

POTENTIAL FINANCIAL CONSTRUCTIONS FOR DAIRY FARMERS ADOPTING CLIMATE SMART AGRICULTURE IN THE CASE OF GITHUNGURI AND OLENGURUONE DAIRY FARMERS COOPERATIVE SOCIETIES IN KENYA

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Potential Financial Constructions for Dairy Farmers Adopting Climate Smart Agriculture in the Case of
Githunguri and Olenguruone Dairy Farmers Cooperative Societies in Kenya

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Sustainable Value Chains

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ABSTRACT

The objective of this study was to understand the best financial practices of members of Githunguri Dairy Farmers Cooperative Society and Olenguruone Dairy Farmers Cooperative Society, and the role of financial service providers operating in Githunguri and Olenguruone, in relation to the adoption of climate smart agricultural practices and techniques. The study was qualitative, in the form of case studies and in-dept interviews, and 41 dairy farmers, 12 financial services providers, 4 CSA suppliers and 5 staff members of both dairy cooperatives participated. The outcome suggests that dairy farmers of both cooperatives operate in different contexts, dairy farmers utilise a wide range of financial practices for different CSA practices and techniques and financial institution are in a position to stimulate the adoption of CSA practices and techniques. However, demand and offer for financial products related to the adoption of CSA practices and techniques do not converge in Githunguri and Olenguruone. To tackle this issue, both dairy cooperatives and other actors in the dairy value chains should consider value chain finance and tripartite arrangements to stimulate and scale up the adoption of CSA practices and techniques among members of GDFCS and ODFCS.

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ACRONYMS

ASCA	Accumulating Savings and Credit Association
ATM	Automated Teller Machine
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CDESK	Inclusive and Climate Smart Business Models in Ethiopian and Kenyan Dairy Value Chains
CSA	Climate Smart Agriculture
DEO	Dairy Extension Officer
GDP	Gross Domestic Product
FSP	Financial Service Provider
GDFCS	Githunguri Dairy Farmers Cooperative Society
KBP	Kenya Biogas Program
KSh	Kenyan Shilling
LPG	Liquified Petroleum Gas
MFI	Micro-Financial Institution
MoU	Memorandum of Understanding
NGO	Non-governmental Organisation
ROSCA	Rotating Savings and Credit Association
SACCO	Savings and Credit Cooperative Organisation
SNV	Netherlands Development Organisation
ODFCS	Olenguruone Dairy Farmers Cooperative Society
VHL	Van Hall Larenstein University of Applied Sciences
VSLA	Village Savings and Loan Association

1. SETTING THE STAGE

The research is a qualitative case study that inquired into the best financial practices of dairy farmers in relation to biodigesters, rainwater harvesting, milking bucket machines and maize silage, and the role of dairy cooperatives, financial services providers (FSP) and suppliers of Climate Smart Agricultural (CSA) practices and techniques, to see whether demand for financial products and services of dairy farmers converges with products and services offered by FSP and suppliers of CSA practices and techniques. The thesis is commissioned by Van Hall Larenstein University of Applied Sciences (VHL) and is part of the project Inclusive and Climate Smart Business Models in Ethiopian and Kenyan Dairy Value Chains (CSDEK)

This first chapter sets the stage and introduces stakeholders that participated in the project, elaborates the background of the study and discusses the problem statement, research objective, research questions and conceptual framework of the project. In chapter 2, relevant terms and concepts are elaborated to provide the reader with a comprehensive understanding of topics discussed in the study. Subsequently, chapter 3, gives a detailed description of both study areas, data collection, data analysis and limitations of the study. Chapter 4 shows the results of the fieldwork in Kenya. Next the results are discussed in chapter 5 of the report and, subsequently, the conclusion is drawn in chapter 6. Finally, chapter 7 gives recommendations to CSDEK.

1.1 STAKEHOLDERS AND PARTICIPANTS

As noted above, the thesis is commissioned and overseen by VHL and is part of CSDEK. CSDEK itself is part of CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and aims to contribute to the outcome of this project. Two Kenyan dairy cooperatives are involved in this study: Githunguri Dairy Farmers Cooperative Society (GDFCS) and Olenguruone Dairy Farmers Cooperative Society (ODFCS). All stakeholders that participate in the study are discussed below.

1.1.1 Van Hall Larenstein University of Applied Sciences

VHL may call itself “the most sustainable university of applied sciences” in the Netherlands. The university educates high quality, ambitious and innovative professionals that want to contribute to a better and sustainable world. Bachelors and masters that are offered relate to animal husbandry, food technology, international business, agri-business and international development.

The bachelor course International Development Management – Sustainable Value Chains concentrates at sustainable trade to achieve equal rights and opportunities around the world. Due to the background of this course, which is tropical agriculture, a lot of emphasis is on the position of farmers in agricultural value chains. The course is taught at the VHL campus in Velp, is fulltime and takes

approximately 4 years. Students receive a Bachelor of Science after successful completion of the course.

Visit [VHL](#) for additional information and contact details.

1.1.2 Githunguri Dairy Farmers Cooperative Society

GDFCS is a dairy cooperative that is located in Githunguri Town, Githunguri Sub-County of Kiambu County, and was established by 21 dairy farmers to market their milk in 1961 (Muriuki, 2006). The core activities of GDFCS are collecting, processing and marketing of milk. Further, the cooperative provides access to dairy inputs, extension services, artificial insemination (AI), and financial products and services to its members. GDFCS numbers 25.000 members, yet only around 15.000 members actively sell their milk to the cooperative. The total milk production of active members is around 270.000 litres a day – individual members produce generally between 15 and 40 litres a day. In order to collect and process milk of its members, GDFCS developed several milk routes, established 82 collection centres and built 7 cooling centres and a processing plant (Kiiza, 2018). The milk is packaged or processed into either yoghurt, butter or ghee. All products of GDFCS are sold to consumers as Fresha Dairy Brands and Zito Dairy Brands.

Visit [Fresha Dairy Brands](#) for additional information and contact details.

1.1.3 Olenguruone Dairy Farmers Cooperative Society

ODFCS is a dairy cooperation that is located in Olenguruone Town, Olenguruone Sub-District of Nakuru county, and was established to collect and market the milk of dairy farmers in the region in 2005. Besides collecting and marketing milk, ODFCS provides its members with access to dairy inputs, extension services, AI, and financial products and services. ODFCS numbers almost 10.000 members, however, only less than 2000 members actively sell their milk to the cooperative. The total milk production of active members is around 7000 litres – individual members produce about 5 litres of milk on a daily base. ODFCS does not collect milk of its members itself. Instead farmers need to organise transportation, often in the form of motorcycles and cars, to collection centres themselves. After collection, the milk is sold to Happy Cow Ltd and New KCC Ltd. Currently, the cooperative is developing its own packaging plant to start marketing its own dairy products in the future.

1.1.4 Inclusive and Smart Business Models for Ethiopian and Kenyan Dairy Value Chains

VHL supports CCFAS that is led by the International Centre for Tropical Agriculture, a collaboration between different partnerships of the Consultative Group for International Agricultural Research. The objective of the project is to increase the adoption of CSA, and develop efficient and fair value chains and inclusiveness for stakeholders involved in dairy value chains (CCFAS, n.d.). VHL supports CCFAS by

conducting research that is related to CSA in both Ethiopia and Kenya; hence CSDEK. The studies are partly funded by the Netherlands Institute for Scientific Research.

Visit [CCFAS](#) for additional information and contact details.

1.2 CLIMATE SMART AGRICULTURE IN GITHUNGRUI AND OLENGURUONE

Previous research by master students of VHL identified CSA practices and techniques for dairy farmers – members of GDFCS and ODFCS – to address climate change and develop inclusive business models in Kenya (Baars et al., 2019). Identified CSA practices and techniques are the use of high productive dairy cattle breeds and zero grazing; conservation and minimum tillage, mulching and the application of cover crops; agroforestry, intercropping and crop rotation; rain water harvesting, storage and irrigation; growing drought resistant fodder plants; producing hay and make use of silage; and the application of manure in crop fields and production of biogas (Kiiza, 2018).

According to Kiiza (2018), dairy farmers had adopted several CSA practices and techniques, e.g. high productive cattle breeds and zero grazing and the use of crop residues and by products of the agricultural industry. However, other CSA practices and technologies are known to have a low adoption rate, due to unawareness among dairy farmers and expenses related to the adoption of such practices and techniques (Kiiza, 2018). Unfortunately, as Vala (2019) stated, because in addition to benefits related to mitigation to climate change, dairy farmers can use CSA practices and techniques to decrease expenses. Thereby positively affecting the solvability of dairy farmers in Githunguri and Olenguruone.

1.3 PROBLEM STATEMENT

In order to tackle the issue of high costs of CSA practices and technologies, Kiiza (2018), Shumba (2018), and Vala (2019) developed business models for small-scale dairy farmers to adopt CSA practices and technologies that require investments from third parties. In these business models, savings and credit cooperative organisations (SACCO) from GDFCS and ODFCS – GDC SACCO Ltd and Mavumo Daima SACCO Ltd – act as such third parties. However, it is not clear for VHL whether GDC SACCO Ltd and Mavumo Daima SACCO Ltd have the capacity, incentives and products to stimulate adoption and implementation of high- and low-cost CSA practices and technologies for members of GDFCS and ODFCS.

Furthermore, VHL wants to obtain more insights about financial institutions that provide financial services to members of GDFCS and ODFCS and operate in Kiambu and Nakuru; that might want to contribute to the development of financial products related to the adoption and implementation of CSA practices and technologies in the region.

1.4 RESEARCH OBJECTIVE

The objective is to identify financial constructions that will contribute to scaling up the adoption of CSA practices and techniques among small-scale dairy farmers in Githunguri and Olenguruone, in order to create feasible and inclusive and climate smart business models for members of GDFCS and ODFCS.

1.5 RESEARCH QUESTIONS

Two main research questions were used to guide the study. Both research questions are supported by several sub questions.

Research Question 1:

What is the role of financial institutions in Githunguri and Olenguruone in providing financial services that will enable small-scale dairy farmers to invest in CSA practices and techniques?

- 1) What financial services do financial institutions provide to small-scale dairy farmers who want to invest in CSA practices and technologies?
- 2) What relationships exist between financial institutions, dairy cooperatives and input suppliers of CSA practices and techniques?
- 3) What are the arguments of financial service providers in dairy chains to adopt CSA practices and technologies into the strategy of their organisations?
- 4) What knowledge and funding do financial service providers have regarding scaling up CSA practices and technologies?

Research Question 2:

What are best financial practices of small-scale dairy farmers investing in CSA practices and techniques?

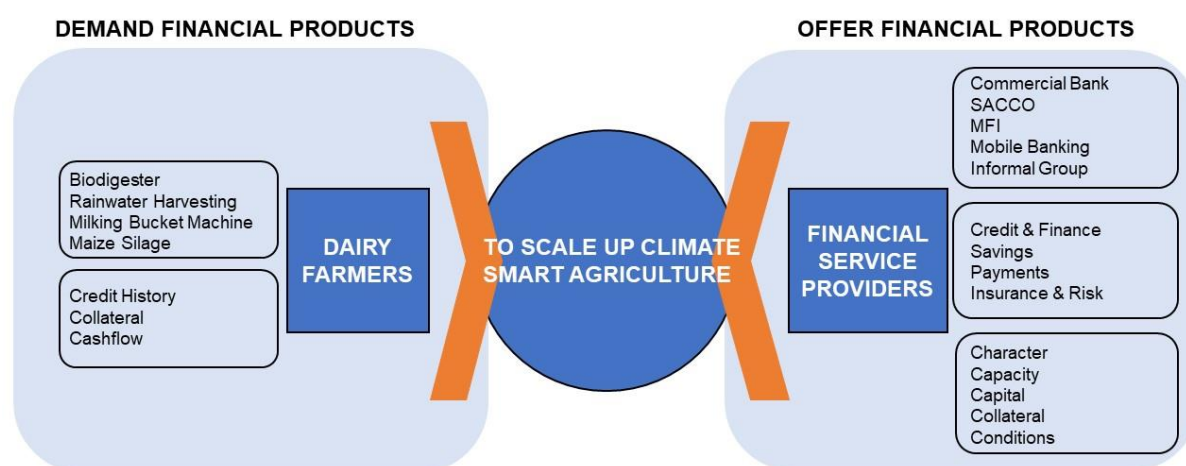
- 1) What financial products and services do small-scale dairy farmers require to invest in CSA practices and techniques?
- 2) What linkages exist between small-scale dairy farmers and traditional banks, MFIs, SACCOs, informal saving groups and mobile banking?
- 3) What are the costs of CSA practices and techniques for small-scale dairy farmers?
- 4) What are the benefits of CSA practices and techniques for small-scale dairy farmers?

1.6 CONCEPTUAL FRAMEWORK

The conceptual framework suggests that dairy farmers want to invest in biodigesters, rainwater harvesting, milking bucket machines and maize silage, to scale up the adoption of CSA practices and techniques (figure 1). However, as stated by Kiiza (2018) and Vala (2019), dairy farmers do not have adequate financial resources to purchase and adopt biodigesters, rainwater harvesting, milking bucket machines and maize silage. As a result, dairy farmers seek for financial products and services provided by FSPs – commercial banks, SACCOs, micro-financial institutions (MFI), mobile banking and informal groups – that will enable them to invest in the CSA practices and techniques discussed above. Financial products and services that FSPs offer are related to disbursing credit and providing finance products, access to savings products, facilitation of payment services and the availability of insurance products and other risk instruments. In order to have access to financial products and services, dairy farmers need to have credit history, collateral and sufficient cashflow. In the case that dairy farmers provide their credit history, collateral and sufficient cashflow to FSPs, such companies and organisations can conduct risk analysis and determine the solvability of dairy farmers. FSPs often use the so called 5Cs, which are character, capacity, capital, collateral and conditions, to implement risks analyses of dairy farmers.

Unfortunately, dairy farmers are not always able to provide their credit history, collateral and cashflow to FSPs. As a result, FSPs consider dairy farmers to be high risk because of under-performance of dairy farmers and thereby the potential loss of capital increases. Due to this negligence, dairy farmers are not able to invest in either biodigesters, rainwater harvesting, milking bucket machines and maize silage, something that affects the adoption of CSA practices and techniques among dairy farmers of GDFCS and ODFCS.

Figure 1: Conceptual Framework



2. CONCEPTS AND TERMS

Before discussing the collection of data at GDFCS and ODFCS, this chapter elaborates concepts and terms that are used throughout the study. Several questions have been used to discuss relevant concepts and terms:

- How does the Kenya dairy sector look like?
- What are the effects of climate change in Kenya?
- What is Climate Smart Agriculture?
- What financial products services do financial institutions provide in Kenya?

2.1 KENYA DAIRY SECTOR

In Kenya, the dairy industry is an important agricultural sector that contributes 14% of the agricultural gross domestic product (GDP), 40% of the livestock sector GDP and 4% of national GDP (Rademaker, et al., 2016). The cattle population numbers over 45 million heads and produces 5.28 billion litres of milk per annum (KDB, n.d.) The sector consists of 1.8 million small-scale dairy farmers and creates, both directly and indirectly, 1.2 million jobs in Kenya (KDB, n.d.). Therefore, it can be stated that the contribution of the dairy sector to socio-economic conditions is significant, especially in the Central Highlands and Rift Valley Regions (Vala, 2019).

Dairy farmers sell, after their own consumption, milk through informal channels to neighbours, friends and family (Kiiza, 2018). Further, there is a formal value chain that consists of milk processors and dairy cooperatives. Around 25 processing plants are licensed by the Kenya Dairy Board, with a capacity of 3.5 million litres per day (Vala, 2019). There are four big milk processors: Brookside Dairy Ltd., New Kenya Cooperative Creameries Ltd., Githunguri Dairy Farmers Cooperative Society and Sameer Agriculture and Livestock, that account for 70 per cent of the total dairy market in Kenya. The consumers of dairy products are from Kiambu, other parts of Kenya and hotels in Nairobi City (Kiiza, 2018). Only five per cent of the produced dairy is exported to Tanzania, Uganda and the Middle East (Obare, 2019).

The dairy sector is well established in Kenya, as noted above, however, the dairy sector still faces challenges related to the diminishing quality of animal genetic resources; a decreasing number of extension workers and advisory services available to dairy farmers; ineffective disease control leading to livestock diseases; inadequate, high costs and a fluctuating supply of dairy feeds; consumer health risk due to low quality milk and poor hygiene in informal markets; poor financial products and services for dairy producers and the dairy industry as a whole; absence of gender equality; and environmental degradation due to intensive use of land and climate change (Ministry of Agriculture, Livestock and Fisheries, 2013). Without addressing the problems that are noted above, the dairy sector will not

become sustainable and profitable the coming decades in Kenya, which is why the Government of Kenya aims to reform the dairy sector.

2.2 CLIMATE CHANGE IN KENYA

The Intergovernmental Panel on Climate Change (2014) defines climate change as “a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer”. These changes are seen in the onset and cessation dates of rainfall, duration and intensity of dry and rainy seasons, amounts and intensity of seasonal rainfall, strengths and direction of winds, outbreaks of diseases and pests and increase of floods and droughts (Okoba, 2018). Though climate change is not a new phenomenon, scientists stated that climate change is either directly or indirectly caused by human activities. Due to the emission of greenhouse gases, e.g. carbon dioxide, nitrous oxide, methane and ozone, and human activities such as burning fossil fuels, deforestation, agriculture, livestock breeding and heavy industries.

In Kenya, the climate is changing as well – though the country only represents less than 1% of global greenhouse gases (Government of Kenya, 2018). The surface temperature of Nairobi and its surroundings increased 2.5°C in the past 50 years (Government of Kenya, 2018). The long rain season became shorter and drier, while the short rain season became longer and more wet (Government of Kenya, 2018). Additionally, the country experiences longer and more intense periods of drought (Government of Kenya, 2018). Due to this change in climate, Kenya faces risks related to environmental degradation, water scarcity, urbanisation, gender inequality, public well-being and multidimensional poverty (Government of Kenya, 2018). In other words, climate change will affect the socio-economic conditions in Kenya and might undo developments from the past.

To address risks mentioned above, The Kenyan Government developed the National Climate change Action Plan 2018-2022 (NCCAP). This five-year action plan will lead Kenya towards its development goals, emphasising on sustainability, low carbon climate resilient development and the inclusion of vulnerable groups, e.g. women, youth, persons with disabilities and marginalised minority communities (Government of Kenya, 2018). Priority areas for The Kenyan Government are disaster risk management, food and nutrition security, water and the blue economy, forestry, wildlife and tourism, health, sanitation, and human settlement, manufacturing, energy and transport (Government of Kenya, 2018). Actions are coordinated by the National Climate Change Council, while the ministry is responsible for the approval of laws and regulation related to addressing climate change, as well as evaluation of policies (Government of Kenya, 2018). NCCAP 2018 – 2022 is not a single framework, as it is supported by other plans and policies such as the National Climate Change Response 2010, the

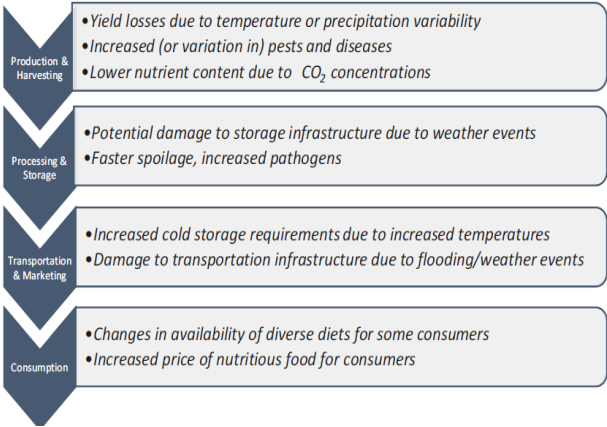
Kenya Climate Smart Agriculture Strategy 2017-209 and the Climate Finance Policy 2017 (Government of Kenya, 2018).

2.3 CLIMATE SMART AGRICULTURE

Scientist learn more and more about the effects of climate change on agriculture every day. Climate change will negatively affect the activities of farmers around the world, especially in Africa (figure 2). On the other hand, due to an increasing world population, demand for food will continue to rise the coming decades. Agriculture and food security are therefore an important topic for policymakers, with no exception for Kenyan policymakers. Besides the roadmaps mentioned above, the Government of Kenya aims to transform the agricultural sectors to meet challenges such as population growth, wealth creation and reducing poverty and degradation of natural resources (Ministry of Agriculture, Livestock and Fisheries, 2017).

FAO (2013) stated that CSA “aims to improve food security, help communities adapt to climate change and contribute to climate change mitigation by adopting appropriate practices, developing enabling policies and institutions and mobilising needed financiers”. According to Okoba (2018), CSA is built on three pillars: 1) increasing the productivity of farmers and raising their income, 2) enhancing resilience or adaptation of livelihood and ecosystems and 3) reducing and removing greenhouse gas emissions. CSA practices and technologies related to livestock and grass management are increasing livestock productivity, increasing grass land productivity, long term management and animal breeding, improved feeding and manure management (Table 1) (Kiiza, 2018). Kiiza (2018) concluded that members of GDFCS and ODFCS already adopted and implemented several CSA practices and technologies. However, the adoption of several CSA practices and technologies, e.g. biodigesters, milking bucket machines and rainwater harvesting, lagged due to limited awareness and high investment costs (Kiiza, 2018).

Figure 2: The effects of climate change on agricultural value chains



Source: World Bank (2015)

Table 1: CSA practices and techniques

Theme	Mitigation Measures
Livestock Productivity	<ul style="list-style-type: none"> Increasing livestock productivity within sustainable limits (i.e. milk yield/cow lifetime efficiency of cows) Increasing livestock productivity through improved herd and pasture management, breeding and veterinary services
Increasing Grass Land Productivity	<ul style="list-style-type: none"> Managing grazing intensity (stocking rate, rotations and their timing) Including deep-rooted fodder species and legumes in fodder crops and pastures while reducing synthetic nitrogen fertilizer Optimising nutrient allocation of manure across the farm Avoiding fires, especially if late and uncontrolled and favouring (fodder) bushes and shrubs on pastures and rangeland
Long Term Management and Animal Breeding	<ul style="list-style-type: none"> Optimising lifecycle of animals to reduce lifetime emissions (favourable ratio between lifetime and product) Optimising the balance between grassland and cropland concerning the factors of carbon sequestration, nutrient management and food production. Optimising recycling of residues and by-products that can serve for animal feed
Improved Feeding	<ul style="list-style-type: none"> Feeding more concentrates to ruminants to improve productivity and reduce enteric methane (even though volatile GHGH in manure is increased)
Manure Management	<ul style="list-style-type: none"> Avoiding wet storage of manure, using solid coverage and favour cooling/shading Manure management

Source: Kiiza (2018)

2.3.1 Biodigesters

Biodigesters are closed, airtight brick containers or plastic bags in which animal manure, crop residues and kitchen waste are deposited to ferment biogas; a process that is also called anaerobic digestion (World Bank, 2018). Biogas can be used by farmers for cooking, lightening and the generation of energy, whereas the residue can be used as a fertilizer for their crops. According to Zalm (2017), prices of biodigesters depend on their size, the location of installation and the contractor. Prices for brick containers range between \$550 and \$900 in 2011 (Zalm, 2017). In general, the farmer will be able to reimburse the investment within 2 – 3 years (Zalm, 2017) Although the initial investment might be high for small-scale farmers, income will be generated due to savings on conventional fuels, savings on fertilizers and higher crops yields (Zalm, 2017).

2.3.2 Rainwater Harvesting

Historically, farmers in Sub-Saharan Africa have been using rainwater to irrigate their fields for thousands of years. As a result, only six per cent of the total cultivated areas are irrigated in Africa (You, et al., 2010). Yet, due to climate change, rainfall will fall less predictable in the region, which will affect the production of agricultural products. African farmers can, however, harvest rainfall, store rainfall and use it to irrigate crops when rainfall is scarce. Methods to harvest rainwater are spate irrigation, floodwater spreading bunds, riverbed reclamation, preambled rock dams, water storage in soil, natural depressions, ponds and pans, cultivated reservoirs, surface dams, pits and basins and

rooftop and courtyard water harvesting (Guarnieri & Salman, 2017). Depending on which methods farmers use, costs will differ for each type of rainwater harvesting, ranging from zero to \$1000.

2.3.3 Milking Bucket Machines

Ombuna (2018) stated that the majority of dairy farmers milk their cows by hand in Kenya. Yet, hand milking exposes dairy animals to injury, disease transmission, incomplete emptying of the udder, also it is slow, tiresome and unhygienic (Ombuna, 2018). To tackle this issue, farmers can make use of milk machines. Milk machines extract milk from a cow by applying a constant vacuum to suck out the milk, transport it through hoses or pipes to a bucket or tank and gives external squeezes to maintain blood circulation in the teat of the cow (FAO, 1989). By adopting the use of milking bucket machines, dairy farmers will manage to milk herds faster, decrease labour costs and the workforce, improve the quality of their milk, face less challenges to find a farm sitter, cool milk faster, use time more efficient and reduces the stress on livestock (FarmersTrend, 2016). However, the costs of bucket milking machines are high for dairy farmers, as the prices of milking machines start at around \$830 (FarmersTrend, 2016).

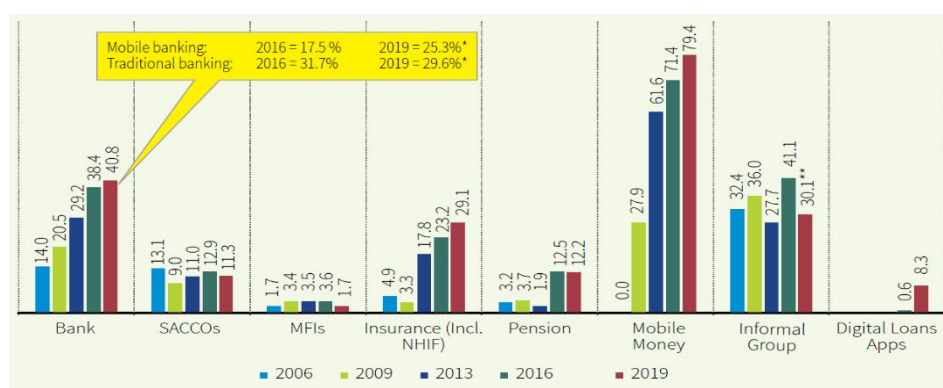
2.3.4 Maize Silage

Shumba (2018) stated that feed production and processing, and enteric fermentation caused by ruminants of beef, are two major contributors to greenhouse gas emissions, the former represents 45% and the latter 39%. Therefore, improved agricultural practices related to the production and processing of forage and better forage will enhance digestibility; thereby reducing the emission of greenhouse gasses (Gerber et al., 2013, as cited in Shumba, 2018). According to Shumba (2018), maize is an appropriate substitution for Napier, which is currently the favourite forage of small-scale dairy farmers, as intercropping maize with legumes will be more profitable because it improves the quality of both forage and soil, maize can be grown three times a year, depending on the variety, and maize is suitable for silage. In addition, maize silage requires low investment to adopt improved forage, making it an accessible CSA practice for small-scale dairy farmers.

2.4 FINANCIAL INCLUSION IN KENYA

According to the Global Findex Database (2017), 82% of Kenyan adults have access to an account that enables them “to make payments, save, borrow and manage risk.” Though gaps in access to finance still exist between men and women, as well as between richer and poorer parts of the population (Demirüç-Kunt, et al., 2018). Furthermore, the 2019 FinAcces Household Survey (2019) stated that 82% of Kenyan household have access to formal financial services (FSDK, 2019).

Figure 3: Usage of financial service providers in Kenya



Source: Kenya Bureau of Statistics (2019)

However, when looking at utilisation of financial products and services, only 30% of Kenyan households had access to traditional bank accounts, while increased access to financial services can be contributed to the development of mobile money accounts (figure 4). Only a small proportion of Kenyans use SACCOs and MFIs, the former 11% and the latter only 1.7%, to access financial products and services (FSDK, 2019). A description of FSPs that operate in Kenya is given in table 2 below.

Table 2: Financial service providers that operate in Kenya

FSP	Description	Examples
Commercial Bank	An organisation, either private or state owned, that conducts banking business by accepting deposits, while employing deposits in the form of credit.	Equity Bank Kenya, Kenya Commercial Bank, Cooperative Bank of Kenya, National Bank of Kenya, Commercial Bank of Africa
Micro-finance Finance Institution	An organisation that aims to contribute to socio-economic development by providing financial services to small and medium enterprises.	SMEP Microfinance Bank, Kenya Women Microfinance Bank, Uwezo Microfinance Bank Ltd, Faulu Kenya
SACCO	An organisation that conducts banking business by providing financial services to members, which is often a cooperation, of the organisation.	GDC SACCO Ltd, Mavumo Daima SACCO Ltd, Kenya Police Sacco, Mwalimu National
Mobile Banking	An organisation that conducts banking business through mobile telecommunication devices.	Mshwari, KCB Mpesa, Equity Eazzy, Tala, Mco-op Cash, Musoni Microfinance
Insurance Company	An organisation that insures liabilities, both short term and long term, of individuals and entities that pay premiums to the organisation.	Liberty Life Assurance Kenya Limited, National Hospital Insurance Fund, Allianz, AIG Kenya Insurance Company
Pension Fund	An organisation, either private or state owned, that makes investments with premiums of members, in order to disburse profits to members when these are retired.	The National Social Security Fund, Kenya Power Pension Fund, Jubilee Insurance Company Personal Pension Plan
Mobile Money	An organisation that owns, operates and manages a public system that sends, receives, stores and processes payments through electronic systems	Mpesa, Mobile Pay, Airtel Money, T-Kash
Informal Group	Unregulated schemes that persons establish to save money or access credit, often in the form of a group.	Village and Loans Savings Associates, Rotating Savings and Credit Associations, Accumulated

Sources: Adopted from Central Bank of Kenya (2015), SACCOs Societies Regulatory Authority (2019), Kenya Bankers Association (2014), Association of Kenya Insurers (n.d.)

A significant number of Kenyan households have access to financial services, however, the financial landscape regarding the agricultural sector looks different than Kenya as a whole. The Global Findex Database (2018) established that 81% of Kenyan households in rural areas have access to financial services – again, the adoption of mobile money accounts is an important factor. The main sources of farmers to financial services are social networks, followed by sales of assets and formal borrowing (FSDK, 2019). SACCOs are important financial service providers in rural areas as well, as 50 out of 174 SACCOs that have agricultural roots in Kenya (SASRA, 2019). The agricultural activities of these SACCOs are related to coffee, tea, sugarcane farming and dairy production (SASRA, 2019). Finally, though the uptake of mobile banking and money, Kenyan farmers still prefer cash as the most important method of payment (FSDK, 2019).

2.5 FINANCIAL PRODUCTS AND SERVICES

Financial products and services are issued to consumers and businesses by organisations shown in table 2 above. The products are contractual agreements between two parties, the financial service provider on one hand and the consumer or business on the other, that start a monetary relationship for a certain period of time (OpenRisk, n.d.). Wattel and Asseldonk (2018) refer to financial products as “a general term for all kinds of services around depositing and lending out of money, management of capital funds and money transactions, and buying and selling of financial risks.” In other words, financial products are credit and finance services, saving services, insurance and other risk instrument and payments (table 3). However, it should be mentioned that financial products and services can be referred to as assets, a consumer uses a mortgage to buy a house, the financial products itself is not a real asset or service (OpenRisk, n.d.)

Table 3: Financial Products and Services

Financial Product/Service	Examples
Credit and Finance Products	Agricultural input loans (inputs on credit), equipment loans or leases, warehouse receipt loans, value chain finance, group loans, working capital loans, investment loans, factoring, consumer loans (housing, consumption, education etc.)
Saving Products	Savings account, term deposit accounts, planned savings (school fees, mortgage, wedding), informal savings (Village and Savings and Loan Associations and solidarity groups)
Insurance and other Risk Instruments	Insurance (life, health, accidents, inventory, agriculture etc.), social security and safety nets, pensions, credit guarantees, credit default swaps
Payments Services	Domestic transfers, international transfers, remittances, mobile money, e-wallets, digital finance

Source: Adopted from Wattel and Wasseldonk (2018)

2.6 FARMERS AND FINANCE

In case of credit and finance services, financial service providers are reluctant to issue agricultural credit due to high risks. To mitigate these risks, financial services providers use the so called 5C's to collect information and assess borrowers. The 5c's refer to: character, capacity, capital, collateral and Conditions (Table 4) (Miller, 2008).

Table 4: The 5Cs

Indicator	Explanation
Character	The character gives an impression of the responsibility of the farmer and his/her financial history.
Capacity	The capacity tells the financial service provider whether a farmer has a strong business, what the cash flows are, if there are contingency plans, what the income-to-debt ratio is and whether the farmer has a realistic plan.
Capital	The capital tells how much equity a farmer invested in his business and whether a farmer can coop if business fails.
Collateral	The collateral tells what physical assets have and what their value is.
Conditions	The conditions tell about the intended purpose of credit and other economic factors that will influence the cashflow of a farmer.

Source: USAID (2008)

3. FIELDWORK AND DATA COLLECTION

The field work of this study was carried out in cooperation with GDFCS and ODFCS. The coming paragraphs discuss the geographical locations of the cooperatives, the research strategy of the field work, data collection at financial services providers, dairy farmers, suppliers of CSA practices and techniques, data collection and limitations of the study.

3.1 STUDY AREAS

3.1.1 Kiambu County

Kiambu County is located in the Central region of Kenya, covers 2543 Km² and borders Nairobi and Kijado Counties, Machakos, Murang'a, Nyandurua and Nakuru (figure 4) (County Government of Kiambu, 2018). There are four topographical zones: Upper Highland (1800-2550 AMSL), Lower Highland (1500-1800 AMSL) Upper Midland (1300-1500 AMSL) and Lower Midland (1200-1360 ASML) (County Government of Kiambu, 2018). Githunguri, where GDFCS was located, is found in the lower highland zone. Rainfall in Kiambu is bimodal, long rains fall between mid-March to May and short rains fall between mid-October to November, and annual rainfall varies from 600 mm to 2000 mm in different topographical zones (County Government of Kiambu, 2018). The mean temperature in Kiambu county is 26°C, ranging from 7°C in the upper highlands to 34°C in the Lower midlands (County Government of Kiambu, 2018).

According to the last housing consensus in 2019, the population of Kiambu County numbered 2.417.735 individuals (Kenya National Bureau of Statistics , 2019). The majority of inhabitants engage either directly or indirectly in agriculture. The main food crops are maize, beans, Irish potatoes, bananas and vegetables, while tea and coffee are important cash crops (County Government of Kiambu, 2018). Further, nearly 70 per cent of farmers own two or three cows on average, making the dairy industry a valuable sector in Kiambu County (County Government of Kiambu, 2018).

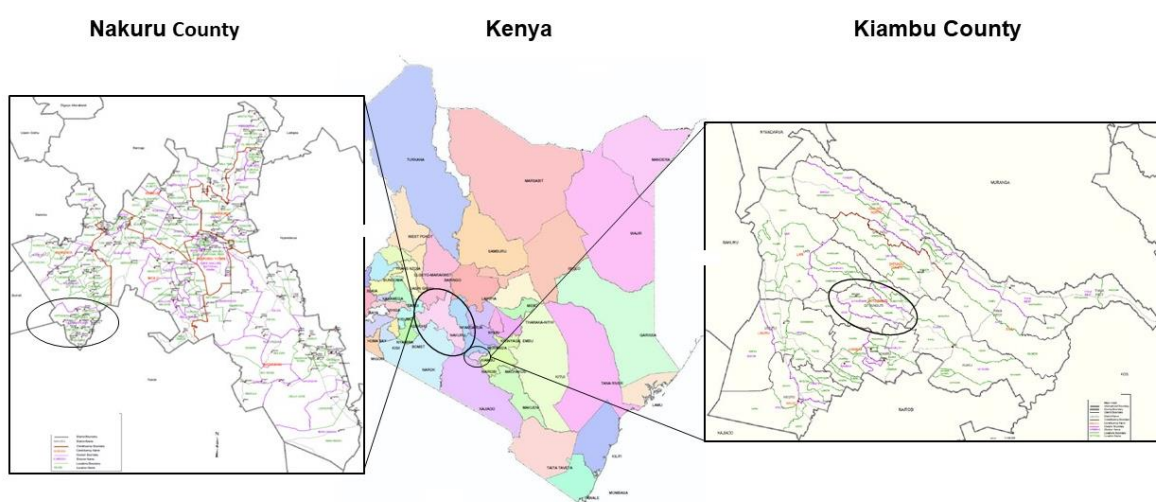
3.1.2 Nakuru County

Nakuru county is located in the Rift Valley province, covers 7498 Km² and borders Laikipia, Kericho, Narok, Kajioda, Baringo, Nyandarua and Bomet (figure 4) (County Government of Nakuru, 2018). The altitudes range between 900 to 2700 AMSL, with differences in rainfall in three climatic zones: Zone II (minimum of 1000 mm per annum), Zone III (between 950 and 1500 mm per annum) and Zone IV (between 500 and 1000 mm per annum) (County Government of Nakuru, 2013). Olenguruone, where members of ODFCS live, is in Zone II. Rainfall in Nakuru County is bimodal, too, with short rainfall between October and December and long rains between March and May (County Government of

Nakuru, 2013). The mean temperature ranges from up to 29.3°C between December and early March to 12°C in June and July (County Government of Nakuru, 2013).

According to the last housing consensus in 2019, the population of Nakuru County numbered 2.162.202 (Kenya National Bureau of Statistics , 2019). Major industries are animal feeds production, agricultural inputs, manufacturing industries dairy products, bakery and tourism (County Government of Nakuru, 2018) As with Kiambu County, livestock production and dairy production are major economic activities (County Government of Nakuru, 2013). The main food crops are maize, beans Irish potatoes, sweet potatoes, vegetables, herbs, spices and fruit, while the main cash crops include wheat, coffee, tea and Pyrethrum (County Government of Nakuru, 2018).

Figure 4: Location of and ODFCS (Left) and GDFCS (Right)



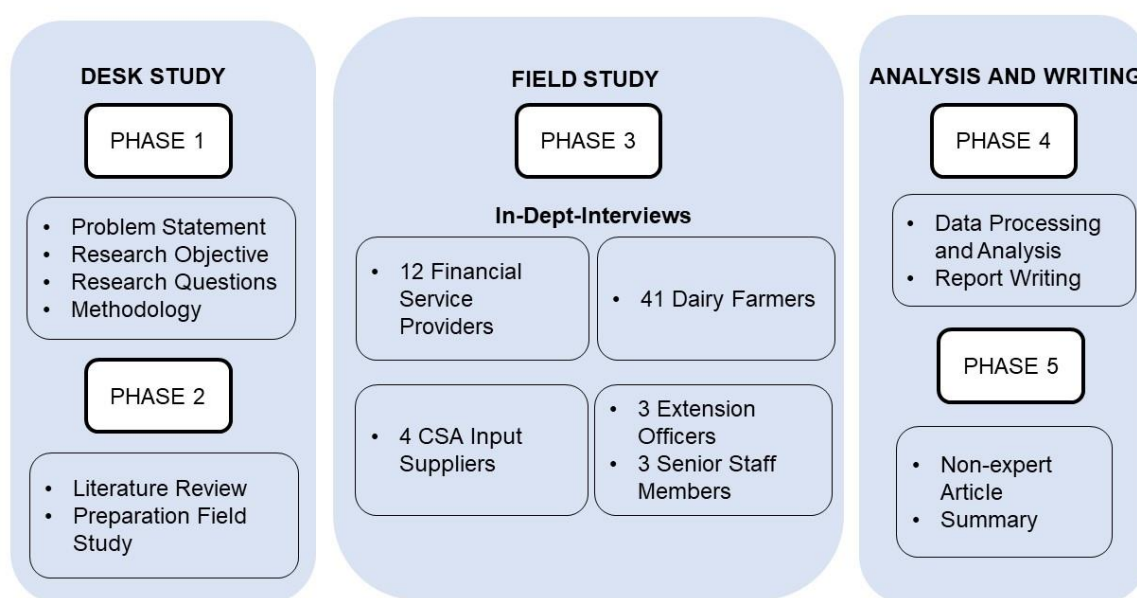
Source: Nakuru and Kiambu Governments (2018)

3.2 RESEARCH METHOD

Qualitative research, in the form of case studies, see sub-chapters 3.3.2 and 3.3.3 for more information, was conducted to understand the best financial practices of dairy farmers and the role of financial institutions in Githunguri and Olenguruone, as the aim of the study was to comprehend an in-dept understanding of experiences, thought and opinions of dairy farmers, FSPs and other actors regarding the adoption of CSA practices and techniques. By applying intensive research, the case studies of dairy farmers, FSPs and other actors sought to expose structural relations and interactions among the sample groups that led to the adoption of CSA practices and techniques among members of GDFCS and ODFCS. The revealed relationships, experiences, thoughts and opinions subsequently were utilised to develop interventions that will enable other members of GDFCS and ODFCS to adopt CSA practices and techniques as well.

A research strategy was developed to guide the study (figure 5). First, the desk study, both phase 1 and 2, led to a research proposal that was approved by VHL. After approval, a field study, which was phase 3 of the project, was carried out in cooperation with GDFCS and ODFCS in Kenya. In addition to members of GDFCS and ODFCS, FSPs and suppliers of CSA practices and techniques that operate in the regions were interviewed, too. A total of 41 dairy farmers and 21 other stakeholders were interviewed throughout a period of eight weeks. Unfortunately, due to circumstances, it was not possible to organise a consultation session during phase 3. As a result, an online consultation session was organised during phase 4 in cooperation with VHL. In addition to the consultation session, phase 4 consisted of processing and analysing the data which was collected throughout phase 3. The processed and analysed data led to a conclusion, discussion and several recommendations that were written down in the final chapters of this research report. Finally, a summary of the case study, was written to share the study with a wide audience.

Figure 5: Research Strategy



3.3 DATA COLLECTION

3.3.1 Desk Research

A desk study was conducted to elaborate, discuss and operationalise concepts and terms that were used during the study. Topics were the Kenyan dairy sector, climate change in Kenya, climate smart agriculture, financial inclusion, financial products and services and the 5C's. Furthermore, the desk study identified FSPs and suppliers of CSA practices and techniques in Githunguri and Olenguruone.

The following secondary sources were used to conduct the desk study:

- Scientific articles and publications from online databases
- Articles and publications from international institutions
- Articles and publications from Kenyan governmental institutions
- Websites from financial institutions and suppliers of CSA practices and techniques in Kenya

3.3.2 Field Study

Case studies, in the form of in-depth-interviews, collected qualitative data from GDFCS, ODFCS, FSPs, suppliers of CSA practices and techniques and dairy farmers. The objective of the in-dept-interviews was to understand the operations of FSPs and the relationships between FSPs, dairy cooperatives, dairy farmers and suppliers of CSA practices and techniques in Githunguri and Olenguruone (table 5). Further, dairy farmers who invested in biodigesters, rainwater harvesting, milking bucket machines and maize silage were interviewed to comprehend best financial practices, as well as reasons and costs related to the adoption of CSA practices and techniques (table 5). The in-dept interviews were semi-structured, see annex 2 for the topic-list that guided the in-depth interviews.

Table 5: Operationalisation Case Study

Type of Organisation	Interviewees	Sub-Research Question
Dairy Cooperatives	GDFCS: Quality and Extension Manager, DEOs ODFCS: General Manager, DEO, Chairman of the Board	SUBQ 2
FSPs	Githunguri: Branch Managers, Marketing Managers, Internal Audit, Chairman of the board Olenguruone: Branch Managers	SUBQ 1, SUBQ 2, SUBQ3, SUB4
Suppliers of CSA	General managers of hardware stores in both Githunguri and Olenguruone	SUBQ 2, SUBQ 8
Dairy Farmers	Dairy farmers that invested in biodigesters, rainwater harvesting, milking bucket machines and maize silage	SUBQ5, SUBQ6, SUBQ7, SUBQ 8

3.3.3 Sampling

The operational population of this research were dairy cooperatives, dairy farmers, FSPs and supplies of CSA practices and technologies in Githunguri and Olenguruone. From these participants, a sample was drawn to obtain a representation of involved stakeholders. The objective was to collect a representation of the operational population and a low-nonresponse bias, not a high response rate, as it was the aim of the study to obtain a comprehensive understanding about the linkages between the cooperatives, dairy farmers and other stakeholders.

Purposive sampling was used to select dairy farmers because in-dept knowledge and information was required, knowledge and information was not freely available and was time efficient. A total of 41 dairy farmers, 23 in Githunguri and 18 in Olenguruone, were interviewed. Members of both GDFCS and

ODFCS were selected with the help of Dairy Extension Officers (DEO) from both cooperatives, who provided transportation and translation. All participants were interviewed at their home. The length of the interviews was 30 to 60 minutes.

Snowball sampling was used to select FSPs and suppliers of CSA practices and techniques. A walk through Githunguri and Olenguruone identified several FSPs, see annex 1 for all identified FSPs in Githunguri and Olenguruone. After identification, FSPs and suppliers of CSA practices and techniques were invited to participate in the study. A total of seven FSPs were interviewed in Githunguri, whereas five FSPs participated in Olenguruone. In both villages two suppliers of CSA practices and techniques have been interviewed during the field study, three suppliers of water tanks and one company that sold biodigesters.

All FSPs and suppliers of CSA practices and techniques that participated are shown in table 6 below. In addition to local value chain actors, HIVOS and SNV were interviewed to discuss the Kenya Biogas Program in Nairobi (KBP).

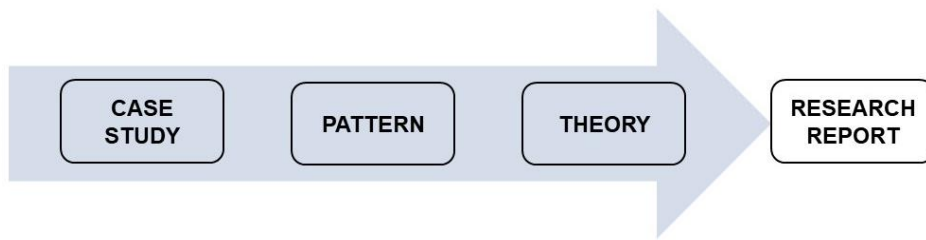
Table 6: FSPs and Suppliers of CSA practices and techniques that participated in the study

Village	FSPs	Suppliers of CSA
Githunguri	Family Bank, Eclof Kenya, K-Unity, Kidapa SACCO, Juakali SACCO, GDC Sacco, Fariji Sacco	Muroto Hardware, Takamoto
Olenguruone	CHAI SACCO, Kenya Women Micro-finance Bank, Stegro Sacco, Mavumo Daima Sacco, Transnational Bank	Akash Hardware, Dyma Hardware

3.4 DATA ANALYSIS

As described above, the study consisted of case studies of different actors in dairy value chains located in Githunguri and Olenguruone. After data collection, an inductive approach was used to analyse the collected data – which is a form of reasoning that starts with observations and ends with a specific theory, derived from those observations (figure 6). First, data was transcribed and uploaded to QDA Miner Lite, software developed to analyse qualitative data. With QDA Miner Lite, patterns and relationships were sought in the in-dept-interviews and labelled. To understand patterns, relationships and establish a theory, research questions were operationalised and coded in three different QDA Minter Lite documents: dairy farmers, FSPs and suppliers of CSA practices and techniques (annex 4). The coded data was retrieved from QDA Miner Lite and converted into Excel sheets to create an overview of the coded data. Subsequently, an iterative process was applied to comprehend the coded data and develop patterns that led to a common theory.

Figure 6: Inductive Research Approach



Source: adopted from Research Methodology (n.d.)

Besides qualitative data analysis, frequencies of qualitative answers were calculated and analysed by applying descriptive statistics in SPSS. The outcomes are discussed and are shown in both tables and graphs.

3.5 LIMITATIONS

Several limitations affected the outcome of the field study:

1. There is a possibility that language barriers affected the answers given by members of GDFCS and ODFCS. Since not all dairy farmers spoke English, DEOs occasionally acted as translators. Therefore, the possibility exists that data got lost due to translation.
2. Because purposive sampling was applied throughout the field study, the outcome of this research does not reflect best financial practices of all dairy farmers that operate in and around Githunguri and Olenguruone.
3. As a result of purposive sampling, there is a possibility that interviewees had a similar social-economic status. Thus, it is possible that poor dairy farmers were not able to share best financial practices regarding the adoption of CSA practices and techniques.
4. As a result of snowball sampling, and participation was voluntary, not all FSPs that operated in Githunguri were interviewed during the field study.
5. The study was carried out at the start of a new academic year. Therefore, the priority of dairy farmers, those who had children, was to collect school- and university fees for their siblings. Hence, the possibility exists that the financial practices of dairy farmers differ throughout, for example, the summer.

4. RESULTS

This chapter shows the results of the field study that was elaborated in the previous chapters. First, farmer characteristics, farming systems and the selected CSA practices are noted. Second, the financial practices of interviewees are elaborated. After the dairy farmers, FSPs and their financial products and services, relationships with dairy cooperatives and financial products for CSA practices are discussed. Finally, answers of interviews with suppliers of CSA practices, junior- and senior staff members and the Kenya Biogas Program are written down.

4.1 DAIRY FARMERS

A total of 41 dairy farmers participated in the case study (table 7), all interviewed dairy farmers were members of GDFCS and ODFCS. The former provided 23 members and the latter 18. At GDFCS, 11 male and 12 female dairy farmers shared their best financial practices and discussed CSA practices and techniques. Thirteen male and five female dairy farmers were interviewed at ODFCS. The mean age of dairy farmers was 51, with the youngest dairy farmer being twenty-three and the oldest dairy farmer being around eighty years old (table 8). The standard deviation of the mean age was 12.7 years. Thirty dairy farmers were married and had children, only five interviewees were single or widow (table 9).

Table 8: Mean, std. deviation, minimum and maximum age of interviewees (N=41)

	Valid	41
	Missing	0
Mean		51
Std. Deviation		12,992
Minimum		23
Maximum		80

Table 7: Sex of interviewees (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Sex	Male	11	13	24
	Female	12	5	17
Total		23	18	41

Table 9: Martial status of interviewees (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Martial Status	Unknow	6	0	6
	Married	15	15	30
	Single	0	2	2
	Widow	2	1	3
Total		23	18	41

Different types of dairy farmers participated in the study. First, there were dairy farmers who solely practiced agriculture. These were either individuals, as well as couples, and both small- and large-scale dairy farmers. The only source of income for such dairy farmers was dairy farming or mixed farming. The other group of dairy farmers had non-farming sources of income, too. The latter, either themselves or their relatives, were employed in, for example, the transportation-, construction- or artisanal sectors. Furthermore, there were dairy farmers that received rent, dividend and pensions.

In Olenguruone, six interviewees were retired teachers – their wives were often still teaching at primary or secondary schools. This can be an indication that Kenyans do look at dairy farming as a

supplementation to their pension, something that could illustrate the rather high average age of dairy farmers in Kenya. According a senior staff member of ODFCS:

“Farming is for old men. It is a big problem that young Kenyans do not see any opportunities regarding dairy farming. For them, dairy farming is something that is conducted by their parents and not themselves”.

4.1.1 Farming Systems

GDFCS and ODFCS are both dairy cooperatives, however, differences existed between the farming systems implemented by their members. Dairy farmers of GDFCS applied zero-grazing and intensive farming systems (table 10). On the other hand, members of ODFCS practiced semi-zero-grazing and extensive farming systems in Olenguruone. This can be attributed to the fact that members of GDFCS had limited access to land due to urbanisation and high population density, whereas dairy farmers had abounded land in Olenguruone. A significant number (50%) of dairy farmers owned between two and ten acres of land, eleven dairy farmers had less than two acres and only seven farmers owned more than ten acres of land (table 11). Dairy farmers in Githunguri often had to lease additional land to grow fodder, this practice was not encountered at dairy farmers in Olenguruone.

Table 11: Numbers of acres owned by interviewees (N=36)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Number of Acres	0 to 1 acres	4	1	5
	1 to 2 acres	6	0	6
	2 to 5 acres	5	6	11
	5 to 10 acres	2	5	7
	10 to 20 acres	0	3	3
	Above 20 acres	2	2	4
Total		19	17	36

Table 10: Farming systems of dairy farmers in Githunguri and Olenguruone (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Farming System	Zero-grazing	23	0	23
	Semi-zero-grazing	0	18	18
Total		23	18	41

Table 12: Production of milk per day and total number of cows of interviewees (N=35)

		Production of milk per day (litres)	Total Number of Cows
N	Valid	35	34
	Missing	6	7
Mean		92,66	10,71
Std. Deviation		174,781	12,583
Minimum		5	1
Maximum		750	65

Large dairy farmers in Githunguri sold 35 to 40 litres of milk to the cooperative on a daily base, while small dairy farmers sold 15 to 20 litres each day. In Olenguruone, the average milk production of a member was only five litres a day, of which only a proportion was sold to ODFCS. The minimum daily milk production of all interviewed dairy farmers was 5 litres and the maximum amount was 750 litres (table 12). Regarding the numbers of cows, some dairy farmers owned only one lactating cow, but others had up to 25 lactating cows. The average number of cows owned by members of both cooperatives was ten to eleven animals. Although members of ODFCS had access to more land, their productivity was small compared to the productivity of dairy farmers in Githunguri. In other words, there was no correlation between the number of acres owned by a dairy farmer and the milk production.

Almost all dairy farmers implemented mixed farming; only two large dairy farmers from GDFCS did not apply mixed farming. Cash crops grown by dairy farmers were coffee, tea, potatoes, cereals, legumes, vegetables, fruits, trees for timber and pyrethrum. In addition to animal husbandry and cash crops, dairy farmers often tended poultry, sheep and goats for domestic use, furthermore some interviewees had kitchen gardens as well.

4.1.2 CSA Practices and Techniques

4.1.2.1 Biodigester

Fourteen participants had purchased a biodigester, of which eight were found in Githunguri and six in Olenguruone (table 13). Also, three dairy farmers already bought a biodigester and awaited delivery – the current weather condition was not suitable due to heavy rains. Further, ten dairy farmers, both members of GDFCS and ODFCS, said that purchasing a biodigester would be a future project. In general, their argument was that because of financial constraints it was not possible to purchase a biodigesters at the moment. According to interviewees, purchasing a biodigester was not a priority, as other expenses, e.g. dairy inputs, school fees or reimbursements to FSPs, etc., were more important. In Githunguri, A dairy farmer and his wife stated:

“there are more important issues within our livelihood that need to be financed, buying a biodigester is not the most imminent and important investment”.

Even though most dairy farmers were positive towards the idea of adopting a biodigester, two interviewees saw no reasons to purchase a biodigester at all. Either due to financial constraints, as mentioned above, or because of limited awareness about biogas, a too small herd and the

implementation of particular farming systems. For example, dairy farmers from Olenguruone said that it is almost impossible to collect cow dung when semi-zero-grazing is practiced.

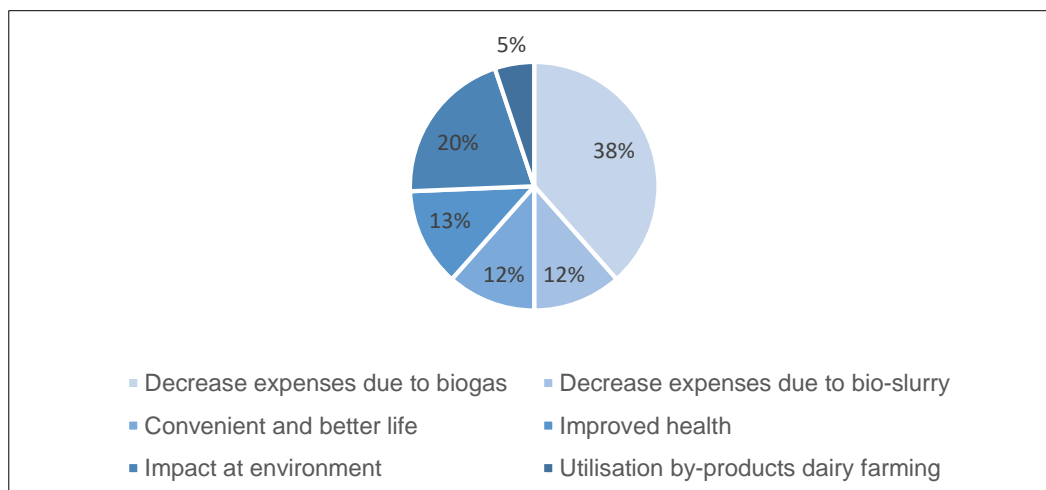
Table 13: Biodigesters in Githunguri and Olenguruone (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Biodigester	Not adopted	15	12	27
	Adopted	8	6	14
Total		23	18	41

Members of GDFCS and ODFCS gave six reasons to adopt biodigesters (graph 1):

- 1) to decrease expenses related to energy by substituting firewood, charcoal, electricity, liquified petroleum (LPG) and petrol with biogas;
- 2) to decrease expenses and increase agricultural production due to the replacement of chemical fertilizers by the residue of the biodigesters, better known as 'bio-slurry';
- 3) a more convenient and better life since there was no more need to seek firewood and light a fire, in order to prepare food, boil water and wash themselves, their siblings or cow utters before milking;
- 4) improved health of dairy farmers and their relatives due to the absence of fire and smoke around their houses;
- 5) environmental benefits since there was no more need to cut trees at their plots and the utilisation of cow dung, instead of disposing it, and substituting fossil fuels with renewable energy;
- 6) Utilising by products of their milk production (e.g. cow dung, cow skins, meat, proper breeds etc.)

Graph 1: Reasons and benefits of interviewees to adopt biodigesters (N=41)



A small-scale dairy farmer from Olenguruone stated that a biodigester would enable him to use bio-slurry to fertilise crops grown to feed his cows. Thereby decreasing production costs, as animal feeds were very expensive. In addition, the biogas would remove the need to purchase firewood, a commodity that was becoming more and more scarce in Olenguruone.

Table 14: Different types of biodigesters bought by members of GDFCS and ODFCS

Type	Material	Company	Price
Bag/Dome Biodigester	Polyethylene	Private enterprises that operate in Kenya	KSh 35.000 – KSh 229.000
Tube Biodigester	Polyethylene	Private enterprises that operate in Kenya	KSh 35.000 – KSh 229.000
Dome Biodigester	Concrete	Local individuals and construction enterprises, specialised enterprises and individual dairy farmers	KSh 100.000 – KSh 200.000

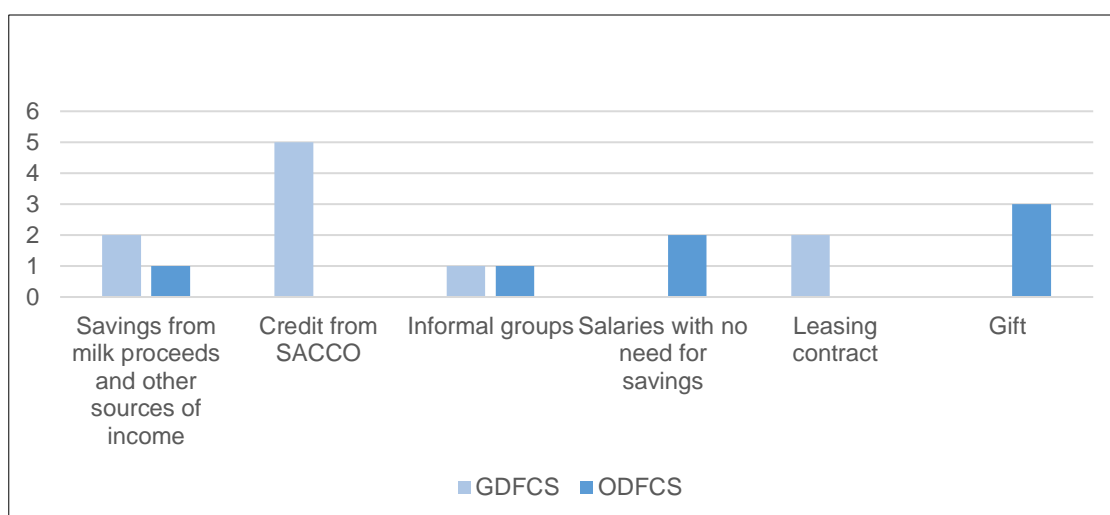
Three different types of biodigesters were identified during this study (table 14). These are polyethylene bag, dome and tube biodigesters and were purchased at enterprises that sell biodigesters in Kenya. The concrete dome biodigesters were constructed by local individuals and construction enterprises, specialised companies or dairy farmers themselves – a list of identified suppliers can be found in annex 3. The expenses related to adopting biodigesters depended on materials and size (table 14). In general, the price of biodigesters became more expensive when size increased and concrete was utilised. The prices of polyethylene bag, dome and tube biodigesters ranged between KSh 35.000 and KSh 229.000, though six interviewees paid less than KSh 100.000. The volumes of biodigesters ranged from a few cubic metres, to digests cow dung of only two animals, to installations that had volumes of 60 cubic metres; although seven dairy farmers had biodigesters with volumes below 20 cubic metres. Other important factors that determined prices of biodigesters were the involvement of dairy cooperatives, non-governmental organisations and suppliers that discounted biodigesters to promote products.

Members of GDFCS and ODFCS obtained money to purchase biodigesters through five different routes:

- savings from milk proceeds and other sources of income – additional agricultural activities, salaries, profits of businesses, pensions, etc. – of themselves and relatives;
- salaries from other sources of income without the need to make savings;
- applying to credit at SACCOs and commercial banks for specific and non-specific loan products;
- informal saving groups;
- down-payment-schemes and leasing contracts;
- and gifts.

Dairy farmers in Githunguri preferred to apply for credit at local SACCOs, make savings from milk proceeds and other sources of income and utilise leasing contracts (graph 2). On the other hand, members of ODFCS favoured purchasing biodigesters with salaries or savings from salaries, milk proceeds and other sources of income. The three gifted biodigesters in Olenguruone can be attributed to dairy farmers that participated in workshops that were organised by ODFCS and Netherlands Development Organisation (SNV).

Graph 2: Sources of funding biodigesters in Githunguri and Olenguruone (N=17)



4.1.2.1 Rainwater Harvesting

Rainwater harvesting was the most widely adopted CSA practice and technique by members of GDFCS and ODFCS. Twenty-six dairy farmers harvested rainwater at their farm, thirteen in Githunguri and thirteen in Olenguruone (table 15). The adoption of rainwater harvesting was not a recent phenomenon, as dairy farmers have been purchasing and constructing water tanks since the 1980s. Besides dairy farmers that already adopted rainwater harvesting, twelve interviewees stated that rainwater harvesting would be a future endeavour. Five dairy farmers were reluctant to adopt rainwater harvesting, due to reasons as having inadequate space to collect rainwater, satisfaction with boreholes and financial constraints.

Table 15: Rainwater harvesting in Githunguri and Olenguruone (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Rainwater Harvesting	Not adopted	10	5	15
	Adopted	13	13	26
Total		23	18	41

Three different types of rainwater harvesting were identified during the field study (table 16). Regarding materials, polyethylene water tanks were seen twenty-four times, concrete water tanks and ponds eight times and iron sheet water tanks were only encountered three times. The majority of interviewees owned medium water tanks made from polyethylene – the biggest polyethylene water tanks sold at local hardware shops had a volume of 10,000 litres. Prices of water tanks depended on size and materials, too (graph 16). Polyethylene water tanks were more expensive compared to concrete water tanks and ponds, considering that concrete water tanks and ponds had a greater volume. However, it should be noted that prices paid differed because dairy farmers have been purchasing water tanks since the 1980s, as prices of water tanks are subject to inflation and other economic influences. More information about the current prices of polyethylene water tanks at local hardware shops in Githunguri and Olenguruone can be found in sub-chapter 4.3.1

Table 16: different types of water tanks in Githunguri and Olenguruone

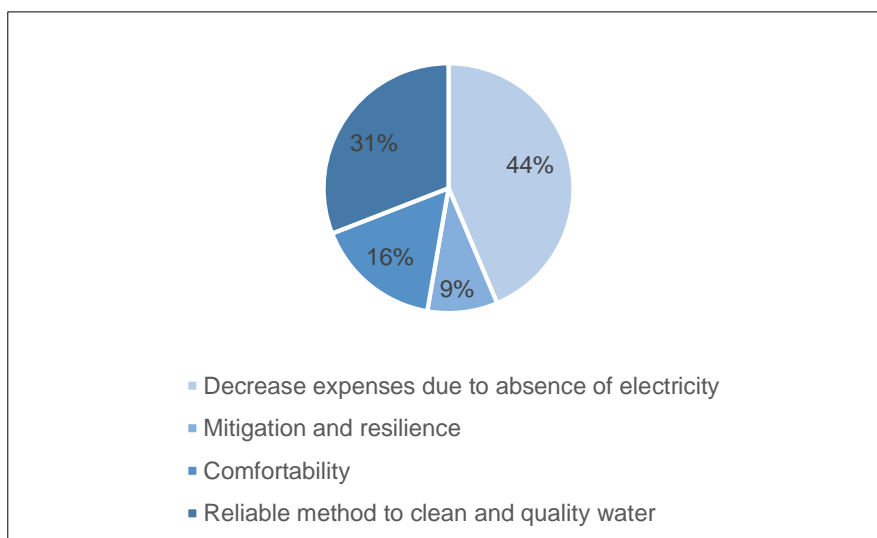
Type	Material	Volume	Price
Small water tanks	Polyethylene and iron	100 litres to 1000 litres	KSh 2600 to KSh 36,000
Medium water tanks	Polyethylene, iron and concrete	1000 litres to 10,000 litres	KSh 5000 to KSh 70,000
Big water tanks	Concrete and ponds	10,000 litres to 100,000 litres	KSh 10,000 to KSh 200,000

In addition to types of water tanks mentioned above, some farmers had small water tanks that were empty barrels or other tanks repurposed to harvest rainwater. For example, a female member of GDFCS was planning to utilise three old IBC containers, formerly used by Kenya Defence Forces, to start harvesting rainwater. Larger water tanks, on the other hand, either concrete water tanks or ponds, were specifically built to harvest rainwater.

Rainwater was harvested by dairy farmers for domestic purposes – preparation of food, drinking water and personal hygiene, drinking water for animals and sporadically to irrigate crops. The reasons and benefits to adopt rainwater harvesting were (graph 3):

- 1) to decrease expenses by stop utilising electricity – the price of electricity continues to rise in Kenya – to pump water from boreholes and little streams because, according to interviewees, *“water from god is free”* and *“water from heaven is clean and free”*;
- 2) to mitigate and become resilient during dry seasons, dairy farmers harvested rainwater to supplement boreholes and little streams;
- 3) to make life more comfortable, especially for aging dairy farmers, due to the absence of physical activities when collecting water;
- 4) and a reliable method to access fresh, clean and quality water without chances of contamination and intoxication.

Graph 3: Reasons and benefits of interviewees to adopt rainwater harvesting (N=41)



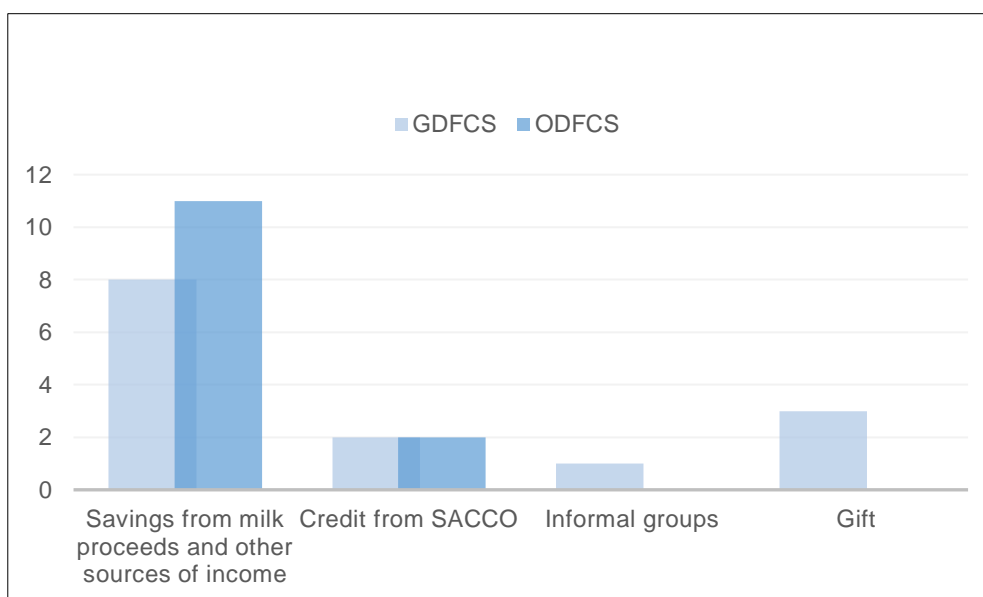
Water tanks and ponds to harvest rainwater were purchased by members of GDFCS and ODFCS with help of different financial methods and tools:

- savings of dairy proceeds, other agricultural activities and non-farming sources of income (e.g. salaries, pensions and profits of investments, etc.);
- credit disbursed by SACCOs;
- savings made at informal groups;
- and gifts.

The majority of interviewees, in both Githunguri and Olenguruone, accumulated savings from dairy proceeds, other agricultural activities and additional sources of income (graph 4). Members of GDFCS and ODFCS stated that, due to the prices of water tanks, there was no need to seek for sources of

finance outside their households. In Githunguri, three dairy farmers were gifted water thanks; once by parents, once by children and once by a member of parliament.

Graph 4: Sources of funding rainwater harvesting in Githunguri and Olenguruone (N=27)



4.1.2.2 Milking Bucket Machines

Milking bucket machines were the least adopted CSA practices and techniques during this study. Only two dairy farmers in Githunguri had milking bucket machines, while none of the members of ODFCS purchased milking bucket machines (table 17). Two other members of GDFCS had experimented with milking bucket machines, however, they were not satisfied due to problems related to hygiene, herd size and unskilled labourers. Almost all interviewees stated that before adopting a milking bucket machine, the size of their herd had to increase significantly. In fact, both dairy farmers that already adopted milking bucket machines had substantial numbers of cows. A young and ambitious member of GDFCS stated:

“Due to the size of my herd, there is no reason to use a milking bucket machine. However, I think about the possibility to buy one when my herd increases as this will be more convenient. I will have no problems with labourers anymore and milking requires less labourers”.

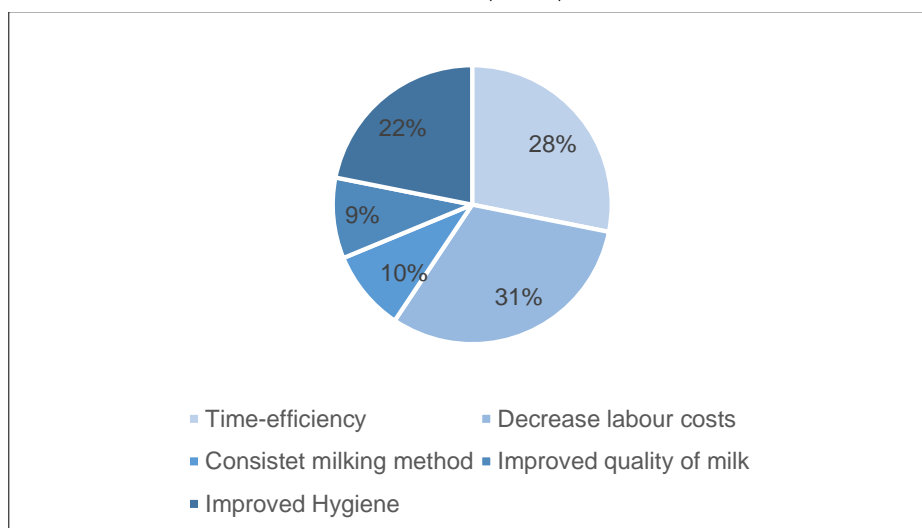
Table 17: Milking Bucket Machines in Githunguri and Olenguruone

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Milking Bucket Machine	Not adopted	21	18	39
	Adopted	2	0	2
Total		23	18	41

The main reasons and benefits of interviewees to purchase a milking bucket machine were (graph 5):

- 1) time-efficiency due to increasing productivity;
- 2) to decrease labour costs as less labourers are needed to milk the cows;
- 3) consistent milking method;
- 4) better milk quality;
- 5) and improved hygiene when the milking bucket machine is handled by an experienced labourer.

Graph 5: Reasons and benefits of interviewees to adopt milking bucket machines (N=421)



Both bucket milking machines adopted by two members of GDFCS had a capacity to milk three cows simultaneously, other systems tried by dairy farmers could only milk one cow at the same time. Expenses related to the former were KSh 250.000 and KSh 350.000, while a dairy farmer only paid KSh 40.000 for the latter – which was, according to the translating DEO, more a kind of a gift. The estimated prices of milking machines, by dairy farmers that thought about purchasing a milking bucket machine, ranged from KSh 90.000 to KSh 230.000. The financial products utilised to purchase the milking bucket machine of KSh 350.000 was a development loan from Agriculture Finance Corporation, a governmental body that provides credit for the purpose of developing agriculture in Kenya. Since it was a development loan, the money was not solely used to purchase a milking bucket machine but to

construct a cow shed, too. Additional information about development loans can be found in sub-chapter 4.2.1. Lastly, only one specific company that produces milking bucket machines was mentioned during the interviews: Delaval from South Africa.

4.1.2.3 Maize Silage

In Olenguruone, thirteen dairy farmers adopted the CSA practice and technique of maize silage (table 18). On the other hand, the adoption of maize silage among interviewees of GDFCS was lower. An important reason for the uptake of maize silage in Olenguruone were extensive and long periods of droughts during previous years. As a result, ODFCS encouraged its members to adopt maize silage to become resilient. Another essential factor was the fact that members of ODFCS had sufficient land to grow their own fodder, whereas members of GDFCS lacked land to grow fodder; making it more difficult for the latter to adopt maize silage. In addition, dairy farmers from Githunguri tended to prefer Napier due to the high productivity of the crop – more Napier grew at their plots with a higher frequency.

Table 18: Maize Silage in Githunguri and Olenguruone (N=41)

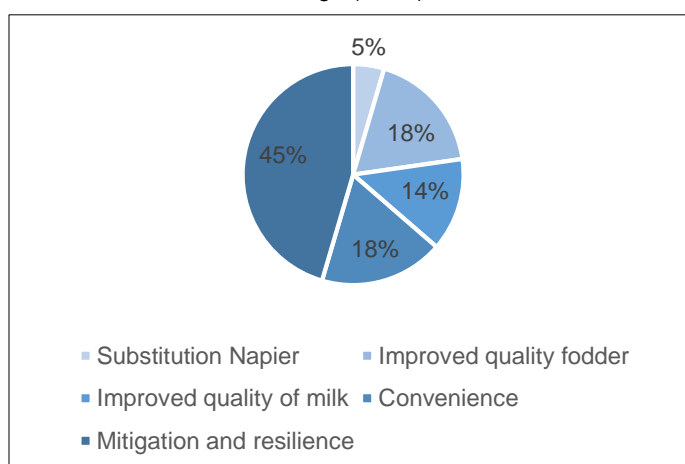
		Dairy Cooperative		Total
		GDFCS	ODFCS	
Maize Silage	Not adopted	20	5	25
	Adopted	3	13	16
Total		23	18	41

Expenses related to the preparation of maize silage depended on several factors: costs of planting and growing maize, labour to harvest maize, transportation from land to farm, whether a dairy farmer had to hire a chaff cutter, purchasing polyethylene material to cover the silage pit and the option of dairy farmers to buy additional maize from other farmers. Of course, the amount of maize silage has to be taken into consideration, too. The interviewed dairy farmers prepared maize silage of 6.5 tonnes up to 20 tonnes. Prices to prepare maize silage, according to interviewees, ranged from KSh 5000 to KSh 200.000 in Githunguri and Olenguruone. Many dairy farmers stated that initial expenses were high, however, the benefits of maize silage compensated their costs without any doubts. A dairy farmer from Olenguruone stated during the interview:

“I have several pits with maize silage that were very expensive, however, my money is well spend”.

Several reasons were given by members of GDFCS and ODFCS to adopt maize silage (graph 6) First and foremost, maize silage was able to substitute Napier as fodder during dry seasons, especially in Olenguruone. Because Napier, which grows abundantly in the wet season, ceases to grow throughout the dry season. Consequently, dairy farmers faced food shortages and animals deceased or

Graph 6: Reasons and benefits of interviewees to adopt maize silage (N=41)

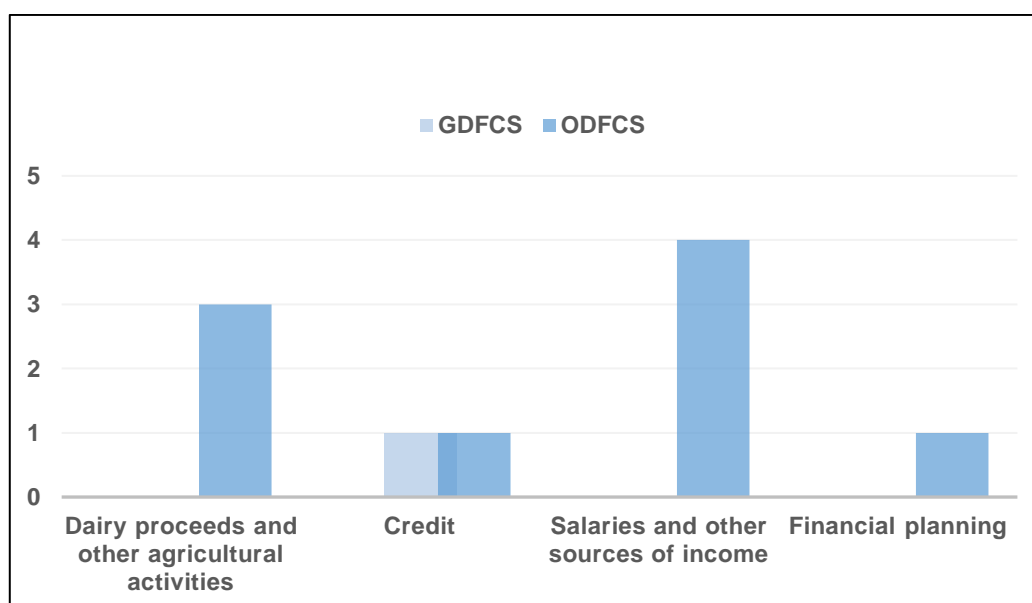


had to be sold. By preparing maize silage, dairy farmers mitigated and became resilient because, if stored properly, maize silage can be utilised as fodder throughout the dry season. Second, the quality of fodder increased significantly due to the nutrients that are found in maize. As a result, thirdly, interviewees stated that the quality and quantity of their milk production increased. Fourth, it became more convenient for dairy farmers to feed their animals, as there was no more need to harvest and cut Napier every time. Finally, dairy farmers had the idea that their animals seemed to like maize silage and became more happier, possibly due to improved nutrients. One member of ODFCS said:

“My cows seem to feel good after eating maize silage”.

Financial methods to pay for the preparation of maize silage differed from farmer to farmer (graph 7). Two dairy farmers applied for loans, both development loans and soft loans, at their SACCOs, while seven members of ODFCS preferred to use dairy proceeds, other agricultural activities and other sources of income. Two interviewees applied for credit at local financial institutions and one dairy farmer implemented financial planning.

Graph 7: Sources of funding maize silage in Githunguri and Olenguruone



4.1.3 Relationships with Financial Service Providers

4.1.3.1 Formal Financial Service Providers

Members of GDFCS and ODFCS utilised different FSPs to access financial products and services (graph 19). In Githunguri, the most important FSP for dairy farmers was GDC SACCO, as 20 out of 23 (87%) interviewees stated that the products and services of this FSP were utilised. More in dept information about FSPs can be found chapter 4.3, The second most important FSP members of GDFCS was K-Unity in Kiambu. Further, four interviewees were customers of Cooperative Bank of Kenya. In Olenguruone, both Mavumo Daima Sacco and Transnational Bank of Kenya were the favourite FSPs of members of ODFCS, up to 80 per cent of the interviewees were members or clients of these FSPs, followed by Imarisha Sacco and Equity Bank Kenya Limited. Other FSPs were utilised sporadically in both Githunguri and Olenguruone.

The reasons to become a member or a client of specific FSPs differed. Answers of interviewees showed that dairy farmers often choose a specific FSP for different sources of incomes and activities. To illustrate, dairy farmers collected dairy proceeds through a SACCO with roots in dairy farming, tea farmers were members of SACCOs that had experience with tea plantations and teachers received salaries at Imarisha SACCO. A SACCO that was established to offer financial products and services to Kenyan teachers in 1978. Further, commercial banks such as Cooperative Bank of Kenya and Equity Bank Kenya Limited were often used by interviewees to finance activities, as well as the collection of non-farming sources of incomes, that were not related to agriculture. Other reasons mentioned by interviewees to choose specific FSPs were interest rates, loan application processes and personal experiences. Commercial banks, for example, had higher interest rates and difficult and time-

consuming loan application processes due to a lack of knowledge about the dairy sector. Regarding the ease of doing business with specific SACCOs, a dairy farmer from Githunguri said:

“GDC Sacco is there for the dairy farmers”.

Table 19: Utilised FSPs in Githunguri and Olenguruone (N=40)

			Dairy Cooperative		Total
			GDFCS	ODFCS	
Utilisation Financial Service Providers	GDC Sacco	Count	20	0	20
	K-Unity Sacco	Count	7	0	7
	TAI Sacco	Count	2	0	2
	Mavumo Daima Sacco	Count	0	14	14
	Kipsigis Edis Sacco	Count	0	1	1
	Imarisha Sacco	Count	0	9	9
	Kenya Woman Microfinance Bank	Count	0	1	1
	Faulu Microfinance	Count	0	1	1
	Transnational Bank	Count	0	13	13
	Cooperative Bank of Kenya	Count	4	2	6
	Absa Bank Kenya Plc	Count	1	0	1
	Equity Bank Kenya Limited	Count	2	5	7
	KCB Bank Kenya Limited	Count	0	3	3
	Family Bank Limited	Count	0	1	1
	Agricultural Finance Cooperation	Count	1	0	1
Total		Count	22	18	40

Dairy farmers utilised different financial products and services. The first and foremost financial product utilised by interviewees were payments and transactions of dairy profits and other sources of income such as salaries, pensions and dividends. As discussed above, interviewees had accounts at different FSP for several sources of incomes. Further, dairy farmers did use credit products to invest in their dairy farms. The different loan products can be divided into short- and long-term financial products and had different purposes (table 20). Besides credit, savings products were utilised by members of GDFCS and ODFCS as well. These savings were accumulated whenever there was a surplus of profits and were not fixed. Though dairy farmers made occasional savings, members of GDFCS and ODFCS stated that SACCOs actively stimulated purchasing shares. As a result, interviewees preferred to purchase shares instead of making savings, since shares could be used to obtain dividend and increase the amount of credit that a dairy farmer could apply for. The general rule was that members of SACCOs can apply for credit that is three times as high as the amount of shares in their portfolio. In other words, interviewees tended to substitute savings with buying shares of SACCOs.

Four dairy farmers discussed insurance throughout the interviews. Only one dairy farmer had insured cows at Jubilee and SIC Insurance Company, as that particular farmer had experiences with the foot-and-mouth disease. Another dairy farmer used to ensure his animals, however, due to bad experiences with insurance companies' contracts were not extended. Also, two interviewees had health insurance. The dairy farmer that did not extend his contract stated that:

“Kenyans tend not to use insurance because they think that there are less risks within their own shambas. Furthermore, Kenyans do think that such risks are more manageable instead of risks exposed to outside their shambas. For example, a car that needs to be insured when driving on public roads”.

Table 20: Reasons of dairy farmers to utilise credit

Types of Credit	Examples
Short-term finance	<ul style="list-style-type: none"> ▪ Purchasing dairy inputs ▪ School- and university fees ▪ Expenses related to children ▪ Emergencies ▪ Preparation of maize silage (Olenguruone) ▪ Investment in biodigesters
Long-term finance	<ul style="list-style-type: none"> ▪ Purchasing vehicles (lorries, cars and tractors) ▪ Construction of cowsheds ▪ Mortgages ▪ Buying land ▪ Purchasing cows ▪ Development of dairy farm (including, chaff cutters, water tanks and biodigesters)

4.1.3.2 Informal Financial Service Providers

In addition to access to formal finance, as was described above, another important source of access to finance of dairy farmers were informal saving groups. Interviewees gave different names and descriptions for such informal saving groups: merry-go-round, VSLA, family group, solidary group, lead farmer group and table banking. In general, such informal savings groups are known as Rotating Savings and Credit Organisations (ROSCA) and Accumulating Savings and Credit Organisations (ASCA). A total of 30 interviewees (73%) stated that they themselves or relatives were members of informal saving groups (graph 21). Of those thirty dairy farmers, ten were members of more than one informal saving group, with the maximum of memberships per dairy farmer counting up to three. The informal saving groups either consisted solely out of women, better known as woman groups, but also men were members of informal savings groups. The small informal saving groups numbered around five dairy farmers, whereas bigger informal groups had up to 80 members.

Table 21: Usage of Informal Groups by Members of GDFCS and ODFCS (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Usage of Informal Groups	No	1	3	4
	Yes	11	13	24
	Relative	4	2	6
	No Answer	7	0	7
Total		23	18	41

Either monthly, every two weeks or weekly, members of informal groups saved cash to disburse to an informal saving group. Depending on the social economic situations of group members, dairy farmers made contributions to informal groups ranging from KSh 100 to KSh 10.000. Some informal groups had accounts at local FSPs to store cash, while others did not utilise such services and saved cash at their own homes. According to members of GDFCS and ODFCS, there were several reasons to become a member of an informal group:

- 1) access to merry-go-round groups;
- 2) access to forms of table banking;
- 3) to purchase household items, e.g. cutlery, furniture and tents;
- 4) to finance funerals or weddings;
- 5) to buy dairy farm inputs;
- 6) to make savings in order to build rentals;
- 7) to invest in maize silage and biodigesters;
- 8) and to share ideas and knowledge.

4.1.3.3 Mobile Money and Banking

The phenomena's mobile money and mobile banking were embedded in the lives of dairy farmers in Githunguri and Olenguruone. Thirty-four (82%) dairy farmers stated that mobile money was utilised in the form of M-Pesa – the most popular mobile phone-based money transfer service in Kenya (graph 22). Dairy farmers used mobile money to transfer money, collect payments and make savings. As stated by interviewees, the high uptake of mobile money can be contributed to safety, convenience, efficiency, reliability and transparency.

Table 22: Usage of Mobile Money by members of GDFCS and ODFCS (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Usage of Mobile Money	Not Adopted	0	1	1
	Adopted	18	16	34
	No Answer	5	1	6
Total		23	18	41

Mobile banking, on the other hand, was less adopted among members of GDFCS and ODFCS. Fourteen dairy farmers (34%) utilised services such as M-Shwari and M-Kesho (table 23). However, it should be noted those 14 interviewees stated that mobile banking was only utilised in cases of emergency. The argument given to use mobile banking when emergencies occurred was that interest rates of mobile banking were considered to be high, 7.5% interest per month, by dairy farmers. Two other interviewees said that communications with such companies was difficult and transparency was lacking. As a result, dairy farmers were reluctant towards mobile banking.

Table 23: Usage of Mobile Banking by members of GDFCS and ODFCS (N=41)

		Dairy Cooperative		Total
		GDFCS	ODFCS	
Usage of Mobile Banking	Not Adopted	14	4	18
	Adopted	3	11	14
	No Answer	6	3	9
Total		23	18	41

4.2 Financial Service Providers

Twelve FSPs were interviewed during the fieldwork, seven in Githunguri and five in Olenguruone, that can be divided into three categories: SACCOs, MFIs and commercial banks (table 24). All FSPs had physical branches in the villages, though differences existed regarding the scope of organisations. There were FSPs that only operated in the surrounding regions of Githunguri and Olenguruone, while others had operations nationwide. The number of members or clients did reflect the scale of operations of FSPs. To illustrate, small and local SACCOs had members and clients that numbered from thousands to several ten thousand, whereas national commercial banks could have over a million clients. The interviewed FSPs had different target groups as well. Local SACCOs, for example, were focused at specific sectors: dairy farmers, tea farmers, artisans and staff members of companies, whereas MFIs and commercial banks targeted a wide range of both individuals and corporations operating in different sectors at a regional and national scale. However, due to diversification of memberships, local SACCOs, too, explored whether it was possible to extend the memberships beyond their initial target groups. The oldest FSPs were founded over 40 years ago, while others were established only several years back. Products and services provided by interviewed FSPs were payment systems, credit and savings products, insurance and other risk instruments, mobile money and mobile banking. All products and services provided by the interviewed FSPs are elaborated in the paragraphs below.

Table 24: Interviewed FSPs in Githunguri and Olenguruone (N=12)

		Village		Total
		Githunguri	Olenguruone	
Category	SACCO	5	3	8
	Commercial Bank	1	1	2
	Micro-financial Institution	1	1	2
Total		7	5	12

4.2.1 Financial Products and Services

4.2.1.1 Payment Services

First of all, FSPs offered payment services to members and clients. Especially SACCOs, as most were founded by cooperatives to become financial hubs for their members. To illustrate, dairy cooperatives established SACCOs to disburse proceeds to dairy farmers, whereas tea cooperatives had SACCOs that paid salaries to farmers that own tea plantations. An important aspect of the payment service was that SACCOs acted as overdraft facilities – it was possible for farmers to withdraw more cash than is stored in his/her account. This system is better known as “check-off system” and can be utilised by farmers

to purchase farm inputs and food for human consumption at stores owned by cooperatives. At the end of each month, the total amount of purchased goods is deducted from salaries before these are disbursed to members. In addition to salary payments and check-off systems, it was possible to withdraw cash at branches and automated teller machines (ATM); check the balance of current and savings accounts at branches; money transfers to both individuals and organisations; and utilise agency-banking when there was no possibility to visit a branch of a FSP.

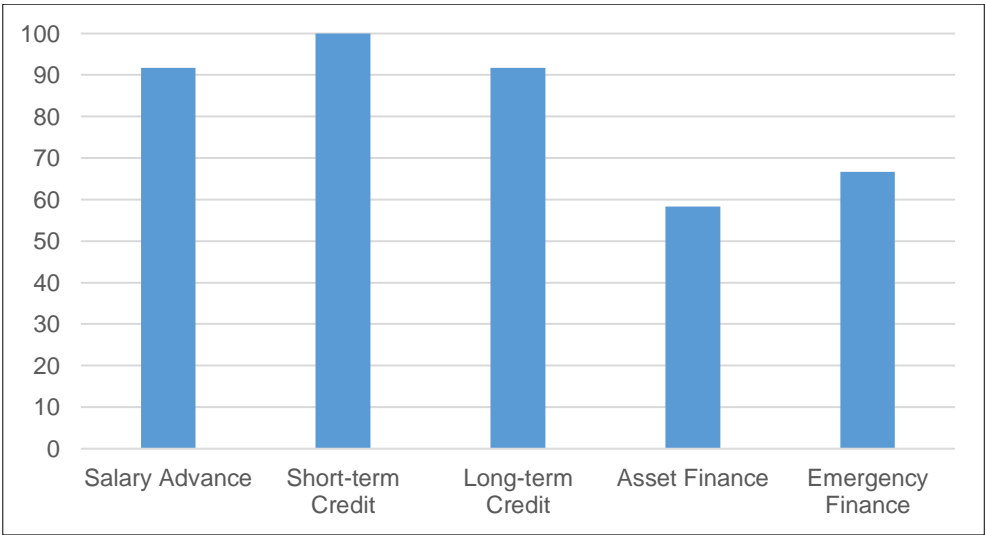
All payments services discussed above were offline, however, all interviewed FSPs were experimenting with online services that enabled members and clients to check balances, transfer funds, send and receive M-Pesa and access credit.

4.2.1.2 Credit Products

FSPs offered five distinctive credit products to members or clients: salary advance, short-term credit, long term credit, asset finance and emergency finance (graph 8). Ninety per cent of FSPs provided salary advance to members or clients. Salary advance is a short-term loan related to the income, e.g. dairy proceeds, tea profits and other sources of income, of a specific member or client. After disbursing salary advances, according to a staff member of SACCO in Githunguri, members and clients utilised salary advance to purchase food, agricultural inputs and low-cost assets. In general, the amount disbursed by FSPs did not exceed KSh 100.000 and had to be reimbursed within one year. A staff member of a SACCO in Olenguruone stated that salary advances were there to:

“Fill gaps when members are in immediate need of cash”

Graph 8: Credit products provided by FSPs in Githunguri and Olenguruone (N=12)



Short-term credit products were similar to salary advance, however, differences existed. First, short term credit is not only related to the income of a member or client. Short term credit also involved increased amounts of money and the lifespan took longer than salary advances. In general, short term loans had reimbursement periods from several months up to four years – every FSP had different terms and conditions. Short term credit was often unsecured, meaning that collateral, savings and the acquisition of shares of SACCOs were not obligated when applying for such financial products. According to staff members of FSPs, short term credit was utilised by dairy farmers to purchase dairy inputs, dairy cows, AI services, other relevant assets for dairy farmers, CSA practices and techniques and to pay school- and university fees of their children. All interviewed FSPs provided short-term credit products to members and clients in Githunguri and Olenguruone (graph 8).

Except for one SACCO in Olenguruone, all interviewed FSPs (90%) offered long-term credit products that are better known as development loans (graph 8). Development loans were utilised by dairy farmers to invest in their dairy farms, construct and extend cowsheds and purchase land, vehicles, machinery and CSA practices and techniques. In contrast to short-term credit products, long-term credit products were secured with collateral, e.g. land, houses, cowsheds, vehicles, deposits, shares and guarantors. A typical development loan ranged from one to six years. The size of a development loan depended on the needs of dairy farmers and the provided collateral. Another important loan characteristic of long-term credit was that FSPs in general did not disburse 100% of the value requested by a dairy farmer, but rather a certain percentage (70%/80%) of the value of the investment. Sometimes this percentage was fixed, while the collateral provided, as well as other forms to secure a loan, by a dairy farmer affected the percentage of the value of the investment that is disbursed at other times.

Besides development loans, dairy farmer had access to asset finance at 60% of the interviewed FSPs (graph 8). The major difference between asset finance and other forms of long-term credit was that asset finance could be solely utilised to purchase assets, e.g. farm machinery, equipment and vehicles, and not to build cowsheds and buy land. The lifetime of loans to finance assets was similar to development loans and loan ceilings were not always fixed. Since, as with development loans, FSPs often disbursed a percentage of the amount of the total value of the loan application. Again, collateral provided by dairy farmers affected the amount of credit disbursed by FSPs.

At almost 70 percent of the FSPs, member and client did have access to emergency loans (graph 25). Emergency finance was utilised by dairy farmers in case of, for example, health issues and the sudden death of relatives. The emergency loans were often characterised by fast loan application processes due to emergency situations.

4.2.1.3 Savings Products

FSPs in Githunguri and Olenguruone offered saving products to members of GDFCS and ODFCS. The savings products can be roughly divided into three categories: current accounts, savings accounts and fixed deposit accounts (table 25). Current- and savings accounts had the same characteristics, though a major difference was the absence of interest on the current account. However, both accounts were interchangeable; some FSPs only used current accounts, whereas at other savings accounts were obligated. Further, some FSPs provided both current account and savings accounts to its members and clients. In other words, current accounts and savings accounts can be seen as compatible. In contrast to current accounts, which are utilised by all sorts of target groups, savings accounts differed because there were distinct savings accounts for target groups: children, young-adults, adults, parents, groups, etc, with specific characteristics and benefits. The fixed deposit account enabled dairy farmers to deposit savings for a fixed period of time, resulting in a higher interest rate given on deposits. Characteristics of such accounts differed, as the minimum fixed periods of time and interest rates were not the same at all FSPs. For example, fixed deposits could be made with a minimum of one month at one SACCO, but members had to deposit savings for a minimum of three years or more at other organisations.

Table 25: Definitions of saving products offered to dairy farmers by FSPs in Githunguri and Olenguruone

Product	Definition
Current Account	An account that dairy farmers can use to receive milk proceeds and other sources of income and transfer money to manage personal finances. Account holders do not get any interest on their balance.
Savings Account	An account that dairy farmers can use to receive milk proceeds and other sources of income, manage personal finances and make deposits. Account holders do get variable interest on their balance.
Fixed Deposit Account	An account that dairy farmers can use to make deposits that are fixed. Account holders do get interest on their balance, often interest is related to the time that money is stocked in the account.

4.2.1.4 Insurance Products

At four FSPs, four in Githunguri and one in Olenguruone, dairy farmers had the option to insure themselves, family members or their businesses. In addition to these four organisations, a fifth had started to incorporate the development of insurance products in its portfolio in Githunguri. The insurance products at different FSPs looked similar: personal insurance (health, temporarily disability, compensation in the events of death, funeral), vehicle insurance (cars, lorries, motorbikes, school busses, vans, etc.), livestock insurance (compensation in the event of death of livestock due to complications). Regarding livestock insurance, a staff member of a SACCO stated:

“If a cow dies, and this is confirmed by a veterinary, the insurance company will disburse money to the farmer to buy a new cow”.

Three FSPs established separate entities that offered insurance products to its members or clients. In other words, dairy farmers could insurance themselves, or their livestock, at subsidiaries of FSPs, not at the actual FSPs. Besides the establishment of subsidiaries, FSPs were experimenting with the possibility of arranging partnerships with insurance companies, to provide insurance products to its members and clients.

4.2.2 Relationships with Dairy Cooperatives and CSA Suppliers

4.2.2.1 Dairy Cooperatives

FSPs did had relationships with cooperatives, suppliers and other FSPs. Two FSPs had direct relationships with GDFCS and ODFCS, since both were subsidiaries of the dairy cooperatives (table 26). Other FSPs did not have direct relationships with GDFCS and ODFCS, however, linkages existed between them and the dairy cooperatives. Two SACCOs were established to offer members of the cooperatives a channel to transfer milk proceeds and have access to finance. In Githunguri, a staff member of the subsidiary stated:

“The relationship between the cooperative and this SACCO can be described as brother and sister”.

The subsidiary of GDFCS was established over a decade ago, was well positioned, offered a wide range of products to members of GDFCS, as well as individuals and companies that were not members of the cooperative, and acted almost independently from the cooperative. On the other hand, the subsidiary of ODFCS was young, not as well positioned as other FSPs located in Olenguruone, had a small portfolio and daily operations were connected to the cooperative.

Table 26: Relationships of FPSs with cooperatives, suppliers and other FSPs

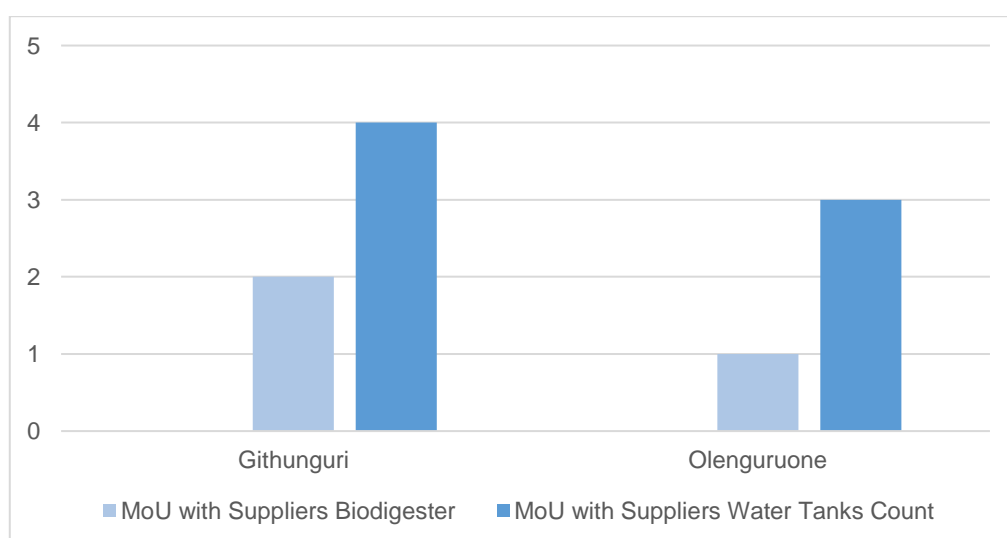
		Dairy Cooperative		Total
		GDFCS	ODFCS	
Relationship with cooperatives	Direct	1	1	2
	Nondirect	6	4	10
Total		7	5	12

While other FSPs had no direct relationship with GDFCS and ODFCS, members of both cooperatives utilised the products and services of these FSPs. To illustrate, all FSPs served members of GDFCS or ODFCS, numbers ranging from tens up to hundreds, as members of GDFCS and ODFCS were free to choose which FSP was utilised. The relationships between the dairy cooperatives and FSPs with non-direct relationships differed, too. Well established and older FSPs, for example, had more tight relationships with GDFCS and ODFCS; in contrast to younger FSPs. Furthermore, the latter stated that the development of better and more formal relationships would be supported, as most communication between FSPs and dairy cooperatives was about solvability of their members instead of cooperation between different actors in the value chain.

4.2.2.2 CSA Suppliers

Seven FSPs signed Memorandum of understandings (MoU) with suppliers of biodigesters and water tanks; none of the FSPs had set up MoUs with suppliers of milking bucket machines and maize silage merchandise (graph 9). In Githunguri, two FSPs formed formal relationships with both suppliers of biodigesters and water tanks, whereas three other FSPs solely had MoUs with suppliers of water tanks. The situation in Olenguruone was similar to the one in Githunguri: one FSP established MoUs with suppliers of both biodigesters and water tanks, the remaining two only developed MoUs with companies that supplied water tanks. Besides the establishment of MoUs with suppliers of specific CSA practices and techniques, three FSPs stated that agreements were signed with a big online webstore. Dairy farmers looking for hardware and equipment would be directed to this supplier.

Graph 9: Established MoUs with suppliers of biodigesters and water tanks in Githunguri and Olenguruone (N=12)



Only SACCOs and MFIs had signed MoU with suppliers of CSA practices and techniques, no commercial banks. According to a branch manager of a commercial bank in Olenguruone, MoUs with suppliers were being reviewed by the headquarters in Nairobi. While a staff member of another commercial bank in Githunguri stated:

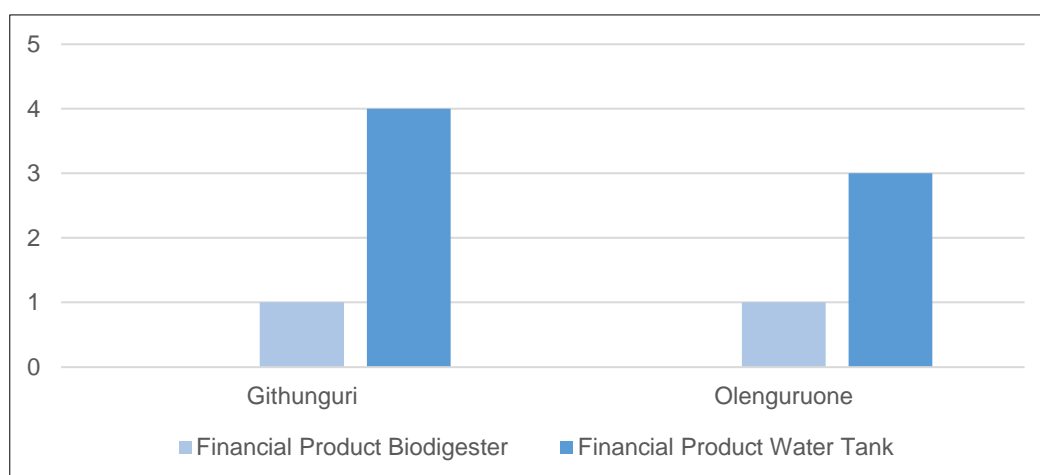
“it is up to suppliers of CSA practices and techniques to contact our bank about possible collaborations”.

4.2.3 Financial Products For CSA Practices and Techniques

Specific financial products to purchase biodigesters and water tanks were available to dairy farmers in both Githunguri and Olenguruone. However, dairy farmers in both villages had to use of non-specific financial products to invest in milking bucket machines and maize silage. In Githunguri, one FSP offered credit products for both biodigesters and water tanks, whereas three other FSPs provided loans to finance water tanks (graph 10). Again, the situation in Githunguri is comparable to Olenguruone. Where one FSP had financial products that enabled dairy farmers to invest in both biodigesters and water tanks, the other two FSPs solely had financial products to purchase water tanks. All the financial products were credit products, as well as loans in combination with savings – either individual or group savings.

Though not all FSPs had specific financial products to invest in CSA practices and techniques, FSPs stated that it was possible to invest in CSA practices and techniques by utilising regular financial products, as was discussed in the paragraph above. In other words, it is possible for dairy farmers to invest in CSA practices and techniques with, for example, short-term loans, long-term loans and asset finance. In addition, as there were no specific financial products that enabled dairy farmers to purchase milking bucket machines and goods to prepare maize silage, regular financial products were also used to lend money to dairy farmers to invest in these CSA practices and techniques. This because, according to interviewed FSPs, demand was too low to create specific financial products for milking bucket machines and maize silage.

Graph 10: Financial Products to invest in Biodigester and Water Tank in Githunguri and Olenguruone



FSPs gave several arguments whether to develop financial products that would enable dairy farmers to invest in CSA practices and techniques:

- Demand for specific financial products of dairy farmers was an important parameter for staff members of FSPs. Since, if there is no demand, there will be no incentives for FSPs to create specific financial products for specific financial products for CSA practices and techniques;
- without awareness among dairy farmers about CSA practices and techniques demand for specific financial products will not grow. Currently, according to staff members of FSPs, there is no market due to limited awareness about CSA practices and techniques;
- some FSPs operate in a wide range of markets. Therefore, it is not possible to create specific financial products for all members and clients;
- and adaptation and resilience to a changing environment of dairy farmers in Githunguri and Olenguruone.

The culture in Kenya might not be suited for specific financial products for CSA practices and techniques because it was not possible to utilise the loan for other purposes, better known as loan diversion. As stated by a SACCO staff member:

“Kenyans do not like it to be micro-managed by others”.

4.2.4 Knowledge and Funding

All staff members of interviewed FSPs had a background in finance instead of agriculture. According to these staff members, their colleagues neither had agricultural backgrounds. Except at one MFI, the branch manager said that within the organisation sufficient agricultural knowledge was available. Nevertheless, familiarity with agriculture was high among all interviewed FSP due to target groups and the locations of the branches in Githunguri and Olenguruone.

Regarding the allocation of funds to finance CSA practices and techniques, well established FSPs did not expect any difficulties; though two FSPs stated that the allocation of new funds had to be assessed. Further, FSPs that utilised non-specific financial products to invest in CSA practices, said the allocation of funds did not distinguish from ordinary loan applications. Only young SACCOs might experience complications when allocating funds to specific CSA loans, as the equity of these organisations did not allow disbursement of huge sums of credit. However, when discussing the allocation of funds to specific financial products for CSA practices and techniques, it should be considered that there are more options than credit products. To illustrate, if FSPs develop savings products for CSA specific financial products, there will be less need to redirect funds.

4.3 CSA SUPPLIERS, DAIRY COOPERATIVES AND OTHER ACTORS

In addition to interviewing dairy farmers and FSPs, the field study inquired into both dairy cooperatives themselves and local suppliers of CSA practices and techniques. Besides suppliers of CSA practices and techniques, discussions were organised with DEOs and managers of both dairy cooperatives. Finally, the interviewer sat down with SNV and HIVOS to discuss the Kenya Biogas Program (KBP) in Nairobi. The results of these interviews are written down in this sub-chapter.

4.3.1 Suppliers of CSA Practices and Techniques

In Githunguri, there was one local suppliers of water tanks and one company that sold biodigester to dairy farmers (table 27). The former was a well-known hardware shop utilised by many interviewed dairy farmers, the latter was a start-up established in 2011. There were two local hardware shops, both popular among dairy farmers, that supplied water tanks to members of ODFCS in the nearby villages of Olenguruone.

Table 27: Local suppliers of CSA practices and techniques (N=4)

		Village		Total
		Githunguri	Olenguruone	
CSA Practice and Technique	Rainwater Harvesting	1	2	3
	Biodigester	1	0	1
Total		2	2	4

4.3.1.1 Biodigester

The company selling biodigesters was based in Githunguri but operated nationwide. The objective of the organisation was to become the lead provider of high quality biodigesters and improve the lives of farmers and their environment in East Africa. According to a staff member:

“biodigesters can substitute “dirty fuel”, in order to improve the health of farmers, decrease the expenses of farmers and implement more sustainable agricultural practices that will benefit the environment of the farmer”.

Two different types of biodigesters were offered to customers: polyethylene bag biodigesters and concrete biodigesters. Both products were of high quality, though a concrete biodigester had advantages, such as longer lifetime, bigger quantities and could be utilised for different purposes, over polyethylene bag biodigesters. However, dairy farmers needed to own less animals to utilise the polyethylene bag biodigester than a concrete biodigester. Prices of biodigesters depended on volume and material and ranged from KSh 15.000 to KSh 300.000. The company offered leasing contracts to

dairy farmers that were not in a position to pay for the biodigester at once; a deposit of KSh 15.000 was made with up to four instalments in a period of three months. The dairy farmers owned the biodigester after finishing the leasing contract. Annually, around 270 biodigesters were sold by the company in Kiambu and Nakuru.

There was no close relationship between the company and GDFCS, only a small percentage of customers were members of the cooperative. However, the staff member suggested that the company was willing to improve the relationship with GDFCS. Further, the company was discussing with Kenya Woman Microfinance Bank whether it was possible to develop certain loan products for dairy farmers as well.

4.3.1.2 Rainwater Harvesting

All three interviewed hardware shops sold construction materials, construction tools, animal feeds and water tanks. The customers of the companies were living in the proximity of the villages where the hardware shops were located. Target groups of the hardware shops were individuals and companies, including dairy farmers.

The companies sold polyethylene water tanks, no concrete or iron sheet water tanks. The smallest water tank's had a capacity of 200 litres, whereas the biggest could harvest up to 10.000 litres of rainwater. Prices of water tanks ranged from KSh 3000 to KSh 70.000. There were no significant differences in price between the shops. Six different brands were sold to customers: Mamba Tank, Jumbo Tanks, POA Tank, KENTANK, Techno Tank and Reliance Polyfoam.

No formal relationships were established between hardware stores and both dairy cooperatives. However, the owner of a hardware store in Olenguruone said that a form of triangulation existed: dairy farmers could apply for a water tank at the cooperative, if accepted, the company would deliver the water tank and be reimbursed through the check-off system of ODFCS. Both other hardware shops, stated there was willingness to develop formal relationships with dairy cooperatives as well.

4.3.2 Dairy Cooperatives and other Actors

4.3.2.1 Dairy Extension Officers

GDFCS and ODFCS both employed DEOs, thirteen in Githunguri and two in Olenguruone, to disseminate knowledge and information to members of the cooperatives. The activities of these DEO were to:

- mobilise, and advice on, quality milk production;
- train best management practices and organise workshops;
- handle complaints and assist dairy farmers with problems;

- and be the link between dairy farmers, the cooperative and other stakeholders.

In Githunguri, DEOs were responsible for individual routes with around 1000 dairy farmers per route. And in Olenguruone, two DEOs served around 1300 active dairy farmers without the use of routes. All DEOs of both cooperatives utilised motorbikes to visit dairy farmers.

In addition to tasks mentioned above, DEOs introduced new technologies and innovation to members of GDFCS and ODFCS. However, due to geographical locations and divergence in needs of dairy farmers, resulting in inadequate time, DEOs were not always in a position to inform dairy farmers about CSA practices and techniques. Further, DEOs stated that CSA practices and techniques were not a priority at workshops organised by the cooperatives. Nevertheless, both obstacles did not affect the willingness of DEOs to introduce CSA practices and techniques to members of the cooperatives.

4.3.2.2 Senior Staff Members

Discussions with senior staff members of GDFCS and ODFCS revealed valuable information regarding the implementation of CSA practices among dairy farmers. First, dairy farmers did not see the effects of dairy farming on their immediate environment and, therefore, the adoption of CSA practices and techniques is not a priority among members of the cooperative. Additionally, as mentioned before, the average age among dairy farmers is very high. The older generation of dairy farmers did not feel the need to innovate and preferred to stick with familiar practices and techniques. A new generation of dairy farmers, however, might see the necessity and the need to adopt CSA practices and techniques.

Nevertheless, according to a senior staff member of ODFCS, most Kenyan households did own a water tank to harvest rainwater, because water tanks supplemented water that is sourced from boreholes during dry seasons. In Olenguruone, dairy farmers started to adopt maize silage, too, after experiences with droughts and support from the cooperative. On the other hand, the adoption of biodigesters was low in Olenguruone. This can be attributed to farming practices and awareness about biodigesters among members of ODFCS.

Further, FSPs in both villages offered specific financial products for CSA practices and techniques to dairy farmers. Despite those offers, as well as demand for these products, dairy farmers were not aware about the existence of such financial products. In other words, it can be said that there was no convergence between the offer and demand of specific financial products, encouraging dairy farmers to invest in CSA practices and techniques in the studied villages. To tackle this barrier, actors in the value chain should come together and organise themselves.

Regardless the need to expand cooperation between dairy cooperatives, FSPs and suppliers of CSA practices and techniques, dairy cooperatives did prefer to keep operations and services for members indoors; to be able to offer a wide range of affordable products and services to its members. To illustrate, ODFCS established their own SACCO in 2018. To strengthen the position of this SACCO, ODFCS might be reluctant to develop relationships with other FSPs, as the SACCO was not in a position to attract capital when members of ODFCS utilise financial products and services of other FSPs.

4.3.2.3 Kenya Biogas Program

Kenya Biogas Program (KBP) is a subsidiary of the Africa Biogas Program and was implemented by SNV and the Humanistic Development Institute (HIVOS), which are two Dutch development organisations. The former provided knowledge, whereas the latter funded the program. KBP consisted of several phases, two had been carried out so far and tenders of a third phase were issued by the Dutch government – apparently the tender process differed from other years, resulting in reluctance at both SNV at HIVOS.

The first phase consisted of establishing relationships between cooperatives, FSPs, suppliers of biodigesters and the Kenyan Government. Further, field trainings were organised, certifications for local suppliers and constructors of biodigesters were created and, in cooperation with MFIs and SACCOs, financial products were developed to stimulate the adoption of biodigesters among farmers. The second phase, which started in 2014, addressed the consolidation of phase one, awareness and training, supply and after sales of biodigesters. Further, “hubs” – partnerships between cooperatives, suppliers of biodigesters, FSPs and KBP – were set up to promote the adoption of biodigesters among farmers. Twenty-three hubs were active in Kenya at the moment, of which one was operating in Olenguruone. The aim of the third phase was to continue and further develop objectives and actions of phase two.

KBP aimed to reach, according to a staff member of HIVOS, “*low hanging fruits*” and immature markets, which explains the absence of the program in Githunguri. To increase the adoption of biodigesters, the program focussed on:

- relatively high prices of biodigesters;
- low knowledge about finance among small-scale farmers;
- improved matchmaking between cooperatives, suppliers of biodigesters and FSPs;
- and diversification of biodigesters available to farmers.

Specific financial credits products were developed in cooperation with Rabobank, Equity Bank Limited and ten other MFIs and SACCOs. So far, however, only 150 tracible loans were distributed to farmers;

though the number of adoptions might be higher as farmers utilise non-specific loans to purchase biodigesters. The low number of utilisations, again, was attributed to limited awareness about the existence of specific-financial products, inadequate knowledge about biogas and a low priority to invest in biodigesters among farmers. Furthermore, a staff member of HIVOS stated that MFIs and SACCOs sometimes were reluctant to cooperate with international development organisations.

5. DISCUSSION

The results of the field study above do not represent the best financial practices of all members of GDFCS and ODGFD, and the role of FSPs that operated in Githunguri and Olenguruone, but rather revealed relationships, experiences, thoughts and opinions of sample groups. Both purposive sampling and snowball sampling, see chapter 3, were applied during the fieldwork in Githunguri and Olenguruone. The objective, therefore, was to obtain a comprehensive understanding of the situation, collect a representation of the operational population and have a low non-response bias. Due to this methodology, the research does not reflect the situation of all members of GDFCS and ODFCS. Yet the aim of the study is to comprehend the best financial practices of dairy farmers who already adopted CSA practices and techniques, besides the role of FSPs that operated in Githunguri and Olenguruone.

This chapter brings together the case studies and aims to understand patterns and relationships exposed during the field study; to establish a common theory. First, the characteristics of dairy farmers, FSPs and dairy cooperatives are elaborated; thereby describing the context in which interviewees operated. Second, the motivations and financial practices of dairy farmers, regarding the adoption of biodigesters, rainwater tanks, milking bucket machines and maize silage, are summarized to understand the situation of dairy farmers in Githunguri and Olenguruone. The third part looks into the operations of FSP and their position about the adoption of CSA practices and techniques in Githunguri and Olenguruone. Next, the horizontal and vertical linkages that existed in the dairy value chains are described and visualised. Finally, the relevance of this study to the CSDEK project is noted.

5.1 CHARACTERISTICS OF DAIRY FARMERS, FINANCIAL SERVICE PROVIDERS AND DAIRY COOPERATIVES

Dairy farmers applied intensive dairy farming on small plots in urbanised areas in Githunguri. In contrast, dairy farmers practiced extensive dairy farming on large parcels in Olenguruone. The average milk production by dairy farmers from Githunguri was 15 to 40 litres, depending on the number of animals, while dairy farmers produced around five litres per day in Olenguruone, both small-scale and large dairy farmers participated in the study. Further, two types of dairy farmers were identified: farmers who solely practiced agriculture and farmers that had non-farming sources of income as well. Members of GDFCS saw dairy farming as a major source of income, an observation that can be contributed to a mature dairy market in Githunguri, whereas most members of ODFCS perceived dairy farming as additional income. Except for two dairy farmers, all interviewees grew cash crops to supplement the income generated by dairy farming.

Financial institutions located in Githunguri and Olenguruone had different characteristics, too. Commercial banks offered financial products and services to a wide range of target groups, MFIs were more specific, thereby focusing on small- and medium entrepreneurs, and SACCOs were founded to offer financial products and services to individuals operating in specific sectors. Commercial banks and MFIs operated nationwide, while SACCOs had local and regional aspirations. As a result, commercial banks and MFIs offered broad ranges of financial products and services to substantial numbers of clients. On the other hand, SACCOs offered more specialised financial products and services for members of different target groups – for example, dairy, tea, artisans, staff members of GDFCS and even teachers.

GDFCS is a well-established cooperative that collects, processes and markets milk of members. The cooperative operates in an urban environment and in the proximity of Nairobi, which is the most important dairy market in Kenya. Additionally, the cooperative provided dairy inputs, technical assistance, extension services and access to finance to dairy farmers. On the other hand, ODFCS is a young dairy cooperative that was established in 2005. The cooperative collects and markets milk of members but is not yet in a position to process milk into dairy products. ODFCS does not operate in the proximity of Nairobi, however, Nakuru Town is labelled as the fastest-growing towns in East and Central Africa. Additional services to members of the cooperative do not have the same quality as GDFCS, though the cooperative is ambitious and aims to consolidate its position in the region.

In short, different characteristics of farming systems, FSPs and dairy markets affected financial practices of members of GDFCS and ODFCS that invested in CSA practices and techniques. This leads to different financial needs and practices of dairy farmers in Githunguri and Olenguruone. In other words, dairy farmers conduct business in different environments and contexts, that ask for specific financial interventions to enable the adoption of CSA practices and techniques among members of GDFCS and ODFCS.

5.2 CSA AND BEST FINANCIAL PRACTICES

5.2.1 CSA Practices and techniques

Fourteen (34%) dairy farmers invested in biodigesters, twenty-six (63%) in rainwater harvesting, two in milking bucket machines (5%) and sixteen (39%) in maize silage. In general, members of GDFCS and ODFCS purchased CSA practices and techniques to decrease expenses, increase productivity, become resilient to climate change and improve quality of life (table 28). Rainwater harvesting was most accessible to dairy farmers, due to low adoption costs and partly because rainwater harvesting is already embedded in the Kenyan society, followed by the adoption of maize silage and biodigesters. Milking bucket machines were not yet relevant to members of GDFCS and ODFCS, as dairy farmers

stated that the number of livestock had to increase first. Other reasons mentioned to not invest in CSA practices and techniques were insufficient access to capital and finance, personal preferences, other priorities of dairy farmers and a lack of awareness about the benefits of CSA practices and techniques.

Table 28: Reasons to invest and financial practices of dairy farmers

CSA Practice/Technique	Identified Reasons and Benefits	Identified Financial Practices
Biodigester	<ul style="list-style-type: none"> ▪ Decrease expenses ▪ Convenient and better life ▪ Improved Health ▪ Environmental benefits 	<ul style="list-style-type: none"> ▪ Credit Products from SACCOs ▪ Savings of milk proceeds and other sources of income ▪ Salaries of other sources without savings ▪ Informal groups ▪ Leasing contracts ▪ Gifts
Rainwater Harvesting	<ul style="list-style-type: none"> ▪ Decrease expenses ▪ Reliable access to clean and quality water ▪ Mitigation and resilience 	<ul style="list-style-type: none"> ▪ Savings from milk proceeds and other sources of income ▪ Credit from SACCOs ▪ Gifts ▪ Informal groups
Milking Bucket Machine	<ul style="list-style-type: none"> ▪ Time-efficiency ▪ Decrease Expenses ▪ Improved hygiene ▪ Consistent milking method ▪ Improved milk quality 	<ul style="list-style-type: none"> ▪ Credit Products
Maize Silage	<ul style="list-style-type: none"> ▪ Mitigation and resilience ▪ Convenience ▪ Improved fodder quality ▪ Improved milk quality 	<ul style="list-style-type: none"> ▪ Non-farming sources of income ▪ Dairy proceeds and other agricultural activities ▪ Credit ▪ Financial planning

The prices of CSA practices and techniques discussed above were determined by different factors: type, materials, size and company (table 29). Because of this observation, dairy farmers paid different prices when purchasing CSA practices and techniques. Interviewees perceived rainwater harvesting as the cheapest CSA practice and technique, followed by biodigesters and maize silage. The majority of dairy farmers stated that milking bucket machines were too expensive. However, estimations of prices of milking bucket machines by dairy farmers were lower than the price of systems that enabled a dairy farmers to milk three cows simultaneously (table 29). The prices of maize silage were not fixed and depended on several factors: costs of seeds, labour, transportation, leasing materials, cost of polyethylene and the option to buy maize from other farmers. Further, the study did not identify differences in prices of CSA practices and techniques between Githunguri and Olenguruone. Hence it can be assumed that dairy farmers pay similar prices for CSA practices and techniques in both villages.

Table 29: Prices of CSA practices and techniques

CSA Practice/Technique	Type	Price
Biodigester	<ul style="list-style-type: none"> ▪ Bag/Dome Biodigester ▪ Tube Biodigester ▪ Dome Biodigester (concrete) 	<ul style="list-style-type: none"> ▪ KSh 35.000 – KSh 229.000 ▪ KSh 35.000 – KSh 229.000 ▪ KSh 100.000 – KSh 200.000
Rainwater Harvesting	<ul style="list-style-type: none"> ▪ Small ▪ Medium ▪ Big 	<ul style="list-style-type: none"> ▪ KSh 2600 – KSh 36.000 ▪ KSh 5000 – KSh 70.000 ▪ KSh 10.000 – KSh 200.000
Milking Bucket Machine	<ul style="list-style-type: none"> ▪ Capacity of 3 cows ▪ Estimations of interviewees 	<ul style="list-style-type: none"> ▪ KSh 250.000 – KSh 350.000 ▪ KSh 90.000 – KSh 230.000
Maize Silage	<ul style="list-style-type: none"> ▪ 6.5 tonnes – 20 tonnes 	<ul style="list-style-type: none"> ▪ KSh 5000 – KSh 200.000

The financial practices that dairy farmers utilised to purchase CSA practices and techniques were not similar in both villages, because dairy farmers operated in different environments and contexts. Dairy farmers preferred to utilise different financial practices to invest in biodigesters, rainwater harvesting, milking bucket machines and maize silage (table 28). The most popular financial practices were utilising dairy proceeds, other agricultural related incomes and non-farming sources of income. Dairy farmers either were in a position to pool sources of income and pay the whole sum at once, while others saved their different sources of income before buying CSA practices and techniques. Credit disbursed by SACCOs were important sources of funding for members of GDFCS and ODFCS as well, since other financial institutions were reluctant to disburse credit to dairy farmers in Githunguri and Olenguruone. In Githunguri, a supplier of biodigesters offered leasing schemes to customers, while suppliers of other CSA practices and techniques did not gave dairy farmers the choice to pay in instalments. CSA practices and techniques were gifted at some occasions, though this was not a common practice. Finally, some members utilised informal groups to invest in CSA practices and techniques. Though only if dairy farmers were members of groups established to collectively save for CSA practices and techniques.

5.2.2 Relationships with Financial Service Providers

Members of GDFCS and ODFCS had relationships with SACCOs established by their cooperatives: GDC SACCO and Mavumo Daima SACCO. Other important FSPs for dairy farmers were K-Unity in Githunguri and Transnational Bank and Imarisha SACCO in Olenguruone. In short, SACCOs were important to dairy farmers due to the relevance of SACCOs to specific agricultural sectors. Dairy farmers became clients of FSPs because of 1) target groups of FSPs, 2) interest rates, 3) loan application processes and 4) personal experiences. Interviewees were clients in order to utilise payment and transactions services; access to savings and credits products; and the possibility to purchase shares of SACCOs. Although insurance products were available, interviewees tended not to utilise risk mitigation products.

Dairy farmers and relatives (73%) had access to finance through informal groups, both ROSCAs and ASCAs. By being an informal group member, dairy farmers had access to merry-go-round groups, different forms of table banking, collective savings to purchase household items and farm inputs,

payments for weddings or funerals and opportunities to share knowledge and ideas. Besides informal groups, dairy farmers (82%) widely adopted mobile money – in the form of M-Pesa – due to safety, convenience, efficiency, reliability and transparency. Mobile banking, on the other hand, was less utilised by interviewees (34%) and only used in cases of emergency. Arguments not to use mobile banking were related to high interest rates, difficult communication and a lack of transparency.

To summarize, dairy farmers made use of financial products and services of different FSPs for specific agricultural activities, as well as other non-agricultural income generating activities. Milk proceeds were collected through SACCOs that had considerable experience with the dairy sector, while FSPs with no agricultural backgrounds were utilised to manage non-farming payments and transactions. Additionally, informal groups were important to most members of GDFCS and ODFCS, since these groups enabled dairy farmers to save collectively, invest and share ideas and knowledge. The adoption of fintech, especially mobile money, was embraced by dairy farmers. Nevertheless, mobile money and banking were not in a position to substitute conventional access to finance at the moment of interviewing.

5.3 FINANCIAL SERVICE PROVIDERS

Commercial banks, SACCOs and MFIs operating in Githunguri and Olenguruone provided financial products to members of GDFCS and ODFCS. Financial products and services offered by FSPs were payment services, credit products, savings products and insurance products. Depending on characteristics, geographical locations and target groups of FSPs, as noted in sub-chapter 5.1, specific financial products and services related to dairy farming were available to members of GDFCS and ODFCS. Considering the 5C concept, which was elaborated in chapter 2, commercial banks tend to look at capacity, capital and collateral of dairy farmers, while MFIs and SACCOs take also characters and conditions of dairy farmers into consideration, when dairy farmers apply for credit at FSPs. This could be a reason why dairy farmers prefer to utilise financial products and services of the latter, as was shown in chapter 4.

To enable dairy farmers to invest in CSA practices and techniques, seven FSPs (58%) offered specific financial products related to biodigesters and rainwater harvesting – the same organisations established MoUs with suppliers of biodigesters and rainwater tanks (figure 7). On the other hand, specific financial products to invest in milking bucket machines and maize silage were not available for members of

Table 30: Available Financial Products for CSA in Githunguri and Olenguruone

CSA Practice/Technique	Non-specific Financial Product	Specific Financial Product
Biodigester		
Rainwater Harvesting		
Milking Bucket Machine		
Maize Silage		

GDFCS and ODFCS (figure 8). However, dairy farmers were in a position to utilise non-specific financial products to invest in milking bucket machines and maize silage, as well as biodigesters and rainwater harvesting. Financial construction to finance CSA practices and techniques did have the same characteristics as conventional credit products and were often compatible, yet not all FSPs did provide dairy farmers with financial products and services to invest in CSA practices and techniques. Arguments whether to develop specific financial products for CSA practices and techniques were related to

- 1) demand for specific financial products for CSA practices and techniques;
- 2) awareness about CSA practices and techniques;
- 3) target groups of FSPs and
- 4) adoption and resilience to a changing climate and culture in Kenya.

Especially demand and awareness were important indicators, as without those there would be no incentives for FSP to create specific financial products that will enable dairy farmers to scale up the adoption of CSA practices and techniques. Other factors influencing the development of specific financial products for CSA practices and technique were agricultural knowledge within FSPs and the allocation of funds. The former was lacking among staff members of interviewed FSPs, whereas the latter will not give obstacles.

In short, FSPs offered a wide range of financial products and services to either homogeneous or heterogeneous target groups. Most FSPs did not have formal relationships with GDFCS and ODFCS, though two SACCOS were subsidiaries of the dairy cooperatives. Regarding the adoption of CSA practices and techniques, it was possible to utilise specific financial products, as several FSPs had established MoUs with suppliers of CSA practices and techniques, and non-specific financial products. Not all FSPs developed specific financial products because of, according to staff members of FSPs, limited awareness, low demand, target groups and culture. Although FSPs did not have sufficient agricultural knowledge, the majority of FSPs had the capacity to allocate funds to the adoption of CSA practices and techniques.

Figure 7: Specific financial products that enabled dairy farmers to invest in CSA Practices and techniques. The financial service provider, either a subsidiary of the dairy cooperatives or not, established MoUs with CSA suppliers, to promote CSA practices and techniques among dairy farmers in Githunguri and Olenguruone. By doing so, a dairy farmers were in a position to apply for a credit product and disburse the FSP, instead of paying the CSA suppliers themselves.

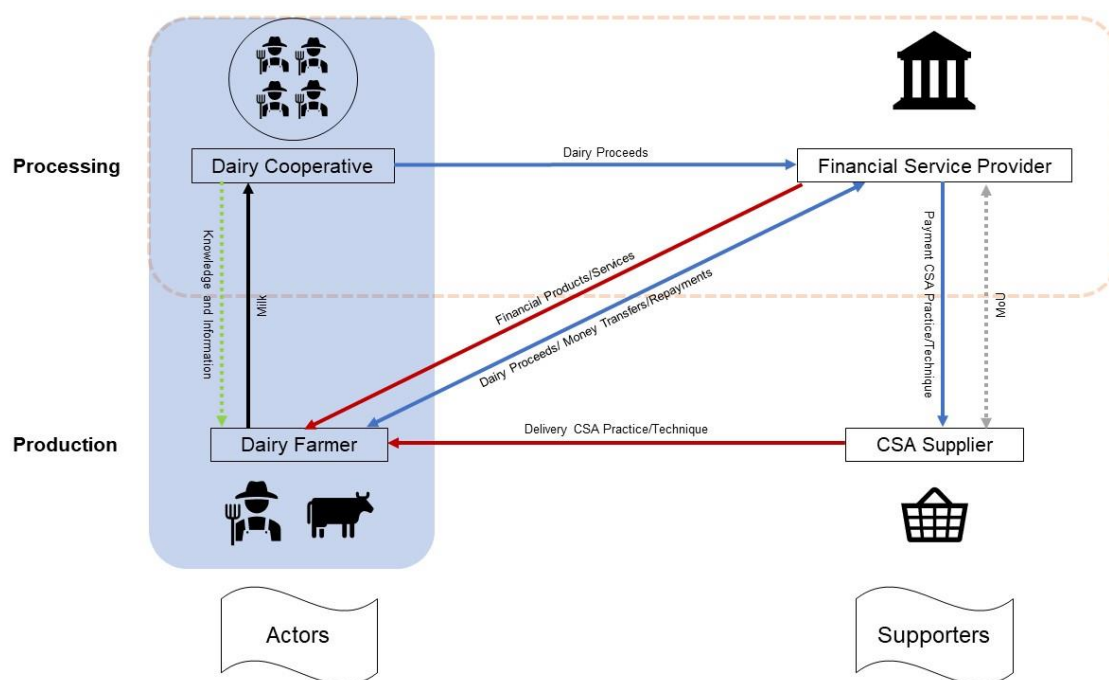
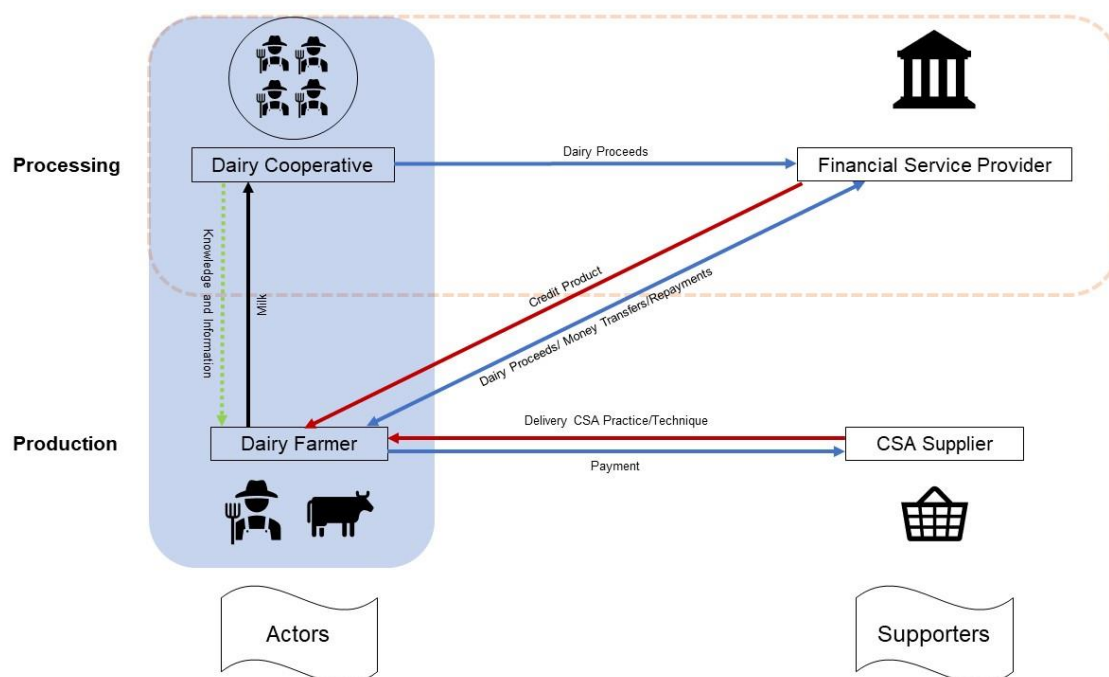


Figure 8: Non-specific products that enable dairy farmers to invest in CSA practices and techniques. There is no cooperation among actors in the value chain. Dairy farmers apply for a credit at FSPs, either a subsidiaries of the dairy cooperatives or not, and pay the CSA suppliers themselves, when purchasing CSA practices and techniques.



5.4 HORIZONTAL AND VERTICAL LINKAGES IN THE DAIRY VALUE CHAINS

The importance of horizontal and vertical coordination in value chains is stressed in publications that study the development of agricultural value chains (; Lazzarini, 2009; Ong'Aro 2012; Trienekens 2011; Hanf, 2014; Kilelu et al,2017). Both GDFCS and ODFCS aimed to integrate operations and services of other chain actors into their organisation as well, to strengthen the positions of the cooperatives and thereby the members of the dairy cooperatives. GDFCS was established to market the milk of members, but the cooperative offers a wide range of services – collection, processing, marketing, supply of dairy inputs, access to finance (GDC SACCO) AI services and extension services – to its members today. In Olenguruone, ODFCS clearly had the same aspirations, since the cooperative was developing a packaging plant, access to finance (Mavumo Daima SACCO), AI services and extension services for dairy farmers. To enhance the adoption of CSA practices and techniques, both dairy cooperatives should consider applying value chain finance to improve coordination in the dairy value chains, to address awareness about CSA practices and techniques and promote financial products related to biodigesters, rainwater harvesting, milking bucket machines and maize silage.

Value chain finance aims to improve access to finance by enhancing cooperation and link FSPs with other actors in value chains (KIT, 2010). In the case of GDFCS and ODFCS, a tripartite arrangement between dairy cooperatives, suppliers of CSA practices and techniques and financial institutions will stimulate the adoption of CSA practices and techniques among dairy farmers. This arrangement will cover the milk production of dairy farmers, information and promotion of CSA practices and techniques, specific financial products related to CSA practices and techniques and the management of risks that come with the adoption of CSA practices and techniques. The current situation in the value chain, without improved coordination in the dairy value chains, will not encourage the adoption of CSA practices and techniques by members of GDCS and ODFCS. Both paragraphs below discuss chain interventions in Githunguri and Olenguruone.

First, the extension services of the cooperatives. Both GDFCS and ODFCS offer extension services to disseminate knowledge and information to members. Unfortunately, employed DEOs were not in a position to introduce CSA practices and techniques actively among members due to time constraints and more urgent problems that had to be addressed. Considering that extension officers are important sources of knowledge to small-scale dairy farmers, as stated by Lwoga, et al. (2011) and Munyua (2011), it is recommendable that dairy cooperatives consider the role of DEOs when discussing the adoption of CSA practices and techniques. Especially since FSPs addressed, as mentioned in sub-chapter 5.4, that awareness among dairy farmers was an important indicator whether to develop specific financial products for CSA practices and techniques. Dairy cooperatives, FSPs and suppliers

and CSA practices and techniques should therefore coordinate the dissemination of knowledge and information related to CSA practices and techniques.

Second, the relationships between dairy cooperatives and suppliers of CSA practices and techniques. The suppliers of biodigesters and water tanks were present in Githunguri and Olenguruone. In Githunguri, companies sold both polyethylene water tanks and biodigesters, while dairy farmers had access to two hardware shops trading polyethylene water tanks in Olenguruone. There were no formal relationships between local suppliers of CSA practices and techniques, FSPs and dairy cooperatives. Nevertheless, local suppliers of CSA practices and techniques were willing to discuss opportunities with FSPs and dairy cooperatives. In other words, local suppliers of CSA practices and techniques were in a position to increase the supply of CSA practices and techniques, but due to the absence of cooperation with dairy cooperatives and FSPs, this opportunity was not utilised appropriately. On the other hand, it should be taken into consideration that FSPs and dairy cooperatives might seek to develop relationships with companies that have no presence in Githunguri or Olenguruone. Nevertheless, suppliers of CSA practices and techniques were willing to increase the promotion of products among members of GDFCS and ODFCS.

5.6 RELEVANCE TO CDESK PROJECT

Previous studies of CDESK focussed on identification of value chain actors and supporters in dairy chains, the creation of business models to enhance the adoption of CSA practices and techniques, analysis of carbon footprints of dairy farmers, farming practices and gross margins of dairy farmers, knowledge about CSA among dairy farmers and feed value chains of dairy farmers (Baars, et al. 2019). So far, however, financial practices of dairy farmers and the financial environments of dairy farmers, in relation to the adoption of CSA practices and techniques, remained a black spot for CSDEK. This study was a first attempt to understand financial practices of dairy farmers and the role of financial institutions when adopting CSA practices and techniques; in order to bolster the development of inclusive and climate smart business models for dairy farmers in Ethiopia and Kenya. Further, the study complements studies of CCFAS that looked into financing the adoption of CSA practices and techniques in Kenya (Odhong, et al., 2019; Wilkes, et al., 2019).

Odhong, et al. (2019) stated that “dairy farmers in Kenya mostly rely on own savings and current income sources for farm investments”, which is in line with financial practices of members of GDFCS and ODFCS. Further, they said: “financial mechanisms used by climate finance are the same as those used in development and commercial finance”. This resonates with the fact that FSPs in Githunguri and Olenguruone disburse non-specific financial products to members of GDFCS and ODFCS that want to invest in CSA practices and techniques. Also, SACCOs were important FSPs for farmers. The same

situation was observed in Githunguri and Olenguruone. Furthermore, “partnerships with other service providers are necessary to link finance to technical support”. A statement which is made in this study as well.

Wilkes et al. (2019) stated, too, that “for the majority of dairy farmers, own savings, and credit institutions and mobile financial services are the main sources of finance for investment and working capital for dairy development”. Which is again similar to the financial practices of dairy farmers in Githunguri and Olenguruone. Regarding the position of dairy cooperatives, they said: “dairy cooperatives not only provide payment for milk, but also serve as business hubs through which farmers can access other inputs and services”. GDFCS and ODFCS are such hubs and should, therefore, consider whether the adoption of CSA practices and techniques should be integrated into the operations of the cooperatives. Furthermore, concerning credit products for dairy farmers, they stressed that “linking technical extension and dairy service provision to credit can support improvements in the productivity of dairy production and the stability of yields and income”. The importance of supportive extensions services for CSA practices and techniques is discussed in this study as well, as the field study showed that extension offers faced difficulties with promoting CSA practices and techniques among members of the cooperatives.

To conclude, CDESK should take into consideration the financial situations of dairy farmers and the role of financial institutions, CSA suppliers and dairy cooperatives towards CSA practices and techniques. Because without the means to finance CSA practices and techniques, and cooperation between stakeholders in the dairy chain, members of GDFCS and ODFCS will not be in a position to adopt CSA practices and techniques the coming years.

6. CONCLUSION

This study examined the role of financial institutions and best financial practices of dairy farmers regarding the adoption of CSA practices and techniques in Githunguri and Olenguruone. In order to see whether demand and offer of financial products and services converge, thereby enhancing the development of climate smart and inclusive business models for dairy farmers in Ethiopia and Kenya, to scale up the adoption of CSA practices among members of GDFCS and ODFCS. The research was guided by two research questions:

1. What is the role of financial institutions in Githunguri and Olenguruone in providing financial services that will enable small-scale dairy farmers to invest in CSA practices and techniques?
2. What are best financial practices of small-scale dairy farmers investing in CSA practices and techniques?

First, financial institutions that operate in Githunguri and Olenguruone are in a position to stimulate the adoption of CSA practices and techniques among dairy farmers. However, FSPs do have different opinions about their role regarding the adoption of CSA practices and techniques, depending on the characteristics of organisations. Some FSPs offer specific financial products that enable dairy farmers to invest in biodigesters and water tanks. On the other hand, other FSPs do not see the need to develop specific financial products, unless demand and awareness for such financial products increase, and prefer to utilise conventional financial products to stimulate the adoption of CSA practices and techniques. The relationships of GDFCS and ODFCS with FSPs, besides GDC SACCO and Mavumo Daima SACCO, are not formal and do not include the adoption of CSA practices and techniques. Nevertheless, financial institutions are willing to consider the development of specific financial products, as well as the utilisation of conventional financial products, that will enable members of GDFCS and ODFCS to scale up to adoption of CSA practices and techniques. Furthermore, financial institutions saw opportunities to improve cooperation with GDFCS and ODFCS.

Second, dairy farmers utilised a wide range of financial practices: milk proceeds, proceeds from other agricultural activities, non-farming sources of income, savings products, credit products, leasing contracts and informal saving groups, to purchase biodigesters, water tanks, milking bucket machines and prepare maize silage. The main reasons and benefits to adopt CSA practices and techniques were to decrease expenses, increase productivity, become resilient to a changing environment and improve quality of life. Dairy farmers did not adopt CSA practices and practices to become climate smart, since awareness about climate change among interviewees was very low. The expenses related to the

adoption of CSA practices and techniques were determined by type, material, size and company. Further, dairy farmers use the products and services of different FSPs to finance agricultural activities, as well as non-agricultural activities. In addition to formal access to finance, informal groups were important sources of finance, too.

Though the above stated facts suggest that members of GDFCS and ODFCS operate in environments that enables them to invest in CSA practices and techniques, it can be concluded that there is no convergence between the demand and offer of financial products that stimulate the adoption of CSA practices and techniques among members of GDFCS and ODFCS. Three statements are written down to support this conclusion:

1. Due to limited awareness among dairy farmers about the benefits of CSA practices and techniques, members of GDFCS and ODFCS do not see the adoption of CSA practices and techniques as a high priority – although dairy farmers who experienced, for example, droughts saw the gains of adopting CSA practices and techniques.
2. Cooperation between dairy cooperatives, FSPs and suppliers CSA practices and techniques does not involve the adoption of CSA practices and techniques among dairy farmers. In other words, there is no visible common agenda among chain actors that aims to stimulate the adoption of CSA practices and techniques among members of GDFCS and ODFCS.
3. Third, dairy cooperatives, financial institutions and suppliers of CSA techniques and practices do not create incentives for members of GDFCS and ODFCS to stimulate the adoption of CSA practices and techniques among dairy farmers in Githunguri and Olenguruone.

To conclude, in order to scale up the adoption of CSA practices and techniques, GDFCS and ODFCS have to establish awareness about the benefits of CSA practices and techniques, increase cooperation in dairy chains to set common objectives and create incentives for members to adopt CSA practices and techniques in the coming years.

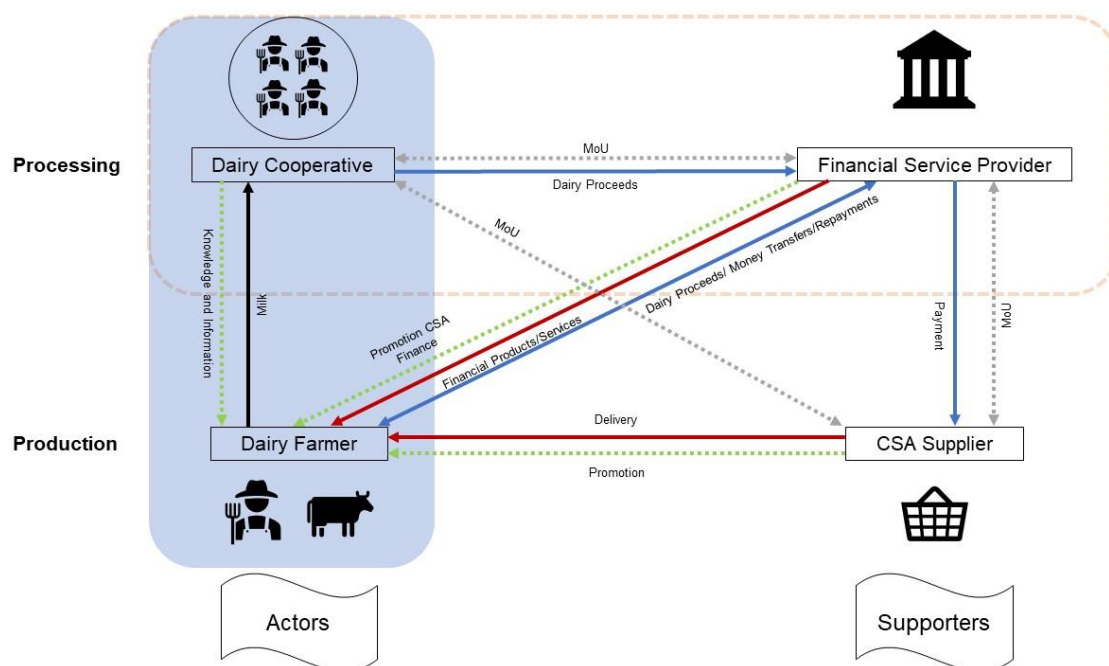
7. RECOMMENDATIONS

To scale up the adoption of CSA practices and techniques, members of GDFCS and ODFCS have to understand the impact of CSA practices and techniques, actors in dairy value chains have enhance communication and encourage dairy farmers to invest in CSA practices and techniques. Therefore, it is recommended that;

- 1) Dairy cooperatives, financial institutions and suppliers of CSA practices and techniques should develop, increase or enhance extension services and marketing related CSA practices and techniques. Thereby developing awareness among dairy farmers about the benefits of CSA practices and techniques, to increase demand for such innovations;
- 2) Dairy cooperatives, financial institutions and suppliers of CSA practices and techniques should get together and align their interests to create a common agenda, that aims to stimulate the adoption of CSA practices and techniques among members of GDCS and ODFCS.
- 3) Dairy cooperatives, financial institutions and suppliers of CSA practices and techniques should develop incentives for members of GDFCS and ODFCS to stimulate the adoption of CSA practices in Githunguri and Olenguruone.

Figure 9 visualises enhanced tripartite coordination that is recommended among actors in the dairy value chains in Githunguri and Olenguruone. Dairy cooperatives, financial institutions, either subsidiaries of dairy cooperatives or not, and suppliers of CSA practices and techniques sign MoUs, to improve dissemination of information, manage risks and align agendas. Awareness about CSA practices and techniques among dairy farmers is developed by the extension services of both cooperatives, financial institutions promote both specific and non-specific financial products related to the adoption of CSA practices and techniques, and CSA suppliers market CSA practices and products to dairy farmers operating in Githunguri and Olenguruone. Also, financial institutions and suppliers of CSA practices and techniques coordinate access to finance and the delivery of CSA practices and techniques. Finally, all actors share their experiences to improve scaling up the adoption of CSA practices and techniques. By doing so, actors in the dairy value chains will create an enabling environment for dairy farmers to adopt CSA practices and techniques in the years to come.

Figure 9: Tripartite relationships between actors in the dairy value chains in Githunguri and Olenguruone.



8. BIBLIOGRAPHY

- Association of Kenya Insurers. (n.d.). *Insurance Guidebook*. Nairobi: Association of Kenya Insurers.
- Association of Kenya Insurers. (n.d.). *A Guide To Personal Pension*. Nairobi: Association of Kenya Insurers.
- Black, J., Malesu, M., Oduor, A., Cherogony, K., & Meshack Nyabenge. (2012). *Rainwater harvesting Inventory of Kenya: An overview of techniques, sustainability factors and stake holders*. Nairobi: World Agroforestry Centre.
- CCFAS. (n.d.). *Inclusive and climate smart business models in Ethiopian and Kenyan dairy value chains, global; Global Challenges Programme Project*. Retrieved October 19, 2019, from <https://ccaafs.cgiar.org/inclusive-and-climate-smart-business-models-ethiopian-and-kenyan-dairy-value-chains-global#.XbLOJugzY2y>
- Central Bank of Kenya. (2015). *The Banking Act CHAPTER 488*. Nairobi: Central Bank of Kenya.
- County Government of Kiambu. (2018). *County Integrated Development Plan 2018-2022*. s.l.: County Government of Kiambu.
- County Government of Nakuru. (2013). *Nakuru County Integrated Development Plan (2013-2017)*. s.l.: County Government of Nakuru.
- County Government of Nakuru. (2018). *Nakuru County Integrated Development Plan (2018-2022)*. Nakuru: County Government of Nakuru.
- Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*. Washington DC: The World Bank .
- FAO. (1989). *Milking, milk production, hygiene and udder health*. Rome: FAO.
- FAO. (2013). *Climate Smart Agriculture Source Book: Module 11 Developing Sustainable and Inclusive Food Value Chains for Climate Smart Agriculture*. Rome: FAO.
- FAO. (2013). *Climate-Smart Agriculture: Sourcebook*. s.l. : FAO.
- FAO and IDF. (2011). *Guide to good dairy farming practices. Animal Production Health Guidelines. No. 8*. Rome: FAO.

- Farmers Trend. (2016). *READ: Pros and Cons before purchasing a Milking Machine in Kenya*. Retrieved December 2, 2019, from <https://farmerstrend.co.ke/read-pros-cons-purchasing-milking-machine-kenya/>
- FSDK. (2019). *2019 FinAccess Household Survey: acces, usage quality, impact*. Nairobi: Financial Sector Deepening Kenya.
- Government of Kenya. (2018). *National Climate Change Action Plan 2018-2022*. Nairobi: Government of Kenya.
- Guarnieri, L., & Salman, M. (2017). *Water Harvesting*. s.l.: FAO.
- Hanf, J. H. (2014). *Processor driven integration of small-scale farmers into value chains in Eastern Europe and Central Asia: A synthesis paper*. Budapest: FAO.
- Kenya National Bureau of Statistics . (2019). *Volume I: Population by county and sub-county*. Nairobi: Kenya National Bureau of Statistics.
- Kiiza, A. (2018). *Scaling Up Climate Change Mitigation Practices in Smallholder Dairy Value Chains: A case study of Githunguri Dairy Farmer Cooperative Society Ltd, Kiambu County, Kenya*. Velp: Van Hall Larenstein University of Applied Sciences.
- Lazzarini, S. G. (2009). Horizontal and Vertical Relationships in Developing Economies: for SMEs' Access to Global Markets. *The Academy of Management Journal*, 2(51), 359-380.
- Malesu, M. M., Oduor, A. R., & Odhiambo, O. J. (2007). *Green Water Management Handbook: Rainwater harvesting for agricultural production and ecological sustainability*. Nairobi: World Agroforestry Centre.
- Micro Enterprises Support Programme Trust. (2018). From Humble Beginnings to Enviably Succes. *The Partner*, 2(2), 3.
- Miller, C. (2008). *A Baker's Dozen Lesson of Value Chain Financing in Agriculture*. s.l. : FAO.
- MINAGRI. (2017). *Strategic Plan for Agriculture Transformation 2018-24*. Kigali : Ministry of Agriculture and Animal Resources.
- Ministry of Agriculture, Livestock and Fisheries. (2013). *Sessional Paper No.5 of 2013 on The National Dairy Development Policy: Towards a Competitive and Sustainable Dairy Industry for Economic Growth in the 21st Century and Beyond*. Nairobi: Ministry of Agriculture, Livestock and Fisheries.

- Ministry of Agriculture, Livestock and Fisheries. (2017). *Kenya Climate Smart Agriculture Strategy*. Nairobi: Ministry of Agriculture, Livestock and Fisheries .
- Muriuki, H. (2006). *A Dairy Co-operative Society*. s.l.: FAO.
- Nederlandse Organisatie voor Wetenschappelijk Onderzoek. (n.d.). *What does NWO do?* Retrieved October 25, 2019, from <https://www.nwo.nl/en/about-nwo/what+does+nwo+do>
- Obare, O. (2019). *Farmer cry foul over cheap milk from Uganda*. Retrieved December 4, 2019, from <https://www.farmers.co.ke/article/2001348016/dairy-farmers-cry-foul-over-cheap-milk-from-uganda>
- Odhong, C., Wilkes, A., van Dijk, S., Vorlaufer, M., Ndonga, S., Sing'ore, B., & Kenyanito, L. (2019). *Financing Large-Scale Mitigation by Smallholder Farmers: What Roles for Public Finance?* s.l.: Frontiers Sustainable Food Systems.
- Okoba, B. O. (2018). *Climate Smart Agriculture: Training Manual for Agricultural Extension Agents in Kenya*. Nairobi: FAO.
- Ombuna, C. (2018). Trends in Hand Milking and Machine Milking in Kenya. *Journal of Enigineering and Applied Sciences* , 13(14), 5655-5660.
- Ong'Aro, D. S. (2012). *Strategies to improve firm- farmer relationship in dairy value chains: an assesment study in Borabu and Kiambu Districts, Kenya*. Wageningen: Van Hall Larenstein University of Applied Sciences.
- Open Risk Manual. (n.d.). *Financial Products*. Retrieved December 31, 2019, from https://www.openriskmanual.org/wiki/Financial_Products
- Pandey, G., & Voskuil, G. (2011). *On Improved Feeding of Dairy Cattle by Smallholder Farmers: For Dairy Extension Workers and Dairy Farmers*. Lusaka: Golden Valley Agricultural Research Trust.
- PlacesMap.net. (n.d.). *Olenguruone Dairy Farmers Cooperative Society*. Retrieved October 25, 2019, from <https://placesmap.net/KE/Olenguruone-Dairy-Farmers-Cooperative-Society-232436/>
- Rademaker, C. J., Bebe, B. O., van der Lee, j., Kilelu, C. W., & Tonui, C. (2016). *Sustainable growth of the Kenyan dairy sector: A quick scan of robustness, reliability and resilience*. Wageningen: Wageningen University & Research.
- Royal Tropical Institute . (2010). *Value Chain Finance: Beyond microfinance for rural entrepreneurs*. Amsterdam: Royal Tropical Institute.

- SASRA. (2019). *The SACCO Supervision Annual Report 2018: The annual statutory on the operations and performance of Deposit-Taking SACCO Societies (DT-SACCOs) in Kenya*. Nairobi: The SACCO Societies Regulatory Authority.
- Shumba, H. S. (2018). *Integrateing Climate Smart Agriculture interventions in small holder dairy feed value chain in Githunguri and Ruiru sub-counties, Kiambu county, Kenya*. Velp : Van Hall Larenstein University of Applied Sciences.
- The World Bank. (2019). *The Power of Dung: Lessons learned from on/farm biodigester programs in Africa*. Washington DC: The World Bank.
- Trienekens, J. H. (2011). Agricultural Value Chains in Developing Countries: A framework for Analysis. *International Food and Agribusiness Management Review*, 2(14), 51-82.
- Vala, A. (2019). *Modeling GHG Emissions, Cost and Benefit Analysis within the Dairy Farming System. A Case study of Githunguri Dairy Farmers Cooperative Society Ltd. and Olenguruone Dairy Farmers Cooperative Society Ltd., Kenya*. Velp: Van Hall Larenstein University of Applied Sciences.
- Verschuur, M., Baars, R., De Vries, J. W., & Eweg, R. (2019). *Practice briefs: Inclusive and climate smart business models in Ethiopian and Kenyan dairy value chains*. Velp: Van Hall larenstein University of Applied Sciences.
- Wilkes, A., Odhong, C., Ndonga, S., Sing'ora, B., & Kenyanito, L. (2019). *Acces to and supply of finance for enhancing dairy productivity*. Wageningen: CGIAR Research Program on Climate Change, Agriculture, and Food Security.
- WUR. (2017). *Klimaatbureau CCAFS geopend in Wageningen*. Retrieved October 19, 2019, from <https://www.wur.nl/nl/nieuws/Nieuw-klimaatbureau-CCAFS-geopend-in-Wageningen-.htm>
- You, L., Ringler, C., Nelson, G., Wood-Sichra, U., Robertson, R., Wood, S., . . . Sun, Y. (2010). *What Is the Irrigation Potential for Africa? A combind Biophysical and Socioeconomic Approach*. s.l. : International Food Policy Research Instituite.

ANNEX 1: IDENTIFIED FINANCIAL SERVICE PROVIDERS

Financial Institutions Githunguri

Financial Service Provider	Participation	Date/Time	Contact
GDC SACCO	Yes	22-02-2020 at 1 PM	Irene W. Kamondo (marketing manager) 0722488625 ikamondo@gdcsacco.co.ke
Co-operative Bank	No		
Equity Bank	No		
Barclays	No		
KCB	Yes	Shared publications and answered questions by e-mail	Irene (director of operations) 0787956296
Family Bank	Yes	24-01-2020 at 3 PM	Francis Muthii Mati (senior relationship officer credit) 0725515734 fmati@familybank.com
Fariji SACCO	Yes	20-01-2020 at 3:30 PM	Stephen Karanja Kirahu (internal audit) 0704192779
Kenya Woman MFI	No		Jonathan (branch manager) 0716666237
Eclof Kenya	Yes	20-01-2020 at 1 PM	Dennis (staff member) Esther (branch manager) 0723865538
SUMAC MFI	No		
K-unity	Yes	13-01-2020 at 2:30 PM	Joseph Ndirity (business development and marketing manager) indiritu@k-unity.co.ke 0721210679
TAI SACCO	No	Suggested questions by e-mail, however e-mail was never answered.	Joy Murithi (marketing) joy.murithi@taisacco.coop 0722689230
Kidapu SACCO	Yes	23/01/2020 at 11 AM	Georgi Macharia (chairman of the board) georgemacharia39@yahoo.com 0799300197

Dimkes SACCO/FOSA	No		Kelvin (branch manager) 0723401741
Juakali SACCO	Yes	09-01-2020 at 10 AM.	Bonface (general manager) 0712499414 Grace (marketing manager) 0713089824

Financial Institutions Olenguruone

Financial Service Provider	Participation	Date/Time	Contact
Mavumo Daima	Yes	06-02-2020 at 9 AM	Geoffri Ngeno (director of operations) mavunodaimasacco@gmail.com geoffringeno@gmail.com
Transnational Bank	Yes	06-02-2020 at 4:30 PM	Peter (branch manager)
Chai Sacco	Yes	04-02-2020 at 10:30 AM	Mark Rotich(branch manager) m.rotich@chai-sacco.co.ke
Stegro Sacco	Yes	06-02-2020	Bennet Kigen (branch manager)
Kenya Women MFI	Yes	05-02-2020 at 9:20 AM	Timothy Kibet (branch manager) 0726443611

ANNEX 2: CHECKLISTS IN-DEPT INTERVIEWS

Checklist In-dept-interview Financial Service Provider

1. Name of the institution
2. Name and sex of the interviewee
3. Position of the interviewee
4. Activities and main tasks of the institution
5. Financial services/products
6. Relationship with GDFCS
7. Knowledge about Climate Smart Agriculture
8. Financial services for Climate Smart Agriculture
9. Assessment credibility Farmers
10. Arguments to develop (or not) financial products for Climate Smart Agriculture
11. Funds for Climate Smart Agriculture

Checklist In-dept-interview Dairy Farmer

1. Name and sex of the interviewee
2. Main occupation and other sources of income
3. Adopted Climate Smart Agriculture practice of technique
4. Reason adoption Climate Smart Agriculture
5. Costs adoption Climate Smart Agriculture
6. Required financial service/product
7. Linkages with Financial Service Providers (banks, MFI, SACCO, informal, mobile)
8. Benefits Climate Smart Agriculture
9. Impact on cashflow/collateral/financial history
10. Opinion of adoption Climate Smart Agriculture

ANNEX 3: IDENTIFIED BIODIGESTER SUPPLIERS

Company/Organisation	Location	Website	Email	Telephone
Takamoto	Githunguri	www.takamoto.org	info@takamoto.org smwaura@gmail.com	Office: +254738689788 Steve Mwaura: +2547247723627
CIDES BIOGAS	Nairobi	www.cidesbiogas.co.ke	innovation.cides@gmail.com joseph.cides@gmail.com	Mobile: +254722688564
Sistema.bio	Nairobi	www.sistema.bio	kenya@sistema.bio	Phone: +254715970131
FlexiBiogas Solutions	Nairobi	www.biogas.co.ke	info@biogas.co.ke biogasinternational@yahoo.com	Phone: +254722700530
Keilot Ltd	Nairobi	www.keilot.co.ke	info@keilot.co.ke	Phone: +254111212242
Kenya Biogas Program	Nairobi	www.kenyabiogas.com	swahome@kbp.co.ke mwasonga@kbp.co.ke	Office: +254791496964 Salome Wahome: +254722542723 Michael Wasonga: +254720813082

ANNEX 4: CODES AND SUB-CODES

Document	Codes	Sub-Codes
Dairy Farmers	Farmer Characteristics	Sex, Age, Acres, Diversion of income, Family status, Herd size and production, Main occupation
	Biodigesters	Company, Type, Capacity, Year of adoption, Expenses, Financial products and services, Reasons and benefits
	Water Tank	Company, Type, Capacity, Year of adoption, Expenses, Financial products and services, Reasons and benefits
	Milking Bucket Machine	Company, Type, Capacity, Year of adoption, Expenses, Financial products and services, Reasons and benefits
	Maize Silage	Capacity, Year of adoption, Financial products and services, Reasons and benefits
Financial Service Providers	Financial Service Providers	Type FSP, Utilisation FSP, Informal groups, Mobile money, Mobile Banking
	General Info	Function interviewee, Members/clients, Target group, Locations, Year of birth
	Financial Products and Services	Credit products, Savings products, Payment products, Insurance and risk products, Mobile money and banking CSA finance
	Relationships	Other FSPs, Dairy cooperatives, CSA suppliers
	Scale up adoption CSA	Arguments, Knowledge/capacity, funding
	Others	Assesment solvability, Future of dairy sector
Other Stakeholders	General Info	Funtion interviewee, Members/clients, Target groups, locations, Year of birth
	Relationships	Dairy cooperatives, FSPs, Dairy farmers, Suppliers
	CSA innovation	Biodigester, Rainwater Harvesting, Milking Bucket Machine, Maize silage

