# LIVESTOCK IMPROVEMENT AND PASTORALISTS LIVELIHOOD OUTCOMES: A STUDY OF SAHIWAL CATTLE ADOPTION AMONG ISIRIA MAASAI OF NAROK COUNTY, KENYA

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# Declaration

## Declaration by Candidate

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# Dedication

I dedicate this work to all pastoralists in the world.

# Acknowledgements

# Abstract

Although pastoralism enables up to 500 million people worldwide to realise their livelihood outcomes, its production has been affected by climatic and socio-economic changes. The changes necessitated adopting alternative livelihood activities undertaken by pastoralists or promoted by government and non-governmental organizations. This study was about one such intervention - introducing Sahiwal cattle. It reviewed the literature on the effects of adopting improved livestock breeds on income, food security, and social capital among pastoralists. It sought to investigate the association between adopting Sahiwal cattle and the livelihood outcomes of household incomes, food security, and social capital through a cross-sectional social survey that mixed qualitative and quantitative approaches. The study targeted pastoral communities, and it surveyed the Isiria Maasai of Narok County with the household and household head as its sampling unit and unit of analysis, respectively. The sample size was 400 households selected using multi-stage proportional random sampling. Key informants were purposely selected. The study collected primary data from households using a questionnaire and an observation checklist, while an FGD guide facilitated data collection from the focus groups. Data from key informants was collected using a key informant interview guide. The study utilised IBM-SPSS version 28 to analyse data and summarised results into frequencies, percentages, mean, and mode displayed in tables, bar graphs and histograms. The study relied on Spearman Correlation Coefficient to test the association between the independent and dependent variables. The study tested its hypotheses using the P-value approach at the 0.05 level of significance. Qualitative handwritten data was typed into a word document and read several times to discern recurring categories, opinions, and themes.

More than two-fifths of the households had adopted Sahiwal cattle for between 3 and 6 years. More than half of the adopters were middle-aged (35 and 64 years). Respondents obtained income from cattle mainly through milk, live animals and breeding stock. There was a positive weak significant association between the adoption of Sahiwal cattle and household income ($r_s$ = .254) and social capital ($r_s$ = .177). The association between adopting Sahiwal cattle and food security was negative, weak ($r_s$ = -160) and significant. The study concludes that adopting Sahiwal cattle is positively associated with household income and social capital but negatively associated with food security. Hence, cattle production among Isiria Maasai is not only for income generation and source of food but also a cultural practice with social utility. Therefore, The Ministry of Agriculture, Livestock, Fisheries and Irrigation should formulate an implementation guideline that promotes a package of interventions rather than one intervention to increase household income successfully. The County Government of Narok should develop a policy spelling out procedures for providing incentives to encourage livelihood diversification to complement the adoption of Sahiwal cattle as a household food security intervention. KALRO, through the County Government of Narok, should develop a practical guideline for the rotational use of pedigree Sahiwal bulls by pastoral households to upgrade their cattle which will enhance household social capital dimensions.

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# Operational Definition of Terms

**Adoption:**           Acceptance, acquisition, integration and use of Sahiwal cattle within Isiria Maasai households

**Breeding stock:** A male Sahiwal animal, irrespective of its age set aside for breeding due to its good qualities

**Crossbreeding:** A reproductive technology involving mating indigenous Zebu cows with Sahiwal bulls to produce offspring with combined characteristics of the two breeds

**Dual-purpose cattle:** Domesticated cows, bulls, heifers and steers that are equally suitable for producing milk and meat

**Food security:** Consumption of a diverse and sufficient diet at all times by all members of Isiria Maasai households to the extent that they lead an active and healthy life

**Household:** A group of people who live in the same homestead regularly cook and eat together and typically include a husband, wife, children and occasionally extended family members.

**Income:** Money or revenue earned or received by a household from their investment, labour, production, property or sale of goods, products and services over some time

**Live cattle:** All categories of cattle such as bulls, cows, steers, bullocks, oxen and calves that are exchanged for cash at home or driven to the market for sale

**Livelihood:** Resources such as finances, human, natural, social, tools, equipment and technology, as well as activities and rights that enable Isiria Maasai households to make a living

**Livelihood outcome:** Increased income, food security and enhanced social capital that Isiria Maasai households seek and strategise to achieve through activities such as the adoption of Sahiwal cattle

**Pastoralism:** A livelihood system relying on herding livestock on natural pastures involving mobility, adaptability, flexibility, diversification and mutual support

**Smallholding:** A cattle production system among the Isiria Maasai where the household is the centre of planning and implementation in a broader network of relations

**Social capital:** The totality of social relations and interactions such as membership to groups, friendship, social solidarity, trust, helping others, information and communication, interaction, sociability, safety as well as empowerment and political action

# List of Abbreviations and Acronyms

| | | |
|---|---|---|
| AHHS | - | Average Household Size |
| AHRQ | - | Agency for Healthcare Research and Quality |
| AI | - | Artificial Insemination |
| AJAR | - | African Journal of Agricultural Research |
| AJFS | - | African Journal of Food Science |
| ANC | - | Ante – Natal Clinic |
| ASM | - | African Study Monographs |
| BMC | - | Bio-Medical Central |
| CCAFS | - | Climate Change, Agriculture and Food Security |
| CELEP | - | Coalition of European Lobbies on East African Pastoralism |
| CGIAR | - | Consultative Group on International Agricultural Research |
| CJASC | - | Central Jersey Ambulatory Surgery Center |
| CNRS | - | *Centre national de la recherche scientifique (French National Centre for Science Research* |
| CORPs | - | Community Resource Persons |
| CSIRO | - | Commonwealth Scientific and Industrial Research Organisation |
| DCA | - | Danish Church Aid |
| DFID | - | Department for International Development |
| DOI | - | Document Object Identification |

| | | |
|---|---|---|
| DoIT | - | Diffusion of Innovation Theory |
| DNA | - | Did Not Answer |
| DP | - | Discussion Paper |
| ECLAC | - | Economic Commission for Latin America and the Caribbean |
| EHESS | - | École des hauntes études en sciences socials (School of Advanced Studies in the Social Sciences) |
| E & PA | - | Empowerment and Political Action |
| f | - | Frequency |
| FAO | - | Food and Agriculture Organization |
| FARA | - | Forum for Agricultural Research in Africa |
| FCS | - | Food Consumption Score |
| FGDs | - | Focus Group Discussions |
| Fig. | - | Figure |
| FM | - | Frequency Modulation |
| FNR | - | Food and Nutrition Research |
| FUDMA | - | Federal University Dutsin-Ma |
| GCA | - | Global Call to Action |
| GDP | - | Gross Domestic Product |
| GJSFR | - | Global Journal of Science Frontier Research |
| GoK | - | Government of Kenya |

| | | |
|---|---|---|
| GTZ | - | Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation |
| HA | - | Alternative Hypothesis |
| HDD | - | Household Dietary Diversity |
| HDDS | - | Household Dietary Diversity Score |
| HH | - | Household |
| HHs | - | Households |
| HIV | - | Human Immuno-deficiency Virus |
| HO | - | Null Hypothesis |
| HQs | - | Headquarters |
| IBM | - | International Business Machines |
| ICC | - | Intra-Class Coefficient |
| ICPALD | - | IGAD Centre for Pastoral Areas and Livestock Development |
| ID | - | Identification |
| IFAD | - | International Fund for Agricultural Development |
| IFRA | - | Institut Francais de Recherche en Afrique (French Institute for Research in Africa) |
| IGAD | - | Inter-Governmental Authority for Development |
| IICA | - | Inter-American Institute for Cooperation on Agriculture |
| ILRI | - | International Livestock Research Institute |
| INDDEX | - | International Dietary Data Expansion |
| Infocom. | - | Information and communication |

| | | |
|---|---|---|
| IOP | - | Institute of Physics |
| ISSN | - | International Standard Serial Number |
| IUCN | - | International Union for Conservation of Nature |
| IZA | - | Institut zu Zukunft der Arbeit (German Institute of the Study of Labour |
| JBAH | - | Journal of Biology, Agriculture and Healthcare |
| JESD | - | Journal of Economics and Sustainable Development |
| JEPER | - | Journal of Educational Policy and Entrepreneurial Research |
| KALRO | - | Kenya Agricultural and Livestock Research Organization |
| KES | - | Kenya Shillings |
| KI | - | Key Informant |
| KIIs | - | Key Informant Interviews |
| Km | - | Kilometre |
| LAPSSET | - | Lamu Port South Sudan Ethiopia Transport |
| LPDP | - | Livestock and Pasture Development Programme |
| LPP | - | League of Pastoral People |
| MD | - | Maryland |
| MPRA | - | Munich Personal RePEc Archive |
| MRD | - | Mountain Research and Development |
| NACOSTI | - | National Commission for Science, Technology and Innovation |
| NDDP | - | Nigerian Dairy Development Programme |

| | | |
|---|---|---|
| NFP | - | New Fringe Pastoralism |
| NGOs | - | Non-Governmental Organization |
| NJAS | - | New Jersey Academy of Science |
| OC | - | Observation Checklist |
| ODI | - | Overseas Development Insitute |
| PAD | - | Project Appraisal Document |
| PDR | - | People's Democratic Republic |
| PEFA | - | Pentecostal Evangelistic Fellowship of Africa |
| PKH | - | Pastoral Knowledge Hub |
| PRC | - | People's Republic of China |
| RAs | - | Research Assistants |
| RGB | - | Rwanda Governing Board |
| RISP | - | Regional Integration Support Programme |
| SACCOS | - | Savings and Credit Cooperative Organizations |
| SCS | - | Social Capital Score |
| SDCP | - | Smallholder Dairy Commercialization Programme |
| SLF | - | Sustainable Livelihood Framework |
| SMART | - | Standardized Monitoring and Assessment of Relief and Transitions |
| SPSS | - | Statistical Package for Social Sciences |
| TDP | - | Transmara Development Programme |
| TOBRA | - | Toggenburg Breeders Association |

| | | |
|---|---|---|
| TV | - | Television |
| UK | - | United Kingdom |
| UMR | - | Unité Mixte de Recherché (French Joint Research Unit) |
| UNDP | - | United Nations Development Programme |
| UNECA | - | United Nations Economic Commission for Africa |
| UNEP | - | United Nations Environmental Programme |
| UNICEF | - | United Nations International Children's Emergency Fund |
| US | - | United States |
| USA | - | United States of America |
| USAID | - | United States Agency for International Development |
| USD | - | United States Dollar |
| WASH | - | Water, Sanitation and Hygiene |
| WFP | - | World Food Programme |

# CHAPTER ONE: INTRODUCTION

## 1.1 Background of the study

Globally, between 200 and 500 million people depend on pastoralism to sustain their lives, especially in arid and semi-arid regions of the world (UNEP, 2017). Pastoralism is a complex livelihood system developed over time to realize maximum production in delicate and intricate environments (Pantuliano & Pavanello, 2016). It involves adaptation to dynamic environmental conditions characterized by unpredictable climatic changes and human interactions (Berhanu & Beyene, 2015). Essentially, pastoralism is a production system of extracting proteins from natural resources such as grasses and shrubs in dry and marginal lands using livestock (Channer, 2015). In this endeavour, pastoral production has relied on innovative strategies such as herd dispersion, diversification, maximization and mobility executed successfully within appropriate socio-cultural norms and relationships. The two factors assured flexibility, spreading risks, and maximum use of available natural resources both in time and space (Berhanu & Beyene, 2015).

Over the years, pastoralists have developed sufficient knowledge and strategies to acquire, care for and use livestock sustainably without degrading their environment (African Union, 2010). Furthermore, pastoralists have built an intricate system of rights that include access to, alienation of, control over, exclusion from, management and withdrawal of resources. Principles of mutual trust and reciprocity implemented through social institutions have guided this rights system (Pearce, 2016). Pastoralist communities achieve adequate feeding, nutrition, watering and mineralization for their

livestock through herd movement (Rota & Sperandini, 2009). Moving livestock is part of an indigenous system of range management that considers the productivity of animals with the biophysical landscape (Oba, 2012). Moreover, the breeds of livestock raised are environmentally fit for the needs of pastoralists (Nyamushamba, Mapiye, Halimani & Muchenje, 2017).

However, in recent years, pastoralists worldwide have experienced numerous climatic and socio-economic changes which have affected their traditional livestock production practices and outcomes. Climate change has become increasingly severe, affecting livestock production by reducing livestock feed intake, growth and birth rates while increasing mortality rates through abortions and other forms of attrition (Salamula, Egeru, Asiimwe, Aleper & Namaalwa, 2017). Similarly, climate change has affected pasture composition by reducing herbage growth and quality (Thornton, 2010).

Pastoral livelihoods have also been affected by a global tightening of immigration laws and increased restrictions on cross border movements, which involve herd movement as state boundaries interfere with migration routes of pastoralists. Likewise, in most countries, state policies on agricultural production tend to favour crop production over pastoral livelihood, which is considered detrimental to the environment, primitive and uneconomical (Djohy, 2017; Nyanjom, 2014). Pastoralists have encountered challenges such as strained relations with the state authorities throughout history. This situation becomes complex as pastoralists lack political influence since they occupy remote areas of their countries and are widely sparse (Simenew, Dejen, Tesfaye, Fekadu, Tesfu & Fufa, 2013).

Furthermore, pastoral livelihoods have been affected by land tenure changes at the government, community and individual levels. With funding from Canada, the Government of the Republic of Tanzania alienated 40,000 hectares of Barabaig grazing land in 1994 for a wheat production project (Bollig & Lesorogol, 2016). Besides this, it also converted 829,200 hectares of Maasai land into a wildlife park - the Ngorongoro Conservation Area (LPP, 2016). Land tenure changes led to privatising communal grazing land among the Maasai and Samburu (Lesorogol & Boon, 2016). Owners of the land parcels either sold or turned them into cropland to produce maize or wheat. The two processes reduced available grazing land, necessitating a reduction in livestock numbers (Njeru, Kirimi & Nthenya., 2017)

In another example, pastoralist livelihood of Waso Boran in Isiolo County is under threat mainly from attacks from neighbouring Somali herders, encroachment by crop cultivators from the neighbouring Meru County, expansion of conservancies under National Rangeland Trust, major investment ventures, including Lamu Port South Sudan Ethiopia Transport (LAPSSET) corridor, resort city and airport (Scoones, 2018a). Besides changes in the land tenure system, pastoralist areas have experienced growth in the human population, further exacerbating the scarcity of pastoral resources (Holechek, Cibils, Bengaly, & Kinyamario, 2017).

Pastoralist communities have responded to climatic and socio-economic changes in various ways. In Nepal, Gentle and Thwaite (2016) found that pastoralism was no longer sufficient to meet the subsistence needs of households, thus compelling them to

increase food purchases. Nepalese pastoralist communities have also experienced increased internal and external migration, especially among the youth, leaving livestock management to women or hiring extra labour to meet shortfalls. In the Indian Himalayas, households adopted crop cultivation and minor trades (Bhasin, 2013). In the Tibetan plateau of China, pastoral production continuously faces uncertainties due to land tenure changes, marketing, massive infrastructural projects, and environmental changes. Local pastoralists addressed the difficulties by purchasing hay and other supplementary feeds (Scoones, 2018b). According to Struelens, Pomar, Herrera, Huanca, Dangles & Rebaudo (2017), increased access to markets influenced Bolivian pastoralists in South America to change their composition herds by raising more sheep and increasing grazing time.

In West Africa, pastoral households in Burkina Faso have adopted alternative fodder and destocking of herds (Kima, Okhimambe, Kiema, Zampaligre & Sule, 2015). In Benin, Fulani pastoralists source and deliver hay to their farms and diversify their income sources (Djohy, 2017). In the Horn of Africa, pastoralists in Ethiopia have expanded their livelihood activities to include crop cultivation, wage labour and petty trading (Goshu & Shibeshi, 2016). In East Africa, pastoralists have also responded to climatic and socio-economic changes. For instance, in Uganda, they have adopted camel production to address climate change (Salamula, Egeru, Asiimwe, Aleper & Namaalwa, 2017). In Tanzanian, pastoralists in the Ihefu Basin have diversified their activities to include crop cultivation, rearing pigs and running small businesses (Msigwa & Mvena, 2014).

According to Galvin (2009), northern Kenya pastoralists such as Ariaal, Borana, Rendille and Samburu settled near urban centres to access good schools, hospitals, famine relief and other economic opportunities. In Marsabit County, pastoralists have adopted alternative livelihood activities such as wage employment, trading, crop farming and transportation services (Komote & Mwaura, 2017). They have also taken up informal milk and live animals marketing, facilitated by an improved and upgraded road network and the M-Pesa mobile money transfer system (Scoones, 2018a).

Furthermore, governments and non-governmental agencies have implemented various interventions to improve the livelihood outcomes of pastoral communities. In the Middle East, especially in Jordan and Israel, governments have directly settled nomadic pastoralists by providing housing, food aid and drilled wells (LPP, 2016). The Asian Development Bank (2008) funded an intervention programme on the genetic improvement of tamed tilapia in Thailand and the Philippines to ensure food security and increased income. In the Lao Peoples Democratic Republic, Government and aid agencies introduced smallholder livestock farmers to forage to meet the increasing demand for meat and live animals (Millar & Photakoun, 2008). In Bangladesh, crossbred cattle were encouraged to alleviate poverty by increasing incomes and improving household nutrition (Quddus, 2017).

In Africa, the Tunisian government implemented two projects that encouraged the cultivation of forages, enhanced livestock farmer skills and upgraded animal genetic potential (Salem & Khemiri, 2008). The Government of Senegal promoted improved

dairy cattle of European ancestry (Niemi, Tapio, Marshall, Tebug & Juga, 2016). The Government of Ethiopia implemented a five-year community-based sheep improvement project to address poverty and low productivity of sheep (Haile, Rischokowsky & Ballantyne, 2014). According to Nziku, Kitaro, Eik, Steine & Adnøy (2016), public and private organizations imported and distributed improved goat and sheep breeds to alleviate poverty and malnutrition in rural households in Tanzania.

One of the critical interventions implemented to improve livelihood outcomes for pastoralists in Kenya is improved cattle breeds. In 1991, with support from the Federal Republic of Germany (FRG), the Government of Kenya (GoK) initiated improved cattle production through an integrated multi-sectoral ten-year rural development programme – the Trans-Mara Development Programme (TDP). The programme aimed at improving pastoralist livelihood outcomes (Kenya Agricultural and Livestock Research Organization, 2019). TDP introduced 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. The intervention aimed at improving pastoralist livelihood outcomes of incomes, food security and social capital.

Studies on cattle improvement interventions indicate mixed-income, food security, and social capital outcomes. Globally, such interventions had yielded favourable results in milk production but unfavourable ones for beef production. In Bangladesh, the adoption of crossbred dairy cattle produced more milk per day than indigenous breeds, leading to

increased household income (Quddus, 2017). In Senegal (Niemi, Tapio, Marshall, Tebug & Juga, 2016), Tunisia (Salem & Khemiri, 2008), Tanzania (Weaver, Mwasi & Weaver, 2015) and Uganda (Kabunga, 2014), improved cattle interventions increased milk yields per cow, reduced calving intervals, raised the quality of milk and increased the price of live cattle.   The overall result was increased household income. However, in contrasting findings, a study in Java revealed that introducing an improved cattle breed for beef production lowered livestock farmers' incomes (Leroy, Baumung, Boettcher, Scherf & Hoffman, 2015).

Similarly, different studies show inconclusive results on the association between introducing improved breeds and food security. For instance, Quddus (2017) found that due to rising incomes due to increased milk yields from improved dairy cattle in Bangladesh, households obtained better nutrition. Weaver, Mwasi & Weaver (2015), Niemi *et al*. (2016) and Kabunga (2014) got similar results in Tanzania, Senegal and Uganda, respectively. On the contrary, Salmon, Teufel, Batenwek, Wijk, Claessens & Marshall (2018) revealed that increased milk yields from improved cattle did not improve food security in poor households. 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, the adoption of improved cattle led to poor nutrition for infants due to the increased workloads that took away the attention of nursing mothers.

Social capital such as socio-cultural norms and relationships are instrumental in utilising pastoral resources, including grasses, shrubs, salt-licks and watering points (Berhanu &

Beyene, 2015). Moreover, the pastoralist system of rights that governs access to, alienation of, control over, exclusion from, management, and withdrawal of resources is guided by mutual trust and reciprocity (Pearce, 2016).     Roschinsky, Kluszczynska, Sölkner, Puskur & Wurzinger (2014) noted that increased milk yields from improved dairy cattle led to a rise in market participation in the tropics probably adding suppliers, feed sellers and customers of milk and milk products to the social capital of the household. Membership in cooperative societies significantly affected technology adoption in China's Sichuan Province (Zang, Sun, Ma & Valentinov, 2020). In Indonesia, Lestari, Sirajuddin & Abdullah (2018) showed that adopters of improved beef cattle had a high level of social capital. In a study on the role of social capital in technology and livestock development, Ntume, Nalule & Baluka (2015) observed that respondents were members of various social groups. Among crop cultivators, a study undertaken by Nato, Shauri and Kadere (2016) revealed a significant positive association between adopting agricultural technologies and group involvement, social support and social networks.

Published research in Transmara covered a wide range of topics, including human-wildlife interactions (Sitati & Ilara, 2012), teenage pregnancies (Mutai & Rono, 2019), infant nutrition (Kotut, 2020), socio-economic factors responsible for the shift from pastoral to agro-pastoralism (Magembe, Bebe, Lagat & Chelang'a, 2013) and the relationship between land tenure changes, agricultural frontiers and conflict between the Maasai and Gusii along the Transmara-Gucha border (Golav & Medard, 2016). In the study area, Lydiah, Ngare, Casper, & Immaculate (2019) researched the gender gaps in the challenges beekeeping farmers face. Ketere-Lelgut, Muia, Ilatsia, Okech and Kitilit

(2018) studied current livestock production challenges and opportunities in Transmara where they assessed feed resources available for Sahiwal and cross-bred weaned calves.

The studies show that introducing and adopting improved cattle breeds on livelihood outcomes yielded contradictory results. Some studies show increased household incomes and improved food security, while others indicated the converse. Similarly, most of the studies had concentrated on adopting improved dairy and beef cattle among respondents practising mixed farming. None of the studies focused on adopting improved dual-purpose cattle breeds like the Sahiwal among pastoralists. Moreover, most studies have concentrated on household income and food security, paying little regard to social capital. Despite its central role in the livelihoods of pastoralists, social capital has not received adequate attention, as most studies mention it in passing. Most studies have concentrated on a few aspects such as membership to social groups and social support while ignoring other important factors such as safety, sociability, empowerment and political action, friendship, solidarity and helping others. As such, this study sought to fill these gaps by investigating the effects of adopting Sahiwal cattle on the livelihood outcomes of household income, food security and social capital among pastoralists.

## 1.2    Statement of the problem

The production potential of pastoralism to meet the livelihood outcomes of income, food security, and social capital has been reduced by socio-economic, geopolitical, ecological and climatic changes. The insufficient singular efforts to remedy the situation by pastoralists have been supplemented by direct governmental or non-governmental

interventions to enhance livestock production and improve livelihood outcomes. One such intervention was the introduction of Sahiwal cattle among Isiria Maasai by the Transmara Development Programme (TDP) – a rural development programme jointly funded by the Government of Kenya (GoK), in collaboration with the Federal Republic of Germany (FRG) between 1994 to 2005.

The GoK and FRG had expended enormous resources in executing the mandate of TDP to enhance cattle production of the pastoral Isiria Maasai to enable them to realise livelihood outcomes by promoting the adoption of Sahiwal cattle – an improved cattle breed. It was, therefore, necessary to find out the livelihood changes brought about by the adoption of Sahiwal cattle and specifically on the livelihood outcomes of household income, food security and social capital. Without such a study, it would be difficult to know what difference the intervention of introducing Sahiwal cattle made in the livelihood of Isiria Maasai. Such knowledge is essential as a justification for resource expenditure and will also provide evidence of what worked, which is vital feedback that can be used in designing similar interventions in the future. Moreover, a new cattle breed such as Sahiwal may replace the indigenous Zebu cattle. This replacement may have economic and sociological effects on households. Thus, the study investigated the associations between adopting Sahiwal cattle and household income, food security, and social capital.

## 1.3    Purpose of the study

This study investigated the association between livelihood outcomes and livestock improvement among pastoralist communities, focusing on adopting Sahiwal cattle among Isiria Maasai of Narok County, Kenya.

## 1.4    Objectives of the study

Specifically, the study sought to:

1)    Determine the association between adopting Sahiwal cattle and household income;

2)    Analyse the association between adopting Sahiwal cattle and household food security;

3)    Establish the association between Sahiwal cattle adoption and household social capital.

## 1.5    Study hypotheses

Regarding the impact of adopting improved livestock breeds among Isiria Maasai households, this study tested the following hypotheses:

$HO_1$    Adoption of Sahiwal cattle was not associated with household income among Isiria Maasai households

$HO_2$    Adoption of Sahiwal cattle was not associated with household food security among Isiria Maasai households

$HO_3$    Adoption of Sahiwal cattle among Isiria Maasai households was not associated with household social capital

## 1.6    Justification for the study

The introduction of Sahiwal cattle into Isiria Maasai households had, in another sense, initiated a replacement of the indigenous Zebu cattle. The replacement has far-reaching consequences on households' livelihood economically and sociologically through a possible alteration of the norms of reciprocity between friends and kinship ties and household division of labour. Moreover, without such a study, it would not be possible to use the experiences from the interventions to improve the design of future interventions. Similarly, without such a study, it would be not easy to know what differences the introduction of Sahiwal cattle made to the livelihood of Isiria Maasai.

The nature of information available on the adoption of improved cattle technologies equally necessitated this study. It was worth noting that the bulk of studies concentrated on the impact of technology adoption among crop cultivators, and a few studies existed on pastoralists and agro-pastoralists. Similarly, there was an emphasis on the contribution of adopted technology to production. This preoccupation ignored other livelihood issues.

Furthermore, assessment reports on the impacts of technological interventions promoted by projects and programmes tended to concentrate on the extent to which they achieved their objectives and the level of efficiency and effectiveness.   While this was an equally good course to follow, it was a narrow and short-term concern given the demands imposed by funding sources. There was a need to focus on broad livelihood concerns to objectively assess the impact of technological interventions.

Furthermore, most studies on technological intervention were carried out immediately after completing project implementation, mostly five years. This duration is too short to assess the impact of technical interventions as beneficiaries' minds, and thoughts might still be preoccupied with the potential outcome of the assessment. Moreover, most livelihood effects require a more extended period to be manifested, which the end-of-project impact assessment cannot capture.

## 1.7    Significance of the study

The findings of this study may add value to policymaking concerning livelihood diversification strategies in general and the adoption of improved livestock breeds in particular. Kenya's current policy promotes improved cattle breeds among pastoralists, particularly Sahiwal and *Boran,* in arid and semi-arid areas. Undertaking this study provides feedback on the impact of the policy on the livelihood of pastoralists. The study also informs practice by providing information on the positive and negative effects of the intervention on pastoral households, thereby reorienting subsequent interventions in other pastoral groups.

Moreover, it adds to the existing knowledge on livelihood diversification by contributing new and empirical data on the current situation of pastoralists in general and Isiria Maasai in particular. It also tested the applicability of both the sustainable livelihood framework and diffusion of innovations theory to the actual lives of herders. Data collected empirically by this study suggests a need to modify the guiding model to explain observed phenomena better.

## 1.8    Scope of the study

Although there may be various changes associated with Sahiwal cattle adoption among Isiria Maasai households, this study only investigated differences in livelihood outcomes, with a specific focus on income, food security, and social capital. The researcher researched the Isiria Maasai pastoral households in Narok County engaged in cattle production. Even though the adoption of Sahiwal cattle may have affected the local and national economy, this study concentrated on the impacts at the household level.

## 1.9    Limitations of the study

This study relied heavily on the respondents' self-reporting. As was expected, self-reporting raised challenges associated with recall and misrepresentation. However, the study triangulated data collected through self-reporting tools through other techniques, including Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), and observation.

The second limitation stemmed from the study design - a survey. In surveys, a researcher collects data not from the population but its selected sample. Thus, data from a population sample may not be as reliable as data collected through a census study. However, the study endeavoured to ensure that the sample was representative of the population. Similarly, triangulation was applied to complement data collected from the sample.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1    Introduction

This chapter presents a literature review on the association between pastoralism and livelihood outcomes and the effects of adopting improved livestock breeds on household income, food security and social capital. The chapter concludes with a summary of issues already studied and those not adequately covered and, therefore, knowledge gaps on the subject that this study partially addressed.

## 2.2    Pastoralism and livelihood outcomes

Pastoralism exists in all continents but is currently practised in more than 100 countries covering over 25% of the earth's surface, predominantly in sub-Sahara Africa, southern Africa, Central Asia, northern Europe, North and South America, and Australia (Dong, 2016, Manzano, Burgas, Cadahı´a, Eronen, Ferna´ndez-Llamazares, Bencherif, Holand, Seitsonen, Byambaa, Fortelius, Ferna´ndez-Gime´nez, Galvin, Cabeza, & Stenseth, 2021, Tamou, Ripoll-Bosch, de Boer & Oosting, 2018). In Chad, pastoralist livestock farming is the second source of income, contributing 53% of GDP (Guinde, Mahamat & Abdallah, 2018) and supplying 60% of all the meat and milk products consumed in West Africa (UNECA, 2016). Pastoralism contributes an estimated 19%, 13% and 8% of Gross Domestic Product (GDP) in Ethiopia, Kenya and Uganda, respectively (Nyariki, 2017). Approximately 1.3 billion people are beneficiaries of the livestock chain in Africa (Nyariki & Amwata, 2019). In Kenya, its total economic value was Kenya Shillings 85.89 billion in 2019 (ICPALD, 2019).

Globally, 200 million pastoralists' households rely heavily on rearing livestock to sustain their livelihoods (Dong, *op. cit*). According to the Coalition of European Lobbies for Eastern African Pastoralism (CELEP) (2017), pastoralists' livestock has direct and indirect household values. Directly they enhance human capital by providing over 90% of employment opportunities in arid and semi-arid areas and a source of indigenous knowledge in breeding and utilization of variable natural resources sustainably. By giving a protein-rich diet in the form of meat and milk consumed directly in households, pastoralists' livestock, including cattle, contributes to food and nutritional security. Also, livestock enables herders to generate direct income by selling live animals or products, act as insurance against risks and are a form of investment (ICPALD, 2019). Similarly, through the payment of bride-wealth, establishing relations and conferment of social status, livestock enables pastoral households to meet their socio-cultural objectives and build social capital (ICPALD, 2019). In West Africa, particularly in Ghana, Fulani pastoralists use cattle as a form of cultural identity and can shape the type of relationships that people have with family, friends and neighbours (Abubakari & Longi, 2014)

According to Mohanty, Senapati, Jena & Palai (2014), Indian pastoralists have long used urine from cows to treat human ailments including diabetes, blood pressure, asthma, psoriasis, eczema, heart attack, blockage in arteries, fits, cancer, arthritis, migraine, thyroid, ulcer, acidity, constipation and gynaecological problems. In this way, cattle enable households to maintain good health.

Among the Chinese Tibetans, pastoralism provides livelihoods for two million households by producing high-value products such as milk, meat, wool, skins and transport (Wangchuk, Wurzinger, Darabant, Gratzer & Zollitsch, 2014). In the Himalayan Mountains, transhumant pastoralism contributes to the livelihood of herder communities by providing income from the sale of livestock and is a central ingredient of culture and identity (Gentle & Thwaite, 2016).

Indirectly, pastoralism facilitates increased crop production by providing both manure and draught power and enabling tourism to flourish by maintaining grazing reserves for wildlife and deterring poachers. Furthermore, by eating dead grass and other biomass, livestock limits the risk posed by bush fires besides helping in dispersing plant seeds and breaking up the soil crust to allow water filtration. As a land-use system, pastoralism accommodates climate change compared to sedentary land uses (CELEP, 2017).

In the Horn of Africa, pastoralists in Somalia and Somaliland rely on livestock to fulfil household livelihood outcomes such as cash income, food, insurance against livelihood risks, a means of transport, and maintaining social relations and prestige (FAO, 2015; Marshall, Mtimet, Wanyoike, Ndiwa, Ghebremariam, Mugunieri & Costagli, 2016). Similarly, in Western Africa, Fulani pastoral households in Nigeria and Cameroon use livestock to satisfy their livelihood outcomes of cash income, provide nutrition and meet socio-cultural obligations (Majekodunmi, Fajinmi, Dongkum, Shaw & Welburn, 2014; Ngalim, 2015). In East Africa, Okello, Muhanguzi, MacLeod, Welburn, Waiswa & Shaw (2015) have documented the use of cattle traction among agro-pastoral

households of Uganda to save on their labour and hire them out, thereby generating a quarter of the total annual income.

Despite facilitating the attainment of livelihood outcomes, pastoralism as a production system and way of life is under strain from climatic, economic, political, resource and socio-cultural factors (Archambault, 2016; Kirimi & Njeru, 2016). Access to pastoral resources is becoming constrained due to the loss of rangelands (African Union, 2010) for the establishment of wildlife sanctuaries (Oba, 2012, League of Pastoral People, 2006; Mutsotso, 2013), the transformation of rangelands into new forms of land-uses (Kirimi & Njeru *ibid*; Levine, 2015; Lesorogol & Boone, 2016) and population growth (Abubakar & Longi, 2014; Oba, 2012 ). Pastoralism has been strained by political factors (Little, McPeak, Barrett, & Kristjanson, 2011), such as policies and mechanisms to discourage pastoralism (Gentle & Thwaite, 2016). Some tools and procedures include over-regulation of pastoral migration and pasture use (Kreutzmann, 2012) and lifting bans on crop cultivation in conservation areas (McCabe, Leslie & DeLuca, 2010). Others include government reluctance to address their insecurity provide social services and development infrastructure (Little, McPeak, Barrett & Kristjanson, 2011). Additional ways include resettlement programmes, implementation of state-sponsored mega-projects and processes of acculturation and integration (Kirimi & Njeru, 2016; Jandreu & Berkes, 2016; Krätli & Schareika, 2016; Lesorogol & Boone, 2016).

With these constraints, it is becoming increasingly difficult for pastoralists to realize their livelihood outcomes without devising other strategies, including adopting improved livestock breeds.

## 2.3 Association between adopting improved livestock and household income

Numerous interventions have crossbred pastoralists' livestock and exotic breeds that grow fast, large and produce more milk and meat to increase productivity and address livelihood challenges (Binswanger-Mkhize & Savastano, 2017; Frankema, 2014). Studies have researched the effects of crossbreeding pastoralist livestock on their livelihood.

Bayan & Dutta (2017) carried out an impact study on household income and consumption in the three districts of Assam, namely; Barpeta, Sonitpur and Karbi Anglong. Using crossbreeding, the government improved indigenous cattle in the region via the Key Village Scheme, Intensive Cattle Development Project, Rashtriya Krishi Vikash Yojana, Assam Rural Infrastructural and Agricultural Services Project, National Cattle and Buffalo Breeding Programme, among others. In their study, the authors found a statistically significant effect of the adoption of crossbred cattle on dairy and livestock income. In particular, the adoption of high-yielding crossbred cows increased by 51.61 Indian Rupees per cow per day. Some households realized an increase of over 73,000 Indian Rupees through the adoption of crossbred cows. Similarly, an analysis of almost one century of crossbreeding of indigenous cattle and *Bos Taurus* indicated that exotic inheritance of around 50% was ideal for growth, reproduction and milk production. Despite the challenges faced, households realized higher output per animal and income; thus, the authors concluded that crossbreeding was likely to continue (Singh, 2016).

In Bangladesh, crossbred cows produced three times more milk than indigenous cows of rural Bangladesh. Thus, the daily profit accrued from a cross-bred dairy cow was more in comparison to an indigenous one. However, the daily feed intake and labour demands for crossbred dairy cattle were more than indigenous cows. Illiterate and highly educated farmers were less motivated to adopt crossbred cattle (Quddus, 2017). In Tajikistan, the US$ 15.8 million Livestock and Pasture Development Project implemented by the government and in collaboration with IFAD in one of the poorest regions – Khatlon - between 2011 and 2017 yielded increased household total annual income by 19%, productive assets by 115% and a 42% increase in livestock net income in almost 24,000 households. Amongst the interventions was the supply of improved rams (Cavatassi & Mallia, 2018).

In West Africa, Baidoo, Yusif & Anwar (2016) found that smallholder livestock production had a positive and statistically significant effect on household income among farmers of Yendi Municipality of Northern Ghana, demonstrating an immense potential in alleviating poverty among rural households. In the Manica Province of Mozambique, Johnson, Njuki, Waithanji, Nhambeto, Rogers & Kruger (2015) observed that households with superior cattle breeds (Jersey) by the Manica Smallholder Dairy Development Programme had their dairy production incomes increased dramatically. Milk production increased from 2.4 to 34.8 litres per week. Monthly milk sales for non-adopter and adopter households were 4.69 and 125.03 litres, which earned 60.00 and 1743.11 Mozambican Meticales.

In a study undertaken in Ethiopia to assess household impacts of adopting dairy cattle technologies such as crossbreeding and improved forages, Kebebe (2017) found vast income differences between adopter and non-adopter households. For instance, families that had adopted crossbred dairy cattle received an average monthly income of US$ 286.57, whereas non-adopter received US$ 66.29; this was a difference of about US$ 220 per month. Thus, the effort to improve dairy productivity based on the introduction of high-yielding exotic cattle and the distribution of hybrid cattle seemed to have increased household income. Similarly, in a study undertaken in the Endamehoni district of the Southern Zone, Tigray, Ethiopia, to determine the contribution of crossbred dairy cattle to household income, Bisrat (2016) found that annual revenue from livestock for non-adopter and adopter households was 4,529 and 7,878 Ethiopian Birrs respectively. The income difference was significant, and Bisrat concluded that crossbred dairy cow technology led to improved smallholder farmers' livelihoods. In another study conducted in the Menz region of Ethiopia, the introduction of an enhanced sheep breed resulted in a positive change in the livelihoods of pastoralists (Haile, Rischokowsky & Ballantyne, 2015). In the intervention, rams of the improved *Awassi* sheep from Israel were imported and interbred with the indigenous *Menz* sheep to improve productivity. Haile, Rischokowsky & Ballantyne (2015) found that adopting the improved breed resulted in higher household incomes. The authors revealed that households that had adopted the new breed sold an average of 100 improved live sheep every three months. Since the enhanced breed is large and grows faster, it is more economically viable. The improved breed was tastier, had a higher demand, and fetched a higher price (Getachew, Haile, Wurzinger, Richkowsky, Gizaw, Abebe & Sölker, 2016).

After the 1994 genocide, the Government of Rwanda implemented the Girinka Programme to promote and distribute one exotic dairy cow with at least 50% genetic make-up (high milk production compared to local milk cows) to one poor household in Rwanda (Harirwa & Karinganiri, 2017). The programme aimed to reduce child malnutrition and increase the incomes of poor household farmers (the Republic of Rwanda, Ministry of Agriculture and Animal Resources, 2015). As of July 2017, the programme had distributed over 297,000 crossbred dairy cows reaching over 1.2 million individuals (Rwanda Governance Board, 2018). Between 2010 and 2015, Girinka contributed to increasing milk production in Rwanda from 372,619 to 706,030 litres enabling poor households to increase their incomes and graduate from poverty to owners of small businesses and growing opportunities for employment (Rwanda Governance Board, 2018).

Similarly, a study in Uganda observed that after crossbreeding Karamojong female goats with imported bucks from South Africa, the crosses produced an average of one litre per day during each lactation period resulting in more income to households for satisfying other domestic needs (Sadler, Kerven, Calo, Manske & Catley, 2016). Elsewhere, Kabunga (2014) also noted that adopting improved dairy cows in Uganda significantly increased milk yield, household orientation to milk markets and food expenditure, reducing poverty and stunting for children below five years. Improved dairy cattle (Holstein Friesian & Ayrshire) in Tanzania created consistent income streams due to an increase in daily milk production from 1 – 7 (or in some instances 12) litres/day, which 29% of households sold. The extra incomes enabled households to send their children to school, buy school uniforms and supplemental food, re-invest in the improved cattle, and construct a new house (Weaver, Mwasi & Weaver, 2015).

In Kenya, the Dual Purpose Goat Project was initiated in 1980 to produce fast-growing goats, have a significant bodyweight averaging 40kg, produce four litres of milk every day, and adapt to prevailing environmental conditions (Ojango, Okeyo & Rege, 2010). The project imported and distributed *Toggenburg* and *Anglo-Nubian* bucks among pastoralists in Kajiado to crossbreed with their indigenous *East African* and *Galla* goats (Sadler, Kerven, Calo, Manske & Catley, 2010). An assessment of the project found that, on average, at half a litre per day, crossbreds produced more milk than the indigenous breeds and registered higher growth rates. In contrast, the pre-weaning survival rates did not differ from indigenous species (Sadler *et al*., 2010). More milk, fast-growing and larger goats fetch higher prices and therefore more income to the household.

While analyzing the Farm Africa twenty-year Goat Model in arid and semi-arid areas in Ethiopia, Kenya, Tanzania and Uganda, Peacock (2008) noted that it led to increased household incomes obtained from selling milk, live male goats and breeding stock. For implementing the model, Farm Africa concluded that the most practical method of breed improvement is crossbreeding indigenous goats and improver breeds until the crossbred stabilizes at 75% of the improver breed. Adoption increased household income from USD 93 to 995 per annum (Peacock, 2008).

The studies reviewed so far have reported that the adoption of improved livestock (cows, goats and sheep) has led to an improvement in the income of households. However, some studies have reported the converse. Widi, Udo, H.M.J., Oldenbroek, K.,

Budisatria, E., Baliarti, E. & van den Zijpp (2015) observed that in the 1980s, the Government of Indonesia initiated a grand programme of crossbreeding European beef breeds with Indonesian cows using artificial insemination (AI) to improve the beef performance of local cattle in response to increasing demand for meat. Although crossbreeding resulted in heavier cattle sold at higher prices, it did not change the farming system as herd sizes, farm types, cattle functions, and farmers' experience remained unchanged. On the contrary, crossbreeding led to a decline in household incomes due to increased expenditure on new inputs. Widiati, Nurtini, Kusumastuti & Syahlani (2019) also observed that the Government of Indonesia intervened in the smallholder beef cattle farms by promoting advanced feeder technology and superior beef cattle breeds such as Simmental and Limousines. The interventions aimed to satisfy local beef demand and stop reliance on beef imports. However, when the authors assessed the economic performance of the interventions on smallholder farms, they discovered that the net income of the adopter smallholder farms was lower than that of non-adopters. As a result of this finding, they recommended the termination of the utilization of the Simmental and Limousines and concentration on local beef cattle to improve the welfare of smallholder beef cattle farmers.

Between 2008 and 2011, the Government in Senegal implemented the artificial insemination (AI) program to boost cow production and increase raw milk supply, processed milk, processed meat, and leather. The AI program aimed at producing 500,000 crossbred cows in Senegal. An assessment of the program's effects revealed that the adoption of hybrid had significantly increased the production of more raw and processed milk, meat and leather. Nevertheless, this was also accompanied by an increase in total factor productivity, which led to a decrease in household incomes

(Cabral, 2016). Gazzarin, Banda & Lips (2018) observed that a similar project in Malawi imported pure dairy genetics such as Holsteins to improve the productivity of indigenous Zebu. After investigating their economic performance by comparing them with Zebu-crossbreds in Southern Malawi, their study found no significant difference between them in terms of lactation yield and calving intervals. Moreover, almost a quarter (23%) of farms studied registered negative incomes, mainly due to increased expenditure on inputs such as concentrates.

In evaluating the impacts of climate change adaptation and mitigation strategies piloted in East Africa on household income and asset accumulation, Ogada, Rao, Radeny, Recha & Solomon (2020) found that adopting improved livestock breeds in the Nyando Basin of Kenya reduced household incomes by 76%. Households that had adopted improved livestock (in this case, Red Maasai sheep and Galla goats) viewed them as valuable assets; thus, a large proportion of household savings went towards their acquisition.

To this extent, it is evident that substantial efforts have been expended in improving the productivity of indigenous livestock in Africa and Asia via crossbreeding with cattle, sheep and goats with genetics for high dairy and beef production from other parts of the world. Many projects have targeted dairy production in cattle and goats, while others have been implemented for beef production in cattle and sheep. Smallholder livestock farmers with a herd of at least ten animals have been the primary recipients of crossbreeding interventions, mainly through AI.

## 2.4 Adoption of improved livestock and household food security

According to Herrero, Grace, Njuki, Johnson, Enahoro, Silvestri & Rufino (2012), increased production due to improved livestock contributes to food security in at least four ways. They grow household access to animal source foods. Their sale and sale of their products generate cash that can be used to purchase food, especially in food-deficit times and increases cereal supply due to increased productivity from manure. Similarly, when productivity increases, prices of dairy products are likely to reduce, thereby enhancing access to food by poor households.

For Sansoucy, Jabbar, Ehui & Fitzhugh (2014), food products from livestock contain high-quality protein, minerals, vitamins and micro-nutrients. They provide all essential amino acids, which plant-source foods often lack. Furthermore, protein from cattle foods is highly palatable and easily digestible. Their metabolism is also efficient compared to plant-based proteins. These qualities are crucial as they enhance human performance, especially of poor populations and other vulnerable populations with high nutritional needs such as infants, children, pregnant and nursing mothers, and people living with HIV (Salem & Khemiri, 2008).

Besides increasing household incomes, livestock crossbreeding interventions in Asia and Africa have improved household food security. The two objectives have been inseparable. In their impact assessment report of the Livestock and Pasture Development Project (LPDP) in Tajikistan, Cavatassi & Mallia (2018) noted that anthropometric measures were significant and positive. This indicated that children from households that benefitted from the project had a better nutritional status than non-

beneficiary households. Part of the interventions included a component of livestock (cattle and sheep) improvement.

In their empirical study of the impact of adopting crossbred dairy cows in the Assam region of India, Bayan & Dutta (2017) found out that households that had adopted crossbred cattle had a significantly higher consumption of nutritious protein-rich high-value food commodities compared to non-adopter households. This was mainly due to increased milk yields. Indeed there was a significant causal association between the adoption of crossbred cattle and increased per capita milk consumption. From this result, the researchers recommended the diffusion of the cattle crossbreeding programme. Elsewhere, in his review of the achievements, challenges and opportunities of livestock crossbreeding efforts in India, Singh (2016) concluded that despite the difficulties experienced, the initiative has led to higher milk production per animal, which has directly contributed to high-value food in Indian households. Similarly, in a study on the performance of crossbred dairy cattle, Quddus (2017) observed that due to rising incomes due to increased milk yield occasioned by crossbred dairy cows in rural Bangladesh, households obtained better nutrition.

Before implementing the Molale Community Based Sheep Breeding and Marketing Project, households in the Molale community of Ethiopia were perennial recipients of food aid. Still, with the adoption of improved sheep, participating households graduated from the government-run emergency food safety net programme to productive farmers with sufficient cash to feed and educate their families (Haile, Rischokowsky & Ballantyne, 2014). Also, compared to non-adopters of crossbred dairy cows, farmers

who owned crossbred cows and had planted improved forages had a higher average dietary diversity score of 5.63 against 4.54 of non-adopter households (Kebebe, 2017).

In Rwanda, the Girinka programme, through which the government provided poor households with improved dairy cows, contributed to the fight against child malnutrition through milk consumed by children and the ability of households to prepare diets rich in ingredients from foods purchased using generated income. At the same time, manure from the cows also enhanced the quality of food crops cultivated in the kitchen gardens (Haririwa & Kuringaniri, 2017).   The adoption of dairy goats promoted by Danish Church Aid (DCA) led to increased milk production per goat per day.   Households either consumed or sold the extra milk for cash to buy other foods not available in the household (Sadler, Kerven, Calo, Manske & Catley, 2010). In this way, the 3500 crossbred goats contributed to food security in the Karamojong pastoral households. Similarly, the adoption of improved dairy cows resulted in high milk yields in Uganda, which led to higher milk sales, milk intakes, integration of households into modern value chains and increased household access to animal source foods. It also led to a 16% increase in household expenditure on food and lower child stunting (Kabunga, Ghosh & Webb, 2017).

In partnership with the Ministry of Livestock, World Vision worked in the Endapash area in Tanzania in 2009 to promote improved livestock breed technology adoption by training livestock farmers and supporting them with improved livestock breeds, particularly Holstein Friesian and Ayrshire. World Vision anticipated that the technology would diffuse and be replicated in the broader community through a merry-

go-round distribution system. In assessing the impact of this intervention, Weaver, Mwasi & Weaver (2015) observed that it resulted in higher milk yields of over 7 litres per cow per day compared to one litre for indigenous cows. The increased production level improved the nutrition and health of the children and families for 29% of households in the Endapash area in Tanzania. In another study in the Morogoro and Tanga regions of Tanzania, Hasler, Msalya, Garza, Fornace, Eltholth, Kurwjila, Rushton & Grace (2018) found that although the Food Consumption Score for all households in the study area was acceptable, it was significantly higher for households with improved dairy cattle.

The high growth rate and increased milk production by crossbred Kenya Dual Purpose Goats among the Maasai of Kajiado led to increased food production by increasing milk consumption within households and food purchased from the cash obtained by selling milk and live goats (Sadler *et al.*, 2010). Peacock (2008) observed that the Goat Development Programme promoted by Farm Africa among pastoralists in Ethiopia, Kenya, Tanzania and Uganda played an essential role in ensuring food security of vulnerable households by improving child and adult nutrition.

Bonilla, McCarthy, Mugatha, Rai, Coombes & Brubaker's (2018) evaluation of the Smallholder Dairy Commercialization Programme (SDCP) in Kenya, which was funded by the International Fund for Agricultural Development and implemented by the Government of Kenya between 2005 to 2015, revealed that it resulted in increased availability of a variety of foods in households and a possibility of consistently taking tea with milk. Similarly, households had translated higher incomes to higher levels of

food security exemplified by diverse foods with higher animal and vegetable protein levels. Thus, there was evidence that SDCP could enhance food security, as exhibited by a higher level of diversification towards more nutritious food items. SDCP included a component of increasing dairy productivity by improving the breed of dairy cows via AI.

The reviewed studies have indicated that promoting improved livestock breeds (cattle, goats and sheep) in different parts of Africa and Asia positively enhanced household food security. However, in a similar study on a project that involved cattle improvement through crossbreeding in Mali, Traore, Reiber, Megersa & Zarate (2018) established that cattle ownership and breed group are essential determinants of all household food security. In their study, households that raised Zebu and mixed herds had the highest FCS. During food shortages, households with Zebu were better off than those with N'dama crossbreds and mixed herds. This was so because selling livestock was the most common coping strategy in times of food shortage. The continued replacement of N'dama with Zebu cattle and their crosses contributed to improved food security in Mali. N'dama is a *Tourane* (hump-less) breed of cattle that, genetically, can produce more milk compared to the Zebu.

## 2.5    Adoption of improved livestock and household social capital

Using a socio-historical approach to analyze the social and ecological impacts of introducing improved cattle in the New World (North and South America) by Spanish colonialists, Ficek (2019) identified deep links between the adoption of improved cattle and capitalism. Improved cattle aided in entrenching the concept of private property,

facilitated annexation of communal lands, turned peasants into wage labourers and demonstrated new ways (such as ranching) of creating wealth by manipulating livestock genetics, thereby enabling some in society to accumulate wealth at the expense of others. By making these differences, the author argued that improved cattle helped the exploited class, mainly indigenous people, consolidate their power against the Spanish colonialist.

In a study undertaken in the Piedmont region of Italy, Muscillo, Pin, Razzolini & Serti (2018) found out that trust and cooperation were highly associated with increased gains and promoted the use and investment of superior quality inputs in beef cattle production. The study indicated that social capital explained the benefits of adopting imported cattle inputs even in a developed economy where access to information and services should not be challenging. Two production systems characterized beef cattle production in Piedmont;  domestic beef cattle with low productivity but less risky and imported beef cattle of high quality and high productivity and highly risky to raise.

To satisfy the rising demand for beef in Indonesia, the government provided beef cattle farmers with technical extension and improved cattle breeds with high productivity (Lestari, Sirajuddin & Abdullah, 2018). In analyzing the social capital among beef cattle farmers who adopted the intervention in South Sulawesi, Indonesia, the authors' research revealed that it was high. The study, which concentrated on three aspects of social capital – mutual trust, norms and linkages - concluded that social capital is not a lesser factor in the economic development of society.

In their study on the impacts of socio-cultural factors on beef cattle value chains in Vietnam, Duong, Pham, Nguyen, Bonney & Stephen (2014) observed that the upgrading of beef cattle led to the expansion of the role of intermediaries in the value chain, which benefitted producers as it reduced the number of actors from eight to four. Intermediaries collected and slaughtered beef cattle as well as retailed the beef. This was beneficial as beef cattle producers were located in South Vietnam while demand for meat was in the north. Moreover, beef cattle producers lived in remote areas and had challenges accessing the markets. Furthermore, the study revealed upgraded beef cattle enhanced the prestige of farmers in the local community as they served as valuable assets and acted as a savings account, especially for poor households.

The Government of Tajikistan implemented the Livestock and Pasture Development Project with complementary funding from IFAD between 2011 and 2017, which cost approximately US$ 15.8 million resulted in the creation of 203 Pasture Users Unions and 131 Community Interest Groups. It also increased ownership of improved livestock by 77% in women-headed households and grew their decision-making power within their households in income and livestock breeding (IFAD, 2016).

In their brief on community-based sheep programme in Ethiopia, Haile, Rischokowsky & Ballantyne (2014) noted that adoption of improved sheep in the Molale community in Ethiopia led to the establishment of the Menz Sheep Production and Fattening Cooperative with the mandate of managing breeding, credit and insurance of the sheep enterprise for the members. Similarly, with the support of livestock research centres, the sheep breeding enterprise had resulted in community animal breeding workers who acted as enumerators and record keepers responsible for tagging and tracking particular

sheep progeny. Through their cooperative society, the Menz community became empowered politically to express their needs and to demand and negotiate for their development as they defined it. This trend was enhanced by the dramatic economic transformation attributed to the adoption of improved sheep breed and cooperative society, which handled the considerable demand for improved rams from the Government, NGOs and neighbouring communities. On these bases, the authors concluded that community-based sheep breeding helped build empowered communities in Ethiopia. Gutu, Haile, Rischkowsky, Mulema, Kinati & Tesfahun (2015) also identified well-functioning cooperative societies' formation as a direct social capital outcome of adopting improved sheep by households in Ethiopia. Bekuma, Galmessa & Fita (2018) reviewed the adoption and impacts of dairy technology in Ethiopia. They observed that multiple actors, including Government, non-government, private and international organizations, had been engaged in promoting and disseminating the technology to smallholder cattle farmers to improve productivity and increase incomes. They claimed that their review was unique because it brought details of the previously ignored interventions into focus. One of the issues previously overlooked in livestock improvement interventions was access to social capital enhanced by belonging to a social group. Social capital, they argued, allowed the exchange of ideas and information about new technologies hastened learning, decision-making and adoption.

Mudingu (2020) summarised the impacts of the Girinka Programme in Rwanda. One result of the programme, which enhanced the adoption of improved dairy cattle in poor households, was to promote reconciliation and unity, especially after the 1994 genocide. For the author, as a symbol of elitism, the colonialist used ownership of a cow to divide people in Rwanda along ethnic lines, a situation that the Rwandan genocide

exacerbated. Girinka changed the meaning and symbolism of owning a cow. Mudingu (2020) observed that the "pass on" component of the programme where a recipient of an improved dairy cow passes on its firstborn calf to a neighbour aided in rebuilding social relationships destroyed by the genocide as giving out a cow sealed a bond of friendship between the two immediate families and their relatives. Thus, the Girinka Programme allowed the Rwandese Government to nurture a shared national identity and turn cultural practices into sustainable programmes. In assessing citizens' perspectives on the Girinka Programme, the Rwandan Governance Board (RGB) also pointed out social cohesion as one of the positive impacts (RGB, 2018).

## 2.6    Gaps in literature

While reviewing literature related to the three objectives of this study, some gaps emerged. The bulk of the studies on the relationship between the adoption of improved livestock breeds and household income were either on dairy or beef cattle. There was a scarcity of studies on the impact of adopting crossbred dual-purpose species (such as the Sahiwal) on the incomes of livestock farmers with a herd of more than ten animals grazing on natural pastures in a free-range system. The studies also reported contradictory results. Studies on dairy cattle in India, Bangladesh, Ghana, Ethiopia and Mozambique indicated that the association between adopting improved dairy cattle and household income was significant and positive. Similar studies were undertaken in Indonesia, Senegal, and Malawi showed that the adoption of improved dairy cattle hurt household income. Studies have also reported the same findings on the adoption of enhanced sheep. At the same time, their adoption by households led to an increase in incomes in Ethiopia but reduced income in the Nyando basin in Kenya. In general,

findings on the adoption of improved beef cattle reported a negative impact on household income.

Literature on the association between improved cattle breeds and household food security predominantly concentrated on the dairy sector and smallholder livestock farmers. Few studies have been undertaken on improved beef cattle breeds and dual-purpose breeds on household food security. Similarly, the results of the interventions were mixed as some returned a positive impact of adopting improved dairy livestock on household food security while others demonstrated reduced food security. Thus, there was a need to study the association between dual-purpose cattle breeds, such as the Sahiwal and household food security. Moreover, it was also necessary to understand the outcome of such an intervention on households of livestock farmers with medium to large herds.

Studies on the impact of adopting improved livestock breeds on social capital overwhelmingly identified the formation of social groups as a consequence. Few studies had considered other aspects of social capital such as empowerment, trust, cooperation, safety, friendship, sociability, level of interaction, information and communication, helping others and political action. Moreover, the bulk of the studies had concentrated on the intervention of dairy cattle and, to a lesser extent, beef cattle and sheep on smallholder livestock farmers. As was the case for household income and food security, there was a scarcity of studies on adopting dual-purpose cattle breeds such as the Sahiwal. Furthermore, studies on the impact of adopting improved livestock breed on the social capital of households in Kenya seem to be scant. It was, therefore,

necessary to assess the effect of adopting dual-purpose cattle breeds on the social capital of households. The current study contributed to addressing the identified gaps in the literature.

## 2.7    Theoretical Framework

The Sustainable Livelihood Framework (SLF) formulated by DFID (2001) guided this study. SLF proposes that a livelihood system comprises five related components, namely: assets, strategies, outcomes, transforming structures and processes and vulnerability context. Each part, in turn, is composed of elements that relate to each other in a myriad of ways.

SLF identifies the five forms crucial for a livelihood on the assets component, including natural, social, human, physical and financial assets. The framework refers to them as capitals. Available resources determine the livelihoods activities that households can undertake to attain their livelihood outcomes as they define them. The second component of the SLF is the livelihood strategies. These are the sets of actions through which households gain a means of survival. They are based on available assets. Households may use common – property resources, access to forests, personal artistic ability to supply food or earn income. The third component of the SLF is livelihood outcomes, which comprises what people seek and strategise to achieve through their activities. According to the SLF, most households strive to increase income, food and water and improve security, health, status, and increased independence and knowledge.

The pursuit of household livelihood outcomes by undertaking certain activities through harnessing available assets occurs in a context that either limits, facilitates or modifies it. Two aspects of the context are critical for any livelihood system, forming the fourth and fifth components of the SLF. First are the transforming structures and processes. Structures are the private or public organizations that formulate and implement policies, laws, design and implement interventions in the form of projects and programmes, offer services and trade, and perform other roles that affect household livelihoods. Processes are the mechanisms through which structures undertake their roles, including policies, legislation, institutions, culture, and power relations. Structures and processes influence livelihoods as they determine access to assets, activities, decision-making bodies and other sources of influence.

The second aspect of the context and the fifth component of the SLF is the vulnerability context. It describes the pattern of natural or economic shocks, trends and seasonal movements in prices, weather and employment availability. These are outside the control of the institutions and those they affect, thereby influencing their ability to achieve desired livelihood outcomes by pursuing a particular strategy (Serrat, 2017).

Thus, the SLF proposed that for households to realise their livelihood outcomes, they ought to undertake activities primarily determined by the level of access to five types of assets. The three – undertaking livelihood activities depending on household access to livelihood assets to attain livelihood outcomes- are mediated by transforming structures, processes, and vulnerability.

SLF was appropriate in guiding this study as it is anchored on understanding people's realities. It also depicts cause-and-effect relationships and consequent chain reactions that arise and factors that limit or promote livelihood opportunities that help understand change within a social system. Moreover, it also depicts a relationship between people and their environment and how it affects livelihood outcomes. More specifically, transforming structures and processes influenced household livelihoods via an external intervention - the Trans-Mara Development Programme (TDP), which promoted numerous innovations in the study area, including crossbreeding local Maasai Zebu with pedigree Sahiwal bulls. Cattle are livelihood assets classified as natural capital by the SLF.

While utilizing the SLF as a guide, this study noted its shortcomings. For instance, SLF suggests that assets are not finite and will always be available for harvesting to pursue livelihood outcomes. It also erroneously assumes that households in the social system possess equal power and have equal access to assets. Furthermore, SLF takes it that enhancing livelihoods for one group in a social system does not undermine the attainment of another group's livelihood outcomes.

Concerning this study, transforming structures and processes influences peoples' livelihoods via four methods of law, policy, institutions and culture. It also affects livelihoods by direct interventions when introducing innovations through well-targeted funding projects such as the Trans-Mara Development Programme (TDP), which promoted numerous innovations in the study area, including crossbreeding local Maasai Zebu with pedigree Sahiwal bulls which in turn belong to the component of livelihood

assets. Similarly, SLF identifies more income, food security, empowerment, improved well-being and environmental sustainability as livelihood outcomes desired by rural households. Each rural household formulates an effective livelihood strategy to attain the results. For this study, the adoption of Sahiwal cattle is part of this strategy.

## 2.8    Conceptual Framework

Deriving from the literature review and guided by the theoretical framework, this study revolved around the conceptual framework presented in Figure 2.1. As identified by SLF, households yearn to have more income, improved food security and improved well-being (including social capital) as desired livelihood outcomes. To attain these outcomes, households utilize a variety of livelihood natural assets such as cattle, pasture and water. They also use human capital assets such as family labour and controlling cattle diseases. Isiria Maasai households considered the adoption of Sahiwal cattle as an appropriate livelihood strategy to attain more income, improve their food security and enhance their social capital.

**Independent**

**Adoption of Sahiwal cattle**

**Intervening**

High cattle production
More milk
Fast maturing
Reduced calving durations
Increased fertility
Large cattle

Social organization
Norms
Status (ascribed & achieved)

Livelihood          Outcomes

**Dependent**

Increased cattle income

Improved food security

Enhanced social capital
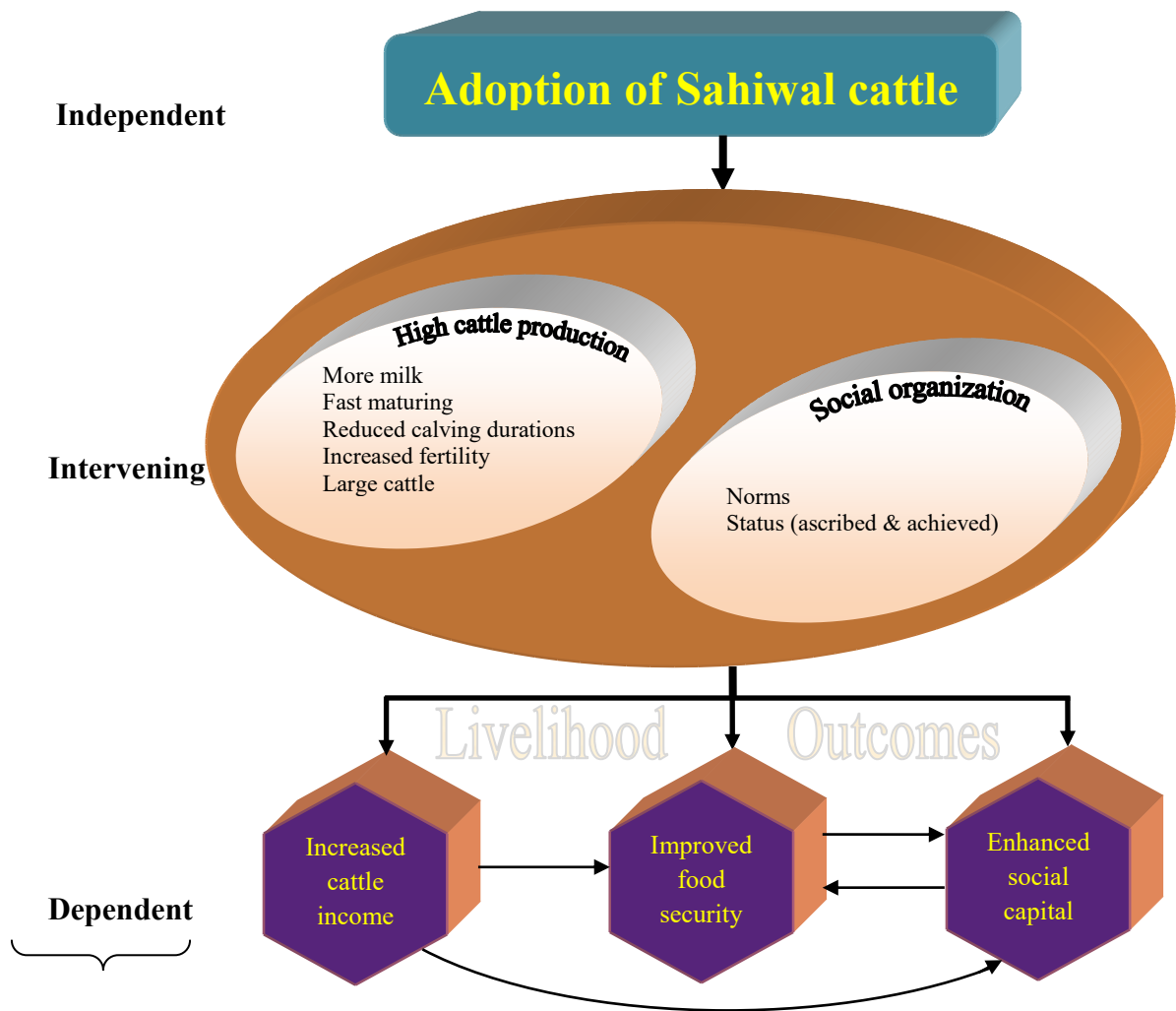
**Variables**

Figure 2.1 Conceptual framework indicating study variables and their relationships

Figure 2.1 proposed a relationship between the independent variable of adoption of Sahiwal cattle and the dependent variable of livelihood outcomes, especially income, food security, and social capital. However, the relationship between the independent and dependent variables was mediated by an intervening variable of high cattle production manifested through more milk, fast-maturing and large cattle with increased fertility and reduced calving durations. As a result of more milk, calves grew and

matured fast, enabling their mothers to conceive frequently, which increased their fertility. The phenomenon also reduces calving down duration – the period between the birth of one calf and the next. Fast maturing cattle also attained an enormous size within short durations.

High cattle production leads to increased incomes through increased milk sales, high prices for improved cattle either sold as live cattle or slaughtered. Increased revenues indirectly improved food security by purchasing additional food types and directly consuming milk. Households with enhanced food security and increased incomes were likely also to have enhanced social capital. The study also expected homes with enhanced social capital might have an extensive network of friends, associates, and groups at their disposal, enabling them to further improve their food security and incomes.

This study also proposed social organization as an additional intervening variable through its essential elements of norms and social status. Within the household, ascribed social statuses of the parent, husband, wife, father, mother, and children define roles and are the basis of division of labour. Societal norms stipulate standards that individuals within households and in society are expected to abide by. It is a societal norm that parents, especially the husband and father, provide food, shelter, and clothing to their children by engaging in productive work such as adopting Sahiwal cattle.

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1    Introduction

This chapter describes the methodological aspects of the study. It describes the research design, study site, population and sampling techniques and procedures. The section also discusses instruments used to collect primary data, the process used to ensure their validity and reliability, and the data collection procedures. Also, this chapter describes the operationalization of study variables, data analysis and presentation and ethical considerations observed in data collection.

## 3.2    Study Design

The design for this study was a cross-sectional survey with a mixed-method approach. A mixed-method process entails "...the systematic integration, or "mixing" of quantitative and qualitative data within a single investigation or sustained program of inquiry (Wisdom & Cresswell, 2013:1)."   First of all, both qualitative and quantitative data were collected and analyzed. Qualitative data gave meaning to and strengthened quantitative data.

Specifically, the study used a cross-sectional survey that entails collecting data from many respondents at a single point in time was suitable for this study. It allowed gathering primary data from the study population using standardized instruments without introducing bias.  It was also an appropriate research design. It enabled the researcher to examine the association between the adoption of Sahiwal among Isiria

Maasai households and the livelihood outcomes of income, food security and social capital. With its practical strength in short duration and few costs, a cross-sectional design was also the best choice for this study.

The information gathered from the survey was complemented by observational and secondary data on the subject of this study. The study utilized direct, non-participant observation of objects, things and events related to the subject of this study. Similarly, this study collected primary data from the adequately large sample from Isiria Maasai households rearing improved Sahiwal cattle (including Sahiwal-Zebu crosses).

## 3.3    Study Site

The study site was Narok County of Kenya which covers an area of 17,933.1 Km$^2$ (see Appendix I on page 166 for a map of the study site). It represents 3.1 per cent of the total area in Kenya and is the eleventh largest County in Kenya. The study purposively selected it amongst 15 counties that commonly practise pastoralism in Kenya. The others are Baringo, Elgeyo Marakwet, Garissa, Isiolo, Kajiado, Laikipia, Lamu, Mandera, Marsabit, Pokot, Samburu, Tana River, Turkana, and Wajir. Like all the other pastoral counties, Narok is predominantly semi-arid. It is situated on the south-western part of the Great Rift Valley and lies between latitudes 0° 50′ and 1° 50′ South and longitude 35° 28′ and 36° 25′ East. It borders the Republic of Tanzania to the South, Kisii, Migori, Nyamira and Bomet counties to the West, Nakuru County to the North and Kajiado County to the East. On average, the County lies at an elevation of 1827m above sea level. However, the highest point is in the Mau escarpment reaching 3100m above sea level. Temperatures range between 8$^0$ and 28$^0$ C. Narok experiences

bi-modal rainfall with long rains falling between February and June and short rains between August and November and receiving between 500mm and 1800mm.

The researcher purposively selected Narok County for the study as the intervention to introduce Sahiwal Cattle by TDP was in the Transmara South Sub-County of Narok County.  Unlike other Maasai pastoral Counties, few studies have been undertaken in Narok County.  Even within Narok County, the Isiria Maasai are among the least studied compared to the other Maasai sections, such as the Purko and Ildamat. Isiria Maasai have undergone socio-economic changes in the last twenty to thirty years, including changes in land tenure systems, rapid increase in population due to in-migration of other non-pastoral non-Maasai community groups, and naturally through birth.

Within Narok County, the Isiria Maasai were purposively selected because TDP concentrated its programme interventions in Trans-Mara South Sub-County, which the Isiria predominantly occupies. The consideration that guided the decision to focus the programme among the Isiria was that their area of residence is relatively wet compared to most areas of Narok County, which made it easier for the improved breed to thrive.

## 3.4    The Population of Study

The target population for this study comprised all Isiria Maasai households residing in Narok County, with a population of approximately 76,250 (the Republic of Kenya, 2020).   Data collected from pastoralist households, the primary respondents, was

complemented by information obtained from key informants, who comprised experts in livestock breeding and Community Resource Persons (CORPs).

Respondents for the study were spread between the five administrative divisions of Transmara South Sub-county, namely, Kereto, Kirindon, Lolgorian, Oloirien and Sitoka. Out of all the respondents, slightly over six per cent were female household heads, while the remaining (93.6%) were males. Similarly, except for Kirindon Division, the five administrative divisions had almost equal respondents. Most residents of Kirindon Division did not satisfy the inclusion criteria as they were Ilwuasin-Gishu Maasai and the Kipsigis and thus were non-Isiria. The study area comprised thirteen administrative locations, further subdivided into twenty administrative sub-locations. Below the administrative sub-locations, the study revealed that the Isiria Maasai spatially organised themselves into neighbourhoods and not villages. The respondents were drawn from eighty-eight neighbourhoods.

## 3.5  Inclusion and Exclusion Criteria

In this study, a household had to be of Isiria Maasai residing in Trans-Mara South Sub-county practising pastoralism and rearing Sahiwal (including Sahiwal-Zebu crosses) cattle. This criterion was essential as it allowed the observation of differences amongst the randomly selected households from a sampling frame of all Isiria Maasai Sahiwal adopter households. These conditions increased the uniformity of households culturally, geographically, and socially, thus minimizing the possibility of other factors interfering with the associations between this study's independent and dependent variables.

## 3.6    Sample Size and Sampling Procedure

The sample size for this study was 400 households arrived at using the formula:

$$n = \frac{N}{1+N(e)^2}$$    adopted from Yamane (1967)

where:        n        is the desired sample size

N        is the total population (which in this case was 3,129 households)

e        is the marginal error (which in this case is 0.05%)

$$n = \frac{3129}{1+3129(0.05)^2} = 399.9 \text{ rounded off to } 400$$

In this study, the sampling unit was the Isiria Maasai household residing in Transmara South Sub-county, and the unit of analysis was the household head in the sampled household.

As described in this section, the study applied a multi-stage sampling procedure. In the first stage, the study selected the Trans-Mara South sub-county purposively because, as earlier mentioned, it was the Sub-County in which the intervention of cross-breeding pedigree Sahiwal bulls with indigenous Zebu cattle was implemented.

Trans-Mara South Sub-County was divided into its six Divisions in the second stage, namely Ang'ata Barrikoi, Kereto, Kirindon, Lolgorian, Oloirien and Sitoka.  The study population, Isiria Maasai, resided in the five administrative Divisions of Kereto,

Kirindon, Lolgorian, Oloirien and Sitoka. This excluded Ang'ata Barrikoi Division from the sample as it is occupied entirely by the Kipsigis, Kisii and Kuria.

In the third stage, the researcher selected the administrative locations to be in the study sample. Two Maasai sections of Ilmoitanik and Isiria resided in Kereto Division. Thus, two administrative locations (Moita and Nkararo), where the study population Isiria Maasai lived, were purposely included in the sample. Similarly, Isiria and Ilwuasi-ngishu Maasai resided in Kirindon Division. Hence the study deliberately selected Esoit-Naiborr and Kimintet Locations where the study population (Isiria Maasai) lived. All the administrative locations of Lolgorian and Oloirien Divisions were purposely chosen as Isiria Maasai resided in them.

In the fourth stage, each of the eight selected Locations was divided into Sub-locations and neighbourhoods, respectively. For a maximum variation that possibly existed amongst Isiria Maasai households on the subject of study, all neighbourhoods and sub-locations were included in the sample, purposively.

In the fifth stage, the sample was selected from all Isiria Maasai Sahiwal adopter households using a table of random numbers formulated by Teri (2004). The study chose the sample proportionately to the number of Sahiwal adopter households per neighbourhood, sub-location, location and division. Proportional sampling was necessary to avoid skewed representation as Sahiwal cattle adopter households in each neighbourhood, administrative sub-location, location, and divisions were not equal.

Moreover, Sahiwal cattle adopter households were of different age groups. Table 3.1 presents a breakdown of the sample size per location.

Table 3. 1: Proportional sample distribution per location

|   | Administrative location | Number of sampled households | *Total number of households* |
|---|---|---|---|
| 1 | Nkararo | 59 | 380 |
| 2 | Moita | 42 | 435 |
| 3 | Oloirien | 69 | 589 |
| 4 | Isokon | 32 | 231 |
| 5 | Moyoi | 107 | 839 |
| 6 | Kimintet | 17 | 114 |
| 7 | Esoit-Naiborr | 74 | 541 |
|   | **Total** | **400** | **3,129** |

To acquire a complete understanding of the inter-relationship of the study variables, four key informants were purposively selected to clarify any issues obtained from responses in the household questionnaires and observations made by the researcher in sampled household visits. This study selected an Officer in Charge of the Sahiwal herd at the Lolgorian KALRO Sub-station to understand the promotion of Sahiwal cattle in the study area.

Due to its role in mobilizing and training all groups (self-help, associations, and cooperatives) and revenue collection, an officer from the County Government Social Development Department was selected purposely as a key informant. This study chose the Social Development Officer for Lolgorian Ward as it was the only ward with such an officer at the time of this study.

The study also selected two community resource persons, one from Kirindon and Lolgorian Divisions, to corroborate data obtained from household questionnaires and clarify any inconsistencies in their responses. Both were opinion leaders and had

resided in the study area for more than fifty years; they were also retired chiefs and had a clear memory of all interventions on various livelihood aspects promoted in the research site. Kirindon and Lolgorian were selected purposely for community resource persons' identification as Sahiwal promotion was more intense.

The study used a comprehensive list of household heads in the custody of the Assistant Chiefs as the sampling frame. The record listed all heads of households in each neighbourhood.

## 3.7 Data Collection Instruments

Data for this study were collected using a questionnaire, a focus group discussion (FGD) guide, a key informant interview (KII) schedule and an observation checklist.

### 3.7.1. Questionnaire

This study utilized a semi-structured questionnaire (see Appendix II on page 167) to collect primary data from sampled households. It was the main data collection instrument for the research. The questionnaire had both closed and open-ended questions. The types of questions asked were open-ended, dichotomous, multiple-choice or scaled. The questionnaire also had grid-matrix questions. The instrument was self-administered, but the researcher and RAs were available for any clarifications without interpreting the items to the respondents to avoid bias. RAs distributed the questionnaires to the sampled households physically.

A questionnaire was appropriate for this study. It enabled the collection of vast amounts of primary data in a standardized way from many households conveniently, affordably and quickly. It also yielded responses that were easily analyzed and offered an opportunity for asking questions in any format, including open-ended and multiple-choice (McLeod, 2018).

The researcher divided the household questionnaire into seven parts to collect the respondents' comprehensive household information relevant to this study. The first part introduced the purpose of the study, the researcher and how the respondent was chosen. The second part was the certificate of consent, where the respondent indicated voluntary participation in the study by a signature. The third part of the questionnaire solicited information on administrative information on the respondents, while the fourth part asked for respondent socio-demographic information. In the fifth section, the questionnaire requested respondents' household information regarding cattle production and income.

In the sixth section, the questionnaire collected information on household food security using a tool formulated by the World Food Programme (2008) - the food consumption score (FCS), which combines data on the frequency and diversity of food consumed in a household over the previous seven days. The last section of the questionnaire asked for information on the respondent's social capital.

### 3.7.2    Focus Group Discussion Guide

This study also collected primary data from focus group discussions using a guide (see Appendix III on page 178). The guide was a set of open-ended questions formulated to flexibly direct the group's conversation on various topics of the subject matter of this study. The researcher primarily used it to moderate the discussions and allowed opportunities to probe further issues raised in the debate.

An FGD guide was appropriate for this study due to its inherent qualities. It aided the researcher and participants keep the discussion and conversations on this survey's topics, themes, and subject matter. The flexible format of the guide also allowed participants to talk freely and spontaneously. The guide acted as a roadmap and checklist that enabled the researcher-moderator to cover all planned topics and themes (Escalada & Heong, 2019). Details of how the focus group discussions were conducted and the selection of participants are explained under section 3.9.2 on page 60 on data collection procedures using the FGD guide.

### 3.7.3    Key Informant Interview Guide

The study also used a Key Informant Interview (KII) guide to obtain more explicit, direct and elaborate in-depth information on the survey subject from informed resource persons (see Appendix IV on page 180). The tool contained a set of open-ended questions on various items of this study that the researcher used to seek the perspectives and opinions of the resource persons. The researcher administered the KII guide in face-to-face interactions.

A KII guide was suitable for collecting primary data on the research topic. It offered an opportunity to clarify ideas and information obtained using the household questionnaire and FGD guide. A KII guide was the mechanism of attaining standardization in presenting items, questions and prompts to the resource persons. The guide also assisted the researcher in maintaining a neutral stance without giving the impression of having a definite opinion on the topic of study, thereby increasing the validity of responses obtained and avoiding being biased.

It was also appropriate for obtaining information on the perspective of resource persons. In this study, as a qualitative data collection tool, the KII schedule was used to collect information about the benefits of adopting Sahiwal cattle and the extent that households realised the benefits. During the interview, the researcher added questions for clarification whenever necessary.

### 3.7.4    Observation Checklist

This study utilized an observation checklist (OC) to supplement primary data obtained through questionnaires (see Appendix V on page 182). Specifically, the study collected indicators of Sahiwal cattle production, household living conditions and social capital. This information supplemented data obtained from questionnaires from each sampled household. The tool was appropriate for the survey as it enabled the study to collect information about the sampled household directly and accurately with the respondent's consent.

## 3.8    Validity and Reliability

To be confident that the questionnaire and observation checklist collected the desired information consistently across the respondents and items, this study piloted the two instruments on a smaller scale at a site that was not part of the research but with identical conditions – culture, production, weather and residential patterns.  The study applied test-retest and inter-rater techniques to test the reliability and consistency of the data collection instruments.

This study undertook three tests before actual primary data collection to ensure that the instruments for collecting primary data produced consistent results over time across respondents (reliable) and items in the tools.

The researcher conducted a test-retest and inter-rater reliability on the questionnaire and the observation checklist.  For this purpose, the study chose the Masurura location in Kereto Division due to its suitability - it was not part of the study site but has similar ecological, cultural and socioeconomic conditions; it is also adjacent to the study area. In determining the sample size for the test and retest of reliability and internal consistency for the formulated household questionnaire, the researcher relied on the tables constructed for this purpose by Bujang & Baharum (2017).  Their article recommended that for two observations per subject of study and attains a minimum acceptable value of 0.8 for data collection instruments, a minimum sample size of 9 is required.  Thus, for this study, a sample size of thirteen households was selected for testing and retesting the reliability and internal consistency of the household questionnaire.  Five RAs were selected and trained to administer the questionnaire.

After two weeks, the same questionnaire was administered on heads of the same sample of thirteen households.  In the retest, the researcher swopped the RAs to distribute the questionnaire to the same heads of household that they administered during the test.  The measure was essential as the reliability of RAs was equally tested.

This study relied on the intra-class correlation coefficient (ICC) for test-retest and inter-rater reliability.  This statistic was appropriate as it does not exaggerate the relationships of small samples of less than 15 compared to the Pearson test and retest coefficient correlation.  ICC also measures the reliability of large data sets collected by more than two raters.  Each household was rated by a different RA chosen randomly from the pool of RAs.  In short, ICC measured the consistency of responses given by subjects and observations across the RAs. It is a measure of absolute agreement.  ICC also estimates the reliability of every rater and all ratters averaged together.

Similarly, test and retest co-efficient of reliability varies between 0 – (no reliability) to 1 (perfect reliability) (see Appendix VI on page 184 for definitions of the coefficient of reliability values).  The minimum acceptable statistic of reliability in social sciences is 0.8.  ICC measures reliability at the 95% level of confidence.

The IBM-SPSS calculation of the ICC 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% confidence level (see Table 3.2).

Table 3. 2 Intra-class correlation coefficient

| | | 99% Confidence Interval | |
|---|---|---|---|
| | Intra-class Correlation | Lower Bound | Upper Bound |
| Single Measures | .614 | .566 | .663 |
| Average Measures | .976 | .971 | .981 |

The result indicated that the questionnaire and observation checklist and the usage of different RAs had excellent reliability. Thus responses given by sampled households for both test and retest administrations of the questionnaire had excellent reliability. Similarly, this applies to observations made by different RAs on the same household. Since the calculated test-retest reliability ICC is above the minimum acceptable value of 0.8 for social sciences, this study concluded that the formulated questionnaire and observation checklist was reliable.

For internal consistency of items measuring the same construct, this study relied on Cronbach's alpha which was calculated using the formula:

$$a = \frac{N.\ r-bar}{(1+(N-1).\ r-bar}$$

Where:      N is the number of components (in this case was 341), and

r-bar is the average of all Pearson correlation coefficients (in this case was 0.825)

Table 3.3 shows the correlations for each sampled household for both the test and retest questionnaire administrations and observations undertaken by the different RAs for both sessions. The sum for all the correlations for the 13 households test and retest sessions was 10.724, which gave an average correlation coefficient of 0.825.

Table 3. 3 Household test-retest Pearson's correlation coefficient

| Household | Pearson's correlation coefficient test and retest values |
|---|---|
| 1 | 0.854 |
| 2 | 0.999 |
| 3 | 0.074 |
| 4 | 1.000 |
| 5 | 0.999 |
| 6 | 1.000 |
| 7 | 0.001 |
| 8 | 0.973 |
| 9 | 1.000 |
| 10 | 1.000 |
| 11 | 1.000 |
| 12 | 0.929 |
| 13 | 0.895 |
| **Total** | **10.724** |

With all the figures inserted, the equation then was:

$$a = \frac{341 \times 0.825}{(1+(341-1).\ 0.825}$$

The result was a 0.99 co-efficient of consistency. Values for the coefficient of consistency range between 0 and 1. A +0.7 and above coefficient of consistency is considered acceptable in social sciences. As a result, this study concluded that there was an excellent internal consistency of items measuring the same study constructs.

To ensure that the items in the instruments for data collection measure the variables and constructs they were intended to measure, that is, they are valid, this study adopted several measures. For face validity, this study ensured that on the face, data collection instruments included items directly measuring adoption of Sahiwal cattle, household

income, food security and household social capital. For content validity, this study ensured that all facets of the variables were covered in data collection instruments according to how this study defined and operationalized them. This study anticipated that Sahiwal cattle adoption would be associated with household income, food security, and social capital. This study tested this expectation when testing and retesting the questionnaire for data collection and, in doing so, addressed both criterion and discriminant validity.

After testing and retesting the household questionnaire and observation checklist at the Masurura location, this study slightly changed the two data collection instruments. Items that either solicited information not related to the objectives of this study or repeated were deleted. Other items were modified to make them more specific to facilitate standardization.

## 3.9    Data collection procedures

This study collected primary data using a questionnaire, focus group discussions (FGDs), key informant interviews (KIIs) and observation, as described in the following section. However, this study fulfilled formal regulatory and administrative prerequisites for data collection in Kenya before commencing field processes.

### 3.9.1    Data collection using the questionnaire

The sampling procedure elaborated under section 3.6 on pages 45 – 47 resulted in a list of household heads of Sahiwal cattle adopters in the study site. The sampling unit was the Isiria Maasai Sahiwal adopter household, and the unit of analysis was the head of the sampled household as per the inclusion and exclusion criteria.

Five RAs – one for each of the five administrative divisions of Kereto, Kirindon and Lolgorian, Oloirien and Sitoka - were engaged to distribute and collect questionnaires from sampled households' heads. Before the task, the researcher trained the RAs for two days on all aspects of the study, including purpose, ethics and handling inquiries from study respondents (see Appendix VII on page 185 for a brief on areas of RAs training). If household heads could not read and write, RAs asked them questions and recorded responses given by the respective sampled household heads. Thus, based on administration, the questionnaire was either self-administered or interviewer-administered.

Competent RAs who could fluently speak and write in the English and Maasai languages were selected. The researcher supplied each RA with a set of official research documents. The documents included a letter of introduction, a copy of the Research Authorization letter and a Research Permit. Others were copies of two letters from the County Commissioner for Narok and the County Director of Education. RAs also had copies of two additional letters from Deputy County Commissioner – Trans-Mara West Sub-County and Sub-County Director of Education and a list of sampled households (see Appendix VIII on page 187 for copies of the documents).

RAs physically traced homesteads of heads of sampled households and handed over one questionnaire to them after introducing the task, explaining the study, and clarifying any concerns raised by respondents. They agreed with the heads of the households when they could come back to collect the filled questionnaires. RAs left their contact mobile telephone contact with respondents. RAs applied the procedure to literate respondents. However, for those respondents unable to read and write, RAs asked for consent and requested to ask the written questions and record responses of household heads who were either female or male. After introducing the task and clarifying any respondents' concerns, RAs asked for consent to participate. Household heads that did not give consent were recorded as such and thanked. If they voluntarily participated, the household heads indicated this willingness by placing a mark on the relevant space in the questionnaire. RAs moved from the first to the last item in the questionnaire and recorded the responses of the household head. Once the respondent has given a complete answer for a question in the questionnaire, RAs read out the recorded responses to the respondent for confirmation and rectification before proceeding to the next item. RAs followed this procedure until all questions were covered. The researcher closely monitored the process through impromptu field visits. All filled and unfilled questionnaires were handed over to the researcher, who closely followed the process via frequent impromptu field visits.

### 3.9.2 Focus group discussions (FGDs)

The researcher conducted three FGDs to collect primary data on the subject of study from a group of 8-12 persons (Herd, 2017). The researcher selected the FGDs

participants from the survey population and ensured that they satisfied the inclusion and exclusion criteria that guided this study. They also had similarities, such as residing in the same region and having similar experiences. The study also ensured that the FGD participants were almost the same age. These criteria were necessary to create an environment for the free articulation of ideas. The researcher moderated the discussions on the study topic using an FGD guide (see Appendix III on page 178).

The researcher determined the venue, date and time for each FGD in consultation with study participants. All FGDs were facilitated by the principal investigator, with the assistance of a RA who recorded proceedings. All FGDs were conducted in a relaxed environment and lasted for approximately one and a half hours. The researcher welcomed discussants to each session, guided them by setting ground rules and encouraged them to participate in the discussion freely. In each FGD, the principal investigator introduced discussion topics and applied probing, challenging, and paraphrasing skills to guide the conversation. The principal investigator provided lunch and refunded transport fares incurred by each FGD participant.

### 3.9.3    Key informant interviews (KIIs)

The researcher interviewed four persons from the study area with specialized knowledge on Sahiwal and Zebu cattle raised by Isiria Maasai households using the Key Informant Interview Guide (see Appendix IV on page 180 for a copy of the guide). The four key informants selected purposively comprised two professionals and two Community Own Resource Persons (CORPS). They included a KALRO Lolgorian Sub-station Officer in Charge of the station's Sahiwal herd. The study benefitted from

the officer's information on promoting Sahiwal cattle. The others were County Government Ward Social Development Officer and two CORPS - one from Kirindon and another Lolgorian administrative Divisions.

The study adopted the face-to-face technique of KIIs because it provided an opportunity for a free exchange of ideas between the researcher and the key informants. Similarly, it was possible to ask more complex questions and get detailed responses from key informants.

The researcher booked an appointment with the key informants and agreed on a comfortable and convenient venue for each key informant. The interviews were conducted on separate days. Once with the key informant, the researcher thanked them and explained the purpose of the conversation and the proposed procedure, pointing out that the researcher will frequently be taking notes of the interviewee's responses. An opportunity to ask questions was extended to the key informants, and the issues raised were addressed. After that, the researcher asked for consent before commencing the interview.

Using the KI interview guide, the researcher asked the key informants to respond to the entire items one after the other and each time recording by way of note-taking the responses given by the key informant. To obtain a comprehensive answer to the items in the KII guide, the researcher applied probing and active listening. After exhausting items in the guide, the researcher allowed the key informant to ask questions. After elaborating on the next steps, the researcher responded to the concerns of key

informants and appreciated them for their time and valuable responses. The researcher also assured the key informant of the anonymity and confidentiality of their responses.

### 3.9.4    Data collection by observation

During the delivery and collection of questionnaires to and from the homesteads of sampled household heads that consented to participate in this study, RAs filled an observation checklist (see Appendix V on page 182).    The observation checklist structured the observation process by identifying information about the research topic in advance.  While physically at the homesteads of the sampled household heads, RAs noted the presence or absence of objects, events and processes related to the study and specified in the observation checklist.  RAs ticked the relevant boxes in the observation checklist.

## 3.10    Ethical considerations

The study fulfilled formal and legal requirements guiding data collection from human subjects.  Among them was acquiring authority and licence to carry out field research in the area of study from the National Commission for Science, Technology and Innovation (NACOSTI) through Rongo University School of Graduate Studies.  The researcher also made courtesy calls at administrative offices as stipulated in the letter of authority to undertake field data collection.

This study was guided by informed consent, anonymity, and confidentiality principles. Informed consent was sought from household heads after elaborating the purpose of the study.  Household heads indicated their consent by signing a certificate of consent on

the first page of the questionnaire. Non-consenting household heads did not participate in this study. The researcher assured heads of households that consented that their identity would remain only with the researcher, establishing a mechanism to delink responses and names.

To further ensure the safety of raw data collected from the respondents, the study removed all obvious identifiers that could link the filled questionnaires with the respondents. Access to the filled hard copy questionnaires was restricted only to the researcher and a limited number of authorised researchers, including study advisers and examiners formally appointed by Rongo University. The filled hard copy questionnaires were kept in a lockable safety box accessible to the researcher. The study utilised data coding and the information stored in a password-protected computer for data entered into the computer. These were the safety standards fulfilled by the study before clearance and issuing the field research licence and authority by NACOSTI through Rongo University School of Graduate Studies.

## 3.11    Data analysis and presentation

The filled questionnaires were processed, coded and analyzed using the Statistical Package for Social Sciences (SPSS) version 28. However, data cleaning preceded these tasks to ensure that collected data was consistent, intelligible, and useable. Filled questionnaires were further subjected to data reduction.

This study utilized descriptive statistics such as frequencies, percentages, mean and mode to classify, tabulate and summarize collected data. In particular, the statistics

were used to summarize the socio-demographic characteristics of the study populations and aspects of cattle production, including age groups and, adoption of Sahiwal cattle, length of adoption. Other issues of the study summarized by descriptive statistics included cattle income groups, household food security and levels of social capital. Collected data was also conveyed visually through tables, bar graphs and histograms to aid interpretation, comprehension and understanding.

The study used Spearman Correlation to test the association between the independent variable of adoption of Sahiwal cattle and the dependent variables of household income, food security and social capital. Other than household income, the other variables were at the ordinal level of measurement. When variables are at the ordinal level of measurement, the appropriate and robust measure of association is the Spearman correlation (Schober, Boer & Schwarte, 2018). The calculated Spearman Correlation Coefficient was used to determine the strength and direction of the association between the independent and dependent variables. The formula used to calculate the Spearman correlation coefficient was:

$$r_s = 1 - \left( \frac{6 \sum_i d_i^2}{n(n^2 - 1)} \right)$$

Where: $r_s$    is the Spearman correlation coefficient

$n$    is the number of data points for the two variables

$d_i$    is the difference in ranks of the two variables

If: $r_s$ value is:

- +1 it meant that there was a perfect positive association between the ranks of the variables

64

- –1 it meant that there was a perfect negative association between the ranks of the variables

- 0 it meant there was no association between the ranks of the variables

- closer to 0 meant the association between the ranks of the variables was weak

This study relied on the P-value approach in testing hypotheses, which comprises four steps (Pennsylvania State University, 2020). The first step was to state both the null and alternative hypotheses, then calculate a test statistic (in this case, the Spearman correlation coefficient). The calculated Spearman correlation coefficient was compared to a critical value at the 0.05 level of significance. Based on the outcome of the process, it was determined whether data supported or did not support the null hypothesis. If the P-value was less or equal to the test statistic, the null hypothesis was rejected, and the alternative hypothesis was adopted. However, if the P-value is more than the test statistic, the null hypothesis is accepted, and the alternative hypothesis is rejected. This result was presented and discussed.

The handwritten qualitative data obtained through key informant interviews and focus group discussions were typed into a word document to make it amenable to further analysis. The researcher typed the handwritten notes into a word document to lessen the task of interpretation. The typed data were read several times to discern recurring categories, opinions, and themes. The KII and FGD guides acted as the bases for comparing responses. Areas of agreement and disagreement were noted and interpreted.

To determine the household level of food security, this study applied the Food Security Score (FCS) formulated by World Food Programme (WFP) in 2008. FCS is a standard instrument for measuring household food security (International Dietary Data Expansion Project, 2019). FCS combines data on the frequency and diversity of food consumed in a household over the previous seven days. For each food, FCS determines its weight according to its nutritional value. Based on the overall score, FCS describes a household's food consumption as either "poor", "at the borderline", or "acceptable". For instance, with a score of 21 and below, FCS describes the household as having "poor food consumption" and thus, food-insecure; 21.5 to 35 were "at the borderline", and above 35 were categorized as having an "acceptable" level of consumption. This study considered respondents whose food consumption was "at the borderline" and "acceptable" as food secure.

This study calculated a Household Dietary Diversity Score (HDDS) to measure respondents' access to various foods. According to FAO (2013), household access to diverse foods is vital and recommended since a food-secure household might repeatedly consume the same food items. In determining the HDDs of respondents, this study used the data already collected and used to determine the FCS. Instead of the eight food groups in the FCS, HDDS identifies 12 food groups, and all the groups have equal weights. The weighted scores for all the 12 groups were summed up and divided by 12. If the product of this calculation was less than 4.5, this study classified the household 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 a score above 6.0 had a "high dietary diversity".

This study formulated a 9-point social capital score (SCS) to measure the ten dimensions of social capital and determine household levels of social capital. While developing the SCS, this study made several observations. First, most studies that have attempted to measure social capital rarely considered more than three of its dimensions. Secondly, like the other four capitals - financial, human, natural and physical – social capital can hinder or enhance development. Thirdly, most analyses on social capital adopted qualitative than quantitative approaches.

In formulating SCS, this study extended the work of Grootaert, Narayan, Jones & Woolcock 2004 in their work: *"Measuring social capital – An integrated questionnaire."* In addition to identifying the six dimensions of social capital, the authors also suggested questions to solicit more information on each dimension. The six dimensions they identified are groups and networks; trust and solidarity; collective action and cooperation; information and communication; social cohesion and inclusion; empowerment and political action.

The work by Grootaert *et al*. attracted this study owing to its comprehensive conceptual view of social capital. Similarly, the work combined the three ways of conceiving social capital in the literature. The first way considers social capital as resources that individuals can obtain due to their relationships with other people. Examples of individuals' resources include information, ideas, and support. Grootaert *et al*. associate this view with sociologists Ronald Burt, Nan Lin and Alejandro Portes.

The authors' second way views social capital as the nature of formal and informal networks and organizations and how individuals are involved. This approach combines the myriad and varied ways community members interact with one another. Grootaert *et al.* associate this approach with political scientist Robert Patnum.

In their third way, the authors view social capital as the linkages individuals have with the public and private institutions' representatives. Some institutions include political parties, the police, lawyers, bankers, managers and administrators. Others are religious leaders, hoteliers, architects, lecturers, veterinarians, engineers, medical doctors etc. Grootaert *et al.* associate this approach with Woolcock (1999) and World Bank (2000). Whereas the other two approaches involve a person's horizontal tie with others, the third approach is a vertical one that ties a person to political and technical resources and economic institutions essential for well-being.

The extensions that this study made to the work of Grootaert *et al.* 2004 are twofold. First, it splits the dimensions into ten aspects and identifies essential items. Secondly, it allocated a weighted score to each item according to its importance. Table 3.4 summarizes the items and the maximum points for each dimension.

Table 3. 4 Social capital dimensions and their respective maximum points

|  | Aspect | Number of items | Points | Scaling |
|---|---|---|---|---|
| 1 | Groups | 3 | 28 | Total points = **585** |
| 2 | Friends | 3 | 12 | Total number of items = **64** |
| 3 | Solidarity | 4 | 32 | Therefore = 585/64 is **9.1** |
| 4 | Trust | 13 | 128 | Thus the social capital scale |
| 5 | Helping others | 10 | 102 | has three levels: |
| 6 | Information and Communication | 11 | 47 | a) Three and below - **social** |
| 7 | Interaction | 6 | 84 | **capital** |
| 8 | Sociability | 4 | 73 | b) Over 3 to 6 - **moderate** |
| 9 | Safety | 1 | 12 | **social capital** |
| 10 | Empowerment and Political action | 9 | 67 | c) Over 6 - **Strong social** |
|  | **Total Points** | **64** | **585** | **capital** |

The total score for the social capital dimensions was 585, while the number of items was 64.  The maximum rounded average was 9.  A household's level of social capital was weak or low if the average was below 3 points; moderate or medium if it was between 3 and 6; and strong or high if the average score was above 6.

Appendix IX (on page 198) details the aspects of the social capital dimensions considered essential by this study, including items, their specific scores and the weights for the respective items of the ten dimensions.

## 3.12    Operationalization of study variables

To attain uniformity and facilitate measurement and observance of the interplay of the study variables, the study operationalised the primary concepts for this study in the manner indicated in the matrix in Table 3.5.

Table 3. 5 Concepts and variables operationalization matrix

| | Variable | Concept | Indicator | Measurement |
|---|---|---|---|---|
| 1 | Adoption of improved cattle breeds | Raising of pure Sahiwal cattle or Sahiwal-Zebu crossbreds | Herd of pure Sahiwal cattle or Sahiwal-Zebu crossbreds | Number of years a household head has raised pure Sahiwal cattle or Sahiwal-Zebu crossbreds |
| 2 | Household income | Total income paid to or received by the household head through the sale of goods and services | Actual cash, money or revenue earned or received through the sale of goods and services, including the sale of live cattle, breeding stock, milk, milk products, draught power | Total cash, money or revenue earned or received by the household head in a month from investments, labour, production, property or sale of goods, products and services including the sale of live cattle, breeding stock, milk, hiring out draught animals, milk products. |
| 3 | Food security | The frequency and diversity of food consumed by the household | The number of times a household consumes the nine food groups in the last seven days before filling the questionnaire. The nine food groups include cereals, tubers and root crops; vegetables and leaves; fruits; eggs, fish and meat; milk and dairy products; oils and fats; sugar and sweets; condiments and spices. | A sum of the consumption frequency of food items in the nine food groups multiplied by their weight.<br><br>Households with scores of 21 and below are food insecure; 21.5 to 35 are at the borderline, and above 35 are categorized as having an acceptable level of food security |
| 4 | Social capital | Resources such as information, ideas and support that an individual can obtain from having relations with others in the social system as well as involvement in informal/ formal organizations and linkages with people in positions of authority | A household head's membership to groups, networks and level of participation; solidarity and trust; usage of information and communication; sociability; safety; as well as empowerment and political participation | The average of the total scores of the weighted ten elements of social capital, which results in a 9.1 scale, equally divided into three to create three levels of social capital:<br>• Below 3 points (weak/low social capital)<br>• 3 to 6 points (moderate or medium social capital)<br>• Six and above points (strong social capital) |

# CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION

## 4.1 Introduction

This study investigated the association between the adoption of improved cattle breeds and household livelihood outcomes - income, food security and social capital. Findings, analyses and discussions are presented in this chapter. It begins with a presentation of the response and completion rates and proceeds to the sociodemographic characteristics of the respondents. After that, findings on adopting improved cattle breeds amongst the respondents are presented according to the study's three objectives: the association between Sahiwal cattle and household income, food security, and social capital. Findings on each theme conclude with results on testing each of the hypotheses proposed for the study.

## 4.2 Response and completion rates

The response rate for the study was 95%. Although there is no recommended response rate for social surveys, the threshold is a minimum of 60% (Fincham, 2008). Response rates measure data quality and potential bias; therefore, low response rates result in insufficient data quality and a high possibility of biased conclusions (Rindifuss, Choe, Tsuya, Bumpass & Tamaki, 2015). However, high response rates are desirable to detect small changes in a population of study and for a population with high variation (Ramshaw, 2019). At 95%, the response rate for the survey can be considered high and

increased the confidence in its data and the possibility for capturing typical characteristics in the study population.

This study attributed the high response rate to the efforts to create public awareness about the survey, especially key stakeholders and community gatekeepers. The researcher made sufficient copies of the official documents allowing the conduct of the study and handed them over to the stakeholders at the county headquarter level (County Director of Education, County Government, County Commissioner), Sub-county level (Deputy County Commissioner, Sub-county Director of Education) and at the Divisional level (Assistant County Commissioner, Divisional Education Officers. The researcher also paid courtesy calls to all the offices of Chiefs, Assistant Chiefs, Education Officers, and those of security agencies where all the details of the study were shared and any questions addressed. A visitor's book was signed, and copies of research authorization documents (Appendix VIII on page 187) were shared.

A variant of the response rate is the completion rate, a percentage ratio of filled/completed responses versus the total invited respondents (Lindemann, 2019). The completion rate for this study was 93.5%. It was an adequate measure for data quality and minimised non-response bias. The completion rate was slightly lower than the response rate as some respondents returned either unfilled, partially-filled or incorrectly filled questionnaires.

The study adopted the completion rate rather than the response rate to enhance uniformity in reporting findings. Of the 400 sampled households, 26 did not return the

questionnaires or did not consent to participate in the study. Furthermore, on applying the inclusion and exclusion criteria, 50 households reported that they had not adopted Sahiwal cattle and hence did not qualify to participate in this study. Thus, the total number of responses considered in writing the results of this study was based on the 324 filled returned questionnaires from Isiria Maasai households that had adopted Sahiwal cattle out of a sample of 400. However, this may reduce depending on the number of responses for particular items in the questionnaire.

## 4.3    Socio-demographic characteristics of respondents

This study set out to establish the socio-demographic characteristics of respondents. Specifically, the study requested information on age, marital status, type of marriage, levels of educational attainment and number of members in the respondents' households. The findings on the respondents' age, marital status and type of marriage are presented in Table 4.1.

Table 4.1 Respondents' age, marital status and type of marriage

| Variable | Element | Frequency | | | Percentage | | |
|---|---|---|---|---|---|---|---|
| | | Males | Females | Total | Males | Females | Total |
| Age group | Young (below 35 years) | 114 | 4 | 118 | 37.7 | 18.2 | 36.4 |
| | Middle age (35 59 years) | 157 | 15 | 172 | 52.0 | 68.2 | 53.1 |
| | Old (60 years and above) | 31 | 3 | 34 | 10.3 | 13.6 | 10.5 |
| | **Total** | **302** | **22** | **324** | **93.2** | **6.8** | **100.0** |
| Marital status | Single | 5 | 0 | 5 | 1.7 | 0 | 1.6 |
| | Married | 293 | 11 | 304 | 93.3 | 50.0 | 95.0 |
| | Widowed | 0 | 10 | 10 | 0 | 45.5 | 3.1 |
| | Separated | 0 | 1 | 1 | 0 | 4.5 | 0.3 |
| | **Total** | **298** | **22** | **320** | **93.1** | **6.9** | **100.0** |
| Marriage type | Monogamous | 180 | 10 | 190 | 60.2 | 45.5 | 59.2 |
| | Polygamous | 116 | 10 | 126 | 38.8 | 45.5 | 39.2 |
| | Not applicable | 3 | 2 | 5 | 1.0 | 9.0 | 1.6 |
| | **Total** | **299** | **22** | **321** | **93.1** | **6.9** | **100.0** |

### 4.3.1    Distribution of respondents according to their age

Focus group discussion results on the approximate age range for the existing six age groups of *Ilnyangusi*, *Isieuri*, *Ilkitoip*, *Ilkisaruni*, *Ilmeshuki* and *Ilkileku* indicated that Isiria Maasai was broadly categorised into three groups young, middle age and old. The old respondents were 60 years and above, while middle-aged individuals were between 35 and 59. The young were respondents below 35 years old.

This finding revealed that slightly more than half (53.1%) of the respondents were middle-aged, and more than a third (36.4%) were young. However, old respondents were 10.5%. Regarding their gender, aged respondents had the least proportion for females and males. Most respondents were middle-aged for, both females and males (see Table 4.1). The mean age for the respondents was 41.5 years, while the median and mode were 39.0 and 35 years, respectively. The range (difference between the youngest and the oldest respondent) was 66 years.

Middle-aged respondents formed the largest proportion of respondents owing to their experience and ability to raise Sahiwal cattle which was a criterion for inclusion and exclusion in the current study. Successful production of Sahiwal cattle is a skill that comes with experience gained over time which few young respondents possessed. On the other hand, older persons tend to be dependent.

Respondents varied in terms of their marital statuses. The following section summarises findings on the respondents' marital status and type of marriage.

### 4.3.2   Distribution of respondents by marital status and type of marriage

Data revealed that four marital statuses existed in the study area – married, widowed, single and separated. Most of the respondents were married, and a sizeable proportion was also widowed (see Table 4.1 on page 74). The proportions of single and separated respondents were less than 5%. The study observed that single respondents were entirely male, whereas separated were females. An examination of the single males revealed that they belonged to both young and middle-aged groups. Regarding the type of marriage, the study found that 59.2% of the respondents were in monogamous marriages, while more than a third (39.2%) was in polygamous marital unions.

Respondents displayed typical family life cycle characteristics where middle-aged households begin the process of decay and disintegration exemplified by the death of one spouse and especially the husband. This explains the observation that all widows were middle-aged and that the males who reported as single had taken over the

management of their fathers' households, with their mothers entirely turning to them for support. The household that defined its status as "separated" and the increasing proportion of monogamous marriages represent a change in the family structure that characterises societies transitioning from traditional to modern. Thus Isiria Maasai is a pastoral community beginning to transition from a traditional to contemporary society. Besides the differences of households in terms of marital statuses and types of marriages, respondents also had varying levels of formal education. The following section highlights respondents' formal levels of educational attainment.

### 4.3.3 Educational attainment of respondents

Table 4.2 shows findings on the respondents' levels of educational attainment, number and age of household members.

Table 4.2 Respondents' educational level, household size and members' ages

| Variable | Element | Frequency | | | Percentage | | |
|---|---|---|---|---|---|---|---|
| | | Males | Females | Total | Males | Females | Total |
| Level of educational attainment | None | 95 | 11 | 106 | 32.8 | 50.0 | 34.0 |
| | Some primary | 74 | 4 | 78 | 25.5 | 18.2 | 25.0 |
| | Primary | 38 | 2 | 40 | 13.1 | 9.1 | 12.8 |
| | Some Secondary | 5 | 0 | 5 | 1.7 | 0 | 1.6 |
| | Secondary | 30 | 3 | 33 | 10.3 | 13.6 | 10.6 |
| | Tertiary | 48 | 2 | 50 | 16.6 | 9.1 | 16.0 |
| | **Total** | **290** | **22** | **312** | **92.9** | **7.1** | **100.0** |
| Number of members in respondents' households | 0 - 3 | 85 | 8 | 93 | 28.1 | 36.4 | 28.7 |
| | 4 - 7 | 181 | 11 | 192 | 59.9 | 50.0 | 59.2 |
| | 8 - 11 | 31 | 1 | 32 | 10.3 | 4.5 | 9.9 |
| | 12 and above | 5 | 2 | 7 | 1.7 | 9.1 | 2.2 |
| | **Total** | **302** | **22** | **324** | **93.2** | **6.8** | **100.0** |
| Total number of household members | 0 - 3 | 210 | 19 | 229 | 14.3 | 18.6 | 14.6 |
| | 4 - 7 | 912 | 48 | 960 | 62.2 | 47.1 | 61.2 |
| | 8 - 11 | 280 | 10 | 290 | 19.1 | 9.8 | 18.5 |
| | 12 and above | 64 | 25 | 89 | 4.4 | 24.5 | 5.7 |
| | **Total** | **1466** | **102** | **1568** | **93.5** | **6.5** | **100.0** |
| | Average household size | 4.9 | 4.6 | 4.8 | | | |
| Age distribution of household members | Below 5 years | 125 | 104 | 229 | 18.6 | 13.7 | 16.0 |
| | 5 to 10 years | 178 | 159 | 337 | 26.4 | 21.0 | 23.6 |
| | 11 to 20 years | 270 | 196 | 466 | 40.1 | 25.9 | 32.6 |
| | 21 to 30 years | 76 | 166 | 242 | 11.3 | 21.9 | 16.9 |
| | 31 to 40 years | 13 | 66 | 79 | 1.9 | 8.7 | 5.5 |
| | 41 to 50 years | 5 | 38 | 43 | 0.8 | 5.0 | 3.0 |
| | 51 to 60 years | 5 | 17 | 22 | 0.8 | 2.3 | 1.5 |
| | 61 and above | 1 | 11 | 12 | 0.1 | 1.5 | 0.9 |
| | **Total** | **673** | **757** | **1430** | **47.1** | **52.9** | **100.0** |

Table 4.2 indicates that the level of formal education for the respondents was low. A third (34.0%) of all respondents had no formal education and a quarter (25.0%) did not complete primary school education. The proportion of respondents with no formal education was the highest for both females and males. Similarly, there was a high level of primary school dropout (25.0%) than secondary schools (almost 1.6%). Less than 20% of the study population had tertiary education, with only 10.6% completing secondary school education.

Further inquiry into why various household members did not attend either a public or private school or both revealed that cost, distance and low quality of education were the primary causes. For instance, out of 114 respondents, half (frequency 58; 50.9%) mentioned that their first member (mainly the wife or husband) did not attend formal schooling due to costs, and slightly less than a third (frequency 35; 30.7%) attributed it to distance. About 8.8% (frequency – 10) of the respondents stated that their first household member could not attend schooling as they had to work (mainly to herd livestock).

Besides respondents' levels of education, the study inquired on the number of household members and their ages. The information is presented in the next section.

### 4.3.4    Size of respondents' households

Regarding the size of respondents' households, data shown in Table 4.2 revealed a range of between zero and thirteen members. The members included the wife, husband, children and siblings, workers, parents, grandparents, and relatives. Whether female- or male-headed, most households (61.2%) had between four and seven members.

According to information carried out in Table 4.2, the total number of household members for the 324 respondents who qualified and participated fully in this study was 1,568. Female-headed households (FHHs) had 102 members, whereas male-headed households (MHHs) had 1,466. On average, the respondents' households comprised 4.8 members, with MHHs having slightly more members (4.9) than FHHs (4.6).

Furthermore, Table 4.2 shows information about the ages of respondent household members. The data indicated that the largest proportion of household members was between eleven and twenty years for female- and male-headed households (32.6%). Almost a quarter (23.6%) of household members was between 5 to 10 years, and a sizeable proportion was between 21 and 30 (16.9%) years and below five years (16.0%). The other age brackets were less than 10 % each. In general, most household members (89.1%) were under 31 years old.

The size and ages of respondents' household members indicated that most respondents were at the childbearing stage. The absence of older members in the households also shows a transition towards nuclear households comprising a husband, wife, and children. More senior members of society seemed to have their independent households. The observation points to a disintegration of the traditional customs and habits, which abhorred the abandonment of older members of society for fear of curses. This further reinforces the view that pastoral Isiria Maasai is a community transitioning from traditional to modern society. If the older members are not in the respondents' households, it is necessary to find out where they are.

This section presented the sociodemographic characteristics of the respondents, where more than half of the respondents were middle-aged and more than a third were young. The majority of the respondents were either married or widowed. A few were also single or separated. The respondents' levels of education were low, with a third having no formal education and a quarter not completing primary school. Less than 20% of the

respondents had a tertiary level of education. On average, respondents' households had 4.8 members, but MHHs had slightly more members than FHHs. The majority of the members were aged 11-20 years, but sizeable proportions were between 5 and 10 years, 21 and 30 years or below five years.

The following section presents findings on the association between the adoption of Sahiwal cattle and household income, which was the study's first objective.

## 4.4    Adoption of Sahiwal Cattle and Respondents' household income

The first objective of this study was to investigate the association between the adoption of Sahiwal cattle and household income. The study presents the findings in this section, which summarises the respondents' Sahiwal cattle adoption durations, adoption rates and age of respondents, sources of income and the specific mechanisms used by respondents to obtain income from their cattle. The section also includes benefits that respondents accrued after adopting Sahiwal cattle and results obtained after testing the hypothesised association between adopting Sahiwal cattle and household income.

### 4.4.1    Duration of Sahiwal cattle adoption among respondents

The study investigated respondents' rate of adopting Sahiwal cattle. The elements analysed include the duration of Sahiwal cattle adoption, and adoption across various ages among respondents, as summarised in Table 4.3.

Table 4.3 Sahiwal cattle adoption rates among respondents

| Variable | Element | Frequency | | | Percentage | | |
|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | Male | Female | Total |
| Number of years respondent has raised Sahiwal cattle | < 3 years | 53 | 7 | 60 | 18.0 | 31.8 | 18.9 |
| | 3 -6 years | 128 | 10 | 138 | 43.5 | 45.5 | 43.6 |
| | 7 - 9 years | 57 | 3 | 60 | 19.3 | 13.6 | 18.9 |
| | 10 years & above | 57 | 2 | 59 | 19.3 | 9.1 | 18.6 |
| | **Total** | **295** | **22** | **317** | **93.1** | **6.9** | **100.0** |
| Adoption of Sahiwal cattle across age groups | Young (<35 years) | 114 | 4 | 118 | 37.7 | 18.2 | 36.4 |
| | Middle age (35-64 years) | 157 | 15 | 172 | 52.0 | 68.2 | 53.1 |
| | Old (65 and above years) | 31 | 3 | 34 | 10.3 | 13.6 | 10.5 |
| | **Total** | **302** | **22** | **324** | **93.2** | **6.8** | **100.0** |
| Adoption of Sahiwal cattle and respondent educational attainment | None | 95 | 11 | 106 | 26.3 | 3 | 29.3 |
| | Some primary | 74 | 4 | 78 | 20.5 | 1.1 | 21.6 |
| | Primary | 38 | 2 | 40 | 10.5 | 0.6 | 11.1 |
| | Some secondary | 5 | 0 | 5 | 1.4 | 0 | 1.4 |
| | Secondary | 30 | 3 | 33 | 8.3 | 0.8 | 9.1 |
| | Tertiary | 48 | 2 | 50 | 13.3 | 0.6 | 13.9 |
| | **Total** | **290** | **22** | **312** | **80.3** | **6.1** | **86.4** |

Data revealed that more than a third of the respondents (43.6%) had adopted Sahiwal cattle for between three and six years preceding this survey (see Table 4.3). Data from FGDs and KIIs confirmed that Isiria Maasai households had embraced Sahiwal as their preferred breed. Considering that TDP introduced Sahiwal cattle into the study area in 1995, probing during FGDs and KIIs revealed that the delayed adoption could be attributed to initial reservations that Isiria Maasai households had concerning the new breed of cattle. Isiria Maasai adopted a "wait and see" approach, especially after the first adopters purchased the Sahiwal bulls to crossbreed with their Zebu cattle.

The study observed that four-fifths (81.1%) of the respondents had adopted Sahiwal cattle for three years and above.  Less than 20% of households had adopted Sahiwal cattle for less than three years (Table 4.3).  It was apparent that half of the respondents (13) who had never raised Zebu cattle were between 25 and 34 years old.  Further inquiry from FGDs revealed that these were primarily children of the first adopters of Sahiwal cattle.

These observations were in line with the Diffusion of Innovations Theory (DoIT) assumptions, which proposed that over time, an innovation diffuses throughout a social system in five stages depending on its characteristics, mode of communicating it and individuals in the social system (Beever, 2016).  Each of the five stages corresponds to a category of adopters.  The innovation of Sahiwal cattle introduced by the Transmara Development Programme in 1995 was in its final adoption stage.  Of all the adopters, DoIT apportioned 2.5% and 13.5% to the innovators and early adopters (total – 16.1%).  For this study, the innovators and early adopters comprised respondents who had raised Sahiwal cattle for ten years and above.  Their proportion was 16.1%, corresponding with DoIT's proportion of innovators and early adopters.  The innovators and early adopters were the initial groups of cattle farmers from the study area who bought the first Sahiwal bulls and whom the TDP assisted with their transport from the source farms to the study area.  The early majority and the late majority (each allotted 34%, total - 68% by DoIT) for this study comprised of three groups of respondents who indicated that they had raised Sahiwal cattle for 7-9 years (16.3%), 3 – 6 years (37.6%) and below three years (16.3%).  When combined, the cumulative proportion of the three groups was 69.2% which was not far from DoIT's allotted proportion of 68% for early and late majority adopters.  Having presented the adoption rates and duration of Sahiwal

cattle adoption among the respondents, this study also compared the age of respondents with the adoption of Sahiwal. Their results are presented in the next section.

### 4.4.2    Adoption of Sahiwal cattle and age of respondents

The study noted that more than half (53.1%) of all Sahiwal cattle adopters were middle-aged respondents, and a third (36.4%) was young.  The proportion of old respondents was 10% (see Table 4.3).  The ratio of middle-aged respondents was large compared to the young and old due to their experience of the benefits of adopting Sahiwal cattle and their general livestock managerial capacity, including that of Sahiwal cattle.  Similarly, households relied on their wealth endowments in adopting Sahiwal cattle.  Middle-aged respondents were wealthier than either young or old respondents.  Moreover, young respondents may be experimenting with numerous occupations and not yet decided on the trajectory of their lives.

This finding that most of the Sahiwal cattle adopters in the study area were middle-aged was consistent with observations of other studies.  It agreed with a survey by Widyobroto, Rochijan, C., Noviandi, T. & Astiti (2017), which indicated that the majority (52.6%) of crossbred dairy cattle adopters in Yogyakarta, Indonesia, were between 46 – 65 years old.  Similarly, in their study on the smallholder dairy farmer characteristics and their relationships with the type of breeds kept in Uganda, Balirwa and Waholi (2018) found that the mean age for smallholder farmers who adopted improved dairy cows was 51 years.  A study by Sahel Consulting (2018) also reported that the majority of adopters (60%) of improved dairy cattle in northern Nigeria were middle-aged (41 to 60 years).  Quddus (2017) also found that most (34.0%) of crossbred

dairy cattle adopters in Bangladesh were above 50 years old.  In adopting improved disease control measures, Karanja-Lumumba, Mugambi & Wesonga (2015) observed the mean age of adopters of a vaccine to control East Coast Fever among smallholder dairy farmers in North Rift was 51 years.  Regarding the age of most improved cattle adopters, Saleh, Atala, Omokore, Ahmed, Ali, & Kajang (2016) and Mazimpaka, Mbuza Michael, Gatari, Bukenya & James (2017) obtained similar results in Nigeria and Rwanda, respectively.

However, studies on the adoption of cattle production-enhancing innovations undertaken daily indicated that most adopters were slightly younger than improved cattle breeds.  In the arid area of Tunisia, Dhraief, Bedhiaf-Romdhania, Dhehibib, Oueslati-Zlaouia, Jebali & Ben (2018) found that in adopting innovative technologies, including enhanced rams, the average age of adopters was lower (44 years) compared to that of non-adopters (51 years). Mekuria, Negatu & Mekonen (2017) also noted that the average age of adopters of dairy cattle in the Central Highlands of Ethiopia was slightly lower (42.7 years) than that of non-adopters (44.0 years).

The divergence in the outcomes was attributable to differences in production systems and labour intensity requirements.  It was easy for middle-aged respondents to adopt Sahiwal cattle in the study area.  The production system was extensive, where cattle grazed on natural pastures with occasional mineral supplementation.  Moreover, with reliance on their wealth rather than loans and subsidies for investments, middle-aged persons were more endowed with resources to invest in Sahiwal adoption than younger persons.  Even loans required collateral that middle-aged cattle farmers could offer.

On the other hand, younger cattle farmers were the majority in adopting daily production-enhancing technologies since they were labour-intensive, which middle-aged and older respondents could not cope with. After describing respondents' ages and adoption of Sahiwal cattle, the current study inquired about the sources of income that households relied on. Results of the inquiry are presented in the next section.

### 4.4.3    Respondents' sources of income

Respondents were asked to list the sources of income they relied upon. Table 4.4 summarizes findings on respondents' sources of income and the proportions for each source. For each source of income, the survey calculated the proportion of respondent households relying on it out of 302 males, 22 females and thus a total of 324 households.

Table 4. 4 Sources of income in respondent households

| Household source of income | Frequencies | | | Percentages | | |
|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total |
| Livestock production | 295 | 22 | 317 | 97.7 | 100 | 97.8 |
| Crop cultivation | 206 | 16 | 222 | 68.2 | 72.7 | 68.5 |
| Employment | 69 | 3 | 72 | 22.8 | 13.6 | 22.2 |
| Remittances | 15 | 5 | 20 | 5 | 22.7 | 6.2 |
| Gifts | 26 | 2 | 28 | 8.6 | 9.1 | 8.6 |
| Business | 78 | 6 | 84 | 25.8 | 27.3 | 25.9 |
| Leasing out land | 72 | 7 | 79 | 23.8 | 31.8 | 24.4 |
| Sale of timber products | 13 | 1 | 14 | 4.3 | 4.5 | 4.3 |
| Sale of sand | 7 | 0 | 7 | 2.3 | 0 | 2.2 |
| Gold mining | 7 | 1 | 8 | 2.3 | 4.5 | 2.5 |
| Pension | 2 | 0 | 2 | 0.7 | 0 | 0.6 |
| Social Protection Programmes | 4 | 1 | 5 | 1.3 | 4.5 | 1.5 |
| Crafts | 6 | 1 | 7 | 2 | 4.5 | 2.2 |
| Boda boda | 5 | 0 | 5 | 1.7 | 0 | 1.5 |
| Livestock trade | 3 | 1 | 4 | 1 | 4.5 | 1.2 |

It emerged that nearly all respondent households (97.8%) indicated that they relied on livestock production and two-thirds (68.5%) on crop farming as sources of income. A quarter (25.9%) of the respondents specified that they relied on trade. Nearly a quarter mentioned depending on leasing out land for pasture or crop cultivation and employment, respectively (see Table 4.4). Other sources of income that the respondents identified included gifts, remittances and the sale of timber products. Less than 10% of the respondents mentioned crafts, commuter motorcycles ("Bodaboda"), gold mining, sand sale, social protection programmes initiated by the government, and pension as their sources of income.

The findings on the sources of income were consistent with other studies on pastoralists. Ducrotoy, Revie, Shaw, Musa, Bertu & Gusi (2017) found that most Fulani pastoralists in Northern Nigeria still ranked livestock production as their first income source despite diversifying livelihood strategies. The other sources were crop farming, off-farm income (business & employment), remittances and crafts. Achiba (2018) found out that although the pastoral households of Isiolo had diversified their income sources to include trading and employment, livestock production remained the primary source of income.

Upon inquiry, five livestock types that respondents drew income from included cattle, goats, sheep, chicken and bees. The majority of the respondents ranked cattle (87.7%) as their first source of livestock income, then goats (57.5%), sheep, chicken and bees, respectively. A study found similar trends in income among pastoralists in Central

Asia, particularly in Kyrgyzstan. According to Sabyrbekov (2019), pastoralists in Kyrgyzstan received their revenues from selling live animals and animal products.

Income diversification among pastoral households is a strategy that pastoralists have recently added into their repertoire of managing livelihood risks along with mobility, herd dispersion, herd maximization, and herd diversification. It manifests a dramatic increase in the vulnerabilities that pastoral households need to address. Even under the prevailing circumstances, cattle production remains central to the livelihoods of pastoral households. Therefore, the additional sources of income appear to be support mechanisms for cattle production, which households have not found an appropriate replacement. Cattle production is not merely an income-generating activity but an industry that satisfies social needs such as status and cultural identity. After describing the sources of income that respondents stated that they relied upon and identifying that nearly all relied on livestock production, this study further established that among the five types of livestock, most respondents ranked cattle income as their first source of livestock income. The mechanisms through which respondents drew income from cattle are discussed in the next section.

### 4.4.4    Mechanisms of obtaining income from cattle

Respondents used numerous methods to obtain income from their cattle. Table 4.5 summarises these findings.

Table 4.5 Mechanisms of getting income from cattle and average monthly incomes

| Cattle income mechanism | Frequency | Percentage | Average monthly incomes (KES) |
|---|---|---|---|
| Sale of milk | 268 | 37.7 | 19.607.2 |
| Sale of live cattle | 264 | 37.1 | 34,726.2 |
| Sale of breeding stock | 107 | 15.0 | 28,485.2 |
| Hire of draught cattle | 38 | 5.4 | 8,750.0 |
| Sale of milk products | 34 | 4.8 | 26,347.9 |
| **Total mentions** | 711 | **100.0** | |

As indicated in Table 4.5, this study found out that the respondents predominantly mentioned the sale of milk (37.7%) and live animals (37.1%) and breeding stock (15.0%) as mechanisms of securing revenue from their cattle. Besides these three mechanisms, respondent households also depended on the hire of draught power (5.4%) and the sale of milk products (4.8%).

On the mean monthly incomes respondents received from these mechanisms, the study revealed that the sale of live cattle and breeding stock yielded the highest and second highest mean monthly incomes, respectively (see Table 4.5). The sale of milk products was the third-highest mechanism through which respondents' households obtained income. Revenue from the hire of draught cattle produced the least monthly payment.

In the FGDs and KIIs, the study established that Isiria Maasai sold their milk in quantities of bottles, and a bottle of milk was equivalent to 750ml or 0.75 litres. Also, the study confirmed that there were three categories of Isiria Maasai milk sellers – small, medium and large. Small milk sellers sold less than ten milk bottles daily, while medium and large sellers sold 10 to 40 and over 40 bottles daily. More than half of the respondents' households (54.9%) were medium-scale daily milk sellers, while more

than a third (38.2%) was small-scale daily milk sellers.  Large-scale daily milk sellers were 6.9%.

During the Kirindon and Sitoka divisions FGD, the researcher learned that even though selling live cattle generated high-income streams, it was not preferred.  It emerged that selling live cattle was not an individual's decision but involved consulting other household members and sometimes relatives.  The category of animals involved also determined cattle sales.  It was much more challenging to sell a productive lactating cow than a non-lactating one.  Similarly, there was reluctance in selling pregnant cows.  It was also difficult to sell the bull depended upon by the herd for breeding.  Draught oxen were also not easy to sell.  Households found it easier to sell young breeding bullocks, especially before they matured.  Castrated oxen not providing draught power were also easy to sell.  According to the FGD, if a husband sells a cow, oxen, bull, bullock or heifer without the consent of his wife, she may protest by fleeing to her parental home.  If this happens, the husband may incur many expenses in bringing his wife back.  Wives then have a lot of say in selling cattle among Isiria Maasai.

This outcome went against a long-held view about patriarchal pastoral communities that portrayed women as subservient to men.  According to Gitungwa, Gustafson, Jimenez, Peterson, Mwanzalila, Makweta, Komba, Kazwala, Mazet & VanWormer (2021), compared to men, women have less authority over household resources as a result of existing norms.  In particular, pastoralist women in East Africa do not control larger and more valuable livestock.    However, the empirical evidence from Isiria Maasai demonstrated that women are crucial and active stakeholders, especially in decisions

over the management and disposal of cattle and cattle products.  This study agrees with Onyima's (2019) views that although women have actively engaged in direct and indirect cattle production activities, their contribution has been obscured.  According to the author, early writers on African pastoralism were preoccupied with stereotypes and were influenced by structural-functionalism.  The perspective views gender as an efficient mechanism of allocating roles to men and women in society.

In addition, this study attributes the 'seemingly odd' outcome concerning the strength of women's power amongst Isiria Maasai on the disposal of cattle as a product of the socio-economic changes that have occurred.  In particular, the penetration of a market economy has turned milk into a reliable source of consistent daily income for women, leading to their empowerment.

The finding on the mechanisms Isiria Maasai study respondents used to obtain income from cattle agreed with other studies on smallholder pastoralists and dairy farmers.  Bayan & Dutta (2017) found out that the dairy farmers of the Assam region of India obtained cash income from their dairy cattle only through the sale of milk.  Smallholder dairy farmers in the Assam region kept high-quality milk cows carefully chosen for high productivity.  The dairy farmers did not harness milk cows to provide draught power as doing so would stress the animals, causing a drop in milk yields.  The sale of breeding stock was also non-existent as they relied on artificial inseminations.

Rural communities in the Republic of Timor-Leste depend on the sale of live cattle, milk, and animal draught power for ploughing and transport (Bettencourt, Narciso,

Carvalho & Henriques, 2015). For draught power, the agro-pastoralists of Timor-Leste use horses and buffaloes rather than cattle. Bettencourt *et al.* (2015) study showed that the sale of live cattle ranked fourth in generating income to Timorese households after selling live sheep, goats and chicken. According to Majekodumni, Fajinmi, Dongkum, Shaw & Welburn (2017), the Fulani pastoralists in Northern Nigeria obtained cash income via the sale of live cattle and milk, which accounted for 83% and 5.9% of household cash income. Thus, the sale of live cattle was the most crucial component of cash income.

Abebe (2016) indicated that the Borana pastoralists of Ethiopia received cash income through milk and live animals. They also sold mature Boran bulls not for cash income but by exchanging them with milk cows. Borana pastoralists do not use cattle for draught power as their camels perform the task. Mahmoud (2016) and Mzingula (2019) obtained similar results for pastoralists of Garissa County in Kenya and Lushoto District in Tanzania. Fulani pastoralists did not trade their breeding stock as their cattle were more productive than Isiria Maasai study respondents. The same applied to Garissa pastoralists who kept Boran type of cattle. Lushoto smallholder dairy farmers mostly kept milk cows. Thus the studies compared well with the findings on obtaining income from cattle among Isiria Maasai respondents. The only point of departure was the diversity of mechanisms.

### 4.4.5    Benefits realised by respondents after adopting Sahiwal cattle

After adopting Sahiwal cattle, respondents realised several benefits.    Figure 4.1 summarizes gendered proportions of respondents according to the benefits they received after adopting Sahiwal cattle.
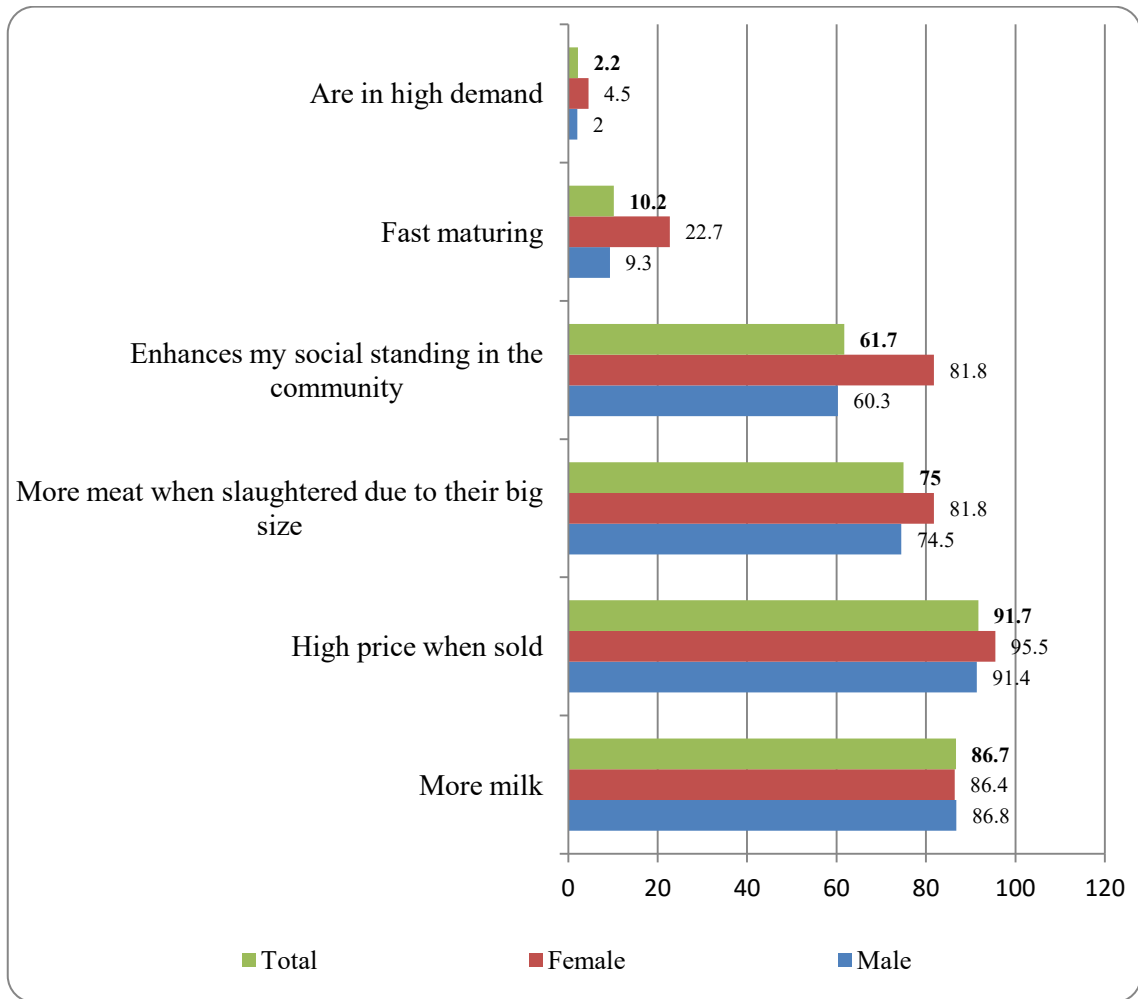


Figure 4.1 Benefits realised by respondents upon adopting Sahiwal cattle

As revealed in Figure 4.1, 91.7% of respondents' households had realised the benefit of high sale prices after adopting Sahiwal cattle.    Data collected from respondent households on the sale prices of Sahiwal confirmed this observation.    On average, households sold a Sahiwal animal at KES 45,413.0

More than four-fifths (86.7%) of the respondents also mentioned increased milk quantities as an additional benefit from adopting Sahiwal cattle. Data from the respondents' households confirmed this observation. On average, Sahiwal cattle adopters sold 24.9 bottles of milk.

A quarter (75.0%) of the adopter respondents mentioned more meat as a benefit they realised after adopting Sahiwal cattle due to their substantial size compared to the indigenous Zebu cattle. Hence households ended up slaughtering fewer animals during ceremonies compared to Zebu cattle. FGD participants from the three sites also reiterated that Sahiwal cattle adopters benefited from more meat. A key informant confirmed that their meat is also tasty and tender in addition to the enormous sizes of Sahiwal cattle. The FGD for Kirindon Division also agreed that the beef from Sahiwal cattle was palatable. On this aspect, Teleu (a young male adult of 24 years) remarked: *"you can eat endlessly."*

More than half (61.7%) of the respondents obtained enhanced social standing as a benefit after adopting Sahiwal cattle. A key informant observed that the adoption of Sahiwal cattle amongst Isiria Maasai had empowered women through increased milk production. Kennedy (Livestock breeding expert, 56 years), a Key Informant (KI), pointed out that: *"Culturally, milk amongst the Maasai belongs to women. Therefore when the quantity of milk increases, women get empowered, and children's needs such as clothes and food are taken care of."* On the same issue, a different KI agreed that with the adoption of Sahiwal cattle among Isiria Maasai, *"the living standards of*

*women have improved"* (Mercy, 50 years old, previous Community Social Development worker).

According to a KI, Sahiwal cattle adoption increased their adopters' prestige as *"no elder can confidently speak before others if they have not adopted Sahiwal cattle"* (Kennedy, Livestock breeding expert, 56 years). The FGD in the Moyoi location also agreed that possession of Sahiwal cattle is a symbol of enhanced communal status. Another KI (Mercy, 50 years old) expressed a similar view by saying that Sahiwal cattle adopters are "visible" as they often talk about their accomplishments in social gatherings in a traditional practice where an individual mentions his unique cows and oxen amid others. The KI further observed that Sahiwal cattle adopters (both males and females) somehow belonged to a particular class in their communities.

The study noted marked differences between male and female respondents concerning the benefits of Sahiwal cattle adoption. Except for more milk, in all the other benefits proportion of female respondents was higher than that of males. Thus, with the adoption of Sahiwal cattle, female respondents benefited more than male respondents among Isiria Maasai households by enhancing their social status. Female respondents are directly able to see the benefits owing to their direct involvement in the production of Sahiwal cattle. They milk the Sahiwal cows and instantly notice the fast rate calves mature. When Sahiwal cattle are slaughtered, female respondents can also directly note the quantity of meat due to their role in preparing meals. With total control on household milk coupled with the penetration of the market economy, female

respondents were also able to realise more income, enabling them to participate in merry-go-rounds and thus realise enhanced social status.

Furthermore, the results in this section have brought forth two sociological aspects of social status and class. First, Sahiwal cattle have enhanced the social status of the adopters. It has increased the adopters' confidence and enabled them to have more say in community gatherings. Thus, adopters of Sahiwal cattle among Isiria Maasai have become more "visible" and "vocal". Therefore, adopting Sahiwal cattle has led to forming the class of adopters and, by extension, non-adopters.

The study established that most adopters had adopted Sahiwal cattle for 3 to 6 years before conducting this research. More than half of the respondents were middle-aged, and a third were young. Although respondents indicated that they relied on numerous sources of income, almost all stated that they relied on livestock production and two-thirds on crop farming as income sources. For income from livestock production, respondents ranked income from cattle as their first income source. In drawing income from cattle, respondents used five main mechanisms: sale of milk, sale of live cattle, sale of breeding stock, hire of draught oxen, and sale of milk products. In general, most respondents confirmed having received the benefits of Sahiwal cattle in terms of high sale prices, more milk and more meat. Having established these aspects of income, the following section tests the association between the adoption of Sahiwal cattle and household income.

### 4.4.6 Hypothesis testing on the association between the adoption of Sahiwal cattle and household income

This study set out to test the null hypothesis that Sahiwal cattle adoption was not associated with household income. The appropriate test statistic was determined by the level of measurement of the independent and dependent variables. The independent variable (adoption of Sahiwal cattle) was measured by the number of years a household has adopted Sahiwal cattle. Ordinarily, this is supposed to be at the interval level of measurement. However, how the study framed the question makes it a categorical variable. Respondents chose four options (below three years, 3 to 6 years, 7 to 9, and 10 and above). Thus the responses were ordered into four levels. The independent variable – total household income is a continuous variable. If both the independent and dependent variables were continuous, the appropriate test statistic of their association would have been Pearson's Correlation Coefficient. But since one variable – the number of years a household has adopted Sahiwal cattle – is at the ordinal level of measurement and thus categorical, the suitable test statistic is the Spearman's Rank Order Correlation Coefficient (Schober, Boer & Schwarte, 2018). Results of the test are presented in Table 4.6.

Table 4. 6 Correlation between household Sahiwal adoption years and total household income

|  |  |  | Number of years household has adopted Sahiwal cattle |
|---|---|---|---|
| Spearman's rho | Total household income | Correlation Coefficient | .254[**] |
|  |  | Sig. (2-tailed) | <.001 |
|  |  | N | 324 |

[**] Correlation was significant at the 0.01 level (2-tailed)

As shown in Table 4.6, the Spearman Rank Order Correlation Coefficient of the number of years a household has adopted Sahiwal cattle and total household income was .254

(n=324; $r_s$ = .254; p < .001).  The result indicates a positive significant but weak association between the adoption of Sahiwal cattle and household income.  Given that the p-value (p < .001) of the association between the adoption of Sahiwal cattle and household income was less than the α-value of .05, the study rejected the null hypothesis, which stated that "adoption of Sahiwal cattle is not associated to the household income" and accepted the alternative hypothesis.  Thus, the study concluded that there was sufficient evidence to indicate that Sahiwal cattle adoption was associated with household income.

This result corresponded with the findings of other studies.  For instance, in their research in the Assam region of India, Bayan & Dutta (2017) showed that the adoption of crossbred cattle had a statistically significant effect on increasing dairy and livestock income.  Cavatassi & Mallia (2018) found out that the intervention of supplying improved rams for crossbreeding enabled households to realise a significant positive increase in their livestock incomes and productive livestock assets by 19%.  In Sweden, Clasen, Fiske, Kargo, Strandberg & Ostergaard (2020) found out that the crossbreeding of pure-breds (Swedish Holstein and Swedish Red) increased the annual contribution margin per cow by between EUROS 20 to 59 (equivalent to approximately KES 2,500 to 7,400 in March 2022).  The increased profitability emanated from improved functional traits such as fertility.  In addition, the study observed that crossbreeding strategies earned EUROS 22 to 42 (equivalent to approximately KES 2,800 to 5,300 in March 2022) more per cow from the sale of live calves for slaughter.

Similarly, in their economic analysis of livestock in the household economy of farmers in the North-eastern Karnataka region, Yasmeen, Joshi, Hiremath, Koppalkar & Ram (2019) noted a significant difference in farmers' incomes with crossbred cattle and those without. The average annual income obtained through the sale of milk by farmers with crossbred cattle was Rupees 111,975 compared to 31,532 received by farmers without crossbred cattle. Thus, adopter farmers earned more than three times the income of non-adopter farmers from the sale of milk. In another study of Indian dairy farmers, Hedge (2018) also found out that crossbreeding enabled dairy farmers to double or more than double their cattle milk yields (100% to 150%). The increased milk yields translated into an increase in between 200 – 400% income.

While comparing the productive and economic performance of the native N'dama cattle, Fulani Zebu and the N'dama-Fulani Zebu crossbreds in southern Mali, Traore, Reiber and Zarate (2018) indicated that cow milk off-take was higher for Fulani Zebu and crossbreds than N'dama cattle. The difference also applied to the gross margin ratios. Fulani Zebu and crossbreds were, therefore, favourable for market-oriented production.

In Ethiopia, Bisrat (2016) assessed the income contribution of crossbred dairy cows of the adopter and non-adopter smallholder dairy farmers in Endamehoni District in Tigray. The study revealed a significant difference in the incomes of the adopter and non-adopter farmers obtained from the sale of live crossbred cows and their products. Adopter dairy incomes were 10,000 Ethiopian Birrs, more than non-adopter farmers' incomes.

According to a study by Johnson, Njuki, Waithanji, Nhambeto, Rogers & Kruger (2015), households in Manica Province in Mozambique with superior cattle breeds dramatically increased dairy production and income. The "one improved cow per poor household" Girinka Programme in Rwanda reduced poverty by selling milk and cattle manure. The revenue generated enabled households to satisfy basic needs such as paying school fees and health insurance and buying daily necessities such as salt, sugar, soap, and clothing (Haririwa & Karinganiri, 2017).

Despite these positive results, other studies revealed contradictory results. In Indonesia, Widiati *et al*. (2019) compared production results of local indigenous cattle breeds and crossbreds of Zebu and exotic beef cattle (Simmental and Limousin). The study found that farmers who adopted crossbred beef cattle engaged in a high-input-high output venture while local beef cattle farmers were involved in a low-input-low output enterprise. The net income of the farmers' two categories revealed that those who raised local Zebu cattle and those who engaged in low input-low-output ventures had the highest net income. The authors recommended the termination of the intervention. An assessment of the effects of an artificial insemination program initiated by the Government in Senegal revealed that hybrid and local cattle production had increased, resulting in more raw and processed milk, processed meat and leather. Nevertheless, this was also accompanied by an increase in total factor productivity, which led to a decrease in household incomes (Cabral, 2016).

Gazzarin, Banda & Lips (2018) investigated the outcome of an intervention that imported pure Holstein Friesians to improve the productivity of indigenous Zebu. Their research revealed that almost a quarter (23%) of all farms in the study registered negative incomes, mainly due to increased expenditure on inputs such as concentrates.

The discrepancy emanated from the cost of inputs invested in adoption. The interventions relied on high-cost inputs such as concentrates not available on the farmers' land, which entailed spending money to adopt improved beef cattle. Beef cattle only yielded income once sold. In comparison to improved dairy cattle, farmers received a regular daily income from the sale of milk. In essence, the enhanced dairy cattle "sustained themselves" through their milk which the farmers sold and used the revenue generated to buy inputs required by the cows. The intervention in the study area involved Sahiwal cattle, a dual-purpose breed suitable for both milk and meat. Besides milk and meat, respondents also received income by selling them as breeding stock and providing draught power, resulting in a significant positive but weak association.

The result of a weak association between the adoption of Sahiwal cattle and household income appears to contradict the other evidence already gathered. For instance, in Table 4.3 on page 81, the study established that four-fifths of the respondents (81.1%) had adopted Sahiwal cattle for three and above years before this study. In addition, as was indicated, almost all the respondents (97.8%) stated reliance on livestock production as a source of income (see page 87) and that respondents ranked cattle income as the first of the livestock incomes (see page 87). Moreover, more than three-

quarters of the respondents confirmed that they had realised Sahiwal cattle high sale prices, increased milk and more meat (see Figure 4.1 on page 92). This seemingly contradictory result of a weak association between the adoption of Sahiwal cattle and household income indicates that respondents do not use Sahiwal cattle solely for economic purposes. The FGD for Kirindon and Sitoka Divisions (see page 90) confirmed that although the sale of live cattle generated the highest cattle income, it was not the preferred mechanism due to the complex process of negotiating the sale of live cattle with its attendant potential for undesired outcomes between the spouses. According to one KI (see page 95), increased prestige was obtained by adopting Sahiwal cattle.

Similarly, according to the views of the FGD for Moyoi location (see page 95), possession of Sahiwal cattle were a symbol of enhancing prestige. Thus, besides the economic value, Sahiwal cattle played other roles, such as the social functions of conferring status to its owners. The complex process involved in the sale of live Sahiwal cattle, as narrated by the Kirindon and Sitoka Divisions FGD (page 90), pointed to the role of Sahiwal Cattle as a means of accumulating savings for the future. A lesson to practitioners planning development interventions is to undertake a detailed background check on the targeted communities before rolling out the intervention. The following section presents results on the association between the adoption of Sahiwal cattle and household food security.

## 4.5    Adoption of Sahiwal cattle and household food security

This study also investigated the association between adopting Sahiwal cattle and food security in the respondents' households.  This section presents and discusses findings on the food consumption patterns and food security status among respondents.  The last part of the sub-section presents and discusses the results of hypothesis testing on the association between adopting Sahiwal cattle and food security.

### 4.5.1    Food consumption patterns among respondents

Following WFP (2008), this study clustered foods into nine groups: cereals, grains, roots and tubers; vegetables and leaves; fruits; egg, fish and meat; pulses, nuts and seeds; milk and dairy products; oils and fats; sugar and sweets; as well as condiments and spices.  The study inquired on the number of days that the respondent's household consumed the various foods in the seven days preceding the filling-in of the questionnaire.  The study termed this duration as "the reference period."  This study considers as low consumption, food types eaten by households between 1 and 3 days, moderate consumption, 4 to 5 days and high consumption, over six days.   This section summarises and presents findings on respondents' consumption patterns of the food types in each food group.

### a)  Cereals, grains, roots and tubers

The number of respondent households consuming the food types under the cereals, grains, roots and tubers for each of the seven days of the reference period are shown in Table 4.7.

Table 4.7 Cereals, grains, roots, tubers, vegetables, leaves & fruits consumption patterns

| Food Group | Type of food | Frequency of consumption | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | None | | 1-3days | | 4 – 6 days | | >6 days | |
| | | f | % | f | % | f | % | f | % |
| Cereals, grains, roots and tubers ★**57.6%** | Rice | 2 | 0.6 | 241 | 76.0 | 52 | 16.4 | 22 | 6.9 |
| | Bread | 47 | 14.8 | 236 | 74.5 | 20 | 6.3 | 14 | 4.4 |
| | Potato | 58 | 18.3 | 191 | 60.3 | 49 | 15.4 | 19 | 6.0 |
| | Sweet Potato | 194 | 61.2 | 116 | 36.6 | 6 | 1.9 | 1 | 0.3 |
| | Cassava | 253 | 79.8 | 62 | 19.6 | 2 | 0.6 | 0 | 0 |
| | Arrowroot | 287 | 90.6 | 28 | 8.8 | 1 | 0.3 | 1 | 0.3 |
| | Maize "Ugali" | 6 | 1.9 | 20 | 6.3 | 67 | 21.1 | 224 | 70.7 |
| | Millet "Ugali" | 219 | 69.1 | 70 | 22.1 | 18 | 5.7 | 10 | 3.1 |
| | Porridge | 143 | 45.1 | 146 | 46.0 | 18 | 5.7 | 10 | 3.2 |
| | Total | 1209 | 381.4 | 1110 | 350.2 | 233 | 73.4 | 301 | 94.9 |
| | **Mean** | **134.3** | **42.4** | **123.3** | **38.9** | **25.9** | **8.2** | **33.4** | **10.5** |
| Vegetables and Leaves ★**67.6%** | Kales | 25 | 7.9 | 124 | 39.1 | 80 | 25.2 | 88 | 27.8 |
| | Cabbage | 21 | 16.6 | 227 | 71.6 | 52 | 16.4 | 17 | 5.4 |
| | Spinach | 128 | 40.4 | 161 | 50.8 | 18 | 5.7 | 10 | 3.1 |
| | Spider plant | 148 | 46.7 | 136 | 42.9 | 29 | 9.1 | 4 | 1.3 |
| | *Bassella alba* | 109 | 34.3 | 173 | 54.6 | 31 | 9.8 | 4 | 1.3 |
| | African Nightshade | 86 | 27.1 | 180 | 56.8 | 43 | 13.6 | 8 | 2.5 |
| | Cow peas leaves | 160 | 50.5 | 133 | 41.9 | 18 | 5.7 | 6 | 1.9 |
| | Pumpkin leaves | 146 | 46.0 | 153 | 48.3 | 18 | 5.7 | 0 | 0 |
| | Total | 823 | 269.5 | 1287 | 406 | 289 | 91.2 | 137 | 43.3 |
| | **Mean** | **91.4** | **32.4** | **143** | **50.8** | **32.1** | **11.4** | **15.2** | **5.4** |
| Fruits ★**73.8%** | Orange | 9 | 15.8 | 235 | 74.1 | 23 | 7.2 | 9 | 2.8 |
| | Mango | 94 | 29.6 | 205 | 64.7 | 17 | 5.4 | 1 | 0.3 |
| | Banana | 26 | 8.2 | 211 | 66.6 | 64 | 20.2 | 16 | 5.0 |
| | Pineapple | 164 | 51.8 | 144 | 45.4 | 8 | 2.5 | 1 | 0.3 |
| | Avocado | 81 | 25.5 | 198 | 62.5 | 30 | 9.5 | 8 | 2.5 |
| | Total | 374 | 130.9 | 993 | 313.3 | 142 | 44.8 | 35 | 10.9 |
| | **Mean** | **74.8** | **26.2** | **198.6** | **62.7** | **28.4** | **9.0** | **7** | **2.2** |

Key:  ★ - Average proportion of respondents consuming the food group

Table 4.7 indicates that respondent households had a high consumption of maize flour ugali (70.7%) and moderate consumption of rice (16.4%) and Irish potatoes (15.4%). Most households had low rice consumption, bread, Irish potatoes, porridge and sweet potatoes. Substantial proportions of the households did not consume Arrow roots (90.6%), cassava (79.8%), millet flour "ugali" (69.1%) and sweet potatoes (61.2%) - see Table 4.7. The overall proportion of respondents that consumed cereals, grains, roots and tubers was 57.6%.

### b) Vegetables and leaves

For vegetables and leaves, the study examined the respondents' consumption of both conventional and traditional vegetables in the study area. Among these were kales, cabbages, spinach, Malabar/Vine spinach (*Basella alba* and locally known as "osuyai"), African Nightshade (Kiswahili "managu"), cowpeas leaves (Kiswahili "Kunde") and pumpkin leaves.

According to Table 4.7, more than a quarter of the respondent households had a high and moderate consumption of kales. Substantial proportions of households had an average consumption of cabbage and African Nightshade. More than half of the respondent households had low consumption of cabbage, African nightshade, *Bassella alba*, spinach, pumpkin and cowpeas leaves and spider plant. The study also noted that half of all the respondent households did not consume cowpeas leaves (50.5%), spider plant (46.7%) and pumpkin leaves (46.0%). In general, 67.5% of the respondents consumed vegetables and leaves. Respondents also consumed various fruits, as presented in the next section.

## c) Fruits

As shown in Table 4.7, respondents consumed the major fruits of bananas, oranges, mangoes, avocado and pineapple. Consumption of the five fruits was low as most respondent households ate them for up to three days during the reference period. Nevertheless, there were households with moderate consumption of bananas (20.2%), avocados (9.5%) and oranges (7.2%). More than a half of the respondent households did not consume a pineapple, while more than a quarter did not consume a mango or avocado. Out of all the respondents, 73.8% consumed fruits during the reference period. Similarly, as presented next, respondents ate food types under the eggs, fish, and meat group.

## d) Eggs, fish and meat

Respondent households consumed the seven types of foods under the food group of eggs, fish and meat. Table 4.8 presents the findings on eggs, fish, mutton, chicken, goat meat, pork, and beef consumption patterns.

Table 4.8 Household consumption patterns for various protein foods

| Food Group | Type of food | Frequency of consumption | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | None | | 1-3days | | 4 – 6 days | | >6 days | |
| | | f | % | f | % | f | % | f | % |
| Egg, Fish and Meat ★47.9% | Eggs | 78 | 24.6 | 196 | 61.8 | 27 | 8.5 | 16 | 5.1 |
| | Fish | 266 | 83.9 | 47 | 14.8 | 4 | 1.3 | 0 | 0 |
| | Mutton | 126 | 39.7 | 181 | 57.1 | 7 | 2.2 | 3 | 1.0 |
| | Chicken | 178 | 56.2 | 126 | 39.7 | 12 | 3.8 | 1 | 0.3 |
| | Goat meat | 156 | 49.2 | 138 | 43.5 | 22 | 6.9 | 1 | 0.3 |
| | Pork | 311 | 98.1 | 6 | 1.9 | 0 | 0 | 0 | 0 |
| | Beef | 41 | 12.9 | 241 | 76.0 | 29 | 9.2 | 6 | 1.9 |
| | Total | 1156 | 364.6 | 935 | 294.8 | 101 | 31.9 | 27 | 8.6 |
| | **Mean** | **165.1** | **52.1** | **133.6** | **42.1** | **14.4** | **4.6** | **3.8** | **1.2** |
| Pulses, Nuts and Seeds ★32.6% | Beans | 20 | 6.3 | 233 | 73.5 | 60 | 18.9 | 4 | 1.3 |
| | Peas | 258 | 81.4 | 54 | 17.0 | 5 | 1.6 | 0 | 0 |
| | Green grams | 264 | 83.3 | 51 | 16.1 | 2 | 0.6 | 0 | 0 |
| | Sesame | 292 | 92.1 | 22 | 6.9 | 3 | 1.0 | 0 | 0 |
| | Ground nuts | 234 | 73.8 | 70 | 22.1 | 12 | 3.8 | 1 | 0.3 |
| | Total | 1068 | 336.9 | 430 | 135.6 | 82 | 25.9 | 5 | 1.6 |
| | **Mean** | **213.6** | **67.4** | **86** | **27.1** | **16.4** | **5.2** | **1** | **0.32** |
| Milk and Dairy products★95.0% | Fresh milk | 3 | 0.9 | 32 | 10.1 | 42 | 13.2 | 240 | 75.7 |
| | Sour milk | 29 | 9.1 | 187 | 59.0 | 69 | 21.8 | 32 | 10.1 |
| | Total | 32 | 10 | 219 | 69.1 | 111 | 35 | 272 | 85.8 |
| | **Mean** | **16** | **5** | **109.5** | **34.6** | **55.5** | **17.5** | **136** | **42.9** |

Key:     ★ - Average proportion of respondents consuming the food group

According to Table 4.8, the majority of the respondent households had low consumption of beef (76.0%), eggs (61.8%) and mutton (57.1%). However, some households had a moderate consumption of meat (9.2%), eggs (8.5%) and goat meat (6.9%). Only 5.1% of respondent households had a high consumption of eggs. A high proportion of households did not consume pork (98.1%), fish (83.9%) and chicken meat (56.2%). In general, the proportion of respondents that consumed foods in this group was 47.9%. In addition to the consumption of eggs, fish and meat, respondents also consumed various food types under the pulses, nuts and seeds, as indicated in the next section.

### e) Pulses, nuts and seeds

Under the pulses, nuts and seeds, the study concentrated on foods available in the study area, including beans, peas, green grams and groundnuts. As Table 4.8 shows, a higher proportion of respondent households had low consumption of beans (73.5%) and groundnuts (22.1%). Nonetheless, households had moderate consumption of beans (18.9%) and groundnuts (3.8%). A tiny proportion of the homes also had a high consumption of beans (1.3%). A majority of the households did not consume sesame (92.1%), green grams (83.3%) and peas (81.4%). For all the respondents, 32.6% consumed food types of the pulses, nuts and seeds group. The following section presents findings on the respondents' consumption patterns of milk and dairy products.

### f) Milk and dairy products

Concerning the consumption patterns of milk and dairy products, Table 4.8 shows that three-quarters of respondent households had a high consumption of fresh milk, and almost a quarter (21.8%) had a moderate consumption of sour milk. More than half of all the respondent households had low consumption of sour milk. Similarly, less than 10% of the homes did not consume sour milk, and only 0.9% did not drink fresh milk during the reference period. The overall proportion of respondents that consumed milk and dairy products was 95.0%. In addition to milk and dairy products, the following section summarises consumption patterns for oil and fat.

### g) Oil and fat

The study also revealed that other than the conventional oils and fat commercially sold in shops and supermarkets, respondents also directly consumed fat from their cattle,

sheep and goats. Respondents also made and consumed oil from milk. Table 4.9 presents the consumption patterns of these food types among respondents in the reference period.

Table 4.9    Respondents' consumption patterns for oils and fat; sugar and sweets; and condiments and spices

| Food Group | Type of food | Frequency of consumption | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | None | | 1-3days | | 4 – 6 days | | >6 days | |
| | | f | % | f | % | f | % | f | % |
| Oil and Fat | Vegetable oil | 62 | 19.6 | 48 | 15.1 | 22 | 6.9 | 185 | 58.4 |
| | Milk oil | 198 | 62.4 | 83 | 26.2 | 11 | 3.5 | 25 | 7.9 |
| ★51.2% | Margarine | 220 | 69.4 | 75 | 23.7 | 13 | 4.1 | 9 | 2.8 |
| | Cattle fat | 146 | 46.1 | 147 | 46.4 | 23 | 7.2 | 1 | 0.3 |
| | Sheep fat | 148 | 46.7 | 149 | 47.0 | 16 | 5.0 | 4 | 1.3 |
| | Total | 774 | 244.2 | 502 | 158.4 | 85 | 26.7 | 224 | 70.7 |
| | **Mean** | **154.8** | **48.8** | **100.4** | **31.7** | **17** | **5.3** | **44.8** | **14.1** |
| Sugar    and Sweets | Honey | 144 | 45.4 | 160 | 50.5 | 12 | 3.8 | 1 | 0.3 |
| | Cakes | 229 | 72.2 | 72 | 22.7 | 13 | 4.1 | 3 | 0.9 |
| | Soda | 158 | 49.9 | 136 | 42.9 | 21 | 6.6 | 2 | 0.6 |
| ★42.4% | Afia Juice | 227 | 71.6 | 85 | 26.8 | 5 | 1.6 | 0 | 0 |
| | Other Juice | 225 | 71.0 | 78 | 24.6 | 12 | 3.8 | 2 | 0.6 |
| | Sugar cane | 112 | 35.3 | 123 | 38.8 | 32 | 10.1 | 50 | 15.8 |
| | Total | 1095 | 345.4 | 654 | 206.3 | 95 | 30 | 58 | 18.2 |
| | **Mean** | **182.5** | **57.6** | **109** | **34.4** | **15.8** | **5** | **9.7** | **3.0** |
| Condiments and Spices | Tea | 6 | 1.9 | 11 | 3.5 | 15 | 4.7 | 285 | 89.9 |
| | Garlic | 252 | 79.5 | 56 | 17.7 | 3 | 0.9 | 6 | 1.9 |
| | Tomato | 54 | 17.0 | 52 | 16.4 | 46 | 14.5 | 165 | 52.1 |
| ★51.9% | Pepper | 211 | 66.6 | 97 | 30.6 | 7 | 2.2 | 2 | 0.6 |
| | Ginger | 257 | 81.1 | 58 | 18.3 | 1 | 0.3 | 1 | 0.3 |
| | Capsicum | 230 | 72.5 | 79 | 24.9 | 5 | 1.6 | 3 | 1.0 |
| | Onions | 58 | 18.3 | 37 | 11.7 | 27 | 8.5 | 195 | 61.5 |
| | Total | 1068 | 336.9 | 390 | 123.1 | 104 | 32.7 | 657 | 207.3 |
| | **Mean** | **152.6** | **48.1** | **55.7** | **17.6** | **14.8** | **4.7** | **93.9** | **29.6** |

Key:    ★ - Average proportion of respondents consuming the food group

As indicated in Table 4.9, half (51.2%) of the respondent households consumed oils and fats during the reference period. Nevertheless, 58.4% had a high consumption of vegetable oil and milk oil (7.9%). Households had lower consumption of the other types of fats, notably sheep and cattle fat (see Table 4.9). Most households did not

consume margarine (69.4%) and milk oil (62.4%). Respondents also consumed various food types under the group sugars and sweets, as shown in the following section.

### h) Sugar and sweets

For this group of foods, the study investigated the consumption of honey, cakes, soda, Afia juice, other juices and sugar cane. Table 4.9 shows that 18.2% of the respondent households had a high consumption of sugarcane. Most households had low consumption of honey (50.5%), soda (42.9%) and sugarcane (38.8%). Some households also consumed sugarcane and soda moderately (see Table 4.9). Almost three-quarters of the households did not consume cakes (72.0%) and Afia juice (71.6%). The overall proportion of respondents that consumed foods belonging to this group was 42.4%. The following section presents consumption patterns for the condiments and spices.

### i) Condiments and spices

The study inquired on respondent household consumption of tea, garlic, tomatoes, pepper, ginger, capsicum, and onions for the category of condiments and spices. According to Table 4.9, households had a high consumption of tea, tomato and onions. Similarly, a sizeable proportion of households had a moderate consumption of tomatoes and low consumption of pepper (30.6%) as well as capsicum (24.9%), ginger (18.3%) and garlic (17.7%). Over three-quarters of households reported non-consumption of ginger (81.1%) and garlic (79.5%). The proportion of non-consumers of capsicum was slightly less than three-quarters (72.3%). In general, over the reference period, 51.9% consumed food types under condiments and spices.

The respondents' consumption patterns of various food types highlighted the importance of food availability, accessibility, social identity, and adaptability. Food consumption patterns were a function of availability and adaptability. Food types that were locally available in large quantities corresponded with high consumption. This explains the observation of increased consumption of milk and milk products and vegetables and leaves. This study established that almost all the respondents relied on livestock production (and especially Sahiwal cattle), and two-thirds relied upon crop farming as a source of income. The two livelihood activities led to abundant availability of milk and milk products; fruits, vegetables and leaves and hence the high proportions of respondents that reported their consumption.

Conversely, foods not produced locally and required to be purchased had low consumption levels. This explains the low consumption reported for the food category of pulses, seeds and nuts, pineapples, sugars and sweets. Besides availability and accessibility, the high consumption of milk and dairy products can also be explained by the phenomenon of social identity. As a pastoral community, Isiria Maasai may have emphasised the consumption of milk and milk products due to its availability and as a form of social identity. Respondents also were experimenting with new food types. A few respondents reported consumption of pork and fish, which emphasizes the respondents' propensity to adapt to new food types. A lot of effort was spent on sourcing and learning to prepare the new foods before their consumption.

The findings of this study on the consumption patterns of various foods agreed with those reported by the Sahel Consulting Agriculture and Nutrition Ltd (2018) in their assessment of the outcome of the Nigerian Dairy Development Programme (NDDP). The study by the firm observed smallholder dairy farmers in Oyo and Kano States consumed cereals, non-leafy vegetables, fats and oils daily. Other researches on pastoralists and livestock farmers with similar results include a study by Bahta, Wanyoike, Katjiuongua & Marumo (2017) in Botswana, Chege & Kobia (2019) in Mandera County, Safari, Timothy & Masanyiwa (2020) in Tanzania and Workicho, Belachew, Feyissa, Wondafrash, Lachat, Verstreten & Kolsteren (2016) in Ethiopia.

On the contrary, the empirical findings of this study varied from studies and summaries of pastoralists' diets. In a webinar presentation on achieving food and nutrition security among pastoralist and agro-pastoralist communities in Kenya, Wamahiu (2018) summarised the Maasai diet as raw blood, milk, fat, meat, honey and that consumption of fish and chicken was prohibited. The presentation also stated that the Maasai viewed green vegetables as livestock feed. Respondents in this study did not mention that raw blood was an integral part of their diet. They also did not say that chicken and fish consumption was prohibited or green vegetables as livestock feed.

Gebremichael & Asfaw (2019) found out that porridge made out of wheat or corn flour (*"Shurow"*) was the most typical food item for the pastoral and agro-pastoral community in the Somali Regional State in Eastern Ethiopia. Occasionally, their respondents consumed fruits, vegetables, beans, rice, pasta and macaroni. This finding from pastoralists from Somalia differed from this study which indicated that although

most respondents ate maize-flour-ugali and milk, other food types were consumed regularly for either two, three or four days a week.

Similarly, unlike the smallholder dairy farmers in Kano and Oyo States in Nigeria (Sahel Consulting Agriculture and Nutrition Ltd., 2018) as well as the livestock keepers in Botswana (Bahta *et al.*, 2017), respondents in this study had a higher consumption of fruits, milk, beans and beef. Study respondents also appeared to consume spices and condiments, unlike their counterparts in Nigeria and Botswana.

The study attributes the differences in the findings to several factors. The factors that determined food choices among the pastoral and agro-pastoral communities in the Somali Region in Ethiopia seemed not to apply to the study area. Drought, income, cost of food, availability, food market access, the familiarity of new foods and knowledge of nutritious foods constrained the availability of diverse food types in the Somali Region in Ethiopia. Although respondents in this study also sold milk, unlike pastoralist households in Botswana and Nigeria, the sale of milk did not take precedence over respondents' household consumption requirements. The reference period differed as some studies had the previous 24hours as their reference periods. After presenting findings on food consumption patterns, it is necessary to determine how they affect household food security. The following section addresses this aspect.

### 4.5.2 Status of food security in respondents' households

This study assessed the food security status of the respondents' households by calculating their Food Consumption Score (FCS). According to the results, respondents' households had food consumption scores that ranged between 36.0 and 346.0, with a mean score of 114.3. Thus, all the respondent households had an "acceptable" level of food consumption (100%), and therefore they were food secure.

The finding on respondents' food security was in agreement with previous studies. In a nutritional survey for Narok County, Kimere (2018) found out that all respondents' households had either an acceptable level of food consumption (97.8%) or borderline (2.2%). No respondent household had an insufficient level of food consumption (0.00%), and hence all were food secure.

Similarly, Häsler et al. (2017), in their nutritional assessment of smallholder dairy farmers in Morogoro and Tanga districts of Tanzania, observed that all households surveyed had an acceptable level of food consumption as their responses scored above 35 - the threshold for under-nutrition.

A study on food security among rural households in the North-western Mount Kenya Region (Laikipia, Samburu, Embu and upper Ewaso Ng'iro River Basin), Mutea, Bottazzi, P., Jacobi, J., Kiteme, B., Speranza, C.I. & Rist (2019) found out that 99.3% of the surveyed households had an acceptable level of food consumption. The study rated 0.7% of the respondents as being on the borderline; no family had an insufficient level of food consumption. This finding indicated that all households were food secure.

A nutritional survey undertaken by the Health Department in Wajir indicated that 97% of the agro-pastoral households surveyed had an acceptable level of food consumption and 3% had a borderline level of food consumption; hence all the respondents were food secure (The Republic of Kenya, Wajir County Health Department, 2018).

Other studies returned somewhat varied results in assessing food security among households that had adopted improved cattle breeds. Bahta *et al.* (2017) studied food security and consumption among smallholder livestock farmers in Botswana. Their study indicated that although the overwhelming majority of the respondents were food secure (acceptable – 91% & borderline – 6%), some (3%) food insecure households.

In Garissa County, a nutritional survey undertaken in 2018 indicated that 6.2% of the respondents' households were food insecure, 7.7% at the borderline and 86.1% acceptable (The Republic of Kenya, County Government of Garissa, 2018). Similarly, in Samburu, the County Department of Health SMART survey report showed that 11% of the surveyed households were food insecure, 19.8% borderline, and 69.1% acceptable (Republic of Kenya, Samburu County Government, 2019).

In assessing household food security, the Food Consumption Score of the World Food Programme assigns the highest weights to animal source foods (milk, beef, mutton, chevon). Thus most pastoralists and agro-pastoralists were anticipated to be food secure. However, the slight variations showed that very minimal crop cultivation occurred in all the populations studied in the respective sites. In Botswana, Bahta *et al.*

(2017) indicated that the Government of Botswana ignored arable farming and animal production and concentrated more on developing the mining industry. The high level of aridity in Garissa and Samburu Counties was a deterrent to crop cultivation. Due to these factors, households marketed milk, meat, mutton and chevon from their livestock to satisfy other essential non-food needs rather than consume the animal-sourced foods they produced. This resulted in food insecurity.

### 4.5.3    Status of respondents' access to a diverse diet

It was not sufficient to know the food security situation of the respondents as this could be misleading. For instance, a food-secure household might repeatedly consume the same type of food. Thus this study worked out an HDDS to measure respondents' access to various foods. Figure 4.2 presents the proportions of households as per their dietary diversity scores.
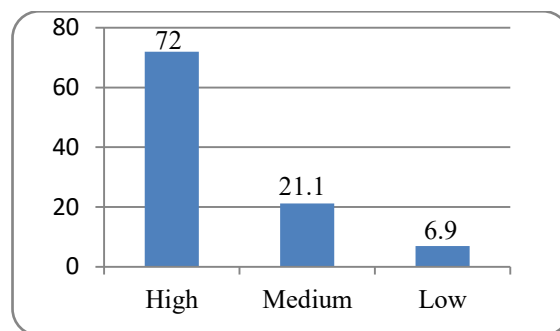


Figure 4.2 Dietary Diversity Scores of the respondents

As shown in Figure 4.2, more than a third (72%) of the respondents had high dietary diversity; 21.1% had medium, and 6.9% had low dietary diversity scores. The respondents' dietary diversity scores ranged from 1.8 to 18.0, and the mean for all respondents was 8.1.

The finding on HDDS was similar to results obtained in a study undertaken by Folorunso, Amadi & Adeniyi (2020) among agro-pastoralist of Barkin-Ladi Plateau State in Nigeria. The authors' study indicated that 66.5% of surveyed households had high HDDs, 28.3% - medium and 5.2% low. Thus, most households had a high HDDS, followed by medium and low, respectively. Although with varying proportions, Mutea *et al.* (2019) also found a similar trend of HDDs among respondents residing on the Northwestern side of Mount Kenya. In their study, 99.5% respondents had a high HDDS, 0.3% - medium and 0.2% - low.

Other studies with varied outcomes indicated that the majority of the respondents had medium HDDs. A survey carried out by Kimere (2018) in Narok County showed that most of the respondents (46.9%) had medium HDDs while 43.4% had high HDDs with a sizeable proportion (9.9%) with low HDDs.

Another study conducted in Finote Selam Town in North-West Ethiopia showed that more than two-thirds (67.2%) of respondents had medium HDDs. In comparison, 21.0% and 11.8% had high and low HDDS, respectively (Mekuria, Wubneh & Tewabe, 2017).

Whereas most studies either had respondents with the lowest HDDS being the least, two studies undertaken in Algeria and Uganda had respondents with the highest HDDS being the least. Lilia (2020) surveyed households in Constantine in Algeria and observed that 86.9%, 7.2%, and 5.2% of respondents had medium, low, and high

HDDS. In the Karamoja sub-region of Uganda, DfID (2017) found out that the average HDDS for the seven districts of Abim, Amudat, Kaabong, Kotido, Moroto, Nakapiripirit and Napak was 49% (medium), 40% (low) and 10% (high) for the study respondents.

This study attributed the variation in the finding to numerous factors. It was probable that differences in the reference period could have contributed to the discrepancies. For instance, whereas this study on Isiria Maasai used the last seven days as the reference period, the other studies used the previous 24 hours. It was also possible that differences in agroecology would have some influence in varying the result. Studies such as the one undertaken in the Karamoja sub-regions covered a vast area of seven districts, while Algeria by Lilia (2020) only covered a town.

Furthermore, study sites differed in weather patterns as some were arid and others were semi-arid or humid. Gitagia, Ramkat, Mutuki, Termote, Covic & Cheserek (2016) found out that more women in the high potential agro-ecological zone (22%) in Rongai Sub-County met the minimum dietary diversity compared to those in the low potential agro-ecological sites (16%).

Closely related to weather patterns was the factor of seasons. The current study and the one conducted by Kimere (2018) shared the same county – Narok, yet they yielded contradictory findings on HDDS. Kimere (2018) collected field data between January and February, whereas the current study was in October 2019. In Narok County, January and February are months for land preparation and planting, but October is the

harvesting period.  Availability of diverse foods differed for the two seasons, probably causing variation in the outcomes.  Chege & Muthamia (2016) demonstrated this phenomenon in their study on food consumption patterns of pastoralists' children in Kajiado County.  The researchers found that dietary diversity scores were high in the long rainy season and low in the dry season.

There was also the factor of differences in the study populations.  Lilia (2020) targeted poor urban women, while Mekuria, Wubneh & Tewabe, 2017 targeted all households that participated in an earlier study.

### 4.5.4    Household dietary diversity and age of respondents

A cross-tabulation of respondents' age and HDDS indicated that in absolute figures, most respondents with "high dietary diversity" were of the age brackets 25 to 34 (29.8%) and 55 to 64 (22.9%) while those with the youngest age bracket (below 25 years) and the eldest (65 years and above) were the least in the category with 6.9 and 6.1 per cent respectively.  However, absolute figures may be misleading since respondents aged 25 and 34 were also proportionally many.  Thus, this study worked out proportions of HDDS levels within each age bracket to get a more helpful analysis. Figure 4.3 presents a comparison of the respondents' ages and their HDDs.
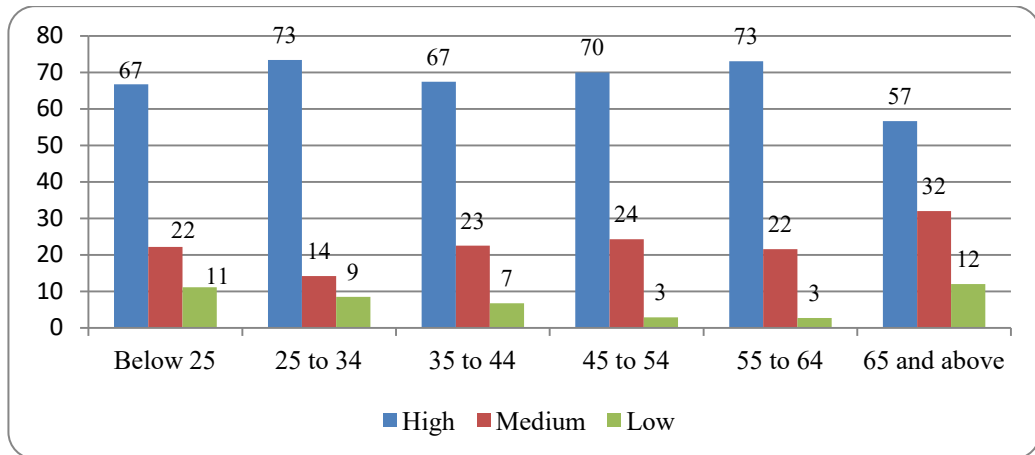
Figure 4.3 Age of respondents and level of dietary diversity

With this approach, the study found out 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 the age bracket of 65 years and above, more than half of the respondents (57%) had high dietary diversity. Almost a third (32%) had a medium dietary diversity, and more than 12% had low dietary diversity. The other age brackets had more than two-thirds of their respondents with high dietary diversity and less than 10% with low dietary diversity. The oldest (65 years and above) and youngest (below 25 years) respondents had the highest proportions of households with low HDDS than the rest. Similarly, the ratio of the oldest respondents with medium dietary diversity was high (32%).

The finding on the association of the HDDS and respondent age among Isiria Maasai corresponded with the results of other studies. In a survey undertaken by Huluka, Wondimagegnhu & Yildiz (2019) in Yayo reserve in Ethiopia, households headed by aged respondents had low dietary diversity. The authors estimated that in the Yayo

reserve, an additional year to the age of the household head increased by 0.3% the probability of being classified as having a low dietary diversity.

Cheteni, Khamfula, & Mah (2020) also found that the age of the household head had a negative association in influencing household food security status. Their study on food security and dietary diversity in the Eastern Cape Province of South Africa showed that a household was 0.978 times more likely to be food secure if its head was young.

Other studies returned contrasting findings. In Zambia, maternal age strongly predicted increased dietary diversity of infant nutrition in Luangwa Valley (Duma, Kassa, Young, & Travis, 2018). According to a study undertaken by Gitaiga *et al.* (2019) in Nakuru County, Kenya, older women were most likely to have a diverse diet compared to younger women in the two agro-ecological zones of their study area. Older women appeared to be more experienced in various infant diets than younger women. The contrast was probably due to their preoccupation with children's dietary diversity within households instead of the entire household members.

### 4.5.5    Household dietary diversity and respondent level of education

This study also compared respondents' HDDS and their levels of educational attainment. It noted differences in the distribution of respondents across the three-level of dietary diversity depending on their level of education. Figure 4.4 presents the results of the comparison.
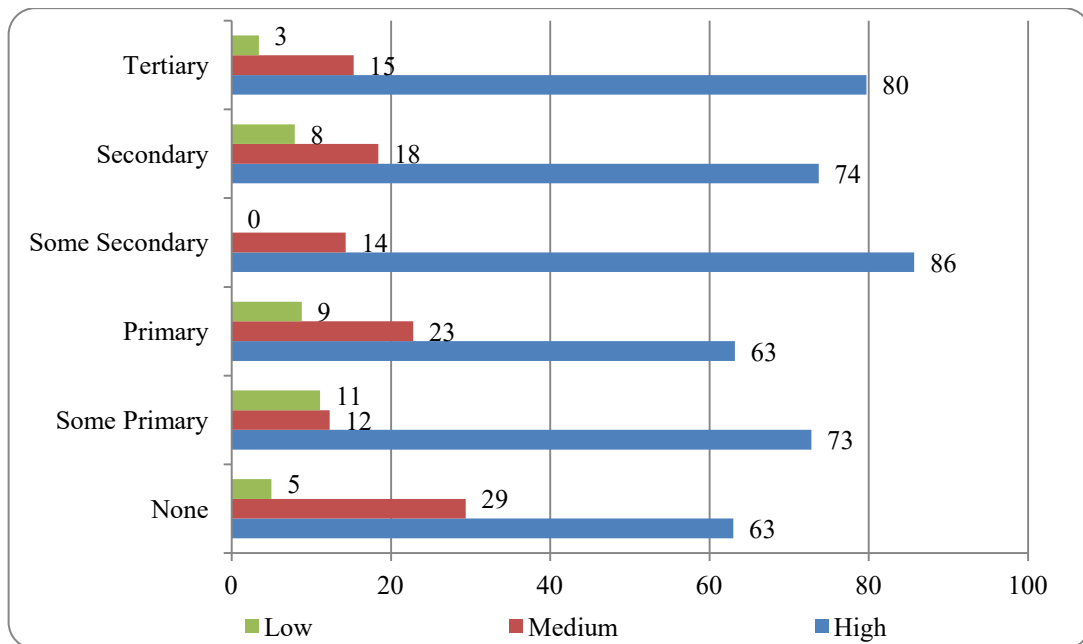
Figure 4.4 Level of respondents' educational attainment and status of dietary diversity

As Figure 4.4 indicates, among primary school drop-outs, the proportion of respondents with high dietary diversity was close to three-quarters (73%). In comparison, the proportion of respondents with at least some secondary education level with a high dietary diversity was more than four-fifths (86%). Thus, higher levels of education corresponded with high dietary diversity.

This finding was consistent with those of other studies. In Morogoro and Dodoma rural regions of Tanzania, Mbwana, Kinabo, Lambert & Biesaski (2016) showed that, among other factors, the literacy status of the mother determined HDD. Literate mothers had higher HDDS in comparison to non-literate ones. In their study on the nutritional impacts of five projects funded by IFAD in Eastern and Southern Africa, Odenigbo, Elabor-Idemudia & Geda (2018) demonstrated that households whose heads were literate had significantly higher HDDS (7.35) than the non-literate heads (6.77). In Zambia, Duma *et al.* (2018) observed that the education of a household head was

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strongly predictive of increased dietary diversity scores. In Ethiopia, Huluka, Wondimagegnhu & Yildiz (2019) revealed that female education positively and significantly increased household dietary diversity. Indeed, the study demonstrated that educating females increased the probability of a household falling into the high dietary diversity category by 13%.

Similarly, in Nakuru County of Kenya, a woman's level of education positively influenced household dietary diversity. High educational levels improved the chances of having a diverse diet by 3.65 times (Gitaiga *et al.,* 2019). In the Konso region of Ethiopia, lower levels of education increased the risk of having inadequate dietary diversity (Urmale, Alemayehu & Woldesemayat, 2020). According to a study undertaken by Tefera, Brhanie & Dereje (2020), pregnant women who possessed a college level of education and above had higher dietary diversity than those without a college education.

### 4.5.6 Hypothesis testing on the association between the adoption of Sahiwal cattle and respondent's household food security

This study endeavoured to test the null hypothesis, which stated that Sahiwal cattle adoption was not associated with household food security. The independent variable – the adoption of Sahiwal cattle is represented measured by the number of years a household has adopted Sahiwal cattle. The number of years is usually at the ratio scale of measurement. However, this study framed the number of years a household has adopted Sahiwal cattle as four categories – below three years, 3 to 6 years, 7 to 10 years and above ten years, with the numbers 1,2,3,4 representing the categories respectively.

Therefore, the number of years ceased being in the ratio scale of measurement but ordinal and thus categorical. The dependent variable – household food security is represented by food security score values obtained after weighing the responses on food. Thus, the values are mere representations of the answers. Given this situation, the food security score values are also at the ordinal level of measurement and therefore categorical. When both the independent and dependent variables are at the ordinal level of measurement, the appropriate statistic is the Spearman's Rank Order Correlation Coefficient (Schober, Boer & Schwarte, 2018). Out of the 324 households that satisfied the inclusion and exclusion criteria, a further 7 (seven) households did not respond to the item on foods and hence were excluded in the analysis. Table 4.10 presents the results of the test.

Table 4.10    Correlation between numbers of years households had adopted Sahiwal cattle and food security score value

|  |  |  | Number of years household has adopted Sahiwal cattle |
|---|---|---|---|
| Spearman's rho | Food Security Score Value | Correlation Coefficient | -.160[**] |
|  |  | Sig. (2-tailed) | .005 |
|  |  | N | 324 |

[**] Correlation is significant at the 0.01 level (2-tailed)

As shown in Table 4.10, the Spearman Rank Order Correlation Coefficient of the adoption of Sahiwal cattle and household food security values was -.160 (n=324; $r_s$ = -.160 p < .004). The result indicates a negative significant but weak association between the number of years a household has adopted Sahiwal cattle and household food security. Given that the p-value (p < .004) was less than the α-value of .05, the study rejected the null hypothesis, which stated that "adoption of Sahiwal cattle is not associated with household food security" and accepted the alternative hypothesis. Thus,

the study concluded that there was sufficient evidence to indicate that Sahiwal cattle adoption was associated with household food security.

This result indicates that the adoption of Sahiwal cattle was partially negatively associated with household food security. This means the adoption of Sahiwal cattle for a longer duration of time in pastoral households partially contributes to household food insecurity. The study anticipated a strong association as Sahiwal cattle adoption may have directly contributed to household food security through consumption of animal foods and indirectly through foods purchased by the cash generated through cattle production.

Besides Sahiwal cattle production, two-thirds of the respondents indicated crop farming as a source of income. Household access to food types enhanced consumption. In turn, local food production is the most effective way to improve access compared to purchase. This explained the high consumption of milk and dairy products, fruits, vegetables and leaves. Most pulses, nuts, and seeds were not produced locally, thus, their low consumption levels.

The result that adopting improved cattle breeds can contribute to household food insecurity corresponded with a study in Mali by Traore, Reiber, Megersa & Zarate (2018), which found out that during times of food shortages, households with indigenous Zebu cattle and mixed herds had the highest Food Consumption Scores compared to households with N'dama crossbreds. Similarly, in an old study that analysed beef and animal improvement services in Kenya, Gamba (2006) found out that

the pre-occupation by households with re-stocking concerns contributed to food insecurity.

Other studies found a different result. Adopting improved sheep by households in the Molale community in Ethiopia turned them from perennial food aid recipients to productive farmers with sufficient cash to buy food and adequately meet other needs such as children's education (Haile, Rischokowsky & Ballantyne, 2014). An evaluation of a World Vision project undertaken at Endapash area in Tanzania revealed that households with improved cattle breeds received higher milk yields per cow which improved the nutrition and health of children and family members in 29% of the households (Weaver, Mwasi & Weaver, 2015). In South West Ethiopia, Chelkeba, Tegegne, Gutema, Erge & Ali (2016) observed that adopters of improved cattle managed to enhance household nutrition by 21.7% and diet diversity by 17.5%.

While studying the impact of livestock technologies on household nutrition in Ethiopia, Kebebe (2017) found out that adopters of dairy cows had access to a diverse diet (HDDS - 5.63) compared to non-adopters (HDDS – 4.54). Similarly, in the Central Highlands of Ethiopia, Mekuria, Negatu & Mekonen (2017) observed that household food security and improved dairy cows had a significant positive association. Through the Girinka Programme that distributed improved dairy cows to poor households, Rwanda managed to fight child malnutrition through milk consumed by children (Haririwa & Kuringaniri, 2017).

In rural Tanzania, Shikuku, Valdivia, Paul, Mwongera, Winowiecki, Laderach, Herero & Silvestri (2017) showed that improved dairy cattle breeds increased milk productivity, raising farm income that households used to satisfy food requirements. The authors' study estimated that household food insecurity reduced by between 20 - 37%. In the Assam region of India, Bayan & Dutta (2017) indicated that households that had adopted crossbred cattle had a significantly higher consumption of nutritious and protein-rich high-value foods than non-adopter households. According to Quddus (2017), households obtained better nutrition due to rising incomes resulting from increased milk yields from improved crossbred dairy cows. Adopting improved cattle and sheep in Tajikistan led to a significant and positive nutritional status in children of adopter households (Cavatassi & Mallia, 2018). In Kenya, the Smallholder Dairy Commercialization Programme increased food types in households and the possibility of taking tea with milk every day. It also enabled adopter households to have diverse diets with higher animal and plant proteins (Bonilla *et al.*, 2018). In the Nyando Basin of Kenya, the adoption of Galla goats and Red Maasai Sheep significantly increased HDDS in adopter villages by three scores. Furthermore, improved small ruminants increased access to livestock products for household consumption or sale to purchase other foods (Radeny, Ogada, Recha, Rao & Solomon*,* 2019).

The divergence in the results was attributed to two factors. First, for Isiria Maasai, food security was not the only objective of adopting Sahiwal cattle. Almost two-thirds of the respondent households (61.7%) mentioned that adoption of Sahiwal cattle had enhanced their social standing in the community. Rather than utilize household resources for food, households spent them on maintaining their Sahiwal cattle to benefit from improved social status. The second is related to the type of cattle breed adopted. The

studies that reported a positive association between adopting improved animal breeds and household food security reviewed dairy cattle or small stock (sheep and goats). Sahiwal cattle are a dual-purpose breed whose utilization may be different from the utilization of dairy cattle and goats and sheep.

Having presented and discussed findings on the association between the adoption of Sahiwal cattle and household food security, the following section presents findings on the association between the adoption of Sahiwal cattle and household social capital.

## 4.6    Adoption of improved cattle breeds and social capital

The study identified and investigated ten dimensions of social capital and their individual and combined association with respondents' adoption of the improved Sahiwal cattle.   The ten social capital dimensions included group membership, friendship, solidarity with others, trusting others, helping others, information, communication, and safety.   The other dimensions were social interaction, sociability, empowerment, and political action.

### 4.6.1.    Distribution of respondents according to their level of social capital

The study designed a Social Capital Scale (SCS) to determine respondents' social capital.  On the scale, respondents either had strong, moderate, or weak social capital. The scale allocated weighted scores to items of the ten dimensions.   The study calculated an average overall score by finding the mean of the total summed weighted scores.  Respondents with less than three scores had weak social capital, while those

with 3 to 6 and over six had moderate and strong social capital.  Table 4.11 presents respondents' social capital characteristics.

Table 4. 11 Respondents levels of social capital

| Variable | Element | Frequency | Percentage |
|---|---|---|---|
| Level of Social capital | Strong | 7 | 2.1 |
| | Moderate | 308 | 95.1 |
| | Weak | 9 | 2.8 |
| | **Total** | **324** | **100.0** |

After applying the SCS to the respondents, results, as indicated in Table 4.11, show that the majority (95.1%) of respondents had a moderate level of social capital. However, 2.8% and 2.1% of respondent households had weak and strong levels of social capital, respectively.

Studies undertaken to determine the level/strength of social capital existing among a study population were scant.  Among the factors contributing to this occurrence was a lack of a standardised instrument that permitted comparative studies across various people.  It was, therefore, necessary for this study to propose such a tool and apply it. Among the few studies that referred to the level/strength of social capital was one undertaken in Sulawesi in Indonesia.  The study observed high social capital among the beef farmers who had adopted improved beef cattle breeds.

The findings differed from Isiria Maasai respondents, which found that the majority had a moderate/medium level of social capital.   Two factors may have caused the discrepancy in the results.  In assessing the level of social capital among Isiria Maasai

respondents, the tool considered ten dimensions compared to three applied by the study among beef cattle farmers in Indonesia. It was also possible that since the Indonesian farmers entirely produced beef cattle and raised an average of four animals, their scores on trust, norms, and linkages had to be high to maximise returns. On the other hand, Isiria Maasai respondents raised the dual-purpose Sahiwal cattle, which generated income by selling breeding stock to other farmers or through milk sales.

### 4.6.2.    Distribution of households according to the social capital dimensions

The study scored respondents on the ten dimensions of social capital items to obtain a total score. It calculated the percentage mean score for all the respondent households. There was variation. Table 4.12 summarizes the percentage scores for the ten social capital dimensions for the respondent households.

Table 4.12 Percentage distribution of households according to their social capital dimension scores

| Social capital dimension | | Percentage distribution of households in the quarters | | |
|---|---|---|---|---|
| | | Below 50 | 50 and above | Total |
| Groups | Frequency | 146 | 178 | 324 |
| | Percentage | 45.2 | 54.8 | 100 |
| Friendship | Frequency | 50 | 274 | 324 |
| | Percentage | 15.4 | 84.6 | 100 |
| Solidarity | Frequency | 118 | 206 | 324 |
| | Percentage | 36.4 | 63.6 | 100 |
| Trust | Frequency | 186 | 138 | 324 |
| | Percentage | 57.4 | 42.6 | 100 |
| Helping | Frequency | 116 | 208 | 324 |
| | Percentage | 35.8 | 64.2 | 100 |
| Information and communication | Frequency | 53 | 271 | 324 |
| | Percentage | 16.3 | 83.7 | 100 |
| Interaction | Frequency | 244 | 80 | 324 |
| | Percentage | 75.3 | 24.7 | 100 |
| Sociability | Frequency | 144 | 180 | 324 |
| | Percentage | 44.4 | 55.6 | 100 |
| Safety | Frequency | 117 | 207 | 324 |
| | Percentage | 36.1 | 63.9 | 100 |
| Empowerment and political action | Frequency | 143 | 181 | 324 |
| | Percentage | 44.1 | 55.9 | 100 |

From Table 4.12, a sum of the proportion of respondents who scored over 50% in the social capital dimensions revealed that it was largest for friends (84.6%) and information and communication (83.7%), but moderate for helping others (64.2%), safety (63.9%), solidarity (63.6%), belonging to groups (54.8%) as well as sociability (55.6%), empowerment and political action (55.9%) and trusting others (42.6%). However, fewer respondents had scored over 50% for the social capital dimension of interaction (24.7%).

This distribution shows that adopters of Sahiwal cattle did not regard the ten dimensions of social capital with equal importance. Respondent households considered the social capital dimensions of friendship and information and communication as most important, and thus more than four-fifths of the respondent households scored more than 50%. Similarly, the social capital dimensions of belonging to groups, sociability, empowerment and political action, and trusting others were of intermediate importance to the respondent households. Social interaction was considered of least importance as almost a quarter of the respondent households had more than 50%.

This finding implies that friendship and information and communication play crucial roles in the technology of crossbreeding pedigree Sahiwal bulls and indigenous Zebu cattle. When the study sought information on the respondents' primary sources of information on what the government was doing, they relied on radios, local markets, relatives, friends and neighbours. It was instructive that respondents did not mention

government agents as a source of information on what the government is doing. The extension agents in the area of study were rare, and hence respondents had to find alternative sources of information. The radio was the source of factual information while friends, relatives, local markets and neighbours acted as mechanisms for clarification and confirmation. This is essential information for future technology intervention projects.

The finding that respondent households value membership to diverse social groups was in agreement with the results of other studies. In a survey conducted in the Hoima region of Uganda on social capital in technology and livestock development, Ntume *et al.* (2015) observed that respondents belonged to different groups. The groups included faith, family, SACCOs, informal savings, women, clan, family, farmer, cooperatives, associations and political parties. According to Kibet *et al.* (2016), pastoral Maasai of Laikipia were members of group ranches, wildlife conservation trusts, self-help women groups, beekeepers associations and churches.

### 4.6.3    Hypothesis testing on the association between the adoption of Sahiwal cattle and household social capital

This study tested the null hypothesis, which stated that Sahiwal cattle adoption was not associated with household social capital. The independent variable here is the adoption of Sahiwal cattle measured by the number of years a household has adopted Sahiwal cattle. The dependent variable is social capital, measured by total social capital score value. The choice of an appropriate test statistic is determined by the level of measurement of the variables. This study measured the number of years a household

has adopted Sahiwal cattle in four categories – below three years, 3 to 6 years, 7 to 9 years, and ten years and above.  Thus, it is at the ordinal level of measurement in this form and hence categorical.

On the other hand, social capital was measured by the total social capital score value at the interval level of measurement and hence continuous.   In instances where the variables whose association is to be tested are a mixture of categorical and continuous, the best test static for their association is Spearman's Correlation Coefficient (Udovičić, Baždarić, Bilić-Zulle & Petrovečki, 2007).  Table 4.13 presents the results of the test.

Table 4.13   Correlation between Sahiwal cattle adoption years and total social capital score value

| Spearman's rho | | Number of years household has adopted Sahiwal cattle |
|---|---|---|
| Total social capital score value | Correlation Coefficient | .177[**] |
| | Sig. (2-tailed) | .001 |
| | N | 324 |

[**] Correlation is significant at the 0.01 level (2-tailed)

Table 4.13 indicates that the Spearman Rank Order Correlation Coefficient of the number of years a household has adopted Sahiwal cattle and total social capital score value was .177 (n=324; $r_s$ = .177; p < .001).  The result indicates a positive significant but very weak association.  Since the p-value (p < .001) of the association between the adoption of Sahiwal cattle and household social capital was less than the α-value of .05, the study rejected the null hypothesis, which stated that "adoption of Sahiwal cattle is not associated to the household social capital" and accepted the alternative hypothesis. Thus, the study concluded that there was sufficient evidence to indicate that Sahiwal cattle adoption was associated with household social capital.

The study also noted that the lengths of time a household has adopted Sahiwal cattle had variable correlations with the ten aspects of social capital considered. Table 4.14 summarizes the significant correlations for three elements of social capital.

Table 4.14 Correlation between Sahiwal cattle adoption years and social capital dimensions

| | Spearman's rho | | Number of years household has adopted Sahiwal cattle |
|---|---|---|---|
| 1 | Score on membership to groups | Correlation Coefficient | .185[**] |
| | | Sig. (2-tailed) | <.001 |
| | | N | 324 |
| 2 | Score on friendship | Correlation Coefficient | .199[**] |
| | | Sig. (2-tailed) | <.001 |
| | | N | 324 |
| 3 | Score on social interaction | Correlation Coefficient | .112[**] |
| | | Sig. (2-tailed) | .044 |
| | | N | 324 |

[**] Correlation is significant at the 0.05 level (2-tailed)

As shown in Table 4.14, the association between adoption of Sahiwal cattle (as measured by the number of adoption years) and three dimensions of membership to groups ((n=324; $r_s$ = .185; p < .001), friendship (n=324; $r_s$ = .199; p < .001)and social interaction (n=324; $r_s$ = .112; p < .044) were positive and significant but weak. This means that the length of time a household adopts Sahiwal cattle partially improves social interactions and friendship with others and increases the probability of belonging to both formal and informal groups.

Spearman's Correlation Coefficient tests with scores on social solidarity, trusting others, helping others, information and communication, safety and empowerment, and political action were positive but not significant. The correlation between the number

of years a household has adopted Sahiwal cattle and sociability was negative but not significant.

Other studies that tested the association between technology adoption and social capital returned variable results. However, it was notable that research on the livestock sector was few; most research dwelt on the association between social capital and the adoption of technologies in crop production.

In their study on the influence of social capital on the adoption of agricultural production technologies, Nato, Shauri and Kadere (2016) showed that there was a positive and significant correlation between the adoption of agricultural production technologies and three aspects of social capital; namely, group involvement (r = 0.539), social support (r = 0.312) and social networks (r = 0.297). Although the correlation with social trust (r = 0.156) and collective action (r = 0.127) were positive, they were not significant.

According to a study on rice farmers in Ghana, Yahaya, Zereyesus, Nakelse & Haruna (2019) demonstrated a positive association between the adoption of rice intensification technologies and the participation of farmers in cooperatives. For family farms in Henan Province of China, Gao, Liu, Yang & Yin (2019) also found that social capital significantly affected adopting green control techniques. Also, in the Sichuan Province of China, a study by Zang, Sun, Ma & Valentinov (2020) revealed that membership to cooperative societies positively affected technology adoption. A survey of the horticultural sector in Kenya by Nigat, Mithofer, Obare & Amudavi (2020) concluded

that there was a positive and significant contribution of social capital in adopting integrated pest management technologies.

The variation in the findings probably emanated from the differences in the conception of social capital. Whereas this study viewed social capital as a livelihood outcome of adopting improved cattle, the other studies considered it as facilitating the adoption of technologies. The other likely factor that caused the differentiation was the scope of social capital. This study on Isiria Maasai applied ten dimensions of social capital, whereas the other studies considered between one and three dimensions. It was also possible that the socio-cultural differences between crop cultivators and pastoralists may have contributed to varying the findings on social capital and adoption of the technologies considered.

The examination of the association indicates that the adoption of improved cattle breeds affects social capital dimensions differently. It partially enhanced dimensions such as group membership, friendship and social interaction. Respondent households had membership in four main groups of merry-go-rounds (54.0%), age-group (32.7%), neighbourhood (28.7%) and church committees (27.8%). In merry-go-round groups, members assemble in a homestead (of their members) and contribute money, livestock or other resources. All collections are handed over to the member. The cycle is repeated until all members have been visited. Their main aim then is to increase the resource-base of their members. It is, therefore, necessary for members to have resources to contribute to participate. Sahiwal cattle adoption allowed an accumulation

of resources that adopters can contribute to merry-go-round groups, which will help further accumulate even more resources.

Age-group, neighbourhood and church committees are structures for providing free service to the community. Sahiwal cattle adoption encouraged appointment into such voluntary community service structures. The result further strengthens this observation that a quarter of the respondent households held decision-making positions in their groups either as leaders (23.8%) or committee members. Furthermore, slightly more than half (51.5%) of the respondent households indicated that groups benefit the community. Other benefits included improving access to services (63.9%), essential for handling emergencies (54.0%) and enhancing spirituality, social status and self-esteem (35.5%).

Among respondent households, adoption of Sahiwal cattle also contributed to enhancing aspects of friendship, such as increasing the number of close friends with whom to share private matters or calling for help – financially or during an emergency. Half of the respondents (50.9%) indicated they had six and above close friends with whom they could share private matters. A further 79.3% mentioned having three and above close friends they can turn to for financial help of small amounts and were sure of getting it. Similarly, 92.6% reported that they had six and above close friends whom they could turn to for help during an emergency.

Furthermore, the adoption of Sahiwal cattle may not necessarily be associated with all the dimensions of social capital as was the case with social solidarity, trusting others,

social interaction, helping others, sociability, safety, empowerment and political action in this study. The social capital dimensions of helping others, interaction, trust and sociability are social phenomena typical of groups. Members of the same group tended to trust, socialise, interact and help those that belong to their group. Thus, whether one has adopted an improved cattle breed for a short or long duration does not affect these dimensions as respondents will end up in some group under all conditions. Members of a group have equal status, cooperate, have similar goals, and help others. It is pretty unlikely for members of different groups to develop trust, socialise, interact and help each other, which led to the absence of an association between these dimensions and the adoption of improved cattle breeds.

The next chapter of the study summarizes the key findings, concludes and makes recommendations.

# CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## 5.1    Introduction

This study investigated the association between the adoption of Sahiwal cattle on the livelihood outcomes of household income, food security and social capital among Isiria Maasai of Narok County in Kenya.  This chapter summarizes the study's key findings, draws conclusions, and makes recommendations for policy, practice, and future studies.

## 5.2    Summary of key findings

The study collected data from 324 respondents' households. The respondent's ages ranged from 22 to 88 years.  The level of formal education among the respondents was low, with a third of the respondents having no formal schooling; nearly a quarter had not completed school.  Respondents' households had up to thirteen members, with the majority having between 4 and 7 members.  More than two-fifths of the respondent households had adopted Sahiwal cattle for between 3 and 6 years.  More than half of the adopters were middle-aged between 35 and 64 years, while a third was below 35 years.  Similarly, adopters of Sahiwal cattle had lower levels of education as these categories of respondents consider livestock production as their primary livelihood activity as contrasted with the more educated who treat livestock production as a side activity.

On the first objective of determining the association between the adoption of Sahiwal cattle and household income, this study found that nearly all respondents listed livestock

production as a source of income. Among the various types of livestock, they ranked cattle income as their first source. The second most common source of income that two-thirds of the respondents listed was crop production (see Table 4.4 on page 85). The main mechanisms used by respondents to draw income from cattle were the sale of milk, sale of live cattle and sale of breeding stock (see Table 4.5 on page 88). The Spearman Rank Order Correlation Coefficient of the adoption of Sahiwal cattle and household income was .254 (n=324; $r_s$ = .254; p < .001). The result indicates a positive significant but weak association between adopting Sahiwal cattle and household income. Based on this, the null hypothesis of this study, which stated no association between the adoption of Sahiwal cattle and household income, is rejected.

Regarding objective two, which aimed to assess the association between the adoption of Sahiwal cattle and household food security, the study found that all the households are food secure, with a mean food security score of 114.3 on the WFP food consumption score (FCS). However, the study noted that most respondents consumed animal-sourced proteins, specifically from livestock. It is also notable that some respondents appeared to be experimenting with new food types indicating food type diversification. The study also established that most households had a medium to high dietary diversity score and consumed a fairly good diverse diet, as illustrated in Figure 4.2 on page 115. Furthermore, the study revealed that higher levels of education correspond with higher dietary diversity, as shown in Figure 4.4 on page 121. The Spearman Rank Order Correlation Coefficient of the adoption of Sahiwal cattle and household food security values was -.160 (n=324; $r_s$ = -.160 p < .004). The result indicates a negative significant but weak association between adopting Sahiwal cattle and household food security. Thus, the study rejected the null hypothesis that Sahiwal cattle adoption was not

associated with household food security.  The implication of the finding demonstrated that adopting Sahiwal cattle contributes to food insecurity in respondent households owing to a pre-occupation with other concerns, including re-stocking and enhanced community social status.

Objective three sought to analyse the association between the adoption of Sahiwal cattle and household social capital.  The study found an overwhelming majority of the respondents (95.1%) with moderate social capital.  A larger proportion of respondent households scored more than 50% on the social capital dimensions of friends and information and communication; the smallest proportion was on the dimension of interaction (see Table 4.12 on page 129).  The study also established an association between age and level of social capital, where middle-aged respondents had a strong social capital compared to their younger and older counterparts.

Based on the findings, the study shows that the association between the adoption of Sahiwal cattle and household social capital was significant.  The correlation coefficient between total social capital score value and adoption of Sahiwal cattle was .177 (n=324; $r_s$ = .177; p < .001).  The result indicates a positive significant but weak association.  Since the p-value (p < .001) of the association between the adoption of Sahiwal cattle and household social capital was less than the α-value of .05, the study rejected the null hypothesis, which stated that "adoption of Sahiwal cattle is not associated to the household social capital" and accepted the alternative hypothesis.  Thus, there was sufficient evidence to indicate that Sahiwal cattle adoption was associated with household social capital (see Table 4.13 on page 132).

On the specific dimensions of social capital, the study established a weak positive association between the adoption of Sahiwal cattle and membership to groups ($r_s$ = 0.185), friendship ($r_s$ = 0.199) and social interaction ($r_s$ = .112).    The social capital dimensions of solidarity, trust, helping, information and communication, sociability, safety and empowerment, and political action were insignificant.  These findings imply that while the adoption of Sahiwal cattle contributes to improving some dimensions of social capital of adopters, it may not have any impact on others.

Similarly, adopters of Sahiwal cattle placed differential importance on the ten social capital dimensions investigated by this study.  Respondent households considered the social capital dimensions of friendship and information and communication more valuable.  Helping, safety, solidarity, membership to groups, sociability, empowerment, political action, and trust were of intermediate value to the respondent households. Social interaction had the lowest value.

## 5.3    Study Conclusions

This study concludes that Sahiwal cattle adoption is associated with household income, although the association is weak.  The study concludes that the weak association emanates from the fact that cattle keeping among the Isiria Maasai are not solely an income-generating activity but also a valued cultural practice.

The study further concludes that there is a negative significant but weak association between adopting Sahiwal cattle and household food security, which implies that

adoption of improved cattle breeds can contribute to food insecurity as households spend their resources to maintain their cattle for other reasons such as the benefit of enhanced social standing. However, most respondents' households had a high household dietary diversity suggesting that the study area is receptive to livelihood diversification.

Finally, the study concludes that Sahiwal cattle adoption is associated with household social capital and specifically with the dimensions of membership to groups, friends, and social interactions. However, the association is weak, which indicates that adoption of an improved cattle breed is just but one of the livelihood activities that contribute to household social capital

## 5.4    Study recommendations

This study derives three recommendations from the objectives, findings, and conclusions.

The Ministry of Agriculture, Livestock, Fisheries and Irrigation should formulate an implementation guideline that promotes a package of interventions rather than one intervention to increase household income successfully. The guideline should spell out the active involvement and role of livestock extension officers, local administrators such as chiefs and village elders, and progressive livestock farmers in sensitizing community members on the benefits of stock crossbreeding.

Secondly, the Ministry of Agriculture, Livestock, Fisheries and Irrigation, in collaboration with the County Government of Narok, should formulate a policy spelling out guidelines for providing incentives that will encourage livelihood diversification to complement the adoption of Sahiwal cattle keeping as a household food security intervention.

Third, the study recommends that KALRO, through the County Government of Narok, develop a practical guideline for the rotational use of pedigree Sahiwal bulls by pastoral households to upgrade their cattle to enhance beneficial household social capital dimensions such as membership to groups, social interaction and friendship. The guideline should precisely spell out practical steps to strengthen local cooperative societies to pool resources to purchase and manage better animal breeds such as Sahiwal cattle.

## 5.5    Recommendations for further research

This study recommends that a comparative study be undertaken in other pastoral populations and neighbouring Kipsigis, Kisii, Kuria and Luo communities that have adopted improved cattle breeds on the management and benefits of improved cattle breeds and to compare findings. Similarly, the study suggests applying the social capital score formulated here to other pastoral communities to test its applicability, robustness and usability to make it appropriate.

# References

Abdirahman, M., Chege, P., Kobia, J. (2019). Nutrition knowledge and dietary practices among pregnant adolescents in Mandera County, Kenya. *Food Science and Nutrition Research,* Vol. 2 (2), 2019:1-8. Accessed on 16/10/2020 at http://scivisionpub.com/pdfs/nutrition-knowledge-and-dietary-practices-among-pregnant-adolescents-in-mandera-county-kenya-80.pdf

Abebe, D. (2016). Resilience and risk in Borana pastoral areas of Southern Ethiopia – Recent trends in diversification and alternative livelihoods. In: "Resilience and Risk in Pastoral Areas: Recent trends in diversified and alternative livelihoods" by USAID East Africa Resilience Learning Project Contract Number AID-623-to-14-00007. Accessed on 11/10/2020 at https://pdf.usaid.gov/pdf_docs/pa00m1pz.pdf

Abubakari, A. & Longi, F.Y.T. (2014). Pastoralism and violence in northern Ghana: Socialization and professional requirement. *International Journal of Research in Social Sciences*, Vol. 4 No. 5, September, 2014.

Achiba, G.A. (2018). Managing livelihood risks: Income diversification and the livelihood strategies of households in pastoral settlements in Isiolo County, Kenya. Pastoralism: Research, Policy and Practice, (2018) 8:20. https://DOI.org/10.1186/s1357-018-0120-x

African Union (2010). Policy framework for pastoralism in Africa: Securing, protecting and improving the lives, livelihoods and rights of pastoralist communities. Department of Rural Economy and Agriculture. Ethiopia: African Union. Retrieved 28/04/2019 at https://au.int/sites/default/files/documents/30240-doc-policy_framework_for_pastoralism.pdf

Archambault, C.S. (2016). Recreating the commons and reconfiguring Maasai women's role on the rangelands in the face of fragmentation. *International Journal of the Commons* Vol. 10 (2): 728–746, 2016. Retrieved 01/10/2016 at https://www.thecommonsjournal.org/articles/10.18352/ijc.685/.

Asian Development Bank. (2005). An impact evaluation of the development of genetically improved farmed tilapia and their dissemination in selected countries. Asian Development Bank. Retrieved 14/02/2019 at https://www.adb.org/sites/default/files/evaluation-document/35050/files/ies-tilapia-dissemination-0.pdf

Bahta, S., Wanyoike, F., Katjiuongua, H. And Marumo, D. (2017). Characterisation of food security and consumption patterns among smallholder livestock farmers in Botswana. *Agriculture and Food Security,* **6**: Article 65 (2017). Accessed on 17/10/20 at https://link.springer.com/article/10.1186/s40066-017-0145-1#Sec4

Baidoo, S.T., Yusif, H. & Anwar, U. (2016). The effect of smallholder livestock production on income of farm households in Northern Ghana. Kwame Nkurumah University of Science and Technology, MPRA Paper No. 90803. Accessed on 12/10/20 at https://mpra.ub.uni-muenchen.de/90803/1/MPRA_paper_90803.pdf

Balirwa, E. & Waholi, E. (2018). Smallholder dairy farmer characteristics and their relationhips with the type of breeds kept in Uganda. Journal of Economics and Sustainable Development, Vol. 9, No. 16, 2018. Accessed on 07/09/2020 at https://www.researchgate.net/publication/327439203_Smallholder_dairy_farmer_characteristics_and_their_relationships_with_type_of_breeds_kept_in_Uganda/link/5b8fc8be45851540d1ca1a8b/download

Bayan, B. & Dutta, M.K. (2017). Crossbred cattle adoption and its impact on income and household milk consumption among dairy farmers: Empirical evidence from Assam. *Indian Journal of Agricultural Economics,* Vol. 72, No. 2. April – June 2017. Accessed on 12/10/2020 at https://ageconsearch.umn.edu/record/302255/files/06-Baban%20Bayan-01.pdf

Beever, G. (2016). Diffusion of innovations theory – Adoption and diffusion. AgriFutures, Australia. Accessed on 11/09/2020 at https://extensionaus.com.au/extension-practice/diffusion-of-innovations-theory-adoption-and-diffusion/

Bekuma, A.; Galmessa, U. & Fita, L. (2018). Review on Adoption, Impacts and Determinant Factors of Dairy Technology in Ethiopia. Food Science and Quality Management, Vol 74, 2018: 24 – 29. Accessed on 23/06/2020 at https://iiste.org/Journals/index.php/FSQM/article/download/41851/43099

Berhanu, W. and Beyene, F. (2015). Climate variability and household adaptation strategies in Southern Ethiopia. Sustainability Vol.7: 6353-6375, 2015. Retrieved 28/03/2019 at www.mdpi.com/journal/sustainability

Bettencourt, E.M.V., Narciso, M.T.V. , Carvalho, M.L.S. & Henriques, P.S. (2015). The Livestock Roles in the Wellbeing of Rural Communities of Timor-Leste. *Rev. Econ. Sociol. Rural vol.53 supl.1 Brasília Mar. 2015*. Accessed on 10/10/2020 at https://DOI.org/10.1590/1234-56781806-94790053s01005

Bhasin, V. (2013). Pastoralists of Himalayas. *Journal of Biodiversity,* Vol. 4:83-113. Retrieved 07/05/2019 at https://www.researchgate.net/publication/321207953_Pastoralists_of_Himalayas

Binswanger-Mkhize, H.P. and Savastano, S. (2017). Agricultural intensification: The status in six African countries. *Elsevier Food Policy Journal,* Vol.67:26 – 40, 2017. Retrieved 8/3/2019 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5384439/pdf/main.pdf

Bisrat, M. (2016). Assess income contribution of adopter and non-adopter of crossbred dairy cows managed under smallholder farmer in Endamehoni District, Southern Zone, Tigray, Ethiopia. *Journal of Biology, Agriculture and Healthcare,* Vol. 6 No 13, 2016, pages 40 – 47. Accessed on 15/10/2020 at https://iiste.org/Journals/index.php/JBAH/article/download/34539/35542.

Bollig, M. and Lesorogol, C. (2016). Editorial: The "new pastoral commons" of Eastern and Southern Africa. International Journal of the Commons, Vol. 10, no 2 2016, pp. 665–687. Retrieved 30/03/2019 at https://www.mendeley.com/research-papers/editorial-new-pastoral-commons-eastern-southern-africa/

Bonilla, J.; McCarthy, N.; Mugatha, S.; Rai, N.; Coombes, A. & Brubaker, F. (2018). Impact evaluation of the Smallholder Dairy Commercialization Programme in Kenya. International Initiative for Impact Evaluation, 3ie Impact Evaluation Report 73, May 2018. Accessed on 29/06/2020 at https://www.3ieimpact.org/sites/default/files/2019-01/IE73-Kenya-dairy-commercialization.pdf

Bujang, M.A. & Baharum, N. (2017). A Simplified guide to determination of sample size requirements for estimating the value of intraclass correlation coefficient: A review. Archives of Orofacial Sciences (2017), 12 (1): 1 -11. Accessed on 26/07/2020 at http://aos.usm.my/docs/Vol_12/aos-article-0246.pdf

Cabral, A. J. (2016). Artificial insemination, livestock production and economic growth in Senegal. African Growth & Development Policy Modelling Consortium, Working Paper 0022, February, 2016 with facilitation from IFRI. Accessed on 29/06/2020 at http://www.agrodep.org/sites/default/files/AGRODEPWP0022_0.pdf

Cavatassi, R. & Mallia, P. (2018). Impact assessment report: Livestock and Pasture Development Project (LPDP), Tajikistan. IFAD, Rome Italy. Accessed on 30/05/2020 at https://www.ifad.org/documents/38714170/41114919/TJ_LPDP_/A+report.pdf/46a3c493-b-24-elb2-3f3a-786255cdc035

CELEP (Coalition of European Lobbies on East African Pastoralism). (2017). Recognising the role and value of pastoralism and pastoralists. Policy Brief No.1 May 2017. Accessed on 24/09/2019 at http://www.celep.info/wp-content/uploads/2017/05/Policybrief-CELEP-May-2017-Value-of-pastoralism.pdf

Chandarsekar, G. K., Satyanarayan, K., Jagedeeswary, V. & Shree, J.S. (2017). Relationship between socio-economic and psychological factors of dairy farmers with days open - A study in rural Karnataka. *International Journal of Pure and Applied Bioscience*, 5 (1): 171 – 177 (2017). Accessed on 07/09/2020 at http://www.ijpab.com/vol5-iss1a23.php

Channer, A. (2015). Trust Building and Mobile Pastoralism in Africa. In "Land Restoration: Reclaiming Landscapes for a Sustainable Future", Edited by Ilan Chabay, Martin Frick and Jennifer Helgeson. Elsevier Inc. Retrieved 28/04/2019 at https://www.sciencedirect.com/book/9780128012314/land-restoration

Chege, P.M. & Muthamia, O.G. (2016). Effects of seasonality on household food security and food consumption patterns of pastoralist's children in Kajiado County, Kenya. *EC Nutrition,* 5.6 (2016): 1266-1276. Accessed on 15/10/20 at https://ecronicon.com/ecnu/pdf/ECNU-05-0000175.pdf

Chelkeba, S.D., Tegegne, M.A., Gutema, E.A., Erge, B.E. & Ali, A.B. (2016). Adoption and impact of dairy production technologies in southwest Ethiopia: The case of Jimma and Ilu Ababora zones. Journal of Biology, Agriculture and Healthcare, Vol. 6 No. 7, 2016, pp 1- 12. Accessed on 26/09/2020 at https://iiste.org/Journals/index.php/JBAH/article/view/29981

Cheteni, P., Khamfula, Y. & Mah, G. (2020). Exploring food security and household dietary diversity in the Eastern Cape Province, South Africa. *Sustainability,* 2020, 12 (5), 1851. DOI:10.3390/su12051851. Accessed on 20/10/20 at https://www.mdpi.com/2017-1050/12/5/1851

Clasen, J.B., Fiske, W.F., Kargo, M., Strandberg, E. & Ostergaard, S. (2020). Economic consequences of dairy crossbreeding in conventional and organic herds in Sweden. *Journal of Dairy Science,* Vol. 103, issue 1, January, 2020:514-528. https://DOI.org/10.3168/jds.2019-16958. Accessed on 14/10/2020 at https://www.sciencedirect.com/science/article/pii/S0022030219309919;

DfID (Department for International Development). (2001). *Sustainable Livelihood Guidance Sheets*. Section 5: Policy Reform. London, UK: Department of International Development. Retrieved 11/12/2018 at http://www.eldis.org/go/topics/dossiers/livelihoods-connect/what-are-livelihoods-approaches/training-and-learning-materials

DfID (Department for International Development). (2017). Food security and nutritional assessment in Karamoja sub-region. UNICEF, FAO and WFP, Karamoja Food Security and Nutritional Assessment, June, 2017. Accessed on 18/10/20 at https://docs.wfp.org/api/documents/WFP-0000022487/download/

Dhraief, M.Z., Bedhiaf-Romdhania, S., Dhehibib, B., Oueslati-Zlaouia, M., Jebali, O., Ben Youssef, S. (2018). Factors affecting the adoption of innovative technologies by livestock farmers in arid areas of Tunisia. Forum for Agricultural Research in Africa (FARA) Research Report. Volume 3 (5): 22. Retrieved on 19/09/2020 at https://www.researchgate.net/publication/327971458_Factors_Affecting_the_Adoption_of_Innovative_Technologies_by_Livestock_Farmers_in_Arid_Area_of_Tunisia/link/5bb06859299bf13e6057242b/download

Djohy, G. (2017). Pastoralism and Socio-technological Transformations in Northern Benin: Fulani Innovations in Pastoral Migration, Livelihood Diversification and Professional Association. Göttingen University Press. Retrieved 30/03/2019 at https://www.univerlag.uni-goettingen.de/handle/3/isbn-978-3-86395-346-1

Dong, S. (2016). Overview: Pastoralism in the world in S. Dong *et al.* (eds.) *Building Resilience of Human-Natural Systems of Pastoralism in the Developing World: Interdisciplinary Perspectives.* Springer International Publishing Switzerland, 2016: 1-37

Ducrotoy, M.J., Revie, C.W., Shaw, A.P.M., Musa, U.B., Bertu, W.J., Gusi, A.M., Ocholi, R. A., Majekodunmi, A.O. Welburn S.C. (2017). Wealth, household heterogeneity and livelihood diversification of Fulani pastoralists in the Kachia Grazing Reserve, northern Nigeria, during a period of social transition. PLoS ONE 12(3): e0172866. https://DOI.org/10.1371/journal.pone.0172866

Duma, S.E., Kassa, L., Young, S.L. & Travis, A.J. (2018). Examining the association between livestock ownership typologies and child nutrition in the Luangwa Valley, Zambia. *PLoSONE*, 13 (2):e0191339. https://DOI.org/10.1371/journal.pone.0191339. Accessed on 20/10/20.

Duong, N.H., Pham, H.V., Nguyen, H.T.T., Bonney, L.B. & Stephen, I. (2014). Impacts of socio-cultural factors on beef cattle value chain: A case study of producers in the Northwest Region of Vietnam. Proceedings of the 16th AAAP Animal Science Congress, Vol. II held between 10 to 14th November 2014 at Gadjah Mada University, Yogyakarta, Indonesia. Accessed on 02/12/2020 at https://www.researchgate.net/publication/267810687_Impacts_of_Socio-Cultural_Factors_on_Beef_Cattle_Value_Chain_A_Case_Study_of_Producers_in_the_Northwest_Region_of_Vietnam

Escalada, M. and Heong, K.L. (2019). Focus group discussion. Accessed on 26/07/2020 at https://stirrrd.org/wp-content/uploads/2019/03/focus_group_discussion_guide-2.pdf

FAO. (2015). The outlook for agriculture and rural development in the Americas: A perspective on Latin America and the Caribbean 2015-2016. Economic Commission for Latin America and the Caribbean (ECLAC), Food and Agriculture Organization of the United Nations (FAO), Inter-American Institute for Cooperation on Agriculture (IICA), 2015. Retrieve 8/3/2019 at http://www.fao.org/3/a-i6606e.pdf

Faruk, M.S.A., Islam, S.K.M.A., Alam, M., Deb, A., & Chanda, G.C. (2015). *Husbandry practices of dairy farming at Chittagong sub-urban area.* International Journal of Natural Sciences, 2015, 5 (2), 59 – 65. Accessed on 07/09/2020 at https://www.banglajol.info/index.php/iJNS/article/view/28613

Ficek, R.E. (2019). Cattle, capital, colonization: Tracking creatures of the anthropocene in and out of human projects. *Current Anthropology* Vol. 60, Supplement 20, August 2019. Accessed on 19/04/2018 at https://www.journals.uchicago.edu/doi/pdf/10.1086/702788

Fincham, J. E. (2008). Response rates and responsiveness for surveys, standards and the Journal. *American Journal of Pharmaceutical education 2008; 72(2) Article 43.* Accessed on 03/11/2020 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2384218/pdf/ajpe43.pdf

Folorunso, S.T., Amadu, O.S. & Adeniyi, A.K. (2020). Analysis of food security and food diversity among agro-pastoralists in Barkin-Ladi, Local Government Area, Plateau State, Nigeria. *FUDMA Journal of Agriculture and Agricultural Technology,* ISSN: 2504-9496, Volume 6, No. 1, June 2020, pp 186-201. Accessed on 16/10/20 at http://journal.fudutsinma.edu.ng/index.php/jaat/article/view/1638

Frankema, E. (2014). Africa and the green revolution: A global historical perspective. *Elsevier NJAS-Wageningen Journal of Life Sciences,* Vol. 70 (71): 17 – 24, 2014 Retrieved 13/2/2019 at https://www.sciencedirect.com/science/article/pii/S1573521414000116?via%3Dihub

Galvin, K. A. (2009). Transitions: Pastoralists Living with Change. Annu. Rev. Anthropol. 38:185–98, 2009. Retrieved 23/03/2019 at https://www.annualreviews.org/DOI/abs/10.1146/annurev-anthro-091908-164442

Gao, Y., Liu, B., Yang, H. & Yin, S. (2019). Social capital, land tenure and the adoption of green control technologies by family farms: Evidence from Shandong and Henan Provinces of China. *Land Use Policy,* Volume 89, December 2019, 104250. https://DOI.org/10.1016/j.landusepol.2019.104250. Accessed on 25/10/20 at https://www.sciencedirect.com/science/article/abs/pii/S0264837718320210

Gazzarin, C., Banda, M.C. & Lips, M. (2018). A comparison of economic performance between high-yielding temperate breeds and zebu-crossbreds on smallholder dairy farms in Southern Malawi with a particular focus on reproductive performance. *Trop Anim Health Prod* 50, 1519–1527 (2018). https://DOI.org/10.1007/s11250-018-1590-y. Accessed on 14/10/20 at https://link.springer.com/article/10.1007/s11250-018-1590-y?shared-article-renderer

Gebremichael, B. & Asaw, A. (2019). Drivers of food choice among pastoral and agro-pastoral community in Somali Regional State, Eastern Ethiopia. Hindawi Advances in Public Health Vol. 2019, Article ID 1472487. Accessed on 12/09/2020 at http://downloads.hindawi.com/journals/aph/2019/1472487.pdf

Gentle, P. and Thwaite, R. (2016). Transhumant pastoralism in the context of socioeconomic and climate change in the mountains of Nepal. *Mountain Research and Development*, 36(2):173-182, 2016. Retrieved 23/03/2019 at https://bioone.org/journals/mountain-research-and-development/volume-36/issue-2/MRD-JOURNAL-D-15-00011.1/Transhumant-Pastoralism-in-the-Context-of-Socioeconomic-and-Climate-Change/10.1659/MRD-JOURNAL-D-15-00011.1.full

Getachew, T.; Haile, A.; Wurzinger, M.; Richkowsky, B.; Gizaw, S.; Abebe, A. and Sölker, J. (2016). Review of sheep crossbreeding based on exotic sires among indigenous breeds in the tropics: An Ethiopian perspective. *African Journal of Agricultural Research,* Vol.11 (11): 901-911, 17th March, 2016. Retrieved 15/02/2019 at https://www.researchgate.net/publication/300370836_Review_of_sheep_crossbreeding_based_on_exotic_sires_and_among_indigenous_breeds_in_the_tropics_An_Ethiopian_perspective

Gitaiga, M.W., Ramkat, R.C., Mutuki, D.M., Termote, C., Covic, N. & Cheserek, M.J. (2019). Determinants of dietary diversity among women of reproductive age in two agro-ecological zones of Rongai Su-County, Nakuru, Kenya. *Food and Nutrition Research,* 63: 1553. http://dx.DOI.org/10.29219/fnr.v63.1553. Accessed on 20/10/20 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6338663/pdf/FNR-63-1553.pdf

Gitungwa, H., Gustafson, C.R., Jimenez, E.Y., Peterson, E.W., Mwanzalila, M., Makweta, A., Komba, E., Kazwala, R.R., Mazet, J.A.K. & VanWormer, E. (2021). Female and male-controlled livestock holdings impact pastoralist food security and women's dietary diversity. One Health Outlook (2021) 3:3, One Health Outlook. Accessed on 11/03/2022 at https://doi.org/10.1186/s42522-020-00032-5

Golaz, V. & Médard, C. (2016) Agricultural frontier, land tenure changes and conflicts along the Gucha-Trans Mara boundary in Kenya. *Journal of Eastern African Studies*, 10:2, 229-246, DOI: 10.1080/17531055.2016.1187814. Retrieved from https://www.tandfonline.com/action/showCitFormats?doi=10.1080%2F17531055.2016.1187814 on 13/03/2022

Goshu, T. and Shibeshi, A. (2016). Social change: Impact of development interventions in the Gelcha community of the Karrayu Pastoralists of the Upper Awash Valley of Ethiopia. Retrieved 30/03/2019 at http://ethiopiawide.net/wp-content/uploads/ICES18Gelcha.pdf

Grootaert, C., Narayan, D., Jones, V.N. & Woolcock, M. (2004). Measuring social capital: An integrated questionnaire. World Bank Working Paper No. 18. The World Bank. Accessed on 07/06/2018 at https://openknowledge.worldbank.org/bitstream/handle/10986/15033/281100PAPER0Measuring0social0capital.pdf?sequence=1&isAllowed=y

Guinde, M., Mahamat, O. & Abdallah, M. (2018). The importance of pastoralism in Chad. Panorama Around the World, World Organization for Animal Health. Accessed on 09/07/2020 at https://oiebulletin.com/?panorama=praps-chad

Gutu Z., Haile A., Rischkowsky B., Mulema A.A., Kinati, W. and Tesfahun, G. (2015). Evaluation of community-based sheep breeding programs in Ethiopia. Addis Ababa: ICARDA. Accessed on 08/11/2019 at https://cgspace.cgiar.org/bitstream/handle/10568/76233/LF_ethiopia_cbbp_evaluation.pdf?sequence=5&isAllowed=y

Haile, A.; Rischokowsky, B. And Ballantyne, P. (2014). Community-based sheep improvement- research help breed strong communities in Ethiopia. CGIAR Research Program on Livestock and Fish. Brief No. 10. Retrieved 17/2/2019 at https://core.ac.uk/download/pdf/132679333.pdf

Harirwa, J. G. & Karinganiri, C. (2017). *Exploring the success and challenges of the Girinka programme and the need for social work involvement: Southern Rwanda.* Rwanda Journal, Series B: Social Sciences, Volume 4 No 1, 2017. Accessed on 23/06/2020 at https://www.ajol.info/index.php/rj/article/view/163306

Häsler, B., Msalya, G., Garza, M., Fornace, K., Eltholth, M., Kurwjila, L., Rushton, J. & Grace, D. (2017). Integrated food safety and nutritional assessments in the dairy cattle value chain in Tanzania. *Global Food Security,* Volume 18, September 2018, pp 102-113. https://DOI.org/10.1016/j.gfs.2018.05.003. Accessed on 17/10/20 at https://www.sciencedirect.com/science/article/pii/S221191241730086X#t0010

Hedge, N. (2018). Impact of crossbreeding and upgrading of nondescript cattle and buffaloes on livestock quality and income. *Indian Journal of Animal Sciences,* Vol. 88, issue 5, 2018: 606-611. Accessed on 14/10/2020 at https://www.researchgate.net/publication/325626140_Impact_of_crossbreeding_and_upgrading_of_nondescript_cattle_and_buffaloes_on_livestock_quality_and_income/link/5cd9969d458515712ea7810d/download

Herd. (2017). Focus group discussions. Herd publication. Accessed on 29/07/2020 at https://www.herd.org.np/uploads/frontend/Publications/PublicationsAttachments1/1485497050-Focus%20Group%20Discussion_0.pdf

Herrero, M.; Grace, D; Njuki, J.; Johnson, N.; Enahoro, D.; Silvestri, S. and Rufino, M.C. (2012). The livestock roles in developing countries. *Animal,* Vol. 7 (S1):3-18, The Animal Consortium, 2012. Retrieved 25/2/2019 at https://federated.kb.wisc.edu/images/group237/shared/0655-Herrero-Roles-Livestock-Developing-Countries.pdf

Holechek, J.L., Cibils, A.F., Bengaly, K. & Kinyamario, J. I. (2017). Human population growth, African pastoralism and rangelands: A perspective. *Rangeland Ecology and Management,* Volume 70, Issue 3, May 2017 pages 273 – 280. Accessed on 02/06/2018 at https://www.sciencedirect.com/science/article/abs/pii/S1550742416300859?via%3Dihub

Huluka, A.T., Wondimagegnhu, B.A. & Yildiz, F. (2019). Determinants of household dietary diversity in the Yayo reserve of Ethiopia: An empirical analysis using sustainable livelihood framework. *Journal of Cogent Food and Agriculture,* Volume 5, issue 1, 2019. Accessed on 20/10/20 at https://www.tandfonline.com/DOI/full/1080/23311932.2019.1690829

ICPALD (IGAD Centre for Pastoral Areas and Livestock Development). (2019). Assessment of total economic valuation of pastoralism in Kenya. Regional Integration Support Programme (RISP III). Inter-Governmental Authority on Development.

IFAD, (2016). Pastoral Community Development Project II Project Performance Assessment. Report No. 4038-ET. Retrieved 25/04/2019 at https://www.ifad.org/en/web/ioe/evaluation/asset/39824375

In, J., & Lee, S. (2017). Statistical data presentation. *Korean Journal of Anesthesiology*, *70*(3), 267–276. https://DOI.org/10.4097/kjae.2017.70.3.267. Accessed on 31/07/2020 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5453888/

INDDEX Project (2018), Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. Accessed on 17 October 2020 at: https://inddex.nutrition.tufts.edu/data4diets

Ingabire, M.C., Liu, Y., Pesha, J.C. & Hardi, A. (2018). Factors affecting adoption of artificial insemination technology by small dairy farmers in Rwanda: A case of Rwamagana district. Journal of Economics and Sustainable Development, Vol. 9, No. 12, 2018, pp 46 – 53. Accessed on 19/09/2020 at https://www.iiste.org/Journals/index.php/JEDS/article/download/43140/44460

Jandreau, C. and Berkes, F. (2016). Continuity and change in the socio-ecological and political landscape of the Maasai Mara, Kenya. *Pastoralism: Research, Policy and Practice,* Vol. 6 (1):2 – 15. Retrieved 02/05/2019 at https://pastoralismjournal.springeropen.com/track/pdf/10.1186/s13570-016-0048-y

Johnson, N.; Njuki, J.; Waithanji, E.; Nhambeto, M.; Rogers, M. & Kruger, E. H. (2015). The gendered impacts of agricultural asset transfer projects: Lessons from Manica Smallholder Dairy Development Program. Gender, Technology and Development, 19 (2), 145 – 180. DOI: 101177/0971852415578041

Kabunga, N. (2014). Adoption and impact of improved cow breeds on household welfare and child nutrition outcomes: Empirical evidence from Uganda. Paper prepared for presentation at the 88th Annual Conference of the Agricultural Economics Society, AgroParisTech, Paris, France from 9-11, April 2014. Retrieved 16/2/2019 at https://pdfs.semanticscholar.org/09b3/f003d7f4c8116eecfe223621bc30c5b3b04d.pdf

Kabunga, N. S., Ghosh, S. & Webb, P. (2017). Does ownership of improved dairy cow breeds improve child nutrition? A pathway analysis for Uganda. PLoS ONE 12(11): e0187816. https://DOI. org/10.1371/journal.pone.0187816

Karanja-Lumumba, T., Mugambi, J. & Wesonga, F. (2015). Adoption of East Coast Fever vaccine among smallholder dairy farmers in Kenya: The case of North Rift Kenya. East African Agricultural and Forestry Journal, Vol. 81:1, pp 34 – 39, 2015. Accesses o 23/09/2020 at https://www.tandfonline.com/DOI/full/10.1080/00128325.2015.1040646

Kebebe, E.G. (2017). Household nutrition and income impacts of using dairy technologies in mixed crop-livestock production systems. *The Australian Journal of Agricultural and Resource Economics,* Volume 61, issue 2, October 2018, pp 626-644. https://DOI.org/10.1111/1467-8489.12223

Ketere-Lelgut J. N 1 , Muia J. M. K 2 , Ilatsia E. D 2 , Oliech G. O 3 and Kitilit J. K. (2018). Current Livestock Production Challenges and Opportunities in Transmara SubCounty: Diagnostic Survey Report. African Journal of Education, Science and Technology, December, 2018, Vol 4, No. 4. Accessed on 13/03/2022 at http://erepository.uoeld.ac.ke/bitstream/handle/123456789/672/Ketere.pdf?sequence=1&isAllowed=y

Kibet, S., Nyangito, M., MacOpiyo, L. & Kenfack, D. (2016). Tracing innovation pathways in the management of natural and social capital on Laikipia Group ranches, Kenya. *Pastoralism: Research, Policy and Practice,* 6, Article number 16, (2016). DOI:10.1186/s13570-016-0063-z. Accessed on 26/10/20 at https://link.springer.com/article/10.1186/s13570-016-0063-z

Kima, S.A., Okhimamhe, A.A., Kiema, A., Zampaligre, N. & Sule, I. (2015). Adapting to the impacts of climate change in the sub-humid zone of Burkina Faso, West Africa: Perceptions of agro-pastoralists. *Pastoralism: Research, Policy and Practice* (2015): 5:6. DOI 10.1186/s13570-015-0034-9. Accessed on 03/05/2020 at https://pastoralismjournal.springeropen.com/track/pdf/10.1186/s13570-015-0034-9.pdf

Kimere, C. (2018). Integrated Nutrition SMART survey report – Narok County, 2018. Accessed on 18/10/20 at http://www.nutritionhealth.or.ke/wp-content/uploads/SMART%20Survey%20Reports/Narok%20County%20SMART%20Survey%20Report%20-%20February%202018.pdf

Kirimi, L. & Njeru, T. (2016). Collective land access regimes in pastoral societies: Lessons from East African countries. Egerton University, Kenya: Tegemeo Institute of Agricultural Policy and Development. Retrieved 18/01/2017 at http://ella.practicalaction.org/knowledge-regional/collective-land-access-regimes-in-pastoralist-societies-lessons-from-east-african-countries/

Komote, A. S. & Mwaura, F. O. (2017). The effect of alternative livelihood strategies on social and economic outcomes of pastoral communities of Saku Sub County in Marsabit County. *International Academic Journal of Information Sciences and Project Management*, Vol. 2(1):17-37. Retrieved 30/03/2019 at https://www.iajournals.org/articles/iajispm_v2_i1_17_37.pdf

Kosgei, J.K., Ng'eno, E.K. & Kibett, J.K. (2020). Factors affecting adoption of dairy cattle milk production technologies in Mosop Sub-County, Nandi County, Kenya. African Journal of Agricultural Research, Vol. 15 (1), pp 140 – 148, January 2020. Accessed on 19/09/2020 at https://academicjournals.org/journal/AJAR/article-full-text-pdf/44958C962785

Kreutzmann, H. (2012). Pastoral practices in transition: Animal husbandry in High Asia Contexts. In: Kreutzmann, H. (eds). Pastoral practices in High Asia. Advances in Asian Human-Environmental Research. Springer, Dordrecht. Retrieved 26/12/2016 at https://link.springer.com/chapter/10.1007/978-94-007-3846-1_1#citeas

Kreutzmann, H. (2012). Pastoralism*:* A way forward or back? Retrieved 04/03/2019 at https://www.geo.fu-berlin.de/geog/fachrichtungen/anthrogeog/zelf/Medien/download/Kreutzmann_PDFs/pdfs_Nov_2012/18__Kreutzmann_Pastoralism_A_Way_Forward_or_Back.pdf

Krätli, S. & Schareika, N. Living off uncertainty: The intelligent animal production of dryland pastoralists*. European Journal of Development Research*, Vol. 22, 5, 2010:605-622. European Association of Development Research and Training Institutes. DOI:10.1057/ejdr.210.41.

League of Pastoral Peoples. (2006). *Threats to pastoralists*. League of Pastoral Peoples. *www.pastoralpeoples.org/pastoralists.htm*

Leroy, R.; Baumung, R.; Boettcher, P.; Scherf, B. And Hoffman, I. (2015). Review: sustainability of crossbreeding in developing countries: Definitely not like crossing a meadow. Food and Agriculture Organization of the United Nations. Retrieved 7/3/2019 at https://www.cambridge.org/core/services/aop-cambridge-core/content/view/A7A1C56C9612E54E965D3173D43EB2CE/S175173111500213Xa.pdf/review_sustainability_of_crossbreeding_in_developing_countries_definitely_not_like_crossing_a_meadow.pdf

Lesorogol, C. K. & Boone, R. B. (2016). Which way forward? Using simulation models and ethnography to understand changing livelihoods among Kenyan pastoralists in a "new commons". *International Journal of the Commons*, Vol. 10, no 2 2016, pp. 747–770 Publisher: Oopen Journals URL:http://www.thecommonsjournal.org DOI: 10.18352/ijc.656

Lestari, V.S., Sirajuddin, S.N. & Abdullah, A. (2018). Identification of social capital on beef cattle farmers group. IOP Conference Series: *Earth and Environmental Science,* 119 (2018), 012066. DOI:1088/1755-1315/119/1/012066. Accessed on 06/07/20 at https://iopscience.iop.org/article/10.1088/1755-1315/119/1/012066/pdf

Levine, N. E. (2015). Transforming inequality: Eastern Tibetan pastoralists from 1955 to the present. In *Nomadic Peoples*, Vol. 19 No. 2, 2015:164-188. White Horse Press.

Lilia, H. (2020). Relationship between diversity dietary score with caloric, nutrient adequacy levels and socio-demographic factors, a case of urban poor household members of charity, Constantine, Algeria. *African Journal of Food Science,* Volume 14 (9), pp 295-303, October 2020.   ; DOI: 10.5897/AJFS2020.1913. Accessed on 18/10/2020 at https://academicjournals.org/journal/AJFS/article-full-text/FA1667264991

Lindemann, N. (2019). What is the average survey response rate?[2019 benchmark]. SurveyAnyplace. Accessed on 01/08/2020 at https://surveyanyplace.com/average-survey-response-rate/

Little, P. D.; McPeak, J. G.; Barrett, C. B. & Kristjanson, P. (2011). Challenging orthodoxies: Understanding poverty in pastoral areas of East Africa. Economics Faculty Scholarship, Paper 83.

Lydiah, M., Ngare, W., Casper, M., & Immaculate, M. (2019). The gender gaps in challenges facing farmers in improved beekeeping: Case of the Maasai community in Trans Mara, Narok County, Kenya. *International Journal of Gender Studies*, *4*(1), 1 – 18. Retrieved from https://www.iprjb.org/journals/index.php/IJGS/article/view/838

Magembe, E. M., Bebe, B. O., Lagat, J. K., Chelang'a, P. K. (2013). Comparison of socio-economic factors associated with shift from pastoral to agropastoral farming systems in Transmara West District of Narok County- Kenya. *Greener Journal of Agricultural Sciences* ISSN: 2276-7770; ICV: 6.15 Vol. 3 (7), pp. 528-535, July 2013. Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1085.6001&rep=rep1&type=pdf on 13/03/2022

Mahmoud, H.A. (2016). Resilience and risk in pastoral areas: Trends in diversified and alternative livelihoods in Garissa, Kenya. In: "Resilience and Risk in Pastoral Areas: Recent trends in diversified and alternative livelihoods" by USAID East Africa Resilience Learning Project Contract Number AID-623-to-14-00007. Accessed on 11/10/2020 at https://pdf.usaid.gov/pdf_docs/pa00m1pz.pdf

Majekodunmi, A.O., Fajinmi, A., Dongkum, C., Shaw, A.P.M., & Welburn, S. C. (2014).   Pastoral livelihoods of the Fulani on the Jos Plateau of Nigeria. *Pastoralism: Research, Policy and Practice,* Vol. 4(20): 1 – 16. Retrieved 04/05/2019 at https://pastoralismjournal.springeropen.com/articles/10.1186/s13570-014-0020-7

Manzano, P., Burgas, D., Cadahı´a, L., Eronen, J.T., Ferna´ndez-Llamazares, A., Bencherif, S., Holand, Ø., Seitsonen, O., Byambaa, B., Fortelius, M., Ferna´ndez-Gime´nez, M.E., Galvin, K.A., Cabeza, M. & Stenseth, N.C. (2021). Toward a holistic understanding of pastoralism. *One Earth 4,* May 2021. Cell Press. Accessed on 11/03/2022 at https://rangelandsgateway.org/sites/default/files/2021-05/Toward%20a%20holistic%20understanding%20of%20pastoralism.pdf

Marshall, K., Mtimet, N., Wanyoike, F., Ndiwa, N., Ghebremariam, H., Mugunieri, L. and Costagli, R. (2016). Traditional livestock breeding practices of men and women Somali pastoralists: trait preferences and selection of breeding animals. *Journal of Animal Breeding and Genetics,* 133: 534–547, 2016. Retrieved 18/01/2017 at https://www.ncbi.nlm.nih.gov/pubmed/27292043

Mazimpaka E., Mbuza F., Michael T., Gatari, E.N., Bukenya, E.M., James, O. A. (2017). Current status of cattle production system in Nyagatare District-Rwanda. *Trop Anim Health Prod.* 2017 Dec; 49(8):1645-1656. DOI: 10.1007/s11250-017-1372-y. Epub 2017 Aug 19. PMID: 28823069. https://pubmed.ncbi.nlm.nih.gov/28823069/

Mbwana, H.H., Kinabo, J., Lambert, C. & Biesaski, H.K. (2016). Determinants of household dietary practices in rural Tanzania: Implications for nutrition interventions. *Journal of Cogent Food and Agriculture,* (2016), 2:1224046. http://dx.DOI.org/10.1080/23311932.2016.1224046. Accessed on 20/10/20 at https://www.cogentoa.com/article/10.1080/23311932.2016.1224046

McCabe, J.T.; Leslie, P.W. and DeLuca, L. (2010). *Adopting cultivation to remain pastoralists: The diversification of Maasai livelihoods in northern Tanzania.* Human Ecology, 2010 June 38(2): 321-334. DOI: 10.1007/s10745-010-9312-8.

McLeod, S. A. (2018). *Questionnaire: definition, examples, design and types.* Simply Psychology. https://www.simplypsychology.org/questionnaires.html

Mekuria, G., Wubneh, Y & Tewabe, T. (2017). Household dietary diversity and associated factors among residents of Finote Selam town, northwest Ethiopia: A cross-sectional study. *BioMedical Central Nutrition, Vol. 3 (28), 2017.* Retrieved on 17/03/2021 at https://bmcnutr.biomedcentral.com/track/pdf/10.1186/s40795-017-0148-0.pdf

Mekuria, W., Negatu, W. & Mekonnen (2017). Adoption of improved dairy cows and implications for household food security: Evidence in Central Highland of Ethiopia. Global Journal of Science Frontier Research: D Agriculture and Veterinary Volume 17 Issue 3 Version 1.0, 2017. Retrieved on 19/09/2020 at https://globaljournals.org/GJSFR_Volume17/5-Adoption-of-Improved-Dairy.pdf

Millar, J. and Photakoun, V. (2008). Livestock development and poverty alleviation: Revolution or evolution for upland livelihoods in Lao PDR. *International Journal of Agricultural Sustainability,* Vol. 6 (1):89-102, Earthscan. Retrieved 14/03/2019 at https://cdn.csu.edu.au/__data/assets/pdf_file/0003/749100/Livestock_development_and_poverty_alleviation.pdf

Mohanty, I., Senapati, M. R., Jena, D., and Palai, S. (2014). Diversified uses of cow urine. *International Journal of Pharmacy and Pharmaceutical Sciences*, Vol. 6 (3): 20-22, 2014 Retrieved 18/01/2017 at https://innovareacademics.in/journal/ijpps/Vol6Issue3/9051.pdf

Msigwa, G. B and Mvena, Z. K. (2014) Changes in livelihoods of evicted agro-pastoralists from Ihefu Basin in Tanzania. *Livestock Research for Rural Development, Vol. 26 (1). Retrieved* 06/04/2016, from http://www.lrrd.org/lrrd26/1/msig26021.htm

Mudingu, J. (2020). Girinka programme transforms livelihoods, reconciles communities. Rwanda Agricultural Board. Accessed on 07/03/2021 at https://rab.gov.rw/fileadmin/user_upload/documentss/article_about_Girinka.pdf

Muscillo, A., Pin, P., Razzolini, T. & Serti, F. (2018). Does "Network Closure" beef up import premium? IZA Institute of Labour Economics. Discussion Paper Series, IZA DP No. 12036. Accessed on 10/07/20 at https://www.econstor.eu/bitstream/10419/193330/1/dp12036.pdf

Mutai, B. & Rono, T. (2019). Socio-cultural determinants of teenage pregnancies in Transmara West, Narok County, Kenya. *International Journal of Research and Scientific Innovation* (IJRSI) | Volume VI, Issue VIII, August 2019 | ISSN 2321–2705. Retrieved from https://www.rsisinternational.org/virtual-library/papers/socio-cultural-determinants-of-teenage-pregnancies-in-transmara-west-narok-county-kenya/ on 13/03/2022

Mutea, E., Bottazzi, P., Jacobi, J., Kiteme, B., Speranza, C.I. & Rist, S. (2019). Livelihoods and food security among rural households in North-western Mount Kenya Region. *Sustainable Food Systems,* 07, November, 2019. Accessed on 18/10/20 at https://DOI.org/10.3389/fsufs.2019.00098

Mutsotso, B. M. (2013). Conflict and social change: The East Pokot pastoralist adjustment to conflict. *American International Journal of Social Science*, Vol. 2, No. 8, December 2013:126-134.

Mzingula, E.P. (2019). Socio-Economic Impacts of Smallholder Dairy Cattle Farming on Livelihood in Sunga Ward of Lushoto District, Tanzania. *International Journal of Economics and Management*, Vol. 1 Issue (2) pp 41 - 49, 2019. Accessed on 12/20/2020 at https://ssrn.com/abstract=3390668 or http://dx.DOI.org/10.2139/ssrn.3390668

Nato, G.N., Shauri, H.S., and Kadere, T.T. (2016). Influence of social capital on adoption of agricultural production technologies of African Institute for Capacity Development Training programmes in Kenya. *International Journal of Social Science and Technology,* Volume 1, No. 1, July 2016. Accessed on 25/10/20 at http://ijsstr.com/data/frontImages/1.pdf

Ncube, A.; Dube, A. B.; Khombe, C. T. & Assan, N. (2015). Issues and concerns in pro-poor community-based cattle breeding programme in Bulilimamangwe district of Zimbabwe. Scientific Journal of Animal Science, 2015, vol. 4 (4), 51 – 64. DOI: 10.14196/sjas.v4i4.1859. http://handle.net/123456789/483

Ngalim, A. N. (2015). Cattle Rearing Systems in the North West Region of Cameroon: Historical Trends on Changing Techniques and Strategies. *Journal of Educational Policy and Entrepreneurial Research,* Vol. 2, (5): 175-189, May 2015. Retrieved 29/04/2019 at http://jeper.org/index.php/JEPER/article/download/131/144

Niemi, J.K.; Tapio, M.; Marshall, K.; Tebug, S. and Juga, J. (2016). Improving dairy production in Senegal. PROIntens Africa, WP2 Light Case Study Report. Retrieved 12/02/2019 at https://cgspace.cgiar.org/bitstream/handle/10568/80632/senegal_germplasm_pr_en.pdf?sequence=1

Nigat, B., Mithofer, D., Obare, G., and Amudavi, D. (2020). The role of social capital and other factors in the adoption of integrated pest management technologies in the horticulture sub-sector of Kenya. *International Journal of Social Science and Technology, Vol. 5 No.3, July 2020.* Retrieved on 15 March, 2021 at http://www.ijsstr.com/data/frontImages/7_July_.2020.pdf

Njeru, T. N., Kirimi, L. & Nthenya, K. (2017). The evolution of collective land access regimes in pastoralist societies: Lessons from East African countries. Responsible Land Governance: Towards an Evidence-Based Approach, Annual World Bank Conference on Land and Poverty, Washington DC, March 20-24, 2017. Retrieved 29/03/2019 at https://www.oicrf.org/-/the-evolution-of-collective-land-access-regimes-in-pastoralist-societies-lessons-from-east-african-countries

Ntume, B., Nalule, A.S. and Baluka, S.A. (2015). The role of social capital in technology adoption and livestock development. *Livestock Research for Rural Development. Volume 27, Article #181.* Retrieved February 25, 2021, from http://www.lrrd.org/lrrd27/9/balu27181.html

Nyariki, D.M. & Amwata, D.A. (2019). The value of pastoralism in Kenya: Application of total economic value approach. *Pastoralism, Policy and Practice*, *Vol. 9, issue 9,* pp. 1-13. https://DOI.org/10.1186/s13570-0190-0144-x

Nyariki, D.M. (2017). Assessment of the economic valuation of pastoralism in Kenya. A report for IGAD, Nairobi, Kenya.

Nyamushamba, G.B.; Mapiye, C.; Halimani, T.E. and Muchenje, V. (2017). Conservation of indigenous cattle genetic resources in Southern Africa's smallholder areas: Turning threats into opportunities – a review. *Asian-Australian Journal of Animal Sciences,* Vol. 00 (00): 1-9, March 2017

Nyanjom, O. (2014). Remarginalising Kenyan pastoralists: The hidden curse of national growth and development. *African Study Monographs*, Suppl. 50: 43–72, October 2014. Retrieved 29/03/2019 at http://jambo.africa.kyoto-u.ac.jp/kiroku/asm_suppl/abstracts/pdf/ASM_s50/Nyanjom.pdf

Nziku, Z.C.; Kitaro, G.C.; Eik, L.O.; Steine, T. And Adnøy, T.; (2016). Reasons for keeping dairy goats in Tanzania and possible goals for sustainable breeding program. *Animal Production Science,* 57(2) 338-346. January, 2016, CSIRO Publishing. Retrieved from https://doi.org/10.1071/AN15423

Oba, G. (2012). Harnessing pastoralists' indigenous knowledge for rangeland management: Three African case studies. *Research, policy and practice*, Springer Open Journal 2012, 2:1. Retrieved from https://pastoralismjournal.springeropen.com/articles/10.1186/2041-7136-2-1

Odenigbo, M.A., Elabor-Idemudia, P. & Geda, N.R. (2018). Influence of nutrition-sensitive interventions on dietary profiles of smallholder farming households in East and Southern Africa. 24 IFAD Research Series. Accessed on 20/10/20 at https://www.ifad.org/documents/38714170/40297386/24_Research_web.pdf/9a96 35f2-8a4d-4859-8559-31138f90d7be?eloutlink=imf2ifad

Ogada, M.J., Rao, E.J.O., Radeny, M., Recha, J.W. and Solomon, D. (2020). Climate-smart agriculture, household income and asset accumulation among smallholder farmers in the Nyando basin of Kenya. World Development Perspectives Volume 18:100203. Accessed on 22/06/2020 at: https://www.sciencedirect.com/science/article/pii/S2452292920300308?via%3Dih ub#s0025

Ojango, J. M., Okeyo, A. M. and Rege, E. (2010). The Kenya Dual Purpose Goat Development Project. International Livestock Research Institute, Nairobi, Kenya. Retrieved 06/05/2019 at https://www.researchgate.net/publication/265916495_The_Kenya_Dual_Purpose_ Goat_development_project

Okello, W.O., Muhanguzi, D., MacLeod, E.T., Welburn, S.C., Waiswa, C. and Shaw, A.P. (2015). Contribution of draft cattle to rural livelihoods in a district of southeastern Uganda endemic for bovine parasitic diseases: an economic evaluation. *Parasites & Vectors,* 8: 571, 2015. Retrieved 13/03/2019 at https://parasitesandvectors.biomedcentral.com/articles/10.1186/s13071-015-1191-9

Onyima, B.N. Article: "Women in Pastoral Societies in Africa" in O. Yacob-Haliso, T. Falola (eds.), The Palgrave Handbook of African Women's Studies. Springer Nature Switzerland AG 2019. Accessed on 11/03/2022 at https://doi.org/10.1007/978-3-319-77030-7_36-1.

Pantuliano, S. and Pavanello, S. (2016). Turning learning into action: Enabling pastoralist livelihood systems in the Horn of Africa. Overseas Development Institute, UK. Retrieved 10/05/2019 at https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/5894.pdf

Peacock, C. (2008). Dairy goat development in East Africa: A replicable model for smallholders? *Small Ruminant Research,* 77 (2008) 225–238. Retrieved 06/05/2019 at https://www.researchgate.net/publication/248445325_Dairy_goat_development_i n_East_Africa_A_replicable_model_for_smallholders

Pearce, F. (2016). COMMON GROUND: Securing land rights and safeguarding the earth. Oxfam, International Land Coalition & Rights and Resources Initiative, 2016. Retrieved 10/05/2019 at https://www.oxfamamerica.org/static/media/files/GCA_REPORT_EN_FINAL.pdf

Pennsylvania State University. (2020). Hypothesis testing (P-value Approach). Pennsylvania State Universsity. Accessed on 31/07/2020 at https://online.stat.psu.edu/statprogram/reviews/statistical-concepts/hypothesis-testing/p-value-approach#:~:text=If%20the%20P%2Dvalue%20is%20less%20than%20(or%20equal%20to,null%20hypothesis%20is%20not%20rejected.&text=P%2Dvalue%20to%20.-,If%20the%20P%2Dvalue%20is%20less%20than%20(or%20equal%20to,favor%20of%20the%20alternative%20hypothesis.

Quddus, M.A. (2017). Performance and perceptions of adoption of crossbred cattle by smallholder farmers in Bangladesh. *International Journal of Agricultural Policy and Research,* Vol. 5 (3):63-69, March, 2017. Retrieved 2/3/2019 at https://journalissues.org/wp-content/uploads/2017/03/Quddus1.pdf

Radeny, M., Ogada, M.J., Recha, J.W., Rao, E.J. & Solomon, D. (2019). Uptake and impact of climate-smart agriculture on food security, incomes and assets in East Africa: Findings from Nyando Climate-Smart Villages in Western Kenya. Climate Change, Agriculture and Food Security (CCAFS) Info Note. Accessed on 24/10/20 at http://www.indiaenvironmentportal.org.in/files/file/Nyando%20Impact%20Assessment%20InfoNote.pdf

Ramshaw, A. (2019). The complete guide to acceptable survey response rates. Accessed on 01/08/2020 at https://www.genroe.com/blog/acceptable-survey-response-rate-2/11504

Republic of Kenya, County Government of Garissa. (2018). Garissa County SMART nutrition survey report – July 2018. Accessed on 17/10/20 at http://www.nutritionhealth.or.ke/wp-content/uploads/SMART%20Survey%20Reports/Garissa%20County%20SMART%20Survey%20Report%20%E2%80%93%20July%202018.pdf

Republic of Kenya, Samburu County Government. (2019). Samburu County SMART survey report 2019. County Department of Health. Accessed on 18/10/20 at http://www.nutritionhealth.or.ke/wp-content/uploads/SMART%20Survey%20Reports/Samburu%20County%20SMART%20Survey%20Report%20-%20June%202019.pdf

Republic of Kenya, Wajir County Health Department. (2018). Wajir health and nutritional SMART survey 2018. Accessed on 18/10/20 at http://www.nutritionhealth.or.ke/wp-content/uploads/SMART%20Survey%20Reports/Wajir%20County%20SMART%20Survey%20Report%20%E2%80%93%20August%202018.pdf

Republic of Rwanda, Ministry of Agriculture and Animal Resources. (2015). "One cow per poor family program 'Girinka'. Ministry of Agriculture and Animal Resources, Rwanda. Accessed on 15/1/2020 at http://www.minagri.gov.rw/index.php?id=28

Rindfuss, R.R., Choe, M.K., Tsuya, N.O., Bumpass, L.L. & Tamaki, E. (2015). Do low survey response rates bias results? *Demographic Research*, January – June 2015, Vol. 32 (2015), pp 797-828. Accessed on 01/08/2020 at https://www.jstor.org/stable/pdf/26350132.pdf

Roschinsky, R.; Kluszczynska, M.; Sölkner, J.; Puskur, R. and Wurzinger, M. (2014). Smallholder experiences with dairy cattle crossbreeding in the tropics: From introduction to impact. *Animal* 2014:1-8, The Animal Consortium. Retrieved 12/2/2019 at https://www.cambridge.org/core/journals/animal/article/smallholder-experiences-with-dairy-cattle-crossbreeding-in-the-tropics-from-introduction-to-impact/229823CED2A15E19F44C4090906CBDF5

Rota, A. & Sperandini, S. (2009). Livestock and pastoralists. Rome: International Fund for Agricultural Development. Livestock Thematic Papers Tools for project design. Accessed at www.ifad.org/lrkm/index.htm

Rwanda Governance Board. (2018). Assessing Girinka Programme, 2006 – 2016: Citizen perspectives. Rwanda Governance Board. Accessed on 14/08/2019 at https://www.rgb.rw/fileadmin/user_upload/RGB/Publications/HOME_GROWN_SOLUTIONS/GIRINKA_REPORT_2018.pdf

Sabyrbekov, R. (2019). Income diversification strategies among pastoralists in Central Asia: Findings from Kyrgyzstan. Pastoralism: Research, Policy and Practice, 9:14 (2019). https://DOI.org/10.1186/s13570-019-0152-x

Sadler, K., Kerven, C., Calo, M., Manske, M. and Catley, A. (2010). The fat and the lean: Review of production and use of milk by pastoralists. *Pastoralism*, Vol. 1(2): 292 – 324 July, 2010. Retrieved 01/05/2019 at https://www.researchgate.net/publication/256706270_The_fat_and_the_lean_review_of_production_and_use_of_milk_by_pastoralists

Safari, J.G., Timothy, S.K. & Masanyiwa, Z.S. (2020). Food consumption patterns and predictors of dietary diversity in pastoral communities of Ngorongoro District, Tanzania. *Current Research Journal of Social Sciences,* Vol. 11(1), 2020:1-12. DOI:10.19026/crjss.11.6050. Accessed on 15/10/2020 at https://maxwellsci.com/msproof.php?DOI=crjss.11.6050

Sahel Consulting Agriculture and Nutrition Ltd. (2018). Nutrition assessment of smallholder dairy farmers in Oyo and Kano States. Nigerian Dairy Development Programme (NDDP) – Nutrition Study Report, 2018. Accessed on 12/09/2020 at https://sahelcp.com/wp-content/uploads/2018/10/NDDP-Nutrition-Study-Report.pdf

Salamula, J. B., Egeru, A., Asiimwe, R., Aleper, D. K., Namaalwa, J. J. (2017). Socio-economic determinants of pastoralists' choice of camel production in Karamoja sub-region, Uganda. *Pastoralism: Research, Policy and Practice* 7:26, 2017. Retrieved 23/03/2019 at https://link.springer.com/article/10.1186/s13570-017-0096-y

Saleh, M.K. (2018). Socio-economic characteristics of dairy cattle farmers in northern Nigeria. Journal of Agricultural Extension, Vol. 22, No. 1 (2018), Special Edition on Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria. Accessed on 07/09/2020 at https://www.ajol.info/index.php/jae/article/view/179985

Salem, M.B. and Khemiri H. 2008: The impact of agricultural projects on cows' productivity, farmers' revenue and rural development in Tunisia. *Livestock Research for Rural Development. Volume 20, Article No. 70.* Retrieved March 9, 2019, from http://www.lrrd.org/lrrd20/5/sale20070.htm

Saleh, M.K., Atala, T.K., Omokore, D.F., Ahmed, B., Ali, F.S. & Kajang, G.Y. (2016). Performance of improved dairy cattle technologies among farmers in Northern Nigeria. *Journal of Agricultural Extension,* Vol. 20 (1), June 2016. Accessed on 21/05/2020 at http://www.ajol.info/index.php/jae

Salmon, G., Teufel, N., Batenwek, I., Wijk, M. V., Claessens, L. & Marshall, K. (2018). Trade-offs in livestock development at the farm level: Different actors with different objectives. *Global Food Security,* Vol. 17 (2018), 103-112. Accessed on 26/05/2019 at http://oar.icrisat.org/11006/1/1-s2.0-S2211912417301372-main.pdf

Sansoucy, R.; Jabbar, M.A.; Ehui, S. and Fitzhugh, H. (2014). Keynote: The contribution of livestock to food security and sustainable development. FAO, Rome, Italy – A revised and extended version of "Livestock – a driving force for food security and sustainable development by R. Sansoucy and staff of the Animal Production and Health Division of FAO. In: T.R. Wilson, S. Ehui and S. Mack (Eds.). (1995): Livestock development strategies for low-income countries. Proceedings of the Joint FAO/ILRI Roundtable, ILRI, Addis Ababa, 25 February – 2 March, 1995, FAO, Rome and ILRI, Addis Ababa, Ethiopia, pp 9-22. Retrieved 16/02/2019 at http://www.fao.org/3/v8180t/v8180T07.htm

Schober, P., Boer, C. & Schwarte, L.A. (2018). Correlation coefficients: Appropriate use and interpretation. Journal of Anesthesia & Analgesia, May 2018 - Volume 126 - Issue 5 - p 1763-1768 DOI: 10.1213/ANE.0000000000002864. Accessed 0n 31/07/2020 at https://journals.lww.com/anesthesia-analgesia/fulltext/2018/05000/correlation_coefficients__appropriate_use_and.50.aspx

Scoones, I. (2018a). Pastoralism under pressure in northern Kenya. PASTRES: Pastoralism, Uncertainty, Resilience, November 2, 2018. Accessed on 18/01/2019 at https://pastres.org/2018/11/02/pastoralism-under-pressure-in-northern-kenya/

Scoones, I. (2018b). Negotiating uncertainties on the Tibetan Plateau in China. PASTRES: Pastoralism, Uncertainty, Resilience, November 30, 2018. Accessed on 18/01/2019 at https://pastres.org/2018/11/30/negotiating-uncertainties-on-the-tibetan-plateau-in-china/

Serrat, O. (2017). The sustainable livelihoods approach. In: Knowledge Solutions. Springer, Singapore. https://doi.org/10.1007/978-981-10-0983-9_5

Shikuku, K.M., Valdivia, R.O., Paul, B.K., Mwongera, C., Winowiecki, L., Laderach, P., Herero, M. & Silvestri, S. (2017). Prioritizing climate-smart livestock technologies in rural Tanzania: A minimum data approach. Agricultural Systems, Vol. 151, February 2017, pp 204-216. Accessed on 19/09/2020 at https://www.sciencedirect.com/science/article/pii/S0308521X16302189

Shuani, M. (2021). Family life cycle: 3 Main Stages. YourArticleLibrary. Retrieved on 18/05/2021 at https://www.yourarticlelibrary.com/family/family-life-cycle-3-main-stages/47660

Simenew, K., Dejen, T., Tesfaye, S., Fekadu, R., Tesfu, K. and Fufa, D. (2013). Characterization of Camel Production System in Afar Pastoralists, North-East Ethiopia. *Asian Journal of Agricultural Sciences* 5(2): 16-24, 2013. Retrieved 20/01/2017 at http://maxwellsci.com/print/ajas/v5-16-24.pdf

Singh, C. V. (2016). Crossbreeding in cattle for milk production: Achievements, challenges and opportunities in India – A review. Advances in Dairy Research, vol. 4 (3), 1- 14. DOI: 10:4172/2329-888x.1000158.

Sitati, N. W. & Ipara, H. (2012). Indigenous Ecological Knowledge of a Human-Elephant Interaction in Transmara District, Kenya: Implications for Research and Management. *Advances in Anthropology*, Vol.2 No.3, August 2012. DOI: 10.4236/aa.2012.23012. Retrieved from https://www.scirp.org/journal/paperinformation.aspx?paperid=21728 on 13/03/2022

Struelens, Q., Pomar, K. G., Herrera, S. L., Huanca, G. N., Dangles O., and Rebaudo, F. (2017) Market access and community size influence pastoral management of native and exotic livestock species: A case study in communities of the Cordillera Real in Bolivia's high Andean wetlands. PLoS ONE 12(12): e0189409. Retrieved 30/03/2019 at https://DOI.org/10.1371/journal.pone.0189409

Tamou, C., Ripoll-Bosch, R., de Boer, I., & Oosting, S. J. (2018). Pastoralists in a changing environment: The competition for grazing land in and around the W Biosphere Reserve, Benin Republic. *Ambio*, *47*(3), 340–354. https://doi.org/10.1007/s13280-017-0942-6

Tefera, W., Brhanie, T.W. & Dereje, M. (2020). Dietary diversity practices and associated factors among pregnant women attending ANC in Kolfe Keranyo Sub-city health centres, Addis Ababa, Ethiopia. MedRxiv preprint DOI: https://DOI.org/10.1101/220.04.27.20081596. Accessed on 20/10/20 at https://www.medrxiv.org/content/10.1101/2020.04.27.20081596v1.full.pdf

Teri, B. (2004). Appendix B. Random number tables. Reproduced from *Million Random Digits,* used with permission of the Rand Corporation, Copyright, 1955, The Free Press. Retrieved from https://www.nist.gov/system/files/documents/2017/04/28/AppenB-HB133-05-Z.pdf. Accessed on 22/04/2019.

Thornton, P.K. (2010). Livestock production: Recent trends, future prospects. *Philosophical Transactions of the Royal Society,* Vol. 365(2853):28-67. Retrieved 22/2/2019 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2935116/

Traore, S.A., Reiber, C., Megersa, B. & Zarate, A.V. (2018). Contribution of cattle of different breeds to household food security in southern Mali. Food Security 10, 549 – 560 (2018). Retrieved on 16/09/2020 at https://link.springer.com/article/10.1007/s12571-018-0795-2?shared-article-renderer

Traore, S.A., Reiber, C. & Zarate, A.V. (2018). Productive and economic performance of endemic N'dama cattle in southern Mali compared to Fulani Zebu and their crossbreds. *Livestock Science,* Vol. 2009, March 2018, pages 77 – 85. Accessed on 14/10/2020 at https://www.sciencedirect.com/science/article/abs/pii/S1871141318300209

Udovičić, M., Baždarić, K., Bilić-Zulle, L. & Petrovečki, M. (2007). What we need to know when calculating the coefficient of correlation?. *Biochem Med (Zagreb).* 2007;17:10-15. Accessed on 12/03/2022 at https://www.biochemia-medica.com/en/journal/17/1/10.11613/BM.2007.002/fullArticle

United Nations Development Programme. (2017). Nationally Appropriate Mitigation Action on climate-smart dairy livestock value chains in Uganda. UNDP, New York. Retrieved at https://www.undp.org/publications/nama-climate-smart-dairy-livestock-value-chains-uganda#modal-publication-download

UNECA (United Nations Economic Commission for Africa). (2016). Expert group meeting on New Fringe Pastoralism (NFP) development, conflict and insecurity in the horn of Africa and the Sahel 25-27 August, 2016. http://databank.worldbank.org/data/databases.aspx/

Urmale, D., Alemayehu, A. & Woldesemayat, E.M. (2020). Household dietary diversity and associated factors in Konso, South Ethiopia. *Diversity and Equality in Health Care,* (2020). Accessed on 20/10/20 at https://diversityhealthcare.imedpub.com/households-dietary-diversity-and-associated-factors-in-konso-south-ethiopia.php?aid=28635

Wamahiu, M. (2018). Achieving food and nutrition security among pastoral and agro-pastoral communities in Kenya – A gendered perspective. A presentation of a webinar held on 30th January 2018 jointly organised by Agriculture, Nutrition and Health Academy and African Nutrition Society. Accessed on 12/09/2020 at https://immana.lcirah.ac.uk/sites/default/files/Achieving%20food%20security%20for%20pastoral%20and%20agro-pastroral%20communities.pdf

Wangchuk, K.; Wurzinger, M.; Darabant, A; Gratzer, G. and Zollitsch, W. (2014). The changing face of cattle raising and forest grazing in Bhutan Himalaya. *Mountain Research and Development,* Vol. 34(2): 131 – 138, May, 2014. International Mountain Society. Retrieved 24/2/2019 at https://bioone.org/journals/mountain-research-and-development/volume-34/issue-2/MRD-JOURNAL-D-13-00021.1/The-Changing-Face-of-Cattle-Raising-and-Forest-Grazing-in/10.1659/MRD-JOURNAL-D-13-00021.1.full

Weaver, J.; Mwasi, A. and Weaver, L. (2015). Improved dairy cattle: Impact and distribution in rural Tanzanian communities. *Interdisciplinary Journal of Best Practices in Global Development,* Vol.1(1), 2015 Retrieved 24/1/2019 at https://knowledge.e.southern.edu/ijbpgd/vol1/iss1/1/

Widiati, R.; Nurtini, S.; Kusumastuti, T.A. & Syahlani, S.P. (2019). Performance and economic incentives of cow-calf operation crossbred in smallholder cattle in Yogyakarta – Indonesia. International Journal of Business Society, vol. 20 No. 1, 2019, 417 – 431

Widi, T.S.M., Udo, H.M.J., Oldenbroek, K., Budisatria, E., Baliarti, E. & van den Zijpp, A.J. (2015). Is crossbreeding of cattle beneficial to mixed farming systems in Central Java? *Animal Genetic Resources*, 2015, 56. Food and Agriculture of the United Nations, 2015. Accessed on 25/1/2019 at https://www.fao.org/3/i4736t/i4736t.pdf.

Widyobroto, B.P., Rochijan, C., Noviandi, T. & Astiti, A. (2017). Dairy cows productivity and socio-economic profile of dairy smallholder's communities in Yogyakarta, Indonesia. IOP Conference Series: Earth and Environmental Science 119 (2018) 0120060. DOI: 10.1088/1755-1315/119/1/012060

Wisdom, J. & Creswell, J.W (2013). Mixed Methods: Integrating quantitative and qualitative data collection and analysis while studying patient-centred medical home models. Rockville, MD: Agency for Healthcare Research and Quality. February 2013. AHRQ Publication No. 13-0028-EF. Accessed on 26/06/2021 at https://pcmh.ahrq.gov/sites/default/files/attachments/MixedMethods_032513comp.pdf

Woolcock, M. (1999). The place of social capital in understanding social and economic outcomes. Accessed on 07/06/2018 at https://www.oecd.org/innovation/research/1824913.pdf

Workicho, A., Belachew, T., Feyissa, G.T., Wondafrash, B., Lachat, C., Verstreten, R. & Kolsteren, P. (2016). Household dietary diversity and animal source food consumption in Ethiopia: Evidence from the 2011 welfare monitoring survey. *BMC Public Health,* 16, Article number: 1192(2016). DOI 10.1186/s12889-016-3861-8. Accessed on 16/10/20 at https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-016-3861-8

World Bank. 2000. World Development Report 2000/2001: Attacking Poverty. New York: Oxford University Press. Accessed on 07/06/2018 at https://openknowledge.worldbank.org/handle/10986/11856

Yahaya, I., Zereyesus, Y.A., Nakelse, T. & Haruna, B. (2019). Complementarity of technology adoption and social capital participation: The case of systems of rice intensification in Ghana. *Journal of International Development,* Volume 31, pp 601-616, 2019. DOI: 10.1002/jid.3420. Accessed on 25/10/20 at https://onlinelibrary.wiley.com/DOI/full/10.1002/jid.3420

Yamane, Taro. (1967). Statistics: An Introductory Analysis, 2nd Ed., New York: Harper and Row. Accessed on 12/09/2019 at https://www.scribd.com/doc/212344776/Taro-Yamane

Yasmeen, Patil, S.S., Joshi, A.T., Hiremath, G.M., Koppalkar, B.G. & Ram, J. (2019). An economic analysis of the share and importance of livestock in the household economy of the farmers. *Journal of Applied Science and Technology,* Vol. 34 (4), pages 1-9, 2019. Article No. CJASC: 52610. DOI: 10.9734/CJAST/2019/v38:430377. Accessed on 14/10/2020 at https://www.journalcjast.com/index.php/CJAST/article/view/30377

Zang, S., Sun, Z., Ma, W. & Valentinov, V. (2020). The effect of cooperative membership on agricultural technology adoption in Sichuan, China. *China Economic Review,* Volume 62, August 2020, 101334. https://DOI.org/10.1016/j.chieco.2019.101334. Accessed on 25/10/20.

# Appendix I: Location of the study site in Kenya
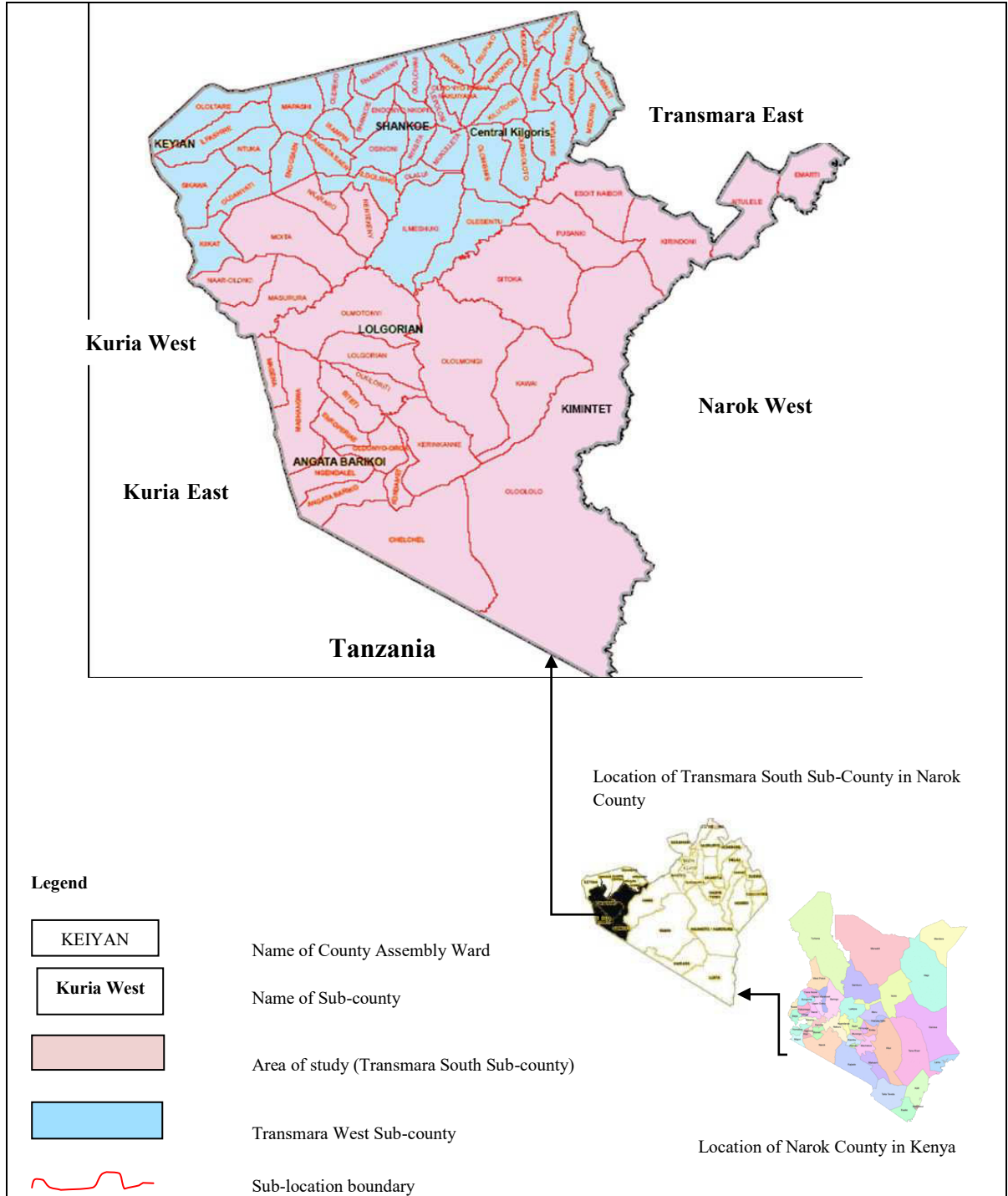


Source: Adapted from Google

# Appendix II: Household Questionnaire

*Questionnaire for the study title: Livestock improvement and pastoralists livelihood outcomes: A study of Sahiwal cattle adoption among Isiria Maasai of Kenya*

**Introduction**

I am Saranta Moses Kipainoi, a student at Rongo University (PSOC/9304/2014). I am undertaking academic research on the **"Livestock improvement and pastoralists livelihood outcomes: A study of Sahiwal cattle adoption among Isiria Maasai of Kenya."**I have randomly selected you to be part of this study and now request that you become my respondent. The purpose of the study is purely academic. I am ready to clarify any issue concerning this study. You can contact me on 0733241572/0722904211. If you agree to participate, kindly indicate this willingness by signing the **Certificate of Consent** below.

Thank you.

Saranta Moses Kipainoi

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**Certificate of Consent**

**I have been fully informed about all aspects of this study. I have had the opportunity to ask questions about it, and all have been answered to my satisfaction. Therefore, I voluntarily consent to participate in this study.**

**Name of Participant** _____

**Signature of Participant** _____

**Date** _____

---

Telephone contact of respondent (optional)

_____

Name of RA (distributing/ collecting/filling the questionnaire) _____

**Instructions: Tick or fill as appropriate**

## 1.0 ADMINISTRATIVE INFORMATION

1.1　　In which sub-county is the household located?　　_____

1.2　　In which Division is the household located?　_____

1.3　　In which location is the homestead found?　　_____

1.4　　In which sub-location is the homestead found?　　_____

1.5　　In which neighbourhood/village is the homestead located?　_____

## 2.0 DEMOGRAPHIC DATA

2.1　　Date of birth　　_____

2.2　　Sex　　　　　　　Male ☐　　　　　　Female ☐

2.3　　Marital status　　　Never Married ☐　　Married ☐　　　　Widowed ☐

　　　　　　　　　　　Separated 　☐　　Other (specify)_____

2.5　　Type of marriage　　Monogamous ☐　　　　Polygamous ☐

2.6　　Level of educational attainment　　　　None ☐　　Some Primary ☐

　　　　Primary　　☐　　Some Secondary ☐　Secondary ☐ Tertiary ☐

## 3.0 HOUSEHOLD CHARACTERISTICS

3.1　　Fill out details of household members in the table provided below

| Member's first name | Age in years | Gender | | Relationship to respondent |
|---|---|---|---|---|
| | | F | M | |
| | | | | |
| | | | | |
| | | | | |

Education:　Fill in the table below

| | 3.2.1 | 3.2.2 | 3.2.3 | 3.2.4 |
|---|---|---|---|---|
| Member's first name | School attendance | Public or private | Why not attending public/private/both | Level of Education |
| | [1]Yes [2] No (go to 3.2.3) | [1] Public [2] private | [1] Too costly [2] Needs to work [3] Distance [4] Low quality of education [5] Other (specify) | [1] Some primary [2] Primary [3] Some Secondary [4] Secondary [5] Tertiary |
| | | | | |

3.3　　Do you rear Sahiwal cattle?　　　　Yes ☐　　　　　　No ☐

3.3.1　If yes, for *how man*y years have been raising them?

Below 3 years ☐    3 – 6 years ☐  7 – 9 years ☐    10 years and above ☐

3.3.2  Have you ever raised Zebu cattle?    Yes    ☐    No ☐ (Go to 3.3.4)

3.3.3  Which benefits have Sahiwal cattle given you that Zebu did not give you? (*Tick as many as apply*).

| Benefit | Tick |
|---|---|
| More milk | |
| More money when sold | |
| When slaughtered more meat as they are big | |
| Enhanced my social standing in the community | |
| Other (Specify)_____ | |
| Other (Specify)_____ | |

## 4.0    HOUSEHOLD INCOME

4.1    Household income sources

In the table below, indicate the income sources that apply to this household by placing a tick (√) in column two. (*Tick as many as apply*)

| | Source of income | Whether it applies to the HH | Monthly Amount |
|---|---|---|---|
| 01 | Livestock production | | |
| 02 | Crop farming | | |
| 03 | Employment | | |
| 04 | Remittances | | |
| 05 | Gifts | | |
| 06 | Business (specify)_____ | | |
| 07 | Leasing out land | | |
| 08 | Sale of Timber products | | |
| 09 | Sale of sand | | |
| 10 | Mining | | |
| 11 | Pension | | |
| 12 | Social Protection Programme | | |
| 13 | Craft (specify)_____ | | |
| | | | |
| | | | |
| | | | |

4.2    If your household receives income from livestock, kindly rank the livestock types according to importance (1 being most important, 2 second most important etc.)

|   | Livestock type | Whether it applies to the HH | Rank |
|---|---|---|---|
| 1 | Cattle | | |
| 2 | Goats | | |
| 3 | Sheep | | |
| 4 | Poultry | | |
| 5 | Bee Keeping | | |
| 6 | Other (specify)_____ | | |
| | | | |
| | | | |

4.3 If your household obtains income from cattle, indicate by placing a tick (√) in column three the mechanism that is relevant to this household.

|   | Mechanism of obtaining income from livestock | Whether it applies to the HH | Monthly amount |
|---|---|---|---|
| 1 | Sale of live animals | | |
| 2 | Sale of breeding stock | | |
| 3 | Sale of milk | | |
| 4 | Sale of milk products (specify) | | |
| 5 | Hire of animal draught power | | |
| 6 | Other (specify)_____ | | |
| 7 | Other (specify)_____ | | |
| | | | |
| | | | |
| | | | |

4.4. For the sale of live animals, how many live animals did you sell since January 2019? __

4.4.1 What cattle breed did you sell? Sahiwal ☐   Number ___ Zebu ☐ Number ___

4.4.2 What was the average cost of one live animal of Sahiwal cattle in Kenya Shillings?

4.4.3 What was the average cost of one live animal of Zebu cattle in Kenya Shillings? ___

4.5.0 If your household sold breeding stock, how many did you sell since January 2019?

4.5.1 What was the cost of one breeding stock animal in Kenya Shillings? _____

4.6.0 If your household sells milk, on average, how many bottles do you sell per day during:

A. The rainy season? _____ B. The dry season? _____

4.6.1 What is the cost of milk per bottle during: Rainy season? _____ Dry season? ____

4.7.0 If your household sold milk products, what quantity did you sell since January 2019? _____

4.7.1 What was the cost per unit measurement? _____

4.8.0 If your household hire out draught animals, how many times did you hire out since January 2019? _____

4.8.1 What was the cost of hiring out per day? _____

## 5.0 HOUSEHOLD FOOD SECURITY

5.1 Over the last seven days, how many days did members of your household eat the following food items prepared and/or consumed at home?

| | Food Group | Type | Consumption Pattern |
|---|---|---|---|
| | | | Number of days consumed in the past seven days |
| 5.1.1 | Cereals, grains, roots & tubers | Rice | |
| | | Bread | |
| | | Potato | |
| | | Sweet Potato | |
| | | Cassava | |
| | | Arrowroot ("Nduma") | |
| | | Maize meal "Ugali" | |
| | | Millet meal "Ugali" | |
| | | Porridge (maize/millet/sorghum flour) | |
| | | Other (Specify) _____ | |
| 5.1.2 | Vegetables & Leaves | Kales | |
| | | Cabbage | |
| | | Spinach | |
| | | Spider plant (Saget) | |
| | | *Bassella alba* "Osuyai." | |
| | | African Nightshade ("Managu") | |
| | | Cowpeas leave ("Kunde") | |
| | | Pumpkin leaves | |
| | | Other vegetables/Leaves | |
| 5.1.3 | Fruits | Orange | |
| | | Mango | |
| | | Banana | |
| | | Pineapple | |
| | | Avocado | |

| 5.1.4 | Egg, Fish & Meat | Eggs | |
| | | Fish | |
| | | Mutton | |
| | | Chicken | |
| | | Chevon (adult goat meat) | |
| | | Pork | |
| | | Beef | |
| 5.1.5 | Pulses, Nuts & Seeds | Beans | |
| | | Peas (minji) | |
| | | Green grams | |
| | | Sesame | |
| | | Groundnuts | |
| | | Others (Specify)_____ | |
| 5.1.6 | Milk & Dairy products | Fresh milk | |
| | | Sour milk | |
| | | Others (Specify)_____ | |
| 5.1.7 | Oil and Fat | Vegetable oil | |
| | | Butter | |
| | | Margarine | |
| | | Animal fat | |
| | | Sheep fat | |
| | | Others (Specify)___ | |
| 5.1.8 | Sugar and Sweets | Honey | |
| | | Cakes | |
| | | Soda | |
| | | Afia | |
| | | Juice | |
| | | Sugar cane | |
| 5.1.9 | Condiments and Spices | Tea | |
| | | Garlic | |
| | | Tomatoes | |
| | | Pepper | |
| | | Ginger | |
| | | Capsicum ("Pilipili hoho") | |
| | | Onions | |
| | | Others (Specify)_____ | |
| | | | |

## 6.0    HOUSEHOLD SOCIAL CAPITAL MODULE

Membership to groups

6.1    Do you belong to any group?          ☐ Yes          ☐ No (Skip to 6.5)

6.1.1   If yes, which ones? *(Tick those that apply)*

| | Type of group | Tick | | | Type of group | Tick |
|---|---|---|---|---|---|---|
| 1 | Merry-go-round | | | 7 | Political Party | |
| 2 | School Committee | | | 8 | Neighbourhood Committee | |
| 3 | Age Group Committee | | | 9 | Cooperative Society | |
| 4 | Project Committee | | | 10 | Land Committee | |
| 5 | Bursary Committee | | | 11 | Peace Committee | |
| 6 | Church Committee | | | 12 | Other (Specify)_____ | |

6.2   How actively are you involved in the decision-making process of your group, organization or association?

Leader ☐   Committee member ☐   Member ☐ Not involved ☐

6.3   Since January 2019, how many times have you participated in this group's activities, e.g. by attending meetings or doing group work etc.?

Less than 5 ☐ 5 – 9 times ☐   11 – 14 times ☐   Over 15 times ☐

6.4   What benefits do you or other members of your household get from these Groups*? (Tick as many as apply)*

Improves my household's current livelihood or access to services ☐
Important in times of emergency/in future ☐
Benefits the community ☐
Enjoyment/Recreation ☐
Spiritual, social status, self-esteem ☐
Other (specify) _____

6.5   How many close friends do you have, i.e. those that you can freely talk about private matters?

Up to 5 ☐   6-10 ☐   11-15 ☐   16 and above ☐

6.6   If you needed a small amount of money, e.g. KES 1,000/=, how many persons beyond your immediate household could you turn to, and who would be willing to give you this money?

Less than 3 ☐   3 - 5 ☐   5 - 10 ☐   Over 10 ☐

6.7   If you suddenly face a long-term emergency, e.g. all your cattle are stolen, how many people could you turn to, and who could be willing to assist you?

Up to 5 ☐   6-10 ☐   11-15 ☐   16 and above ☐

Solidarity and trust

6.8 In general, do you agree or disagree with the following statements? Use the following as a key and tick the box relevant to your opinion.

[1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree]

| Statements | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Most people in this neighbourhood can be trusted | | | | | |
| In this neighbourhood, one has to be alert, or else someone will take advantage of you | | | | | |
| Most people in this neighbourhood are willing to help if you need it | | | | | |
| In this neighbourhood, people generally do not trust each other in lending or borrowing money | | | | | |

6.9 Indicate your level of trust to the following categories of people.

Tick the relevant boxes where: [1 – Not at all; 2 – Slightly; 3 – Neither trust nor distrust them; 4 – I trust them; 5 – I trust them to a great extent]

| Statements | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Veterinary officers | | | | | |
| Own age-group | | | | | |
| Other age groups | | | | | |
| Livestock traders | | | | | |
| Police | | | | | |
| County Government Officials | | | | | |
| Central Government Officials | | | | | |
| Spiritual leader | | | | | |
| Your workers | | | | | |
| Other ethnic groups | | | | | |
| Your Maasai section e.g. Isiria | | | | | |
| Other Isiria Sub-sections, i.e. "*Nkutot*" | | | | | |
| Other Maasai sections e.g. Ilmoitanik, Ilpurko, Ilwuasin-Gishu | | | | | |

6.10 How often do you help other people? Use the following key to tick the relevant box.

[1 - Always; 2 - Most of the time; 3 - Sometimes; 4 - Rarely; 5 – Never]

| Statements | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Siblings | | | | | |
| Clan | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Age group member | | | | | |
| Members of other age groups | | | | | |
| Your Maasai section e.g. Isiria | | | | | |
| Other Isiria Sub-sections i.e. "*Nkutot*"e.g. *Ilkunono, Ilaiser etc.* | | | | | |
| Other Maasai sections e.g. Ilmoitanik, Ilpurko, Ilwuasingishu | | | | | |
| Other ethnic groups (Kisii, Kuria, Kikuyu, Luo etc.) | | | | | |

6.11   If a community project that does not benefit you but others in your neighbourhood is initiated, would you contribute your time and money?

| Contribution | 1 Yes | 2 No |
|---|---|---|
| Time | | |
| Money | | |

Information and communication

6.12   How often do you listen to the radio?

Every day ☐   Several times a week☐       Once a week ☐       Never ☐

6.13   How often do you watch television?

Every day ☐   Several times a week ☐       Once a week ☐       Never ☐

6.14   What are your three most important sources of information about what the government is doing?

| | Source of Information | Tick the ones that apply | Rank |
|---|---|---|---|
| 1 | Relatives, friends and neighbours | | |
| 2 | Local market | | |
| 3 | Radio | | |
| 4 | Newspaper | | |
| 5 | Television | | |
| 6 | Groups, associations | | |
| 7 | Business or work associates | | |
| 8 | Political associates | | |
| 9 | Community leaders | | |
| 10 | Government Agents | | |
| 11 | Internet | | |
| 12 | NGOs | | |
| 13 | Other (Specify) _____ | | |

6.15   What are your three most important sources of information about the market prices of cattle and milk?

| | Source of Information | Cattle | Rank | Milk | Rank |
|---|---|---|---|---|---|
| 1 | Relatives, friends and neighbours | | | | |
| 2 | Local market | | | | |
| 3 | Radio | | | | |
| 4 | Newspaper | | | | |
| 5 | Television | | | | |
| 6 | Groups, associations | | | | |
| 7 | Business or work associates | | | | |
| 8 | Political associates | | | | |
| 9 | Community leaders | | | | |
| 10 | Government Agents | | | | |
| 11 | Internet | | | | |
| 12 | NGOs | | | | |
| 13 | Other (Specify) _____ | | | | |

6.16    In the past 12 months, how many times have you visited other neighbourhoods, local market centres, towns and major urban centres? Use the following codes to indicate the response relevant to you: [1 - Always; 2 - Most of the time; 3 - Sometimes; 4 - Rarely; 5 – Never]

| | Place | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| A | Neighbourhoods | | | | | |
| B | Local market centre | | | | | |
| C | Towns | | | | | |
| D | Major urban centres | | | | | |
| E | County Headquarters | | | | | |
| F | Nairobi | | | | | |

Sociability

6.17    In the past one week, how many times have you met with other people in a public place to either talk, have a meal or drink? _____

6.18    In the past one week, how many people have visited you in your home? _____

6.19    In the past one week, how many times have you visited other people in their homes? _____

6.20 In the past 12 months, how many times have you participated in a family, clan, neighbourhood festival or ceremony e.g. wedding, funeral, religious festival?

_____

Safety

6.21 Have you lost any property to thieves in the past 12 months?   Yes ☐   No ☐

If yes, how many times? _____

Empowerment and Political action

6.22 How much control do you feel you have over decisions that affect your daily activities?

No control ☐   Some control ☐   Most control ☐   Total Control ☐

6.23 In the past 12 months, have you done any of the following?

|   | Activity | Yes | No |
|---|---|---|---|
| A | Attend a neighbourhood meeting, hearing or public discussion? | | |
| B | Met with, called or written a letter to a politician? | | |
| C | Participated in a protest or demonstration? | | |
| D | Participated in an election of information campaign? | | |
| E | Alerted a newspaper, radio or TV station about a local problem? | | |
| F | Notified police or other law enforcement agencies about a local problem? | | |

6.24 Did you vote in the last general election?   Yes ☐   No ☐

6.25 What influence do your opinions have on decisions made by local leaders or government officials?

None at all ☐   A little ☐   A lot ☐

# Appendix III: Focus Group Discussion Guide

**Topic:**      **Livestock improvement and pastoralists livelihood outcomes: A study of Sahiwal cattle adoption among Isiria Maasai of Kenya**

*Date* _____      *Name of Facilitator*      _____

*Venue of Interview* _____      *Name of Recorder*      _____

Number of participants      _____      (See attached list of participants)

1. In your opinion, to what extent have the Maasai adopted Sahiwal cattle? What has been the effect of *adopting* Sahiwal cattle on the household:
   a) Food security?
   b) Income?
   c) Social capital of Isiria Maasai households?
2. In your opinion, how has the adoption of improved breeds affected livelihoods?
3. In this area, how many months in a year would you consider to be (i) dry and (ii) wet?
4. In terms of milk production, on average, how much milk does a Sahiwal and zebu cow produce both in the wet and dry season?
5. What is the average sale price of a zebu and Sahiwal heifer, bullock, lactating cow, mature bull?
6. What is the cost of milk per bottle during the rainy and dry seasons?
7. In general, which age group(s) has adopted Sahiwal cattle the most?
8. What are the age ranges in years for the following age groups: Ilnyangusi, Isieuri, Ilkitoip, Ilkisaruni, Iromboi, Ilkaraantura, Others?
9. For how many years have Isiria Maasai been rearing Sahiwal cattle?
10. Which benefits do Sahiwal cattle have over Zebu cattle and vice versa?
11. In what ways have Sahiwal cattle increased income in your household?

12. For households that have used Sahiwal cattle for draught power, how has been their performance in terms of strength and length of working time per day? Week? Month?

13. In what specific ways has the rearing of Sahiwal cattle improved the sociability of your household, i.e. helping others, membership to groups, decision-making participation in community meetings, friendship, social standing in the community, leadership election participation, opinion-shaping in the community?

List of participants:

|    | Name of Participant | Age group | Male | Female | Sign |
|----|---------------------|-----------|------|--------|------|
| 1  |                     |           |      |        |      |
| 2  |                     |           |      |        |      |
| 3  |                     |           |      |        |      |
| 4  |                     |           |      |        |      |
| 5  |                     |           |      |        |      |
| 6  |                     |           |      |        |      |
| 7  |                     |           |      |        |      |
| 8  |                     |           |      |        |      |
| 9  |                     |           |      |        |      |
| 10 |                     |           |      |        |      |
| 11 |                     |           |      |        |      |
| 12 |                     |           |      |        |      |
| 13 |                     |           |      |        |      |
| 14 |                     |           |      |        |      |
| 15 |                     |           |      |        |      |

# Appendix IV: Key Informant Interview Guide

**For a study on:** "*Livestock improvement and pastoralists livelihood outcomes: A study of Sahiwal cattle adoption among Isiria Maasai of Kenya.*"

Date of Interview _____ Name of Interviewer _____

Venue of Interview _____ Key Informant Identifier Code _____

Age group of Key Informant _____ Sex of Key Informant: Female ☐ Male ☐

1. What are the expected benefits of adopting Sahiwal cattle?

2. To what extent have the expected benefits been realized?

3. Compare households that have adopted Sahiwal and those that have not.

4. When did Isiria Maasai start to rear Sahiwal cattle?

5. In the given climatic and cattle husbandry practices of Isiria Maasai, what is the approximate highest and lowest milk production capacities of (i) Sahiwal cows (dry and wet season); (ii) Zebu cattle (dry and wet season)

6. With the prevailing cattle husbandry practices of Isiria Maasai, how long can it take a female Sahiwal cow from birth to being served by a bull and to calving down?

7. What are the general sale prices in KES for the following categories of Sahiwal cattle:
   a) Weaned heifer
   b) Weaned bullock
   c) Lactating cow
   d) Bullock ready to serve
   e) Heifer ready to be served
   f) Mature bull

8. What category or category (ies) of cattle does Isiria Maasai prefer to sell?  Why?

9. How often does Isiria Maasai sell the category (ies) of Sahiwal cattle you have mentioned?

10 What is your opinion regarding the stage at which Isiria Maasai are in terms of adopting Sahiwal animals? All have adopted, three quarters have adopted, half of all households have adopted, a quarter of all households have adopted.

11. In what specific ways have the adoption of Sahiwal cattle Isiria Maasai households'
    a) Food security
    b) Income
    c) Social capital, i.e. helping others, membership to groups, decision-making participation in community meetings, friendship, social standing in the community, leadership election participation, opinion-shaping in the community, women empowerment

11. Characterize the adoption of Isiria Maasai in terms of age groups, regions (divisions, location etc.).

12. What are the major sale points of milk, live animals among Isiria Maasai?

13. What are the most common challenges encountered by Isiria Maasai in raising Sahiwal cattle? How can these challenges be remedied?

# Appendix V: Observation Checklist

*Note:*   *To be filled when submitting and collecting filled questionnaires from sampled households or when filling for sampled households unable to fill the questionnaire.*

Topic:       **Livestock improvement and pastoralists livelihood outcomes: A study of Sahiwal cattle adoption among Isiria Maasai of Kenya**

Date(s) _____   Name of RA  _____

Filled when:   Submitting questionnaire   ☐         Tel.:_____

Collecting questionnaire     ☐

Filling in the questionnaire ☐

## 1.0 Evidence of cattle production in the household

1.1 Is there a cattle kraal or any other enclosure for cattle?        Yes      ☐      No      ☐

1.2 Is there a calves' shed, i.e. an enclosure where calves rest during the day and/or night?
☐Yes        ☐  No

1.3 Have you seen the household herd of cattle?  Yes        ☐No     (Go ☐1.4.2)

1.4 If yes, what is the breed of cattle?

Sahiwal only ☐         Zebu Only ☐         Mixture of Sahiwal and Zebu   ☐

1.5 If the household cattle herd is mixed, which cattle breed is more than the other?
Sahiwal ☐     Zebu ☐       They are equal in proportion  ☐

1.6 Have you seen young calves that normally remain at home?  Yes        ☐      No ☐

1.7 If yes, what is the breed of the calves?

Sahiwal only ☐         Zebu Only☐    Mixture of Sahiwal and Zebu ☐

## 2.0     Household Living conditions

2.1     What is the type of roof for the main living house? Iron sheets ☐ Grass  ☐

2.2     What material(s) are the walls of the main living house made of?

Bricks/Quarry stones/Cement Blocks ☐       Mud alone ☐

Mud but plastered with cement ☐     Wood   ☐      Iron Sheets  ☐

2.3     What material is the floor of the main house made of?

Earth ☐         Cement ☐         Wood   ☐      Tiles ☐

2.4       Is the homestead connected to grid electricity?    Yes ☐        No ☐  (Go to 2.5)

2.5       Were any solar panels seen, e.g. on roofs, Mkopa-Solar etc.?  Yes ☐    No ☐

2.6       What is the type of furniture in the living room?

None   ☐      Ordinary plain chairs & tables  ☐

Sofa sets & polished coffee tables  ☐

2.7       What is the general health condition of household members you met when submitting, collecting, or filling the questionnaire?

               Good     ☐      Fair   ☐    Poor   ☐

2.8       Is there a cat or dog in the homestead?   Yes ☐      No ☐ (Go to 2.9)

2.9       What is the health condition of the cat/dog?

               Very good ☐      Good ☐     Poor ☐     Very poor ☐

2.10     Which of the following items exist seen in the homestead?     Oxen yokes & chains  ☐

Tractor     ☐ Vehicle ☐    Motorcycle ☐     TV ☐       Radio ☐

Toilet     ☐   Food left-over ☐    Bicycle ☐    Hand-sprayer for dip spraying ☐

## 3.0     Household social capital

3.1       Did you see any visitors in the homestead?     Yes ☐      No ☐

3.1       Is there a fence around the homestead?      Yes ☐      No ☐

3.2       If yes, how strong is the fence?      Very strong  ☐

                                          Strong        ☐

                                          Weak         ☐

                                          Very weak  ☐

3.3       Are there any posters for election in the main living house walls (including pictures of candidates for various elective seats in the previous election) and/or health campaigns?

               Yes ☐      No ☐

# Appendix VI: Test-retest reliability coefficient values

The values vary between 0 and 1 where:

| | |
|---|---|
| 1 | is perfect reliability |
| $\geq 0.9$ | is excellent reliability |
| $\geq 0.8 < 0.9$ | is good reliability |
| $\geq 0.7 < 0.8$ | is acceptable reliability |
| $\geq 0.6 < 0.7$ | is questionable reliability |
| $\geq 0.5 < 0.6$ | is poor reliability |
| $\geq 0.4 < 0.5$ | is poor reliability |
| $< 0.5$ | is unacceptable reliability |
| 0 | means there is no reliability |

Source: https://www.statisticshowto.datasciencecentral.com/test-retest-reliability/

# Appendix VII: Research Assistant Brief

**Information to Consider Before Taking Part in this Research Study**

**Title:** Livestock improvement and pastoralists livelihood outcomes: A study of Sahiwal cattle adoption among Isiria Maasai of Kenya

**Overview:** Respondents are asked to take part in a research study. The information in this document should help them decide if they would like to participate. The sections in this Overview provide the basic and essential information about the study.

**Study Staff**: This study is being undertaken by **Saranta Moses Kipainoi,** a student of Rongo University with the registration number **PSOC/9304/2014**. He is being guided in this study by **Professor Wilson A. P. Otengah** and **Dr Daniel Muia**. In the field, Moses will have Research Assistants having introductory letters for this purpose and copies of research permits from the National Commission of Science, Technology and Innovation (NACOSTI).

**Study Details**: This study is being conducted at Trans-Mara South Sub-county. The study aims to determine the association between adopting Sahiwal cattle and household livelihood outcomes of income, food security and social capital.

**Participants**: The participant is asked to participate because he/she is practising cattle production in the Trans-Mara South Sub-county. The GTZ -Trans-Mara Development Programme promoted Sahiwal bulls, and thus, you will help the student understand the effects of Sahiwal cattle on the lives of cattle producers.

**Voluntary Participation**: Participation in the study is voluntary. You do not have to participate and may stop your participation at any time. There will be no penalties or loss of benefits or opportunities if you do not participate or decide to stop once you start. Alternatives to participating in the study include filling a study questionnaire submitted to you by a Research Assistant. If you cannot read and

write or understand the items in the questionnaire, a Research Assistant will ask you the questions and write your responses in the spaces provided in the questionnaire.

Your decision to participate or not to participate will not affect you or your household members in any way now or even in future

**Benefits, Compensation, and Risk**:  You will not directly benefit from the results of this academic study, but the information you will offer may influence the way future projects on cattle will be implemented.  You will not incur any cost for participating. Finally, this study will not introduce any risk to your life.

**Confidentiality**:  Even if we publish the findings from this study, we will keep your study information private and confidential. Anyone with the authority to look at your records must keep them secret.  We will do our best to keep your records personal and confidential by removing any identifiers that may link your name with the responses in the questionnaires, and it is unlikely that unauthorized individuals could gain access to your answers.

If you have any questions, concerns or complaints about this study, the Research Assistants are willing to respond and address them.  However, if you need further information, you may call the student researcher **Saranta Moses Kipainoi at 0722904211/0733241572** or email him at: saranta@outlook.com

Would you like to participate in this study?  If yes, kindly fill out the attached Informed Consent Form Certificate on the front page of the household questionnaire.  Thank you.

# Appendix VIII: Official Research Authorization Documents

**RONGO UNIVERSITY**

OFFICE OF THE DEAN

SCHOOL OF GRADUATE STUDIES

| | |
|---|---|
| Tel. 0771349741 | P.O. Box 103 - 40404 **RONGO** |

Our Ref: **PSOC/9304/2014**                    **Date:** Thursday, June 13, 2019

The Chief Executive Officer,
National Commission for Science, Technology & Innovation,
off Waiyaki Way, Upper Kabete,
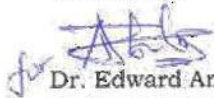P.O Box 30623-00100,
**Nairobi-KENYA**.

Dear Sir,

**RE:**      **RESEARCH PERMIT FOR MR. SARANTA MOSES KIPAINOI-PSOC/9304/2014**

We wish to inform you that the above person is a bona fide graduate student of Rongo University in the School of Arts and Social Sciences pursuing a PhD degree in Sociology. He has been authorized by the University to undertake research titled; **"Effects of Adopting Sahiwal Cattle on Livelihood Outcomes among Pastoralist Communities: The Case of Isiria Maasai of Kenya"**.

This is, therefore, to request the commission to issue him with a research permit to enable him proceed for field work.

Your assistance to him shall be highly appreciated.

Thank you.

Dr. Edward Anino
**DEAN, SCHOOL OF GRADUATE STUDIES**

> RONGO UNIVERSITY
> THE DEAN
> 13 JUN 2019
> SCHOOL OF GRADUATE STUDIES
> P. O. BOX 103 - 40404, RONGO

Copy to:    Vice Chancellor
            Deputy Vice Chancellor (Academic and Student Affairs).
            Dean, School of Arts and Social Sciences
            HoD, Social Sciences

# NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349;3310571.2219420
Fax:+254-20-318245;318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref No. **NACOSTI/P/19/69192/31362**

Date: **5th July, 2019.**

Moses Kipainoi Saranta
Rongo University
P.O. Box 103-40404
**RONGO.**

## RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on *"Effects of adopting Sahiwal cattle on livelihood outcomes of pastoralist communities: The case of Isiria Maasai of Kenya."* I am pleased to inform you that you have been authorized to undertake research in **Narok County** for the period ending **5th July, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, Narok County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

**BONFACE WANYAMA.**
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner
Narok County.

The County Director of Education
Narok County.

National Commission for Science, Technology and Innovation is ISO9001 2008 Certified

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# THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

## CONDITIONS

1. The License is valid for the proposed research, location and specified period.

2. The License and any rights thereunder are non-transferable.

3. The Licensee shall inform the County Governor before commencement of the research.

4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.

5. The License does not give authority to transfer research materials.

6. NACOSTI may monitor and evaluate the licensed research project.

7. The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.

8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.

National Commission for Science, Technology and Innovation

P.O. Box 30623 – 00100, Nairobi, Kenya

TEL: 020 400 7000, 0713 788787, 0735 404245

Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

---

REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 25737

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:

Permit No : NACOSTI/P/19/69192/31362

Date Of Issue : 5th July,2019

Fee Recieved :Ksh 2000

MR. MOSES KIPAINOI SARANTA
of RONGO UNIVERSITY, 0-40701
LOLGORIAN,has been permitted to
conduct research in Narok County

on the topic: EFFECTS OF ADOPTING
SAHIWAL CATTLE ON LIVELIHOOD
OUTCOMES OF PASTORALIST
COMMUNITIES:THE CASE OF ISIRIA
MAASAIOF KENYA

for the period ending:
5th July,2020

.....................
Applicant's
Signature

Director General
National Commission for Science,
Technology & Innovation

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**OFFICE OF THE PRESIDENT**
**MINISTRY OF INTERIOR AND**
**COORDINATION OF NATIONAL GOVERNMENT**

Telegram: "narok@go.ke", Narok
Telephone: Narok [050] 22433
Fax: [050] 22588
If calling or telephoning ask for the undersigned.
When replying please quote;
RE: SR.ADM.15/6 VOL. I/148

County Commissioner
Narok County
P.O. Box 4 – 20500
**NAROK**

22nd July, 2019

**Deputy County Commissioner**
**Transmara West Sub County**

**RE: RESEARCH AUTHORIZATION: MOSES KIPAINOI SARANTA**

Mr. Moses Kipainoi Saranta of University of Rongo has been authorized to carry out research on **"Effects of adopting sahiwal cattle on livelihood outcomes of pastroralist communities: The case if Isiria Maasai of Kenya"** in Transmara West Sub County of this County for the period ending 5th July, 2020.

Kindly accord him necessary assistance.

SAMUEL KIMITI, MBS
COUNTY COMMISSIONER
**NAROK COUNTY**

CC.
Mr.Moses Kipainoi Saranta

**REPUBLIC OF KENYA**

MINISTRY OF EDUCATION

State Department of Early Learning and Basic Education

FAX NO. 050-22391

When replying please quote:

Ref. CDE/NRK/RES/VOL1/193

COUNTY DIRECTOR OF EDUCATION
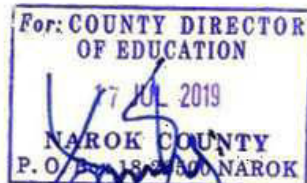NAROK COUNTY
P.O BOX 18
NAROK

DATE: 17TH JULY, 2019

## TO WHOM IT MAY CONCERN

**RE: RESEARCH AUTHORIZATION – MOSES KIPAINOI SARANTA.**

The above mentioned is a student of Rongo University.

He has been authorized to carry out research on *"Effects of adopting Sahiwal cattle on livelihood outcomes of pastoralist communities: The case of Isiria Maasai Kenya, in Narok County for* the period ending *5th July, 2020.*

Please accord him the necessary assistance.

For: COUNTY DIRECTOR
OF EDUCATION

17 JUL 2019

NAROK COUNTY
P. O. BOX 18-20500 NAROK

PHILIP WAMBUA
**COUNTY DIRECTOR OF EDUCATION**
**NAROK**

C.C

- The County Commissioner    – **Narok**

- Moses Kipainoi Saranta

# MINISTRY OF EDUCATION SCIENCE AND TECHNOLOGY

Telegrams: "EDUCATION", T/WEST
Telephone: KILGORIS 058 5122010
Telkom Wireless:
FAX NO. 058 5122010
E-Mail:
deotranmarawest@yahoo.com
When replying please quote:
Ref. No.

SUB COUNTY EDUCATION OFFICE
TRANS MARA WEST SUB COUNTY
P.O. BOX 19,
40700 – KILGORIS.

22/07/2019

## STATE DEPARTMENT EARLY LEARNING AND BASIC EDUCATION

TM/ED/RA/49/VOL.1/89

## TO WHOM I MAY CONCERN

## RE:  RESEARCH AUTHORIZATION – MOSES KIPAINOI SARANTA

The above named is student of Rongo university.

He have  been authorized to carry out research on "**Effects of adapting Sahiwal cattle on live hood outcomes of pastoralists communities** : The  case study of Isiria Maasai Kenya . Narok county in  Trans Mara West Sub County for a period ending 5th July 2020.

Any assistant accorded to him is highly appreciated.

NDOMBI GEORGE
FOR  SUB COUNTY DIRECTOR OF EDUCATION
     TRANS MARA WEST.

**OFFICE OF THE PRESIDENT**

**MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT**

Telegram: "SUB COUNTY", KILGORS
Telephone: Kilgoris [058 5122002/5122226
Email. dcctransmarawest@gmail.com
If calling or telephoning ask for the undersigned.
When replying please quote:

Deputy County Commissioner's Office
Trans Mara West Sub- County,
P.O. Box 1 – 40700
**KILGORIS**

.OUR REF: SEC.17/1 L&O.VOL.IV/50

Date 23July 2019

---

**ALL ASSISTANT COUNTY COMMISSIONER**
**TRANS MARA WEST** LOLGORIAN

**RE:    RESEARCH AUTHORIZATION- MOSES KIPAINOI SARANTA**

Refer to the above subject matter.

This is to bring to your attention that Mr. Moses Kipainoi Saranta of Rongo University has been authorized to carry out research on *"Effects of adopting Sahiwal Cattle in livelihood outcomes of pastroralist communities; The Case of Isiria Maasai of Kenya"* within this Sub County for the period ending 5th July, 2020.

Kindly inform all Chiefs and Assistants to accord him all necessary assistance.

**MOHAMED N. HASSAN**
**DEPUTY COUNTY COMMISSIONER**
**TRANS MARA WEST**

## OFFICE OF THE PRESIDENT
### MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegram: "SUB COUNTY", KILGORS
Telephone: Kilgoris [058 5122002/5122226
Email. dcctransmarawest@gmail.com
If calling or telephoning ask for the undersigned.
When replying please quote:

Deputy County Commissioner's Office
Trans Mara West Sub- County.
P.O. Box I– 40700
**KILGORIS**

**OUR REF: SEC.17/1 L&O.VOL.IV/50**

Date 23July 2019

---

**ALL ASSISTANT COUNTY COMMISSIONER**
**TRANS MARA WEST**    KIRINDON

**RE:    RESEARCH AUTHORIZATION- MOSES KIPAINOI SARANTA**

Refer to the above subject matter.

This is to bring to your attention that Mr. Moses Kipainoi Saranta of Rongo University has been authorized to carry out research on *"Effects of adopting Sahiwal Cattle in livelihood outcomes of pastroralist communities; The Case of Isiria Maasai of Kenya"* within this Sub County for the period ending 5th July, 2020.

Kindly inform all Chiefs and Assistants to accord him all necessary assistance.

**MOHAMED N. HASSAN**
**DEPUTY COUNTY COMMISSIONER**
**TRANS MARA WEST**

# OFFICE OF THE PRESIDENT
## MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegram: "SUB COUNTY", KILGORS
Telephone: Kilgoris [058 5122002/5122226
Email. dcctransmarawest@gmail.com
If calling or telephoning ask for the undersigned.
When replying please quote:

**OUR REF: SEC.17/1 L&O.VOL.IV/50**

Deputy County Commissioner's Office
Trans Mara West Sub- County.
P.O. Box 1– 40700
**KILGORIS**

Date 23July 2019

**ALL ASSISTANT COUNTY COMMISSIONER**
**TRANS MARA WEST** KEIYAN

**RE:    RESEARCH AUTHORIZATION- MOSES KIPAINOI SARANTA**

Refer to the above subject matter.

This is to bring to your attention that Mr. Moses Kipainoi Saranta of Rongo University has been authorized to carry out research on *"Effects of adopting Sahiwal Cattle in livelihood outcomes of pastroralist communities; The Case of Isiria Maasai of Kenya"* within  this Sub County for the period ending 5th July, 2020.

Kindly inform all Chiefs and Assistants to accord him all necessary assistance.

**MOHAMED N. HASSAN**
**DEPUTY COUNTY COMMISSIONER**
**TRANS MARA WEST**

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# Appendix IX: Social Capital Score Guidelines

## Areas, Items and Respective Scores

### 1. Groups (3 items)

a) Membership to Groups: A household whose members belong to 6 and above different groups will have a maximum score of 12, i.e. membership to a group earns a household 2 points

b) Involvement in the decision-making process of the group, organization or association. Four levels of involvement are distinguished, i.e. leader, committee member, member, not involved. Scores will be awarded thus:

- 8 is awarded to a household whose member is a leader (chairperson/president/etc.);
- 6 to a household whose member is part of the committee responsible for steering the affairs of the group;
- 4 for a household with membership in a group and can occasionally be consulted in matters of the group; and
- 1 to a household whose member is not involved in the group's decision-making/ or consulted in any group issue.

  N/B. An average score will be worked out for households with different levels of involvement in decision-making for the various groups that its members belong to

c) The number of times a household member has participated in the group's activities, e.g. attending meetings, DoITng group work etc. Four levels of participation are distinguished, each with a specific score as follows
- 8 points for a household whose member has participated **more than 15** times
- 6 points for a household whose members have participated in the activities of the group between **11 and 14 times**
- 4 points for a household whose members have participated in the activities of the group between **5 and 9** times
- 1 point for a household whose members have participated in the activities of the group **less than 5 times**

$$a + b + c \quad \text{i.e.} \quad 12 + 8 + 8 = 28 \text{ points}$$

## 2. Friends (3 items)

a) The number of close friends (those that one can freely talk about private matters). Four categories are distinguished with specific scores as follows:

- 1 point for a household head with **up to 5 close friends**
- 2 points for a household whose head has **between 6 and 10 close friends**
- 3 points for a household whose head has **between 11 and 15 close friends**
- 4 points for a household whose head has **over 15 close friends**

b) The number of persons beyond the immediate household that the head of the household can turn to and are willing to lend a small amount of money, e.g. KES 1,000. Four categories of households are distinguished with specific scores as follows:

- 1 point for a household head with **less than 3 persons**
- 2 points for a household whose head has **between 3 and 5 persons**
- 3 points for a household whose head has **between 6 and 10**
- 4 points for a household whose head has **over 10 persons**

c) Number of persons a household head can turn to and are willing to assist when suddenly faced by a long-term emergency (cattle stolen)

- 1 point for a household head with **up to 5 persons**
- 2 points for a household whose head has **between 6 and 10 persons**
- 3 points for a household whose head has **between 11 and 15 persons**
- 4 points for a household whose head has **16 and above persons**

$$a + b + c \quad \text{i.e.} \quad 4 + 4 + 4 = 12 \text{ points}$$

## 3.  Solidarity (4 items)

a)  Whether most people in the neighbourhood can be trusted. Five positions are distinguished with different scores as follows:

- 2 points for a household head who strongly disagrees with the statement
- 4 points for a household head who disagrees with the statement
- 0 points for a household that is neutral with the statement
- 6 points for a household who agrees with the statement
- 8 points for a household who strongly agrees with the statement

b)  Whether one has to be alert lest you will be taken advantage of by people in the neighbourhood. Five positions are identified with different scores as follows:

- 8 points for a household head who strongly disagrees with the statement
- 6 points for a household head who disagrees with the statement
- 0 points for a household that is neutral with the statement
- 4 points for a household who agrees with the statement
- 2 points for a household who strongly agrees with the statement

c)  Whether most people in the neighbourhood are willing to help if one needed help. Five positions are identified with different scores as follows:

- 2 points for a household head who strongly disagrees with the statement
- 4 points for a household head who disagrees with the statement
- 0 points for a household that is neutral with the statement
- 6 points for a household who agrees with the statement
- 8 points for a household who strongly agrees with the statement

d) Whether people in the neighbourhood generally do not trust each other in lending and borrowing money. Five positions are identified with different scores as follows:

- 8 points for a household head who strongly disagrees with the statement
- 6 points for a household head who disagrees with the statement
- 0 points for a household that is neutral with the statement
- 4 points for a household who agrees with the statement
- 2 points for a household who strongly agrees with the statement

**a + b + c + d     i.e.   8 + 8 + 8 + 8 = 32 points**

## 4.    Trust (13 categories of people)

a) Level of trust for different categories of people – from those close to the respondent and those remotely associated to.  Five levels are distinguished with varying scores as follows:

- 1 point for a household head with a not at all trust
- 2 points for a household head with a slight trust to the category of person
- 0 points for a household head who is neutral, i.e. neither trust nor distrust the person
- 3 points for a household head who trusts the person
- 4 points for a household head who trusts the person to a great extent

In addition, different categories of persons are assigned different weights, the remotely the person is associated to the respondent, the higher the weight and vice versa e.g.

- 4 for the level of trust for other Maasai sections (Ilmoitanik, Ilpurko etc.)
- 3 for the level of trust for Veterinary Officers, Police, County and Central/National Government Officials as well as other Isiria Maasai sections (Nkutot)
- 2 for the level of trust for members of other age groups as well as own Maasai section, i.e. Isiria Maasai
- 1 for the level of trust for members of own age-group, spiritual leader and own workers

$$a + b + c + d + e + f + g + h + i + j + k + l + m$$

i.e. $12 + 4 + 8 + 8 + 12 + 12 + 12 + 4 + 4 + 16 + 8 + 12 + 16$
$$= 128 \text{ points}$$

## 5. Helping other people (10 items)

a) The frequency of helping other people. Five descriptors are distinguished with different scores as follows:

- 5 points for always helping
- 4 points for a household that helps most of the time
- 3 points for a household that sometimes helps others
- 2 points for a household that rarely helps others
- 0 points for a household that never helps others

b) Willingness to contribute time and money in a community project that does not benefit the respondent directly but the community. Two positions are distinguished:

- 6 points for the willingness to contribute your own time to a community project
- 6 points for the desire to donate money to a community project
- 0 points for unwillingness to contribute either time or money

In addition, different categories of persons offered help are assigned different weights. The remotely the person is associated to the respondent, the higher the weight and vice versa e.g.

- 5 for helping other ethnic groups, e.g. Kisii, Kuria, Kikuyu, Luo etc.
- 4 for helping other Maasai sections (Ilmoitanik, Ilpurko etc)
- 3 for helping Other Isiria Maasai sections (Nkutot – Ilkunono, Ilaiserr etc.)
- 2 for helping own Maasai section (enkutoto)
- 1 for assisting own siblings, own clan member, own age-group members and other age-group members

$$a + b + c + d + e + f + g + h + i + j$$

**i.e.  5 + 5 + 5 + 5 + 10 + 15 + 20 + 25 + 6 + 6 = 102 points**


## 6.  Information and Communication (5 items)

a)  The frequency of listening to the radio.  Four descriptors are distinguished with different scores as follows:

- 10 points for listening to the radio every day
- 6 points for listening to the radio several times a week
- 2 points for listening to the radio once a week
- 0 points for a household that never listens to the radio

b)  The frequency of watching TV.  Four descriptors are distinguished with different scores as follows:

- 10 points for watching TV every day
- 6 points for watching TV several times a week
- 2 points for watching TV once a week
- 0 points for a household that was never watching TV at all

c) Three important sources of information about what the Government is doing. A maximum score of 3 points is allocated to each source.  However, some sources have lower points depending on the effort invested by the household on the source, i.e. less effort, low weight and score and vice versa. The weights for various sources are as follows:

- 3 points for radio, newspaper, TV, government agents, internet, NGOs

- 2 points for the local market, business/work associates, political associates, community leaders

- 1 point for relatives, friends and neighbours

d) Three important sources of information about market prices of cattle. A maximum score of 3 points is allocated to each source.  However, some sources have lower points depending on the effort invested by the household on the source, i.e. less effort, low weight and score and vice versa. The weights for various sources are as follows:

- 3 points for radio, newspaper, TV, government agents, internet, NGOs

- 2 points for the local market, business/work associates, political associates, community leaders

- 1 point for relatives, friends and neighbours

e) Three important sources of information about market prices of milk. A maximum score of 3 points is allocated to each source.  However, some sources have lower points depending on the effort invested by the household on the

source, i.e. less effort, low weight and score and vice versa. The weights for various sources are as follows:

- 3 points for radio, newspaper, TV, government agents, internet, NGOs
- 2 points for the local market, business/work associates, political associates, community leaders
- 1 point for relatives, friends and neighbours

$$a + b + c + d + e$$

i.e. $10 + 10 + 9 + 9 + 90 = 47$ points

## 7. Interaction (6 items)

Measures the frequency of a household visit to other neighbourhoods, local market centres, towns, major urban centres, County HQs and Nairobi's capital city. Five frequencies are distinguished with varying points as follows:

- 4 points for a household that visits always
- 3 points for a household that visits most of the time
- 2 points for a household that visits sometimes
- 1 point for a household that visits rarely
- 0 point for a household that never visits

Depending on the distance from the household, areas that a household head visits have varying weights, i.e. the further the place is from a household, the higher the weight and vice versa. The weights for various places are as follows:

- 6 points for Nairobi

- 5 points for the County HQ

- 4 points for major urban centres

- 3 points for towns

- 2 points for local market centres

- 1 point for other neighbourhoods

$$\textbf{a + b + c + d + e + f}$$

$$\textbf{i.e. \quad 4 + 8 + 12 + 16 + 20 + 24 = 84 points}$$

## 8. Sociability (4 items)

a) The number of times in the past one week that a household head has met other people in a public place to talk, have a meal or drink. The number of times is indicated up to a maximum of **7**. This item is given a weight of **2**. The score is determined by multiplying the number of times by 2: i.e. **2n,** where **n** is the number of times a household head has met other people in a public place to talk, meal or drink.

b) The number of people who have visited the respondent's home in the past one week. The number of people is indicated up to a maximum of **7**. This item is allocated a weight of **3**. The score is determined by multiplying the number of people who have visited the respondent at home by 3: i.e. **3p,** where p is the number of people who have visited the respondent at home in the past one week.

c) The number of times in the past one week that the respondent has visited other people in their homes. The number of times is indicated up to a maximum of **7**. This item is given a weight of **2**. The score is determined by multiplying the number of times by 2: i.e. **2t,** where **t** is the number of times the respondent has visited other people in their homes.

d) The number of times in the past 12 months that the respondent has participated in a family, clan, neighbourhood festival or ceremony, e.g. wedding, funeral, religious festival etc. The number of times is indicated up to a maximum of **12**. This item is given a weight of **2**. The score is determined by multiplying the number of times by 2: i.e. **2t,** where **t** is the number of times the respondent has participated in a family, clan, neighbourhood festival or ceremony.

$$a + b + c + d$$

$$\text{i.e.} \quad 14 + 21 + 14 + 24 = 73 \text{ points}$$

## 9. Safety (1 item)

Whether the household has experienced any loss of property to thieves in the past 12 months. Two positions are distinguished with corresponding points as follows:

- **0** point if the household has experienced the loss of property to thieves
- **12** points if the household has not experienced the loss of property to thieves

$$a = 12 \text{ points}$$

## 10. Empowerment and Political Action (9 items)

a) Control over decisions affecting the daily lives of the household. Four levels of control are distinguished, with each allocated different points as follows:

- 0 point for no control

- 3 points for households with some control

- 6 points for households with most control

- 12 points for households with total control

b) Whether a household head has attended a neighbourhood meeting, hearing or public discussion. Two positions are distinguished with different points as follows:

- 0 point for households that have not attended

- 4 points for households that have attended

c) Whether the household head has met, called or written a letter to a politician. Two positions are distinguished with different points as follows:

- 0 point for households that have not met, called or written a letter to a politician

- 5 points for households that met, called or written a letter to a politician

d) Whether the household head has participated in a protest or demonstration. Two positions are distinguished with different points as follows:

- 0 point for households that have not participated in a protest or demonstration

- 5 points for households that have participated in a protest or demonstration

e) Whether the household head has participated in an election or information campaign. Two positions are distinguished with different points as follows:

- 0 point for households that have not participated in an election or information campaign

- 5 points for households that have participated in an election or information campaign

f) Whether the household head has alerted a newspaper, radio or TV station about a local problem. Two positions are distinguished with different points as follows:

- 0 point for households that have not alerted a newspaper, radio or TV station about a local problem

- 6 points for households that have alerted a newspaper, radio or TV station about a local problem

g) Whether the household head has notified the police or other law enforcement agency about a local problem. Two positions are distinguished with different points as follows:

- 0 point for households that have not notified the police or other law enforcement agency about a local problem

- 6 points for households that have notified the police or other law enforcement agency about a local problem

h) Whether the household head voted in the last general election. Two positions are distinguished with different points as follows:

- 0 point for a households head who did not vote in the previous general election

- 12 points for a households head who voted in the last general election

i) The level of influence that the household head has on decisions made by local leaders or government officials. Three levels of influence are distinguished with different points as follows:

- 0 point for a household head with no effect on decisions made by local leaders or government officials

- 6 points for a household head with a bit of influence on decisions made by local leaders or government officials

- 12 points for a household head with a lot of influence on decisions made by local leaders or government officials

$$a + b + c + d + e + f + g + h + i$$

**i.e.  12 + 4 + 5 + 5 + 5 + 6 + 6 + 12 + 12 = 67 points**

| | | |
|---|---|---|
| Total points | = | 585 |
| Total number of items | = | 64 |

| Therefore | = | 585/64 | is | 9.1 |
| | | | which is rounded up to 9.0 | |

Thus the social capital scale has 3 levels:

    a)  3 and below      -      weak or low social capital

    b)  Over 3 to 6      -      moderate or medium social capital

    c)  Over 6 to 9      -      Strong or high social capital