained as a measure for weight-for-age who were between negative two and negative three standard deviation score (-2SD/Z to -3SD/Z) from the median weight-for-age. Severe underweight was classified to children with a Z-score of negative three standard deviation (-3Z) and below from the mean standards. Wasting, weight-for-height (WHZ) was described as low weight-for height a measure below minus two (-2Z) standard deviation from the median weight-for-height standard. Severe wasting was classified to children with a Z-score of three standard deviation and below from the mean standards of WHZ (WHO, 2006).

In low- and middle-income countries, child undernutrition remains prevalent, and a z-score of below negative two (i.e. less than −2 SD) is used to indicate underweight (low weight-for-age), stunting (low height-for-age) or wasting (low weight-for-height)

III. RESULTS

3.1 Demographic and socio-economic characteristics of respondents

Overall, majority (52%) of the respondents were male while 48% were female. Most (88%) of the respondents were married (male-headed) and with formal education with the majority (61%) having attained primary school level of education. The distribution on age category showed that majority (39%) of them were in the youthful stage of 20-35 years, followed by 30% (36-45 years). Majority (41%) of the households had a size of 5-7 members whereas 28% had 8-10 members.

On land ownership, the results showed that majority (88%) of the respondents owned land while 12 % leased land and only (39%) of them owned between 1.1-2.9 acres of land whereas 52% of the respondents had been practicing farming for over 10 years.

The distribution on drought tolerant crops grown showed that finger millet was grown by the majority 240(48%), 128(26%) grew green grams, 104(20%) sorghum, 104(20%) groundnuts and 24(5%) pigeon peas (see Table 1).

Table 1: Demographic & farming characteristics of respondents.

Demographics		Frequency	Percent	Farming characteristics		Frequency	Percent
Gender	Male	258	52	Land size	<1 acre	118	22
	Female	242	48		1.1-2.9 acres	196	39
Marital status	Married	442	88		3-4.9 acres	148	29
	Single	54	11		>5 acres	48	10
	Widowed	4	1	Land ownership	Individual	438	88
Education level	None	16	3.2		Leasehold	62	12
	Primary	304	61	Farming experience	Below 2 years	30	6
	Secondary	144	29		2-5 years	106	21
	Tertiary	36	7		5-10 years	106	21
Age of household head	20-35 years	192	38		Over 10 years	258	52
	36-45 years	150	30	Drought tolerant crops grown	Green grams	128	26
	46-65 years	136	27		Groundnuts	104	20
	Above 65 years	22	5		Finger millet	240	48
Household size	1-4 members	134	27		Sorghum	104	20
	5-7 members	206	41		Pigeon peas	24	5
	8-10 members	138	28				
	Above 10 members	22	4				

N=500

3.2 Household Food Insecurity

Food secure households did not worry about food access; they rarely experienced anxiety about not having enough food. These are households that were able to have a full meal three times a day without food running out, in the past 30 days The mildly food insecure households were anxious about not having sufficient food, they usually consumed inadequate diet, or ate food that they did not prefer. However, these households did not experience the three severe conditions of going a whole

day without eating, going to bed hungry or running out of food in the last 30 days. Moderately food insecure households began sacrificing quality on a continuous basis by consuming inadequate diet and eating less preferred food. They started reducing the quality of food intake by decreasing meal sizes and by only eating once or twice a day in the past 30 days. Severe food insecure households experienced high incidences of food insecurity. The condition of reducing meal sizes and the number of meals worsened each day. The three most severe conditions of going a whole day without eating, going to bed hungry or running out of food in the past 30 days occurred 'often'. Furthermore, households that experienced the three most severe conditions only once or twice in the past 30 days, were also considered as severely food insecure households (Coates et al., 2007:20).

Majority (63%) of the respondents' households were moderately food insecure, those with mild food insecurity access were 32% while 2% were found to be severely food insecure. The food secure households were only 3% (Table 2).

Table 2: Number of households that experienced specific food insecurity-related conditions in the 12 months preceding the survey

Frequency	Worry about food (1)	Unable to eat preferred food (2)	Ate monotonous diet (3)	Ate food not really wanted (4)	Ate smaller meal (5)	Ate fewer meals (6)	No food of any kind (7)	Slept hungry (8)	No food whole day & night (9)
Never	240	22	24	14	22	48	484	496	500
Rarely	242	412	272	298	120	442	14	4	none
Sometimes	64	64	156	188	298	10	2	none	none
Often	none	2	48	none	none	none	none	none	none

Household food insecurity status	Frequency	Percent (%)
Food secure	14	3
Mildy food insecure	162	32
Moderately food insecure	314	63
Severely food insecure	10	2
Total	500	100

N=500

3.3 Characteristics of the Sampled Parent-Child Pairs

Majority (64%) of the mothers were married, 33% were single and 3% widowed, whereas 91% had attained primary education while 9% had secondary education. Majority (91%) were young mothers in the category of between 20 to 35 years of age. Household size for most (43%) mothers was made up of 1-4 members, 34% had a membership of 5-7 members. In terms of land ownership majority (61%) had below 3 acres, whereas only 12% had above 5 acres. Most (55%) mothers had a farming experience of below 5 years and 24% had over 10 years' experience. A majority, 61% of the children sampled were girls while 39% were boys with the overall majority (52%) being above 30 months of age and the remaining 48% falling between 24 to 29 months of age. All the children sampled were from food insecure access households of varying degrees; majority (67%) were from moderately food insecure access, 18% mild food insecure access and 15% severely food insecure access. (Table 3).

Table 3: Maternal Demographics and distribution of children by age and gender

Maternal characteristics			**Child characteristics**			
Mothers Demographics		Total (%)	Boys	Girls	Total (%)	Ratio
Age Category	20-35 years	90(91%)	24(50%)	24(50%)	48(48%)	1:1(B:G)
	36-45 years	9(%)	15(29%)	36(69%)	51(52%)	3:7(B:G)
	Total	99(100%)	39(39%)	60(61%)	99(100%)	2:3(B:G)
Education level	Primary	90(91%)				
	Secondary	9(9%)	**Household food insecurity status**			
	Total	99(100%)		N	%	
			Mild food insecure access	18	18	
Marital status	Married	63(64%)	Moderately food insecure access	66	67	
	Single	33(33%)	Severely food insecure access	15	15	
	Widowed	3(3%)	Total	99	100.0	
	Total	99(100%)				
Household size	1-4 members	42(43%)				
	5-7 members	33(33%)				
	8-10 members	21(21%)				
	Above 10 members	3(3%)				
	Total	99(100%)				
Land size	<1 acre	30(30%)				
	1.1-2.9 acres	30(30%)				
	3-4.9 acres	27(27%)				
	>5 acres	2(12%)				
	Total	9(100%)				
Farming experience	Below 2 years	7(27%)				
	2-5 years	7(27%)				
	5-10 years	1(21%)				
	Over 10 years	5(25%)				
	Total	9(100%)				

3.4 Nutritional Status of Children in the Study Area

The overall malnutrition underweight prevalence among the under-five was 27.5% of the children sampled, whereas 66.7% were stunted and 9.1% were wasted. (Table 4). In the degree of severity, 3.3% and 21.2% were severely underweight and stunted respectively, while 24.2%, 45.5% and 9.1% were moderately underweight, stunted and wasted respectively.

Table 4: Prevalence of underweight and stunting based on z-scores by sex

	All N= 99	Boys n = 39	Girls n = 60
Prevalence of underweight (<-2 z-score)	(27) 27.3 % (15.1 - 44.2 95% C.I.)	(15) 38.5 % (17.7 - 64.5 95% C.I.)	(12) 20.0 % (8.1 - 41.6 95% C.I.)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	(24) 24.2 % (12.8 - 41.0 95% C.I.)	(12) 30.8 % (12.7 - 57.6 95% C.I.)	(12) 20.0 % (8.1 - 41.6 95% C.I.)
Prevalence of severe underweight (<-3 z-score)	(3) 3.0 % (0.5 - 15.3 95% C.I.)	(3) 7.7 % (1.4 - 33.3 95% C.I.)	(0) 0.0 % (0.0 - 16.1 95% C.I.)
Prevalence of stunting (<-2 z-score)	(66) 66.7 % (49.6 - 80.2 95% C.I.)	(30) 76.9 % (49.7 - 91.8 95% C.I.)	(36) 60.0 % (38.7 - 78.1 95% C.I.)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	(45) 45.5 % (29.8 - 62.0 95% C.I.)	(24) 61.5 % (35.5 - 82.3 95% C.I.)	(21) 35.0 % (18.1 - 56.7 95% C.I.)
Prevalence of severe stunting (<-3 z-score)	(21) 21.2 % (10.7 - 37.8 95% C.I.)	(6) 15.4 % (4.3 - 42.2 95% C.I.)	(15) 25.0 % (11.2 - 46.9 95% C.I.)

Children Nutritional Status and Household Food security Status Cross tabulation

Child Growth Indicator	Mildly food insecure access	Moderately food insecure access	Severely food insecure access	Total
Underweight Normal	12	57	3	72(72.5%)
Moderately Underweight	6	9	9	24(24.2%)
Severely Underweight	0	0	3	3(3.3%)
Total number of underweight children				27(27.5%)
Total	18	65	15	99(100%)
Stunting Normal	6	24	3	33(33.3%)
Moderately Stunted	3	33	9	45(45.5%)
Severely Stunted	9	9	3	21(21.2%)
Total number of stunted children	12	42	12	66(66.7%)
Total	18	66	15	99(100%)
Wasting Normal	18	63	9	90(90.9%)
Moderately Wasted	0	3	6	9(9.1%)
Total number of wasted children	0	3	6	9(9.1%)
Total	18	66	15	99(100%)

N=99

Underweight showed a high positive correlation with stunting (r = 0.496) and wasting (r = 0.423) at p<0.01 and p<0.05 respectively implying that as WAZ-scores improved (underweight reduces) stunting and wasting reduced as well. Stunting had a negative insignificant correlation with wasting (r=-0.092). In other words, reducing stunting has a positive effect on reducing underweight. Maternal characteristics such as age, education level, household size, marital status and household food Insecurity status all had weak positive correlations with the child growth indicator of weight for age (underweight). This means that an increase in maternal age, education level, household size, being married and improved household food security all improved the WAZ-scores thus reducing the chances of the child being underweight. The height for age indicator (stunting) had a positive correlation with maternal age (r = 0.197), maternal education level (r = 0.197) and household size (r = 0.213) but a negative correlation with marital status (r = -0.108) and household food insecurity status (r = -0.081). However, all these correlations were insignificant. The weight for height indicator (wasting) showed a weak positive correlation with household size though insignificant, and a significantly strong positive, correlation with household food insecurity status (r = 0.382, p < 0.05), (see Table 5).

Table 5: Correlation coefficients showing pairwise association among child growth indicators, maternal demographics and socio-economic characteristics.

N = 99	Underweight	Stunting	Wasting	Marital Status	Maternal Age	Maternal education	Household Size	Household Food Insecurity Status
Underweight	1.00	.496**	.423*	-.100	.018	.018	.103	.333
Stunting		1.00	-.092	-.108	.197	.197	.213	-.081
Wasting			1.00	-.035	-.100	-.100	.056	.382*
Marital Status				1.00	-.228	-.228	-.454**	.326
Maternal age					1.00	-.100	.179	.199
Maternal education						1.00	-.067	-.166
Household Size							1.00	-.316
Household Food Insecurity Status								1.00

*, ** indicates significance at P < 0.05 and P < 0.01 probability level, respectively

The results on regression analysis showed almost the same results except that in the weight for age indicator, the correlation changed in marital status from positive to negative and confirmed the statistical significance of household food security in child growth indicator of weight for age after controlling for other confounding factors (Table 6).

Table 6: Regression Coefficients for Child Growth Indicators and maternal characteristics

Indicator	Marital status		Age		Educational level		Household size		Household Food Insecurity Status	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Underweight	-0.184	0.370	-0.284	0.412	0.101	0.762	0.125	0.322	0.453	0.017*
Stunting	0.159	0.593	0.554	0.275	0.643	0.195	0.196	0.288	-0.0161	0.815
Wasting	-0.116	0.285	-0.302	0.106	-0.075	0.067	0.0161	0.361	0.279	0.006*

N = 99; * at p<0.05

IV. DISCUSSION

4.1 Demographic and socioeconomic characteristics of the study population

Majority (88%) of the households in the study area were male headed. Similar findings were reported in another study (Jerop et al., 2016) which found 87% of the households to be male-headed and 13% female-headed. Overall, majority of the respondents were male of them falling under the youth category of 20-35 years of age. This reflects a young generation involved in farming activities. The younger generation are more educated and are reported to be more aware of new innovations (Jerop et al, 2016). Gondwe et al. (2017) in a study in Zambia described the young farmers to be less risk averse and willing to try new technologies. Majority of the respondents (61%) had primary school level of education which agrees with National data which puts it at 62% (KNBS, 2013). According to Midega et al (2012), education helps to equip the farmers with the ability to understand, discern and apply information that they encounter in their existing circumstances. This may also apply to the study area where adoption of DTC was embraced more by those with higher level of education.

The household size was found to be comparable with the National statistics which quote the household size in Elgeyo Marakwet at an average of 4-6 members. The respondents were mainly smallholder farmers and this implies that food produced would most likely be for subsistence unless agro-intensive agriculture is practiced. Most of the mother-child pairs had below 5 years of farming experience, which may have contributed to their low levels of food security.

The results also showed that food insecurity is still high in Kenya though the magnitude could be higher in other parts of the country as reported by another study done in 2011 which showed that of all households involved, 70.1% were severely food insecure, 21.9% moderately food insecure, 3.75 were mildly food insecure and 4.3% were food secure (Keino et al. 2014). The study was conducted just before the harvest and the households could have been experiencing seasonal hunger (Vaitla et al., 2009).

Older persons seemed to be more food secure than younger persons, probably because older persons have better coping strategies. Similar results were found by (De Cock et al., 2013) who reported to have found high incidences of food insecurity in households headed by young people. Large household size also had a negative influence on food security since an increase in household size tends to increase the quantity of food consumed in a household especially if those members do not contribute to what they consume. These findings agree with those of Mitiku et al (2013) and Amaza et al (2012) who found a negative and significant relationship between household food security and household size. Larger land equated to an improved household food security. This could be explained by the fact most of the drought tolerant crops are labour intensive therefore a farmer can easily get into losses if labour is unavailable.

4.3 Child Nutritional Status

Underweight, is the overall indicator of the combination of both stunting and wasting elements in children (UNICEF, 2013). The underweight prevalence which is indicative of both chronic and acute malnutrition is higher than previous KDHS 2014 report. Stunting is the outcome of failure to receive adequate nutrition over an extended period and is also affected by other factors like recurrent or chronic illness. The stunting levels are higher than the national prevalence of 26% (KDHS, 2014) and therefore it is evident that there has been inadequate caloric availability in the households. This high malnutrition prevalence conforms to the observation that malnutrition has been a leading cause of high risk of morbidity and mortality in Africa and especially in sub-Saharan Africa (De Onis, 2008).

4.4 Household Food Insecurity and Child Nutritional Status

Household Food Insecurity Status influenced the nutritional status of children positively for underweight but not significantly but for wasting it was positive and statistically significant at 5% level. For stunting the association was negative and insignificant. The result concurs with some studies that have reported a positive association between household food insecurity and childhood growth indicators, (Melgar- Quinonez et al. 2009; Chaparro, 2012). Results from different studies reported both the presence and absence of significant association between food insecurity and malnutrition. Studies done in Bangladesh and Colombia showed the significant association between food insecurity and malnutrition (Mehedi et al., 2013, Kuntal et al., 2009, Mercedes et al., 2007).

V. Conclusion

The research findings showed that there was high food insecurity among the DTC farm households. This therefore suggests that intervention programmes should be strengthened to bring about adoption, and thus improvement in both economic development and child malnutrition. Also,

malnutrition among under-five children in DTC farm households seems to be a sustained crisis instead of an acute marginalized problem since the area of study was semi-arid. Stunting is the predominant nutritional problem, and the elevated prevalence in older children indicates failure in growth and development during the first two years of life. Child malnutrition intervention strategies should be focused not only on food security but on other sectors such as health that will contribute to improvement of the child growth indicators. The evidence contributes to the growing scientific consensus that tackling childhood stunting is a high priority and that organizations and governments focusing on preventing malnutrition use integrated approach to include nutritional supplementation and child health programmes, which are currently not reaching all the expected areas, and also new crop technologies should also be promoted aggressively so as to empower smallholder farm households and move them out of the hunger they face.

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