International Journal of Scientific Research and Engineering Development-– Volume 3 Issue 6, Nov-Dec 2020

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Adoption of Sahiwal Cattle and Household Food Security among Pastoralist Communities: The Case of Isiria Maasai of Kenya

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Abstract:
Pastoralism enabled households to attain livelihood outcomes, including food security. Over the years climatic and socio-economic changes have affected livestock production practices and pastoralist have responded in a myriad of ways. Governments and non-governmental organizations also intervened through programmes to improve pastoralists' food security. Studies on the impact of the programmes indicated mixed results with some recording improved food security while others indicated deterioration. This study investigated the association between adoption of Sahiwal cattle and household food security among Isiria Maasai of Narok County, Kenya. The cross-sectional social survey utilized quantitative and qualitative methods to collect and analyse information from a sample of 400 households selected through a multi-stage sampling procedure. Descriptive statistics were used to summarize and compare respondents' attributes. The study used Spearman Correlation Coefficient to test for the association between adoption of Sahiwal cattle and household food security. Results indicated that all households were food secure with 70.0% of the respondents having high dietary diversities. Most respondents consumed milk and milk products (91%), fruits (69%) as well as vegetables and leaves (61.7%). Sahiwal cattle adopters with high dietary diversity were more than non-adopters. There was a positive, significant weak association between adoption of Sahiwal cattle and household food security.

Keywords — **Adoption, cattle, food, Maasai, Sahiwal, security**

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I. INTRODUCTION

There are about 200 and 500 million people in the world who rely on pastoralism to sustain their lives, especially in arid and semi-arid regions of the world [1]. In recent past, pastoralists have experienced numerous climatic and socioeconomic changes which have affected their traditional livestock production practices and outcomes.

Pastoralist communities have responded to climatic and socioeconomic changes in various ways, including increased food purchases in Nepal [2], adoption of crop cultivation and minor trades in the Indian Himalaya [3], purchase and transportation of hay and supplementary animal feeds in the Tibetan plateau of China [4] as well as increasing grazing time in Bolivia [5]. Other responses include destocking in Burkina Faso [6], sourcing and delivery of fodder in Benin [7], diversification into crop cultivation and wage labour in Ethiopia [8] and adoption of camel production [9] in Uganda and rearing pigs in Tanzania respectively [10]. In Kenya pastoralist communities responded to the changes by adopting sedentarisation near urban centres [11], wage employment, trading, crop farming and transportation services [12].

Governments and non-governmental agencies have also implemented various interventions in pastoralist communities to improve their food security. In the Middle East, especially in Jordan and Israel, governments have provided food aid [13], invested in genetic improvement of tamed tilapia [14] and promotion of crossbred cattle [15]. Other interventions included encouraging the cultivation of forages, enhancement of livestock

farmer skills [16] as well as distribution of improved goat and sheep breeds to address malnutrition in rural households [17].

Studies on cattle improvement interventions indicated mixed outcomes on food security. For instance, Quddus [15] found that as a result of rising incomes due to increased milk yields from improved dairy cattle in Bangladesh, households obtained better nutrition. Similar results were obtained in Tanzania [18], Senegal [19] and Uganda [20]. On the contrary, [21]Salmon *et al*. (2018) revealed that increased milk yields from improved cattle did not improve food security in poor households as it accentuated the trade-off between consuming milk and milk products for nutritional value and selling them for the much-needed cash income. Even in the initial stages of production, adoption of improved cattle led to poor nutrition for infants as increased workloads preoccupied nursing mothers.

In 1991, the Government of Kenya, with support from the Federal Republic of Germany initiated improved cattle production through an integrated multi-sectoral year rural development programme – the Trans-Mara Development Programme (TDP). The programme aimed at improving pastoralist household food security through the introduction of the *Sahiwal* breed of cattle among pastoralist communities, including the Isiria Maasai of Narok County. The strategy adopted by TDP was cross-breeding; where traditional smallholder livestock producers obtained incentives to buy pedigree *Sahiwal* bulls and cross-breed them with their conventional *Zebu* cows [22](Kenya Agricultural and Livestock Research Organization, 2019).

This study was formulated to investigate the effect of the intervention on household food security among Isiria Maasai. It was necessitated by the mixed outcomes of previous cattle improvement interventions on food security in other parts of the world and the observation that the bulk of studies concentrated on the effect of technology adoption among crop farmers with few studies on pastoral and agro-pastoral communities.

II. METHODS

The study adopted a mixed-method approach that involved both qualitative and quantitative data collection and analysis. It also used both the survey and observation designs. The site of the study was Narok County of Kenya which covers an area of 17,933.1 Km^2. It represents 3.1 per cent of the total area in Kenya and is the eleventh largest County in Kenya. Within Narok County, the Isiria Maasai were purposively selected based on the fact that TDP concentrated its programme interventions in Trans-Mara West Sub-County, which is occupied by the Isiria. The consideration that guided the decision to focus the program among the Isiria was that the area predominantly occupied by the Isiria is relatively wet compared to most areas of the, which made it easier for the improved breed to thrive. Households participated in the study if they practiced cattle farming rearing either rearing the improved Sahiwal or indigenous Zebu cattle or crossbreds of the two.

The sample size of 400 household heads was obtained through multi-stage sampling while key informants were selected purposively. Data was collected using pretested questionnaires, focus group discussions guide and key informant interview schedule. To assure validity and reliability, the tools were tested and retested on a sample in Masurura location – an area adjacent to the study site. The intra-class correlation coefficient for the test-retest and inter-rater reliability for this study returned a coefficient correlation of 0.976 as the average measure at the 99% level of confidence which indicated acceptable reliability. For internal consistence Cronbach's alpha calculation returned a 0.99 coefficient of consistency.

Of the 400 household questionnaires submitted to respondents, 374 questionnaires were filled and returned, representing a completion rate of 93.5%. The data was analysed using the Statistical Package for Social Sciences (SPSS) version 26. To test for the association between adoption of improved cattle breeds (the independent variable) and household food security (dependent variable), the study relied

on Spearman Correlation to determine the strength and direction of association.

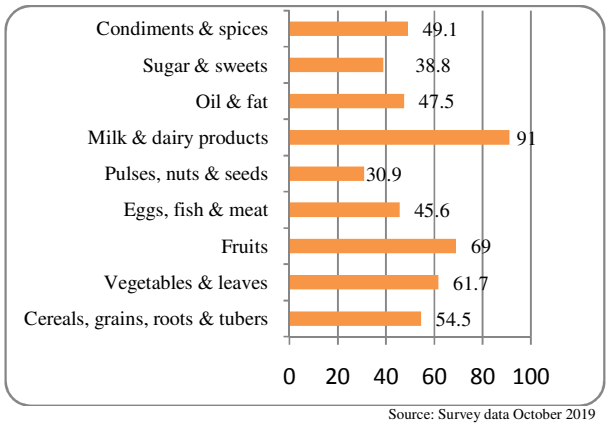
III. RESULTS

The study set out to investigate the association between adoption of improved cattle and household food security and its results are hereby presented.

A. Status of Food Security in Respondents' Households

The study collected data on food consumption from the respondents was subjected to the Household Food Security Score (HFCS) formulated by World Food Programme [23]. By combining the frequency and diversity of food consumed for the seven days preceding data collection, HFCS distinguished three levels of household food security "poor", "at the borderline" or "acceptable" depending on the calculated weighted scores. Respondents with a score of 21 and below were categorised as having "poor food consumption" and were food insecure; 21.5 to 35 were "at the borderline"; and above 35 were categorized as having an "acceptable" level of consumption. For respondents whose food consumption was described as being "at the borderline" and "acceptable", this study considered them as being food secure.

After subjecting the responses to the HFCS, this study found out that all the respondents had an "acceptable" level of food consumption meaning they were food secure. An analysis of the respondents' consumption of food types revealed that they consumed the food categories in varying degrees. Figure 1 summarizes the average consumption patterns of the respondents for the various categories of food.

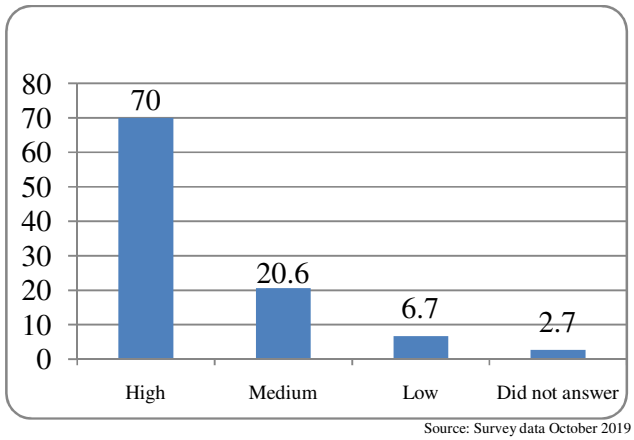


Source: Survey data October 2019

Fig. 1 Average proportion of respondents consuming the food groups

As shown in Figure 1 more than a half of the respondents consumed milk and dairy products (91.0%), fruits (69.0%), vegetables and leaves (61.7%) as well as cereals, grains, roots and tubers (54.5%). More than a third also consumed condiments and spices (49.1%), used oil and fat in preparing their foods (47.5%), ate eggs, fish and meat (45.6%) as well as foods in the category of sugar and sweets (38.8%). Almost a third (30.9%) of the study respondents consumed pulses, nuts and seeds.

To supplement information on food security and average consumption for each of the food categories, a Household Dietary Diversity Score (HDDS) was also calculated. HDDS measured respondents' access to a variety of foods. This was in line with the recommendation of FAO (2013). In determining the HDDS of respondents this study used the information already collected on HFCS. In determining HDDS, all food groups had equal weights which were summed up. An average was worked out and interpreted. If the score was less than 4.5, the household was classified as having a "low dietary diversity" but if it fell between 4.5 and 6.0, the household had a "medium dietary diversity. Households with over a score of 6.0 were described as having a "good dietary diversity". Results of the respondents HDDS are summarized in Figure 2.



Source: Survey data October 2019

Fig. 2 Percent Dietary Diversity Scores for the study respondents

As Figure 2 indicates, the study observed that their dietary diversity varied. Majority (70%) of the respondents had a good dietary diversity; there were also respondents with medium (20.6%) and low (6.7%) dietary diversity scores. Dietary diversity scores for the respondents ranged from 1.8 to 18.0 and the mean for all respondents was 8.1.

A comparison between the respondents' ages and level of education with their HDDS yielded results summarized in Table 1.

TABLE I
COMPARING RESPONDENTS' AGE AND LEVEL OF EDUCATION WITH THEIR HOUSEHOLD DIETARY DIVERSITY SCORE

Aspect	Bracket	Household Dietary Diversity Score			
		High	Medium	Low	DNA
Age	<25	68	21	11	0
	25-34	73	14	9	4
	35-44	67	23	7	3
	45-54	70	24	3	3
	55-64	71	23	3	3
	>65	56	33	11	0
	DNA	1	0	0	0
Education	None	63	29	5	3
	Some Primary	73	12	11	4
	Primary	63	23	9	5
	Some Secondary	86	14	0	0
	Secondary	74	18	8	0
	Tertiary	80	15	3	2
Sahiwal cattle adoption	No	50	32	12	6
	Yes	70	20	7	3

Source: Survey data October 2019

Table 1 show that the distribution of respondents across the three levels of HDDS was uniform except for the eldest age bracket of 65 years and above. For respondents of 65 years and above, slightly more than a half (56%) had good dietary diversity, almost a third (33%) had a medium dietary diversity and more than 10% had low dietary diversity. The other age brackets had more than two-thirds of their respondents with good dietary diversity and less than 10% with low dietary diversity.

When compared to educational attainment of respondents, this study established there was a difference in the distribution of respondents across the three levels of dietary diversity depending on their level of education. For instance, among respondents who were primary school leavers, the proportion with good dietary diversity was 63% whereas those with some secondary level of education were 74%. Thus, respondents with higher levels of education tended to also have good dietary diversity.

In comparison to their ages, the study observed that the youngest (below 25 years) and oldest (65 and above years) had the lowest proportion of respondents with good dietary diversity at 66.7% and 56.0% respectively. Similarly, they also had the highest proportions of households with low dietary diversity at 11%.

The study also compared the HDDS for Sahiwal cattle adopter and non-adopter respondents. Almost three-quarters (70%) of the adopter respondents had good dietary diversity, 20% medium dietary diversity and 7% had low dietary diversity. The corresponding proportions for non-adopters were 50%, 32% and 12% respectively. Almost a half of the non-adopter respondents had medium and low dietary diversity compared to slightly more than a quarter of the adopter respondent. Adoption of improved cattle breeds seemed to improve on household dietary diversity.

B. Sahiwal Cattle Adoption and Respondents' Food Consumption Patterns

This study also compared adoption of Sahiwal cattle and food consumption patterns among the

respondents. Under the food category of cereals, grains, roots and tubers, the study observed that 72.0% of non-adopter respondents as compared to 57.4% consumed maize flour ugali daily. There were no differences in the proportions of adopter and non-adopter respondents in the consumption of Irish potatoes and rice. For the consumption of bread, 36% of non-adopters reported non-consumption of bread compared to 2.0% for the adopters. A larger proportion of adopter respondents consumed arrow root and sweet potatoes compared to non-adopters.

Under the group of vegetables and leaves, there were no major differences between adopters and non-adopters of Sahiwal cattle in the consumption of kales, cabbages, spider plant, *Basella alba*, cow peas and pumpkin leaves. However, for spinach the proportion of adopters consuming the vegetable was double that of non-adopters.

For fruits, the study noticed that almost as twice non-adopter respondents who did not consume an orange, mango, banana, pineapple or avocado as there were adopter respondents. For instance, whereas 36.0% of non-adopter respondents did not consume an orange and a mango in the reference period, only 15.4% and 29.0% adopter respondents did not respectively.

In the food category of eggs, fish and meat, the study noted a clear difference between adopter and non-adopter respondents in the consumption of fish and pork. Pork was consumed exclusively by adopters while the proportion of non-adopter respondents was almost twice that of adopters in the consumption of fish. A larger proportion of adopter respondents consumed mutton and chicken meat as compared to non-adopters. In terms of non-consumption of beef during the reference period, this study established that the size of adopter respondents was double (12.7%) that of non-adopters (6.0%).

In the food category of pulses, nuts and seeds, the study found out that there were no major differences between adopter and non-adopter respondents in the consumption of beans and groundnuts for the reference period. For peas, green grams, and simsim, the proportion of adopter respondents that consumed the foods was double or more that of non-adopter. For instance, whereas 10.2% of adopter respondents consumed peas for one day and 5.6% for two days only 4.0% and 2.0% non-adopters respectively did so. Of the adopter respondents, 5.2% consumed simsim for one day as compared to 2.0% non-adopters. For green grams, adopter consumers were 7.7%, 4.6% and 3.4% for one, two and three days respectively with their corresponding non-adopter proportions as 4.0%, 2.0% and 0%.

For fresh and sour milk, the study observed that a larger percentage of non-adopter respondents consumed milk daily and that none of them reported not consuming fresh milk during the reference period. This observation is contrasted with that of adopter respondents whose 0.9% proportion reported non-consumption of fresh milk during the reference period and 61.7% consumed it daily. In the consumption of sour milk, the proportion of non-adopter respondents who did not consume it during the reference period was three times higher (30.0%) than for adopters (9.0%). FGD and KIIs inquiry about these observations revealed that adopter respondents tended to sell most of their fresh morning milked milk and reserving the evening milk for household consumption whereas non-adopter respondents consumed their produced milk in their households. As the quantity of evening milk was also large in the adopter respondents' households, the surplus is stored for fermentation and hence the differences in the patterns of sour milk consumption.

The proportion of non-adopter respondents that did not consume oils and fat during the reference period was higher than that of adopter respondents. Among the non-adopters 28.0%, 74.0%, 84.0%, 60.0% and 66.0% reported non-consumption of vegetable oil, butter, margarine, cattle and sheep fat respectively in comparison to 19.1%, 61.1%, 67.9%, 45.1% and 45.7% for adopters respectively. For butter, 11.4%, 4.3% and 4.9% of adopter respondents consumed it for two, three and four days of the reference period compared to 2.0% of

non-adopters for the corresponding days. In regard to margarine, 10.5% of adopters consumed it for a day whereas only 2.0% of non-respondents did. FGDs and KIIs indicated that the observations were as a result of differential access between adopter and non-adopter respondents. Sahiwal cattle were huge in size and produced more milk compared to Zebu cattle. With more milk, adopter respondents tended to be motivated to store milk butter and converted it to oil when the quantity was sufficient. With their huge size, Sahiwal cattle tended to put on weight and produced substantial fat when slaughtered.

In the consumption of foods under the category of sugar and sweets, this study noted that adopter and non-adopter respondents were of almost equal proportions for eating cakes and in drinking of soda. Nevertheless, more adopter respondents consumed honey, Afia juice and ordinary juices as well as chewing of sugar cane. Similarly the proportion of non-adopter respondents who reported non-consumption of these foods was higher than that of adopter respondents. For Afia juice and ordinary juices, the proportion of adopters was markedly higher than that of non-adopters for respondent that consumed the juices for one, two and three days of the reference period. Of all the adopter respondents, 10.5%, 12.3% and 3.4% consumed Afia juice for one, two and three days compared to 8.0% and 0% for the corresponding days. For sugar cane consumption, 11.7% and 18.2% of the adopter respondents consumed it for one and two days respectively in comparison to 4.0 % and 8.0% for non-adopters.

For condiments and spices, there was even distribution of adopter and non-adopter respondents across the days in consuming tea and onions. Adopter respondents reported higher proportions of non-consumption of tea (40.0%), garlic (92.0%), tomatoes (30.0%), pepper (82.0%), ginger (88.0%) and capsicum (86.0%). The corresponding proportions for adopter respondents were 1.9% (tea), 77.8% (garlic), 16.6% (tomatoes), 65.1% (pepper), 79.3% (ginger) and 71.0% (capsicum). However, for the consumption of onions, adopter respondents reported a higher percentage (17.9%) of non-consumption compared to non-adopters (4.0%). Similarly, the proportion of non-adopter respondents who reported daily consumption of tea in the reference period was higher (82.0%) than the one for adopters (79.0%).

C. Association between Adoption of Sahiwal Cattle and Household Food Security

Both variables were at the ordinal level of measurement and thus the appropriate statistic to test the nature of association between them was the Spearman's rho. This study examined two aspects of food security – level and value. Three levels of food security existed poor, borderline and acceptable. There was a significant association between the number of years a household has raised Sahiwal cattle and food security score value. The correlation coefficient of the association was r_s = .149 which was significant at the 0.01 level. This association was weak and positive.

The null hypothesis for this study was "Adoption of Sahiwal cattle were not associated with food security among Isiria Maasai households and its alternative hypothesis was "Adoption of Sahiwal cattle was associated with food security among Isiria Maasai households. The calculated p-value (two-tailed test) of the association adoption of Sahiwal cattle and food security was .004. This was less that the α – value of .05 and hence this study rejected HO_2 and accepted HA_2. Thus, there was sufficient evidence to indicate that adoption of Sahiwal cattle was associated with food security among Isiria Maasai households.

IV. DISCUSSION

Most studies have anlysed the impact of adopting dairy cattle on household food security. Few studies have also been undertaken to assess the impact of adopting improved beef breeds on household food security. Moreover, a substantial number of the studies have also concentrated on non-pastoral communities. Studies on the impact of

adopting dual-purpose cattle breeds are scant. This study was therefore formulated to investigate the relationship between the adoption of Sahiwal cattle – a dual purpose breed – and household food security among pastoralist communities with a specific focus on Isiria Maasai of Kenya.

The study observed that adoption of Sahiwal cattle among the respondents had a positive association with household food security. The finding was in line with other studies. Although relating to adoption of improved cows, Kabunga, Ghosh & Webb [24](2017) noted that households that had adopted improved dairy cows in Uganda had improved nutritional outcomes. This came through increased milk yields which improved their food security either through direct intake of milk or through food purchased from cash income obtained from sale of milk. In their impact assessment of the Livestock and Pasture Development Project (LPDP) in Tajikistan Cavatassi & Mallia [25](2018) noted that anthropometric measures were significant and positive indicating that children from households that benefitted from the project had a better nutritional status compared to children from non-beneficiary households. Bayan & Dutta [26](2017) found out that households that had adopted crossbred cattle in the Assam region of India had a significantly higher consumption of nutritious and protein-rich high-value food commodities compared with non-adopter households, mainly due to increased milk yields. This tendency improved the household food security situation.

The study also found out that respondents with higher levels of education had a good dietary diversity and that except for the oldest respondents, dietary diversity improved with the age of respondents. The findings agreed with those of Alamu et al. [27](2019) who found out that the level of education and age of households in Eastern and Southern provinces of Zambia influenced the diversity of foods consumed in the household. They attributed the observation to increased knowledge and awareness of the existence and value of a range of food types. Ochieng et al. [28](2017) also found that education was one of the determinants of dietary diversity in Bahi and Mbarali districts in Tanzania.

V. CONLUSION

This study concluded that adoption of improved cattle breeds had a positive association with respondents' household food security. Commonly consumed categories of food by the respondents were milk and milk products (91%), fruits (69%) as well as vegetables and leaves (61.7%). The majority (70%) of respondents consumed a highly diverse diet. Respondents with higher levels of education were likely to have good dietary diversity. Except for the oldest respondents, dietary diversity improved with the age of respondents. Non-adopters of improved cattle breeds relied most on locally available foods.

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