

A Realist Explanation of Long Run Development Interventions
Contexts, Adaptations and Outcomes of Dairy Improvement in Kenya

By

Obadia Okinda Miroro

Submitted in fulfilment of the requirements for the degree of:

Doctor of Philosophy (Development Studies) in the
School of Built Environment and Development Studies
University of KwaZulu-Natal
Howard College Campus
Durban
South Africa

March 2014

As the candidate's supervisor, I have approved this thesis for submission.

Date: 14/03/2014

Name: Professor Julian May

Signed:



Abstract

Despite continued pursuit of development interventions to improve people's livelihoods and reduce poverty, intended and actual outcomes of developments interventions may differ. Some scholars attribute this variation to flawed conceptualisation of development interventions while others view this divergence as evidence that implementation processes are complex and actual outcomes result from adaptations of the interventions by actors. To move beyond the discursive approaches to analysis of development interventions, this thesis addresses the question how do actors adapt them, why and with what outcomes in the long run? Empirically, it looks at how project officers and farmers adapted the National Dairy Development Project (NDDP), a dairy intervention implemented in Kenya between 1980 and 1995, and its long run outcomes. The intervention promoted zero grazing, intensive management of dairy cattle whose implementation by farmers was expected to increase land productivity as a means to address land scarcity, increase milk production and reduce poverty through generation of incomes from milk sales.

The methodology of this thesis links mechanisms, contexts, and outcomes, three elements of realist explanation, to understand adaptations and outcomes of development interventions. Through thematic synthesis of in-depth interviews and analysis of project documents, this thesis explains adaptations and long run outcomes of the NDDP. Findings reveal that developers and farmers adapted several components of the intervention. With close reference to context, incentives and continuity pressures, this thesis utilises intervention effectiveness and matching mechanisms to explain how project officers adapted the NDDP. Further, through fit and resistance mechanisms, this thesis explains how farmers adapted zero grazing in the context of inadequate fodder, labour shortage and lack of resources to invest in dairy. In the long run, findings show that the intervention diminished as evident in coexistence of indigenous and modern dairy technologies and non-implementation of any dairy technologies by farmers. Despite adaptations of zero grazing by project officers and farmers, intensification of dairy cattle management has diminished in the context of resource constraints, neoliberal policies and labour shortage. Consequently, the objective to increase land productivity through intensive dairy cattle management, the rationale for initiation of the intervention, remains unresolved.

Declaration - Plagiarism

I, Obadia Okinda Miroro, declare that

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
3. This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
4. This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:
 - a. Their words have been re-written but the general information attributed to them has been referenced
 - b. Where their exact words have been used, then their writing has been placed in italics and inside quotation marks, and referenced.
5. This thesis does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the References sections.



Student signature

14/03/2014

Date

List of contents

Abstract	ii
Declaration - Plagiarism	iii
List of contents	iv
List of Tables	viii
List of Figures	ix
Acknowledgements	x
List of acronyms and abbreviations	xii
CHAPTER ONE	1
Introduction	1
1.1 Introduction	1
1.2 What are development interventions?	6
1.3 Why do planned and actual outcomes of development interventions differ?	9
1.4 Adaptations of development interventions	13
1.5 Organisation of the thesis	17
CHAPTER TWO	19
Research Context and Setting	19
2.1 Introduction	19
2.2 Agriculture, livestock and dairy industry in Kenya	19
2.3 Historical development of commercial dairy farming in Kenya	23
2.3.1 Establishment of large-scale settler dairy farming (1900-1950s)	23
2.3.2 Support and growth of smallholder dairy farmers	26
2.4.3 Structural reforms, liberalisation, and privatisation of the dairy sector	28
2.3.4 Revitalisation of the dairy sub sector (since 2003)	31
2.4 Research site and its agro-ecological characteristics	32
2.4.1 Socio-economic features of Kakamega district	34
2.5 Conclusion	36
CHAPTER THREE	38

Methodology and methods	38
3.1 Introduction	38
3.2 Methodology not quite the same as methods	39
3.3 Realism and realist ontology	40
3.4 Knowledge cumulation in realism	42
3.4.1 Mechanisms in realist explanation of events	44
3.4.2 Contexts and outcomes in realist explanation	49
3.5 Methods of conducting realist research	50
3.6 Data analytic methods	52
3.7 The research process	54
3.7.1 Exploratory phase	54
3.7.2 Explanatory Phase	61
3.7.3 Confirmatory phase	74
3.8 Conclusion	75
CHAPTER FOUR	76
The National Dairy Development Project	76
4.1 Introduction	76
4.2 Establishment, organisation and objectives of the NDDP	76
4.2.1 Phase one, orientation (1980-1981)	78
4.2.2 Phase two, introduction (1982-1983)	79
4.2.3 Phase three, consolidation (1984-1986)	79
4.2.4 Phase four, expansion (1987-1990)	80
4.2.5 Phase five, integration (1991-1994)	80
4.3 Rationale for initiation of the DDP	83
4.3.2 Expected increase in demand for dairy products and income generation	83
4.4 The components of zero grazing	86
4.5 The NDDP extension strategy and inherent mechanisms	89
4.5.1 “Seeing is believing” mechanism	91
4.5.2 Capacitation mechanism	94
4.6 Standardised dairy intervention	97

4.6.1	Advice based on research on conditions of average farmers	101
4.6.2	Diversity of high potential areas	102
4.3.1	Intensification of land use due to population pressure and land scarcity	104
4.6.3	Availability and access to dairy cattle support services and inputs	106
4.7	Multiple interpretations of the intervention by farmers	108
4.8	Conclusion	109
CHAPTER FIVE		111
5.1	Introduction	111
5.2	The transition from first to second generation farmers	112
5.3	Evolution of NDDP extension	114
5.3.1	Change from commodity to farming systems and participatory approaches	115
5.3.2	Extension in the context budgetary constraints	119
5.3.3	Change of extension in search of intervention effectiveness and continuity	123
5.4	Fodder establishment and management	127
5.4.1	Establishment of a fodder research unit	133
5.4.2	Fodder preservation and cultivation in smallholder farms	134
5.4.3	Protein gap and its supplementation	141
5.5	Housing of dairy cattle	144
5.6	Milk marketing	147
5.7	Calf rearing	152
5.8	Management of soil fertility	155
5.9	Conclusion	161
CHAPTER SIX		164
The diminished intensification of dairy cattle management		164
6.1	Introduction	164
6.2	Long run outcomes of the NDDP	164
6.3.1	Inadequate finances for intensive dairy cattle management	166
6.3.2	Demographic changes in households	170
6.3.3	Labour shortage in smallholder dairy farms	172
6.3.4	Structural reforms in the dairy subsector	176

6.3.5	Commodification of grazing and sale of fodder in local markets	181
6.5	Conclusion	186
CHAPTER SEVEN		187
Conclusions		187
References		195
Appendix 1	Kiswahili interviews quoted	208
Appendix 2	Phases of NDDP implementation	215
Appendix 3	Research permit	216
Appendix 4	Informed consent form	217
Appendix 5	Interview guides	218

List of Tables

Table 1 Human and cattle population by region	21
Table 2 Alternative definition of mechanisms	47
Table 3 Intensive and extensive research designs	51
Table 4 Budgetary allocation for the NDDP (KSh)	77
Table 5 Registered farmers per district	81
Table 6 Farmers who were participated in the NDDP in Kakamega district	82
Table 7 Status of access to services and inputs in project districts	107
Table 8 Extent to which farmers conserved fodder	131
Table 9 Milk sales, calf feeding, and home consumption (l/day)	148

List of Figures

Figure 1 Recoded milk production (Million litres)	22
Figure 2 Location and features of Kakamega district	33
Figure 3 Layered ontology and research strategies	41
Figure 4 NVivo database showing sources of data for this study	57
Figure 5 Tethering code in NVivo	58
Figure 6 Nodes organised into a hierarchical tree structure	59
Figure 7 Projected demand and actual milk production (Million litres)	84
Figure 8 NDDP zero grazing unit plan	87
Figure 9 Features of zero grazing systems	89
Figure 10 Standardised inputs and outputs of the NDDP	98
Figure 11 Kenya population growth rate	105
Figure 12 Changing information flow in NDDP extension	117
Figure 13 Preservation of dry maize stovers	136
Figure 14 Tethered cow feeding on green maize stovers	138
Figure 15 Cultivation of Napier grass on the roadside	139
Figure 16 Composting cow dung and other organic matter	159
Figure 17 Zero grazing unit and a cow grazing on natural grass	168
Figure 18 Management of Napier grass	174
Figure 19 Provision of AI Services by KNAIS and private sector (1980-2008) (in thousands)	179
Figure 20 Changing dairy technologies and practices over time	180
Figure 21 Sale of fodder in local markets	182
Figure 22 Transportation of fodder	183

Acknowledgements

Several people and institutions have contributed to the success of this thesis. When I started to consider postgraduate study, I shared my initial ideas with Prof. Mary Omosa who motivated and encouraged me to seek admission. Prof. Omosa, who was the team leader of the Poverty and Information Communications Technologies in Urban and Rural Eastern (PICTURE) Africa research project and together with Prof. Timothy Mwololo Waema offered me the opportunity to work as project assistant for the project. I thank Prof. Omosa and Prof. Waema because through my interactions with them and when I worked as a project assistant for the PICTURE Africa project, they inspired me to work in the academia and my postgraduate study started.

My supervisor, Prof. Julian May offered invaluable insights and assistance throughout my study for which I am very grateful. My appreciation dates back to the PICTURE-Africa research project breakfast meeting in Nairobi when he accepted to assist me secure funding and supervise my PhD study. I am also grateful for his efforts that enabled me to settle in Durban, when I arrived for the first time. Prof. May did not only allow me to walk to his office to discuss any concerns I had about my study but also discussed and engaged through emails and Skype, that deepened my insight of the issues covered in this thesis. Prof. May did not hesitate to provide additional reading materials. By reading and commenting on all the versions of the proposal and thesis, my knowledge and understanding of the themes that this thesis covers widened and my analytical ability sharpened. I also acknowledge the support of Prof. Imraan Valodia.

I thank the members of staff at the School of Built Environment and Development Studies and the University of KwaZulu-Natal who in a number of ways facilitated my work. Ms. Priya Konan, the postgraduate administrator at the School facilitated my stay at the school severally. Ms. Germaine Barnard and Ms. Kathleen Diga facilitated administrative and research arrangements with the South African Research Chair on Applied Poverty Reduction Assessment (SARCHi), the project within which my study was funded.

Had it not been for the financial support from several sources, I would not have had the opportunity to start and complete this thesis. The National Research Foundation (NRF) through

the SARCHi enabled me to start my postgraduate study. The financial assistance of the National Research Foundation (NRF) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the NRF. Because the NRF bursary could not cover all the expenses for my PhD work, two other sources of funds came in handy. The International Development Research Centre (IDRC) provided funds for my fieldwork through the PICTURE-Africa research project for which I thank Ms. Edith Adera. The UKZN's School of Built Environment and Development Studies offered me a bursary during the thesis write-up.

At various stages in this work, I had a privilege to visit and stay at institutions that allowed me to use their resources. At the Institute for Development Studies (IDS), The University of Nairobi, I would like to thank Prof. Mohamud Jama, the director IDS, for his support. I shared work space with Abel Oyuke, Herbert Wamalwa and Erick Manga with no friction. At the Institute for Social Development (ISD), University of Western Cape, I would like to thank Ms. Priscilla Kippie who did not hesitate to offer any assistance that I required.

I would like to thank friends in South Africa as well as in Nairobi, namely Geoffrey Obonyo, Linet Misati, Cheng'etich Sambu, Philista Sang, Alexio Mberekio, Kassahun Khelifa, Armstrong Dzomba, Komlan Agbedahin, Kennedy Alantinga and Terry Kuzhanga, who supported me in one way or another during my PhD work.

I would like to express my gratitude to the officers at the Ministry of Livestock Development in Nairobi and in Kakamega district who assisted me to obtain NDDP documents and locate officers and farmers who were involved in the intervention.

Lastly, I would like to highly appreciate the support of my family who had to do with my absence at different times during this PhD work.

List of acronyms and abbreviations

AFC	Agricultural Finance Corporation
AI	Artificial Insemination
CDES	Christian Development and Educational Services
DC	District Commissioner
DDP	Dairy Development Policy
DDP	Dairy Development Project
DEAF	Dairy Extension and Advice Form
DMP	Dairy Master Plan
DCRP	Dairy Cattle Research Project
FAO	Food and Agricultural Organisation
FSA	Farming Systems Approach
FTC	Farmers Training Centre
GDP	Gross Domestic Product
HPI	Heifer Project International
ITN	Insecticide Treated Net
KARI	Kenya Agricultural Research Institute
KCC	Kenya Cooperative Creameries
KDB	Kenya Dairy Board
KIPPRA	Kenya Institute of Public Policy Research and Analysis
KNAIS	Kenya National Artificial Insemination Service
KNBS	Kenya National Bureau of Statistics
KWAP	Kenya Agroforestry Wood fuel Project
MALDM	Ministry of Agriculture Development and Marketing

MLD	Ministry of Livestock Development
MoA	Ministry of Agriculture
MPND	Ministry for Planning and National Development
MPTs	Multi-Purpose Trees
NAHRS	National Animal Husbandry Research Station
NDDP	National Dairy Development Project
NGO	Non-Governmental Organisation
NLEP	National Livestock Extension Programme
PHPP	Rainwater Harvesting Pond Programme
PSNP	Productive Safety Net Programme
RoK	Republic of Kenya
SDP	Smallholder Dairy Development

CHAPTER ONE

Introduction

1.1 Introduction

Despite continued pursuit of development interventions as a means to improve people's livelihoods and reduce poverty, intended and actual outcomes of the interventions may differ. This divergence is sometimes referred to as "unanticipated consequences" (Klitgaard, 1997, p. 1963). Although concerns that have been raised over development interventions outcomes, and the difficulty of evidence that such interventions achieve their intended objectives, some actors continue to have 'faith' in development interventions. It seems that interventions are a common response by state and non-state agents to all kinds of problems that range from climate change, internal or cross border conflicts, terrorism, liberation struggles and extremes of weather conditions to poverty. It appears to be taken for granted that development interventions would alleviate challenges that societies face, and at the same time bring about prosperity. Therefore, development agencies have initiated numerous interventions such that a cumulative history of development interventions is a common feature in communities, societies and states. This was very evident while I conducted fieldwork for my Master's degree. I observed that different agencies had initiated development interventions in the study site, at different times, or even concurrently in an attempt to reduce poverty, variously conceived. Then, I started to think about what happens to development interventions after they have been implemented. Related to this is the question of what outcomes of development interventions are, not just in the short-term but also over a long period.

Turning to the literature, development interventions have been discussed and it is acknowledged that planned and outcomes of development interventions may differ. For example, in Bangladesh, although some of the people who took credit invested in income activities like the providers intended, others used credit to pay for household expenditure (Davis, 2010). In Nepal, an evaluation of how different systems of irrigation fared on after construction of irrigation infrastructure revealed that while some systems performed well for a long period, other irrigation

systems failed soon after intervention (Lam & Ostrom, 2010). Similarly, in Tigray, Ethiopia, because developers favoured farmers who constructed rainwater-harvesting ponds under the Rainwater Harvesting Pond Programme (RHPP) for employment in another project, Productive Safety Net Programme (PSNP), most rainwater-harvesting ponds that farmers constructed failed because the farmers used them only as a means of gaining access to the PSNP (Segers et al., (2008). Moreover, in western Kenya, although interventionists provided Insecticide Treated Nets (ITNs) to control malaria, beneficiaries also used them to catch fish and dry it. According to Minakawa et al. (2008) who described the phenomenon as ‘misuse’, beneficiaries preferred the nets because fish dried faster on the ITNs compared to papyrus sheets that they previously used, the fish fetched higher prices because they were straighter and because the ITNs were obtained for free or at a small fee.

The divergence between intended and actual outcomes of development interventions should not be interpreted to mean that outcomes of development interventions do not provide any benefit or that they always fail. We are reminded, “The outcomes of improvement schemes are not always bad. Programmes of improvement often bring changes that people want—more roads and bridges, fewer floods and diseases, less corruption and waste” (Li, 2007, p. 1). Further, “...houses are built, jobs are created, inoculations are provided, and much food is delivered to the hungry” (Klitgaard, 1997, p. 1963). Because some interventions fail, outcomes of development interventions not only differ from intended, but that this variation can be neutral, beneficial or of no benefit to the actors involved or environments where they are implemented (Klitgaard, 1997).

Explanations for divergence between intended and actual outcomes of development interventions abound in the literature. Although I will discuss these reasons in section 1.3, at this point, I set out a brief outline of the competing claims. I start with post-development because its proponents were among the first to criticise development especially after the Second World War. Proponents of post-development view this divergence as failure of the way development was conceptualised after the Second World War (Sachs ed., 2010; Escobar, 1995; Everett, 2010; Ziai, 2004, 2011; Nustad, 2001). However, post-development proponents have been criticised that they tend to view development as a homogenous discourse and do not clearly articulate how development

interventions play out during implementation especially how other actors adapt or resist them (Everett, 1997; Nustad, 2001). It has been argued that social actors in general and not just developers influence outcomes of development interventions due to their agency (Archer, 1995; Emirbayer & Mische, 1998; Pawson, 2006; 2013). As a result, other studies have demonstrated the agency of target beneficiaries in development interventions. For example, Scott (1998) demonstrates how farmers in Tanzania rejected ridging as a solution to soil erosion because it was unstable on sandy soil, it created larger erosion gullies in the rainy season and encouraged white ants to attack the roots of crops. In central Kenya, farmers kept larger mature size breeds of dairy cows against the recommended breeding practices, which emphasised smaller mature size breeds (Bebe et al., 2003). In addition, negotiations and compromises between actors even those who seem to be powerful and common during intervention implementation processes, and they influence outcomes of the interventions (Pawson, 2006; Li, 2007). Furthermore, although developers face challenges in their attempt to bring about change, they also do respond to these challenges in creative ways (Klitgaard, 1997).

The foregoing discussion implies that development intervention outcomes do not necessarily evolve as conceived by developers but are due also to adaptation by implementers and other actors. While others reportedly argue that development critics especially proponents of post-development have not provided an alternative for development and that their ideas are unhelpful, development studies can benefit by learning from post-development and moving beyond discursive approaches to analysing development (Nustad, 2001). Therefore, the divergence between intended and actual outcomes should be seen as evidence that “Implementation of development interventions is multi-layered, that every layer has political dimensions, and while the official agenda may be trumpeted with bombast; it is often undercut by other, less overt, agendas” (Lund, 2010, p. 24). In recognition that some interventions have failed, and because inequality, poverty and provision of basic services remain a challenge in some countries or regions, Berg (2007) supports renewed research on development interventions. Further, “Rather than attempt to generalize, the effects of planned interventions have to be examined empirically, in the various sites where they unfold-families, villages, towns and inside the bureaucracy, among others” (Li, 2005, p. 391). What this means is that in addition to understanding outcomes

of development schemes from the developers' perspective, there is need to understand the outcomes from the perspective of the beneficiaries and other actors during implementation processes. This is more so because the beliefs that form the basis of development interventions may not be evident during implementation of those interventions (Nustad, 2001). Due to this:

There is need to shift focus from development discourses (how it constructs and orders the reality in which it seeks to intervene) to the practice of development. In particular, how these processes are manifested in concrete encounters with target populations-transformed, reformulated, adopted, or resisted. (Nustad, 2001, p. 485)

One way of extending analysis of development interventions is by looking at how they are adapted by actors, why and with what outcomes not just in the short-term but also in the long run. Therefore, in this thesis, I extend research on development interventions by looking at how they are adapted by actors, and explain their outcomes over an extended duration, an area that remains under explored. The question is not whether and how development interventions fail but understanding how they are adapted by actors during implementation processes and their outcomes as a way of moving beyond the discursive approaches which explain why development interventions fail. In doing so, the focus is not just on the developers but also on target beneficiaries and the context in which they adapt development interventions. The central question that this thesis addresses is how do actors adapt development interventions, why and with what outcomes? This key question was explored by looking at the National Dairy Development Project (NDDP), an intensive dairy cattle management intervention that was implemented in Kenya from 1980 to 1995. Empirically, this thesis explains how developers (Kenyan and Dutch government officers) and farmers adapted the NDDP since its inception in 1980 and its long run outcomes. The specific questions are what was the rationale of the NDDP intervention and its subsequent adaptations? What roles did different actors play in the intervention, and how did they rationalise the intervention? What strategies did the developers use to introduce, promote and implement the NDDP, and how were these strategies changed over time and why? Which NDDP dairy technologies did farmers implement, how and why? How did the different actors adapt the NDDP intervention and why? If farmers are still implementing the NDDP dairy technologies that they adopted, which ones are they, and in what form?

The main argument through this thesis is that in initiating the NDDP, developers assumed that implementation of its various components of zero grazing by farmers would increase land productivity to address land scarcity, increase milk production to meet demand for milk that was expected to rise and reduce poverty among smallholder farmers through increased income from milk sales. However, because in conceptualising the NDDP, the project officers did not incorporate some elements of the context of the farmers who were to implement it, the NDDP was a decontextualized intervention and conceived as a standardised package. As a result, I show that when project officers started to promote it, they realised that it could not be implemented as planned. I argue that due to the incentives that they received and pressures to report progress, the project officers sought to attain intervention effectiveness and continuity through adaptations of the intervention. Furthermore, because the intervention was not entirely relevant to the context of farmers, in this thesis, I show how farmers adapted it to fit their socio-economic, demographic and cultural context, and resisted some of its components, resistance which took the form of adaptation. This thesis therefore explores implementation of the NDDP over a long period and reveals how both the project officers and the farmers adapted it, sometimes mutually, as project officers attempted to enhance its effectiveness and continuity and farmers sought to make it fit their context or resisted it.

In this thesis, I analytically situate the NDDP along a trajectory over an extended period. I show that due to adaptations of NDDP by project officers and farmers in the context of labour shortage, inadequate finances, neoliberal policies, land scarcity, in the long run, intensification of dairy cattle management diminished. Diminished intensification of the project was characterised by coexistence of indigenous and modern dairy technologies and non-implementation of any dairy technologies among farmers who were involved in the project. Focus on long run outcomes is essential because “Some effects take years, perhaps decades, to emerge. Some of the downstream effects of improvement schemes are very serious indeed, and they will be felt for a long time to come” (Li, 2005, pp. 391-392). Indeed, when development is viewed as intentional efforts to be attained through interventions, it my argument that researchers should be concerned with not just short-term outcomes but also outcomes over a long period.

1.2 What are development interventions?

Development interventions have been termed as improvement schemes (Scott, 1998; Li, 2007), social programmes or interventions (Pawson & Tilley, 1997; Pawson, 2006; 2013), development projects and programmes (Ziai, 2011) and projects of intervention (Quarles van Ufford, Giri, & Mosse, 2003). Common to all these terms is the view of development as deliberate efforts by agencies to improve livelihoods of others (Cowen & Shenton, 1996). Therefore, in this thesis, the focus is not so much on development as immanent change but development as intentional change. Although Cowen & Shenton (1996) trace development as an intentional process back to industrial capitalism when it was expected to address the damage that had been brought about by immanent process of change in society, proponents of post-development date development as intervention back to the mid-20th century. Similarly, “the idea of development in its present interventionist mode originated at the end of the Second World War as a new vision of hope against the backdrop of the devastating experiences of the war and the rising process of decolonisation” (Quarles van Ufford et al., 2003, p. 3). In its origin, the notion of intervention described “... a process of ‘coming in between’, that is, between the self and the other, agents of development interventions and their interlocutors, the developing society and the developed and vice versa, and between cultures” (Quarles van Ufford et al., 2003, p. 31). In this sense, development intervention “... is made up of targeted efforts at improving certain conditions” (Lund, 2010, p. 21). What this means is that development interventions involve many actors and that an actor in the form of a development agency, takes the initiative to improve lives of those that they think needs improvement. In other words, central to the development intervention is the notion of trusteeship (see Cowen & Shenton, 1996, Nustad, 2001). From this perspective, development describes intentional development, which is actualised through development interventions. It is in this context that proponents of post-development criticised development especially how its principles as well as how it was framed and implemented after the Second World War or the “Post World War II development project” Mathews (2004, p. 376).

In an attempt to understand development from multiple dimensions, a distinction has been made between projects of intervention and development interventions. The difference is that:

Projects of interventions are initiated either by external donor agencies or the state whereas development interventions are not the sole programmes of state or donor agencies or even market, and are undertaken by local communities, voluntary organisations and people's movements have also undertaken significant development activities. (Quarles van Ufford et al., 2003, pp. 30-31)

The notions of self-development or self-initiated development seek to understand development based on the type of actors who initiate interventions. This implies that development agencies can be external or internal to the milieu of the intervention. However, this does not change the understanding of development as intentional change because whether development interventions are initiated by external agencies or self-initiated, they both are based on the idea of trusteeship, which such a distinction does not address (Nustad, 2001). This is because regardless who initiates, "... there is distinct agency, there is a notion of target and an ambition of purposive change and it is generally 'instigated by institutions or actors who do not belong to the milieu in question but who seek to mobilize the milieu'" (Olivier de Sardan, 2005, p. 25 cited in Lund, 2010, p. 21). In this case, during conceptualisation of development interventions, they can be seen to involve at least two actors, namely developers and target beneficiaries. Therefore, attempts to understand outcomes of development interventions should not just focus on developers or target beneficiaries only.

As involving intentional processes of change, development interventions have several features. First, because development interventions aim to bring about change based on developers' assumptions of how what needs change came about in the first place, they are theories of social change (Pawson, 2006). As an example, during his speech to the 35th Annual Ditchley Foundation Lecture, Kofi Annan, the Secretary General of the United Nations at the time identified undesirable conditions and interventions that could alleviate the situation. He said:

In so many cases, ethnic tensions are exacerbated by poverty and famine, or by uneven economic development, which brings wealth to one section of a community while destroying the homes and livelihood of another. If outsiders can help avert this by suitably targeted aid and investment, by giving information and training to local entrepreneurs, or by suggesting more appropriate state policies, their 'intervention' should surely be welcomed by all concerned. (Annan, 1999, p. 119)

Second, through interventions, developers believe that they can improve certain aspects of target beneficiaries lives. However, the interventions may be resisted by target beneficiaries when what they seek to promote differs from interests and needs of the target beneficiaries (Ziai, 2011; Li, 2005). Designing interventions that do not adequately address the problems of beneficiaries occurs when “developers identify deficiencies that need to be rectified (problematisation) and translate information available to them into actual programs (rendering technical), and in so doing they may inadvertently exclude the structure of political economic relations from their diagnosis and prescriptions” (Li, 2007, p. 7). Notably, without problematisation and rendering technical, it would be difficult for developers to intervene because they have limited resources and time, yet they have to show progress for their efforts (Scott, 1998; Li, 2007). This resonates with the conceptualisation of compulsory villages in Tanzania where “only by radically simplifying the settlement patterns was it possible for the state to efficiently deliver such development services as schools, clinics and clean water” (Scott, 1998, p. 224). Nevertheless, the challenge of problematisation and rendering technical is that interventions may not be relevant to the context in which they are to be implemented, which may increase their likelihood of being resisted and having outcomes, which vary from those that were intended. Another feature of development interventions is that they bring about change based on the decisions and actions of the actors involved (Pawson & Tilley, 1997). This is due to human agency, a:

Temporally embedded process of social engagement, informed by the past (in its habitual aspect), but also oriented toward the future (as a capacity to imagine alternative possibilities) and toward the present (as a capacity to contextualize past habits and future projects within the contingencies of the moment. (Emirbayer & Mische, 1998, p. 963)

Because, usually, interventions involve numerous actors, who have agency, outcomes can be understood by analysing how the various actors “...negotiate, resist, reject, ignore or adapt the intervention or some of its aspects along the implementation chain” (Pawson et al., 2005, p. 22). Due to this, outcomes may be viewed as being the cumulative influence of actors as opposed to merely assuming that particular actors especially those perceived as powerful always have their way in development intervention processes (Pawson, 2013).

The fourth feature is that interventions are implemented in society where other changes are already taking place, in other words, in “pre-existing contexts” (Pawson, 2006, p. 24). This is attested by the morphogenetic sequence which views social change as continuous due to the interplay between structure and agency over time in three stages involving structural conditioning, social interaction, and reproduction (morphostasis) or transformation (morphogenesis) (Archer, 1995). This view of agency is similar to Pawson & Tilley’s (1997) who point out that social structure or pre-existing conditions enable or constrain actors’ choices. This is the reason that “Although interventions are often heralded as ‘instruments for change’-what they actually do is to change the course of change” (Pawson, 2011, p. 194). The implication of this is that even without interventions, change will still occur in society. As an example of continuing agency, Scott (1998) found that agricultural practices of cultivators in West Africa were a reflection of their previous experiences modified by interaction with their natural and human environment. Because society is an open system and changes, interventions “cannot be fully isolated or kept constant and can be self-transformational” (Pawson, 2006, p. 34). This implies that development interventions evolve over time, a process that may lead both to intended and unintended outcomes, some of which may change the intervention. Due to the foregoing features of development interventions, “...social interventions are always *complex systems thrust amidst complex systems*” (Pawson, 2006, p. 34). Therefore, this thesis conceives the NDDP as a complex intervention because its features are similar to those described above, as it will become evident in subsequent chapters.

1.3 Why do planned and actual outcomes of development interventions differ?

Concerns over development interventions came into sharp focus when improvements that they sought did not occur especially in the 1980s and 1990s (Mkandawire, 2011). There are many criticisms of development from different perspectives. In this section, the intention is not to examine all the criticisms of development but to focus more on how some of the critiques explain the divergence between intended and actual outcomes of development interventions. Among the critics of development are a group of scholars associated with post-development. Although post-development proponents are viewed to be against development, this is not the case. Their critique was against “...ideas and practices which have been premised upon the belief that some areas of

the world are ‘developed’, and others not, and that those which are not can and should set about achieving the ‘development’ which has thus far eluded them” (Mathews, 2004, p. 375). Ahorro (2008) and Nustad (2001) categorise post-development theorists into two groups, a classification which is not generally agreed upon.

The first group includes the contributors to the *Development Dictionary a Guide to Knowledge as Power*, edited by Wolfgang Sachs. The first edition of the book was published in 1992 and in the second edition released in 2010, the authors restate their positions in response to their critics. Overall, although the critiques of development and what they see as the way forward for development differs, they argue that development was conceptualised on weak principles, which made its failure inevitable (Escobar, 1995; Sachs, 2010; Nustad, 2001). Based on their claims, most of the post-development writers “... are in some way inspired by the writings of Foucault, and tends to see development as a discourse that orders and creates the object that it pertains to address” (Nustad, 2001, p. 480). They explore “... how a particular way of speaking and thinking about social change in African, Asian and Latin American societies had certain origins and effects and was linked to relations of power” (Ziai, 2011, p. 4). For example, Escobar (1995) views development as a means that the west used to spread their values in countries that the west collectively described as third world. Related to this, Esteva (2010) argues that development was conceived as a homogenous discourse by western powers directed at countries they viewed as underdeveloped to achieve their own hidden interests. Some have claimed that the development efforts by the west created new relationships and networks that adversely affected people at the local level by ignoring their views, indigenous knowledge and practices (Escobar, 1995; Esteva, 2010). As a result, Escobar (1995) describes initiatives development agencies to improve well-being and reduce poverty in least developed countries as ethnocentric and misguided failures. From this perspective, failure of some post-World War Two projects in Africa was not due inappropriate implementation but because developers misconceived them by ignoring heterogeneity in different countries (Mathews, 2004). Another argument raised by post-development proponents is that post-World War II development projects were a means to counter the spread of communism and as a continuation of colonialism (Sachs, 2010). Consequently, the assumptions on which development is based have Eurocentric, depoliticising and authoritarian

implications (Ziai, 2011). One of the depoliticising effects is the assumption that development projects would be beneficial to all members of society yet some members gain while others lose from the same intervention (Ziai, 2011). Because they claim that development failed to meet its intended objectives, this group of post-development scholars entirely reject development. They call for alternatives to development, not alternative development because development is inherently flawed that no amount of change can solve (Mathews, 2004).

In turn, post-development proponents have been challenged in a number of ways, setting forth arguments and counterarguments about development and intervention outcomes. For example, proponents of post-development rejected development in its entirety yet some benefits arise from it (Mathews, 2004). Further, they have been accused of failing to critically conceptualise development and analyse development interventions (Corbridge, 1998). For instance, they largely analysed development discourse and in so doing failed to examine actual development interventions processes and how actors interact (Everett, 1997; Nustad, 2001). This does not reflect the reality because:

In defining the power of such agencies (especially the World Bank) these authors focus not on the practices of actors or sets of actors, but rather on the ability of such institutions to shape perceptions of Third World peoples and to limit ways of thinking about the world and imagining change. While the focus on language is helpful to understanding how development agendas are “deployed” throughout the world, many critics overlook the important role of local elite groups as well as the agency of development’s “target populations”. (Everett, 1997, p. 137)

Due to these criticisms, another group, the second group of post-development theorists (Mathews, 2004; Ziai, 2004; 2011; Ferguson, 1994) “... sought to widen the meaning of post-development by making the theory more reflexive and nuanced in its analysis of development and of people from the subaltern” (Ahorro, 2008, p. 9). This second group, which moved away from purely a discursive approach provided a more detailed description of the history of development or explained the effects of development (Nustad, 2001). For example, Ferguson (1994) focused on outcomes of development discourse, which in a study of development projects in Lesotho were depoliticisation of development and spread of bureaucratic power relations. In

this case, unintended outcomes of development are not necessarily a result of failure by developers to understand local contexts, but because they “... have to construct the field in which they want to intervene in such a way that intervention is possible. A local, technical perspective is substituted for a more global, political perspective on the processes that produce poverty in the first place” (Nustad, 2001, p. 482). As a way forward for development, this second group proposes examination of diversity within regions and some like Mathews (2004) note that past weaknesses of development projects should not mean the end to efforts to improve people’s lives. As an example of this, Scott (1998) demonstrates numerous improvement schemes which failed because the schemes “... did not successfully represent the actual activity of the society they depicted, nor were they intended to; they represented only that slice of it that interested the official observer” (Scott, 1998, p. 3). One of the ways in which the schemes did not represent the context in which they were implemented was that they ignored local knowledge (métis) (Scott, 1998). As a result, such grand improvement schemes failed to attain their intended objectives.

Relatedly, Li (2005; 2007) analyses Scott’s analytical framework in *Seeing like a state*, which implies that the state has a monopoly on improvement schemes. Li (2007) argues that in improvement schemes, understanding the positioning of actors in relation to what or where they perceive as the centre is important. However, like Scott (1998), Li (2007) describes processes of problematisation and rendering technical as part of the processes through which developers conceptualise interventions to make it possible for them to intervene but in doing so “they address some problems and necessarily not others” (Li, 2007, p. 2). Further, in contrast to Scott (1998) who argues that developers use different forms of violence and coercion in implementation of improvement schemes, Li (2005; 2007) notes that developers rarely coerce their subjects but use tactics to influence the subjects who retain the freedom of action. In addition, improvement schemes work on and through the practices and desires of their target populations (Li, 2005). In recognition that resistance can occur even in the bureaucracy by those involved in the scheme, Li (2005, p. 391) asserts, “The emergence of practices of compromise and collusion to fill the gap between project plans and on-the-ground realities is an effect. It jeopardizes, or at least compromises, the authority of officials and the position of those who claim expertise”. From this view, outcomes of improvement schemes are a result of how actors

position themselves and the relations that they establish during different processes and activities of improvement schemes initiation and implementation.

1.4 Adaptations of development interventions

In defining adaptation, Buttolph (1992, p. 460) explains that “*In diffusion of innovations*, a process exists in which the adopter changes, to varying degrees, the innovation he or she is adopting” and subsequently refers to adaptation as the “change phenomenon”. This change phenomenon has been referred to as translation, co-construction, creolization, domestication, and reconfiguration and editing (Ansari, Fiss, & Zajac, 2010), redesigning (Mango, 2002), re-invention and modifications (Castro et al., 2004), improvisations (Scott, 1998) and compromises (Li, 2007). In this thesis, I use the notion of adaptation because it involves actors as individuals with agency as acknowledged in different studies. Notably, mutual adaptation may also occur when actors “...change agents modify the application of an innovation according to user needs and local contexts whereas the users themselves perform adaptation” (Buttolph, 1992, p. 462).

There are different forms of adaptations. The first involves adaptation in the content of an intervention while the second one involves adaptations in the strategy that an agency employs to promote or deliver the intervention to beneficiaries (Castro et al., 2004; Stirman et al., 2013; Kumpfer et al., 2002: 44). Notably, these two forms of adaptations involve changes to interventions by developers. In addition to these two forms, adaptation may involve changes of how a practice is perceived or framed (Ansari et al., 2010). Adaptations can be planned or unintentional (Castro et al., 2004), and can be positive when they enhance effectiveness of a programme or be a drift when they adversely affect its effectiveness (Aarons, Miller, Green, Perrott, & Bradway, 2012, p. 234). Sometimes, adaptations may simultaneously affect effectiveness of a programme positively and negatively. For example, a study on the extent to which adaptations affect programmes found that although adaptations made the intervention more relevant and improved retention rates, the same adaptations made the intervention less effective because they did away with some components initially inbuilt in the intervention (O'Connor et al., 2007).

Adaptation of interventions has been acknowledged in different fields. In diffusion studies, re-invention arose to challenge the diffusion models, which assumed that innovations were implemented in the same way in different contexts. In this regard, “re-invention [was] seen as part and parcel of the diffusion process” (Whitten and Collins, 1997 cited in Ansari et al., 2010, p. 71). In implementation science, “Practitioners often change or adapt evidence-based programs as they implement them, whether intentionally or not” (O’Connor et al., 2007, p. 1). Similarly, adaptation is a component of implementation of Evidence Based Practice (EBP) interventions (Aarons et al., 2012). As a result, although initially the question was whether adaptation influences implementation of interventions, when the inevitability of adaptation was recognised, the focus turned to the kind of adaptations that would not adversely affect implementation of interventions (O’Connor et al., 2007). Consequently:

It is not wise to inquire whether some unadulterated, unalloyed, perfectly formed, correctly configured programme has worked in its various properly implemented incarnations. Learning and adaptation is a condition of being for social programmes. Rather than being a conceptual fixture in the review hypothesis, a useful meta-question involves probing the life course dynamics of programmes. (Pawson, 2006, p. 46)

Because improvisations occur in improvement schemes, Scott (1998, p. 49) cautions “We must keep in mind not only the capacity to transform the world but also the capacity of the society to modify, subvert, block, and even overturn the categories imposed upon it”. As evidence of this, Scott (1998) explains how during implementation of Villagisation in Tanzania, when the state officials realised that people resisted the intervention, to avoid failure, they allowed farmers to improvise some aspects, and even tolerated informal or illegal activities that farmers engaged in, which is the reason that the large scheme survived. In another case, during implementation of resettlement programmes in central Sulawesi, Indonesia, Li (2007, p. 94) found that “Officials made many compromises to take account of floods and diseases, the condition of the land, and the habits and desires of the target population”. These two cases reveal that adaptations usually occur in improvement schemes and at the same time, developers allow beneficiaries to adapt them in order to continue with implementation of the interventions.

In the literature, reasons why development interventions are adapted have been advanced. Because actors drive adaptations in an intervention, in the literature, reasons for adaptations are based on the actors who adapt an intervention. When developers adapt interventions, they do so due to variation between the features of an intervention and the context within which the intervention is to be implemented (Douthwaite et al., 2001; Ansari et al., 2010; Stirman et al., 2013; and Aarons et al., 2012). For instance, in implementation science “Evidence-based programs and interventions are frequently modified during the implementation process to address differences between the context in which the intervention was originally designed and tested, and the one into which it is ultimately implemented” (Stirman et al., 2013, p. 2). Related to this is a study which found that “modification of content may be necessary if a consumer group needs or wants certain programmatic content not offered by the original model program” (Kumpfer et al., 2002, p. 44). In organisations, adaptation occurs when the features of an intervention being implemented differ from the context of the organisation in which the intervention is being implemented (Ansari et al., 2010). In this sense, “adaptation is a means to overcome the programme-community mismatch where sources of non-fit and “mismatch effect” would threaten program efficacy, despite high fidelity in program implementation” (Castro et al., 2004, p. 43). Therefore, adaptations aim at improving the fit between the intervention and the target population or the context into which it is introduced (Stirman et al., 2013). It is also to maintain effectiveness of an intervention (Aarons et al., 2012). In implementation science, the concept of cultural adaptation describes adaptation of interventions in response to cultural differences between an intervention practices and the communities where it is implemented (O’Connor et al., 2007; Kumpfer et al., 2002). What emerges from EBP and implementation science studies cited above is that adaptation is an undertaking by developers, and in doing so, they do not show how other actors engage in adaptation.

Adaptation of interventions by beneficiaries has been associated with their context. In diffusion of innovations, “.... adopters strive to create a better fit between an external practice and the adopter’s particular needs to increase its “zone of acceptance” during implementation” (Ansari et al., 2010, p. 71). Studies show that farmers adapted innovations in accordance with their diverse farming activities (Douthwaite et al., 2001) or redesigned hybrid maize, zero grazing and

agroforestry innovations to meet their distinct objectives of involvement an intervention (Mango, 2002). What these mean is that context influences adaptation of interventions by developers and even the beneficiaries. In recognition of the central and active role that adopters play in diffusion of innovations, Buttolph (1992) attributes adaptation to interpretation, adopter innovativeness and generative learning. Through adopter innovativeness, individuals adapt innovations in order to make them appear familiar and to avoid major changes in their lives while generative learning influences leads to adaptation when individuals relate new information to their knowledge (Buttolph, 1992). In terms of how interpretation drives adaptation:

When an individual interprets an innovation, she or he focuses on a particular component, a cluster of components, components in relation to the overarching innovative idea, just the main idea or some combination of these. Any two individuals focus on any number of components in the same innovation and interpret those components differently from each other. Different interpretations result in unique adaptations of the original innovation. (Buttolph, 1992, p. 463)

This is similar to the view that some characteristics of a practice, namely interpretive viability and divisibility, make it more or less likely for it to be adapted (Ansari et al., 2010). Interpretative viability refers to features of a practice that makes it possible for it to be interpreted in multiple ways for example when “concepts are characterised by certain degrees of ambiguity” (Benders & van Veen, 2001, p. 37). Divisibility of a practice which “refers to the degree to which the practice can be implemented independent of scale” (Fliegel, Kivlin, & Sekhon, 1968 cited in Ansari et al., 2010, p. 83) imply that some components of the intervention can be implemented as opposed to the entire intervention. High interpretative viability and divisibility make practices more likely to be adapted (Buttolph, 1992). In addition to interpretative viability and divisibility of practices, complexity of a practice may make it possible for it to be adapted, that is, enable or constrain its adaptation. On the one hand, complex practices are less likely to be adapted compared to less complex ones while on the other hand, adaptation may occur due to incorrect understanding and interpretation of complex practices (Ansari et al., 2010).

From the foregoing, adaptations occur in the content, strategy of delivering interventions or how it is framed as evident in diffusion studies, evidence based policy, prevention science and in

improvement schemes. This thesis extends understanding of adaptation of development interventions by developers and beneficiaries including mutual adaptation through mechanism and context explanation.

1.5 Organisation of the thesis

The thesis consists of seven chapters. Chapter Two looks at the research context and setting. This chapter explains significance of the agricultural sector as well as the dairy subsector in the Kenyan economy. It reveals that the NDDP is one of the numerous interventions that have been initiated to improve dairy cattle farming, which date back to about a century ago. The chapter also describes the research site, Kakamega district in Western Kenya, in terms of its geographical location, socio-economic and demographic characteristics.

Chapter Three discusses the research methodology and methods that guide this study. I emphasise the importance of articulating the research paradigm and describe realism, the paradigm on which this thesis is anchored. I explain three elements of realist explanation, namely mechanisms, contexts and outcomes which form the explanatory framework for this thesis. The chapter further discusses the intensive research methods that were used to gather and analyse data and the research process that was followed. Lastly, I explain how I identified, mechanisms, contexts and outcomes.

Chapter Four looks at the NDDP as a decontextualized intervention. It explores the NDDP in terms of its objectives, rationale, components and the extension strategy that the project officers used to promote it among farmers. It also looks at the mechanisms that were inherent in the extension strategy and how farmers interpreted it in multiple ways.

Chapter Five explains adaptations of the NDDP by project officers and farmers. I utilise intervention effectiveness and matching mechanisms in the context of incentives, continuity pressures and budgetary constraints to explain adaptations of intervention by the project officers. Further, I explain adaptation of the intervention by farmers by employing fit and resistance mechanisms. I show how the benefits which the farmers expected to gain from the intervention

and their awareness of costs and benefits of implementing the components of zero grazing motivated their adaptation of the components to fit their context and resisted other components. The argument is that farmers, as beneficiaries did not simply accept or reject the NDDP but interpreted it in different ways, which influenced how they adapted it to fit their context. By drawing on the in-depth interviews and project documents, I provide evidence of the mechanisms and contexts in which the project was implemented and how this influenced its adaptation by the developers and the farmers. I explore the interaction between the adaptations by project officers and farmers and show how project officers learnt from farmers during implementation processes.

Chapter Six explains the eventual and interim outcomes of the NDDP. I identify and explain how the NDDP has diminished and the context in which this occurred. In this chapter, I provide a detailed discussion of the diminishing effect mechanism by looking the coexistence of indigenous and modern dairy technologies and non-implementation of any of the dairy technologies. I emphasise on the primacy of context in explaining how and why the intervention diminished in the long run.

In conclusion, Chapter Seven elaborates on the centrality of adaptations in development interventions and proposes mechanisms that can be utilised to explain adaptations and outcomes of development interventions.

CHAPTER TWO

Research Context and Setting

2.1 Introduction

This chapter looks at the historical context in which dairy improvement in Kenya may be understood and features of the study site. In the first section, I look at the importance of agriculture and its contribution to the Kenyan economy. I show that the changes in the dairy subsector reflect largely the changes that have taken place in the livestock sector, which in turn is a reflection of changes in the agricultural sector. Noteworthy is also that policies and regulations that drive the agricultural sector, to some extent mirror the broader national development policy of the ruling regime. Because this thesis focuses on a dairy improvement intervention, I explain the changes that have occurred in the dairy subsector over the last century. In particular, I describe the various dairy improvement interventions that have been initiated, the actors who were involved, the policies that have influenced dairy and the status of the dairy subsector.

In the last section of this chapter, I describe Kakamega district, western Kenya, where research for this thesis was conducted. Kakamega district being an agricultural area, this section describes the agro-ecological characteristics and the socio-economic features that provide the context in which the dairy improvement project was implemented and therefore the context in which its subsequent adaptations and outcomes can be understood.

2.2 Agriculture, livestock and dairy industry in Kenya

Although Kenya's surface area is 59,195,800 hectares, less than a third of this is suitable for agriculture and classified either as being of medium or high potential. The importance of agriculture in the country is reflected in its contribution to the Gross Domestic Product (GDP) and livelihoods of many households. Although at independence in 1963, agriculture directly contributed 15.7% to the country's GDP, in 2011, the contribution of agriculture and forestry was 24.5% (Kenya National Bureau of Statistics [KNBS], 2009a; 2012). Agriculture provides about three quarters of industrial raw materials (Republic of Kenya [RoK], 2008) and about 70%

employment (Kenya Institute of Public Policy Research and Analysis [KIPPRA], 2009). The KNBS estimated that 69% of all households in Kenya were involved in agriculture in 2005/06 (KNBS & Ministry of Planning and National Development [MPND], 2007). Estimates also reveal that “about 3.8 million Kenyans are directly employed in farm, livestock production, and fishing” (RoK, 2008, p. 63). What is evident is that agricultural sector performance has a direct relationship with the performance of Kenya’s economy (KIPPRA, 2009; KNBS, 2009a). Due to its importance, agriculture is among the six critical sectors expected to play a leading role in the push towards attainment of a middle-income country status by 2030 in the country’s long-term development plan, *The Kenya Vision 2030* (RoK, 2008).

Livestock (cattle, sheep, goats, poultry, pigs, rabbits, bees) are important in the Kenyan economy. About two thirds of Kenyan households owned livestock in 2005/06 of which 84% lived in rural areas (KNBS & MPND, 2007). Estimates show that “... the country’s livestock sector contributes 10% to GDP, about 42% of total agricultural output and about 30% of all marketed agricultural output” (KIPPRA, 2009, p. xxiii). There is ample evidence that the dairy subsector contributes to livelihoods of many households in Kenya. For example, it is estimated that “...1000 litres of milk daily production generate 77 direct on the farm dairy activities and 13 jobs in milk processing activities” (Muriuki, 2011, p. iv). With an estimated annual cow milk production of about five billion litres (Behnke & Muntami, 2011), the subsector offers jobs to many Kenyans. Furthermore, in Arid and Semi-Arid Lands (ASALs), livestock “...employs 90% of the people and generates nearly 95% of the family incomes in these regions” (RoK, 2007, p. 14). It is in this respect that the livestock sector plays an important role in the country’s economy not just in high potential and medium potential areas but also in ASALs.

Of the different livestock products, milk remains the most significant in terms of its marketed value in the economy (Behnke and Muthami, 2011). Goats, camels and indigenous cattle contribute to the national milk production although “the total annual milk output is largely from dairy cattle (70%)” (Muriuki, 2011, p. 13). The dairy cattle are either exotic breeds or their crosses, usually referred to as grade cattle. The “grade cattle are about 50% pure breeds (mainly Friesian, followed by Ayrshire, Jersey and Guernsey) and crosses” (Muriuki, 2011, p. 5). Most of

the exotic cattle (80%) are found in Central and Rift Valley provinces (Omiti et al., 2008). Due to this, “about 60% of the milk produced in Kenya comes from less than 10% of the country’s landmass in Central and Rift Valley provinces...” (Omore et al., 1999, p. 2). Table 1 below shows human and cattle population in different provinces.

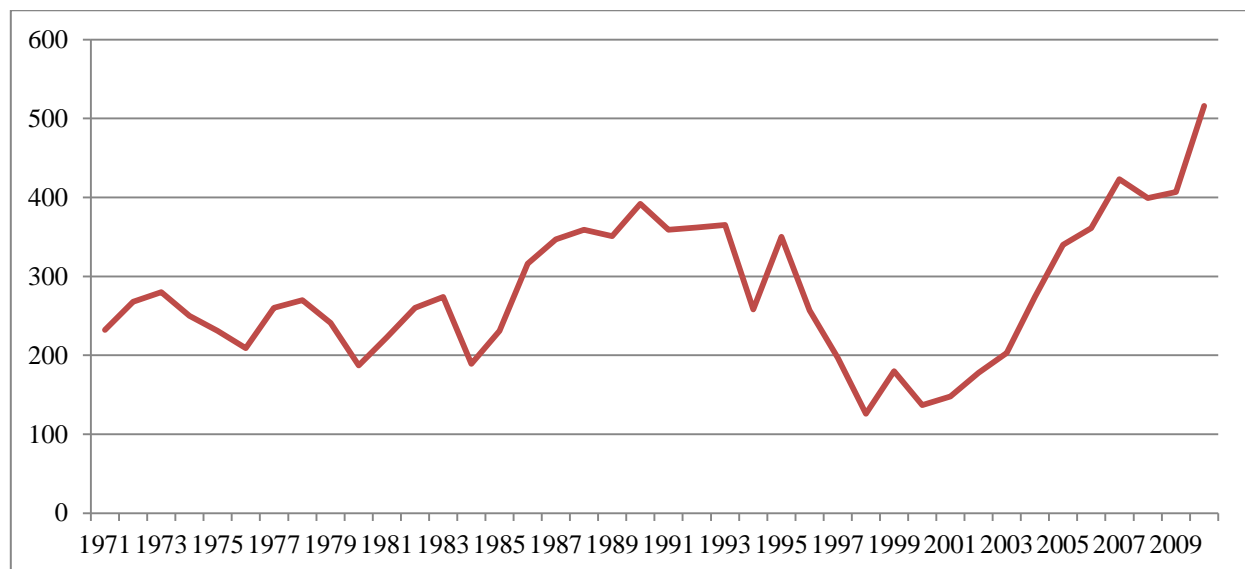
Table 1 Human and cattle population by region

Region	Cattle			People
	Exotic	Indigenous	Total	
Nairobi	25,536	29,010	54,546	3,138,369
Coast	74,119	885,846	959,965	3,325,307
North Eastern	80,422	2,694,786	2,775,161	2,310,757
Western	219,904	843,608	1,063,512	4,334,282
Nyanza	221,670	1,527,000	1,748,670	5,442,711
Eastern	373,307	1,886,854	2,260,161	5,668,123
Central	800,227	325,678	1,125,905	4,383,743
Rift Valley	1,560,222	5,919,585	7,479,807	10,006,805
Total	3,355,407	14,112,367	17,467,774	38,610,097

Source: KNBS (2009b)

Although there are large-scale and pastoralists who produce milk, small producers dominate milk production in Kenya. Small milk producers are estimated to be “one million [and] produce over 80% of the domestic milk” (MLD, 2010, p. viii). Small dairy producers own two to five cows and operate a mixed crop-livestock farming system (Omiti et al., 2008; Muriuki, 2011). The amount of recorded milk produced in the country has varied of time (Figure 1 below). In Kenya, milk production is influenced by weather, which affects fodder quality and quantity through the amount of rainfall, natural disasters that influence farm activities and government policies that affect the cost of production and milk marketing (KNBS, 2007). Furthermore, “The country’s per capita dairy production is ranked the highest in sub-Saharan Africa (SSA)” (Adekunle, 2012, p. 3). As evident in Figure 1, recorded milk production in the country reduced in the 1990s due to state withdrawal from the agricultural sector through liberalisation and privatisation of the sector. Notably, estimates of annual milk production by the KNBS, an estimate that is contested (see Karanja, 2003; Omore et al., 1999; Muriuki, 2011; FAO, 2005; Behnke & Muthami, 2011). I discuss this contention in Chapter Four under the rationale of the NDDP.

Figure 1 Recoded milk production (Million litres)



Source: Compiled from Kenya Statistical Abstracts, various years

With regard to milk demand, in 1991, the first Kenya Dairy Master Plan (DMP) estimated annual per capita consumption of marketed milk to be 125 litres in urban and 19 litres in rural areas (MLD, 1991a). Most recently, the second DMP estimated annual average per capita milk consumption at 110 litres (MLD, 2010). It has been noted that in addition to having the largest dairy cattle herds in Africa, Kenya has one of the highest levels of milk and dairy product consumption amongst developing countries (Omiti et al., 2008).

The Kenya Dairy Board (KDB), established in 1958 under the Dairy Industry Act (CAP 336), regulates the dairy industry in Kenya. At the time of its establishment and up to independence in 1963, KDB's regulations supported dairy development for large-scale farmers. In addition to regulation, due to liberalisation and privatisation of the dairy subsector in the 1990s, the role of KDB extended to development and promotion of the dairy industry in Kenya (Muriuki, 2011). Other actors in the sector include input suppliers, milk processors, service providers, market agents, research and development organizations, development partners, dairy farmers and their groups, credit providers, and non-governmental organizations. The roles that these actors play in the dairy industry changed due to liberalization and privatisation. As an example, dairy

cooperatives, which contributed significantly to marketing smallholder milk and provided farm inputs and services at lower cost, have lost out since liberalisation (Omiti & Muma, 2000). Notable is also that milk marketing has changed over time largely due to government policies, which I discuss further in the subsequent section on the implications of structural reforms on milk marketing in Kenya under the history of commercial dairy farming in Kenya.

2.3 Historical development of commercial dairy farming in Kenya

The historical development of the dairy industry in Kenya is widely documented. The intention of this discussion is to highlight historical issues that are relevant for this thesis. It is important to note that many communities in Kenya have always kept livestock that include the East African zebu, the Boran cattle, East African goats, the Galla goats, red Maasai sheep, Black Head Somali sheep, the one hump camel and indigenous poultry. Farming in pre-colonial Kenya was not just for subsistence and production of food but also for exchange with livestock. Hakansson (1994) and Parker (1952) demonstrate that in the pre-colonial Kenya, food was produced for subsistence and for exchange against livestock. Such exchanges may have led to intensification of farming especially in areas where population density was high (Parker, 1952). For example, in the 19th century the Gusii and the Luo of Western Kenya kept livestock for multiple purposes that included subsistence, prestige and as a form of insurance against drought and natural calamities (Hakansson, 1994). Dairy farming with exotic cattle in Kenya has been traced to over a century ago when European settlers introduced exotic dairy cattle breeds (Conelly, 1998; Omore et al., 1999). For purposes of understanding the changes that have occurred in the dairy industry, I have categorised this history into four phases, each of which shows distinct dairy farming policies.

2.3.1 Establishment of large-scale settler dairy farming (1900-1950s)

The colonial settlers introduced exotic dairy cattle breeds in their farms at the beginning of the twentieth century in high potential and highland areas of the country. At the time, commercial dairying was constrained by animal diseases and appropriate dairy cattle breeds that could withstand the local climate and ecology (Mertz et al., 1995, p. 1). In response to these constraints, a Veterinary Research Laboratory and an Animal Husbandry Research Station were established in 1903 (Omore et al., 1999). Therefore, control of animal diseases and animal husbandry

services were the first interventions geared towards dairy improvement in Kenya. To control livestock diseases, the veterinary department was established to among others immunize cattle against diseases like rinderpest. In 1937, the Cattle Cleansing Act was enacted to control tick borne diseases like East Coast fever through mandatory dipping of cattle. Further, another law, “the Animal Diseases Act was implemented to control spread of animal diseases by restricting the movement of livestock owned by Africans outside the stock owner’s reserve and to impose quarantines on diseased animals” (Conelly, 1998, p. 1735). Therefore, although at the start of the 20th century, mortality rates of exotic cattle breeds was high, this reduced due interventions that were initiated to control diseases and the discovery of acaricide in 1930s (Mertz et al., 1995).

During the first half of the 20th century, agriculture and dairy were politically regulated for the profit of the colonial settlers (Omiti et al., 2008). For example, KCC was started 1925 to improve milk marketing and minimise competition (Conelly, 1998). To maintain its market dominance of KCC, the Dairy Industries Act of 1958 under which the KDB was established to regulate the industry was enacted. Subsequently, KDB appointed KCC the sole agent for the processing, packaging and sale of milk in the scheduled urban areas. The veterinary department began breeding improved dairy cattle. Breeding had twin objectives to introduce varieties that would produce high milk and at the same time withstand local diseases (Conelly, 1998). By 1928, there were 14 Livestock Improvement Centres across Kenya. Further, the Veterinary Department began to supplement animal breeding programmes with research on Artificial Insemination (AI) to control breeding diseases. Due to failure to increase milk yields of Zebu cattle, by 1939, the Veterinary Department started a programme to grade up the local cattle by crossing them with Sahiwal bulls from India. In 1946, the Central Artificial Insemination Station (CAIS) was established to promote use of AI to control reproductive diseases and improve genotype quality (Omiti et al., 2008).

What also emerges is that the some components of the NDDP especially stall-feeding was not entirely new. MAAR (1937) cited in Conelly (1998, p. 1735) shows that in the 1930s the Agriculture Department had advocated for a mixed farming programme that encouraged closer integration of livestock and crop farming. This initiative recommended the construction of

cowsheds for collection of animal dung as a source of fertilizer, production of improved fodder crops and stall-feeding in densely populated areas. However, British officials reported that African farmers frequently ignored or resisted these recommendations for improvements in their crop-animal management techniques (Parker, 1952). Clearly, indigenous farmers did not always like and follow the colonial livestock policies. As an example, Conelly (1998) records that African farmers who worked in settler farms brought with them stock, which continued to multiply in labour quarters in contravention of livestock policies of the time. Squatter stock, which consisted of indigenous livestock were viewed as a source of ticks and diseases that might infect the exotic breeds owned by settlers. Settlers advocated for a campaign that was dubbed *kifagio* (broom) to reduce stock in mixed farming areas or eliminate them in dairy farming areas. In response to *kifagio*, squatters hid livestock by the riverside or in farms that had been inspected, returned to original areas, went on strike, maimed settler livestock and set settler crops on fire. African farmers resisted related attempts to regulate indigenous stock through destocking.

Therefore, during the first half of the 20th century dairy production especially with exotic or improved breeds of dairy cattle was mainly a large-scale commercial farmer activity supported by public sector quarantine laws, veterinary and AI services. During this time, “Indigenous farmers were not allowed to keep exotic or crossbred dairy animals” (Mertz et al., 1995, p. 1). Discriminatory practices against smallholders included grazing controls and imposed illegality of raw milk sales in urban areas. Towards the end of the first half of the 20th century, the colonial government sought to solve the development challenges that Africans were experiencing. Parker (1952) noted that soil erosion and overgrazing resulted from overstocking by native farmers who were not willing to implement good husbandry practices. Consequently, in 1946, the colonial government came up with the Worthington Plan for African agriculture, mainly for the prevention of soil erosion (Parker, 1952). This Plan was to address recurrence of food shortages and to address rural poverty, enhance self-sufficiency in food and increased overall productivity by increasing number of African farmers. Further, in 1954, the Swynnerton Plan was implemented. The Plan introduced policy reforms, which allowed Africans to start keeping dairy cattle (Swynnerton, 1955). Consequently, implementation of the Swynnerton Plan ended domination of dairy farming by large-scale dairy white settlers.

2.3.2 Support and growth of smallholder dairy farmers

The Swynnerton Plan (1954-1963)

As already noted, by the early 1950s, concerns were mounting over increasing levels of poverty, low standards of living, land scarcity and low productivity across the country. Related problems were poor farming practices, soil erosion and inadequate use of livestock manure to maintain soil fertility, land fragmentation and excessive cultivation of maize [Thurston (1987) cited in Conelly (1998)]. As a result, R. J. M. Swynnerton, an Assistant Director of Agriculture was tasked to prepare a five-year plan to provide a framework for agricultural development. The Plan was named *The Swynnerton Plan*, and came into effect in 1954. It has been argued that the Swynnerton Plan was motivated largely by concern that poverty and lack of economic opportunities informed the growing demand by Africans for independence from colonial rule (Conelly, 1998, p. 1733). The Plan proposed a series of land reforms that were to consolidate fragmented farmers' holdings into a single parcel with a certificate of land ownership. The policy makers thought that land consolidation would encourage implementation of good husbandry practices and stimulate investments in the improvement of the land (Swynnerton, 1955). The Swynnerton Plan also provided a shift from primarily grain production for local sale and subsistence to the widespread introduction of new cash crops for sale on the export market. As part of the Plan, the colonial government planned to provide native farmers with improved dairy cattle. I will not dwell so much on other aspects of the Plan but note that one of the key issues that emanated from the Swynnerton Plan of interest in this thesis was that for the first time, African farmers were supported and allowed to own improved dairy cattle.

Although the colonial government sought to distribute dairy cattle to African farmers, they experienced a number of challenges when they started to do so. These challenges were high on farm mortality rates due to disease, spread of diseases from local breeds that farmers kept in the same farms, inability of farmers to produce adequate fodder, high cost of extension and lack of sufficient numbers of dairy cattle (Conelly, 1998). Because direct breeding using local zebu cows with European bulls was slow and tedious, agricultural officials opted to use AI. By 1956, preliminary AI trials had been initiated for peasant farmers in the Central and Nyanza Provinces. In 1957, the

government started introduction of Channel Island breeds to smallholder farmers located at high elevations and farmers in central province benefited during this time. However, government support for dairy improvement declined after 1959 when the five-year period of the Swynnerton Plan ended (Conelly, 1998, p. 1741). As a result, introduction of improved dairy cattle to other parts of the country especially western Kenya delayed. Despite improvements mentioned above, African areas had poorly developed roads and lacked reliable milk marketing systems (Muriuki, 2011).

Government subsidies and market control (1963-1980s)

Due to implementation of the Swynnerton Plan, by 1963 when Kenya gained independence, the dairy herd had expanded to “about 400,000 exotic cattle and their crosses with the local East African zebu” (Omore et al., 1999, p. 6). In the enthusiasm that followed independence, the government prioritised rural development and indigenisation programmes (RoK, 1965) through which smallholder farmers were given land in the former white highlands. In addition:

The governments sought to modernize agricultural production through ‘packages’ of new crops and crop varieties, fertilizers, improved cultivation and management practices, credit [and so forth]. State peasantries-describes those peasants incorporated into the most highly controlled projects, which require them to follow strict farming schedule laid down by project planners and managers. (Bernstein, 1992, p. 71)

The government considered control of economic activities including agriculture and the dairy subsector central to attainment of development objectives. Consequently, the government shifted focus from settler owned large-scale farms to smallholder production (Gamba, 2006; Omiti et al., 2008). Government extension, other support services and price controls were modified to encourage smallholder production (Muriuki, 1992). In 1965/66, the government established Kenya National Artificial Insemination Service (KNAIS) to boost AI service. The central function of this unit was to conduct AI field services, while the CAIS was to remain the semen production and distribution unit (Muriuki, 1992). AI services were subsidized by up to 80% while veterinary services and medicines were provided at nominal charges. In addition, in 1971, the government abolished milk production and delivery quota system to allow smallholders to sell their milk to KCC. This effectively ended the domination of KCC by large-scale producers. Overall, through government funded programmes on breed improvement, fodder, disease control

and milk marketing, which were affordable and more accessible, small producers came to dominate dairy production (Omiti et al., 2008). Notably, the NDDP was mooted during this time in 1980 as a bilateral initiative between the Governments of Kenya and the Netherlands as a part of other efforts to improve dairy among smallholder farmers.

2.4.3 Structural reforms, liberalisation, and privatisation of the dairy sector

Due to budgetary constraints, in the 1980s the provision of clinical, breeding and extension services by the government for free or very cheaply to farmers started to decline (Omore et al., 1999). The decline in their provision prompted the government to consider restructuring the industry with a view to increase the role of the private sector. These changes were contained in various policy documents including the National Livestock Development Policy (1980) and the National Food Policy (No. 4 of 1981). In line with these and other policy changes, the government introduced user charges as part of a gradual withdrawal from state subsidised agricultural services other than extension (Omiti et al., 2008). For example, the government controlled feed prices until 1987 through the Kenya Farmers Association that enjoyed a legal monopoly in the marketing of animal feeds (Omore et al., 1999). Cost sharing continued until early 1990s when the sector became fully liberalised (Gamba, 2006). In 1991, the government developed a DMP which outlined strategies for improving efficiency and productivity in the dairy sub-sector although it was never implemented (MLD, 2010). AI services were privatised in 1991. Further, following recommendations of the DMP (1991), milk marketing was liberalised in 1992 by licensing other traders to sell milk especially in urban areas, a monopoly that the KCC had enjoyed for about 60 years (Omore et al., 1999). Below, I discuss a brief history of the KCC in order to highlight the implications of the liberalisation of milk marketing in Kenya.

In Kenya, milk is marketed through formal or informal channels. Notably, history of formal milk marketing in Kenya is closely related to the history of KCC. The colonial government formed KCC in 1925 to improve marketing of milk and to insulate large-scale dairy farmers from the impact of the depression (Conelly 1998; Omore *et al.*, 2009; Mertz, 1995; Muriuki, 2011). Due to this, “The formation of KCC is considered as the landmark in the formal milk marketing in Kenya” (Mertz, 1995, p. 1). Therefore, KCC was established as a monopoly parastatal to cushion

the settler dairy farmers from competitions with other dairy producers. Relatedly, in 1958, the Dairy Industries Act was enacted to preserve the dominance of KCC in the market. The KDB, which was instituted as the regulator of the dairy industry under the 1958 Dairy Act appointed KCC the sole agent for the processing, packaging and sale of milk in the scheduled urban areas. Milk vending was criminalised under the Dairy Industry Act of 1958 and smallholder farmers were not allowed to sale milk through KCC (Muriuki, 2011). Although KCC still monopolised milk marketing, in 1971 the government abolished milk production and delivery quota system to allow smallholders to sell their milk to KCC in 1971 (Omiti *et al.*, 2008). Before market liberalization in the early 1990s, in the formal market, milk collection and bulking was organised and milk was delivered to KCC through dairy cooperative societies or individual farmers.

In 1992, the dairy industry was liberalised and the monopoly that KCC enjoyed in milk marketing ended (Omiti *et al.*, 2008). Consequently, in 1992, the number of formal and informal players that collected, bulked and sold milk increased (Adekunle 2012). Overall, the end of KCC's processing monopoly permitted the emergence of many privately owned processors and encouraged raw milk traders in urban areas (Muriuki, 2011). Liberalisation led to competition in milk marketing and processing between KCC, formal private processors and small-scale milk traders. Because of competition from other milk processors and mismanagement due to political interference, KCC struggled to market milk and collapsed in 1999 when it was put under receivership for failure to repay its debts. Farmers who had delivered milk to KCC lost funds owed to KCC and there were no immediate channel to sell their milk. This made some farmers to sell their herds or resort to selling milk through co-operatives or informal channels (Omiti *et al.*, 2008). To fill the gap that KCC left, small vendors who purchased unprocessed milk directly from farmers and sold it to consumers emerged (Muriuki, 2011). Therefore, the milk collection and bulking system that had been in operation for over a half a century collapsed. Although KCC was revived in 2003 as New KCC, many milk-processing outlets have been established. There are many processors, mini dairies, cottage industries, cooling plants, informal traders, distributors and retailers. Market channels depend on geographical location, presence of processors and intermediaries, nature of road network, presence of milk sheds and so forth.

Presently the proportion of milk production marketed is 65% leaving 35% for home consumption. Further, “Of the 2.925 billion litres of milk marketed, 45% (1.316 billion litres) is handled in the formal market or through the processors. The remaining 55% (1.609 billion litres) is handled in informal market outlets dominated by hawkers” (MLD, 2010, p. 39). It is estimated that processors handle more than 80% of the total milk and dairy products marketed through the formal market channel (Muriuki, 2011). The existence of informal milk market is due to a combination of failure of the formal system, consumers prefer the taste of raw milk which has a higher fat content, wide availability of raw milk and lower price of raw milk, which is availed in units, based on the requirements of buyers (Smallholder Dairy Project [SDP], 2004). As already noted, “The problems in the formal milk market caused growth of the informal market, which penetrated the urban centres previously dominated by the formal trade” (Muriuki, 2011, p. 15). As a result, regulations by the KDB to discourage trade in raw milk and massive market campaigns to encourage consumption of processed milk have not achieved their objectives.

Overall, the late 1990s was also the time that the government had problems with donors, who discontinued their support to government programmes including those in agriculture. The economy performed so poorly that in 2002, agriculture recorded negative growth. The withdrawal of the government from the agriculture which included the dairy subsector and subsequent liberalisation in 1991, led to decline of smallholder dairy activities. For example, the majority of the farmers could not access or afford to pay for the more expensive AI, dipping and clinical services (Gamba, 2006). In response, some farmers opted to use hand-sprayers, which were more expensive (Owango et al., 1998). The expectations that the private sector would fill the gap left by the government and provide affordable services to the farmers were not fully realized. A study done by Muraghe & Ilatsia (2011) on farmers’ breeding preferences found that costs and access became a problem. As part of structural reforms, the Dairy Development Policy (DDP) was first formulated in 1993 to guide the industry through the liberalisation process initiated the previous years. In, 1995 Kenya Veterinary Association Privatization Scheme formulated to assist the privatisation of veterinary services. The DDP was updated in 1997 and in 2000, a draft DDP that explicitly provided institutional guidelines to support small-scale milk

production and informal marketing was introduced. It also redefined the role of KDB to go beyond regulation and be a catalyst for dairy development (see Kaitibie, 2011).

2.3.4 Revitalisation of the dairy sub sector (since 2003)

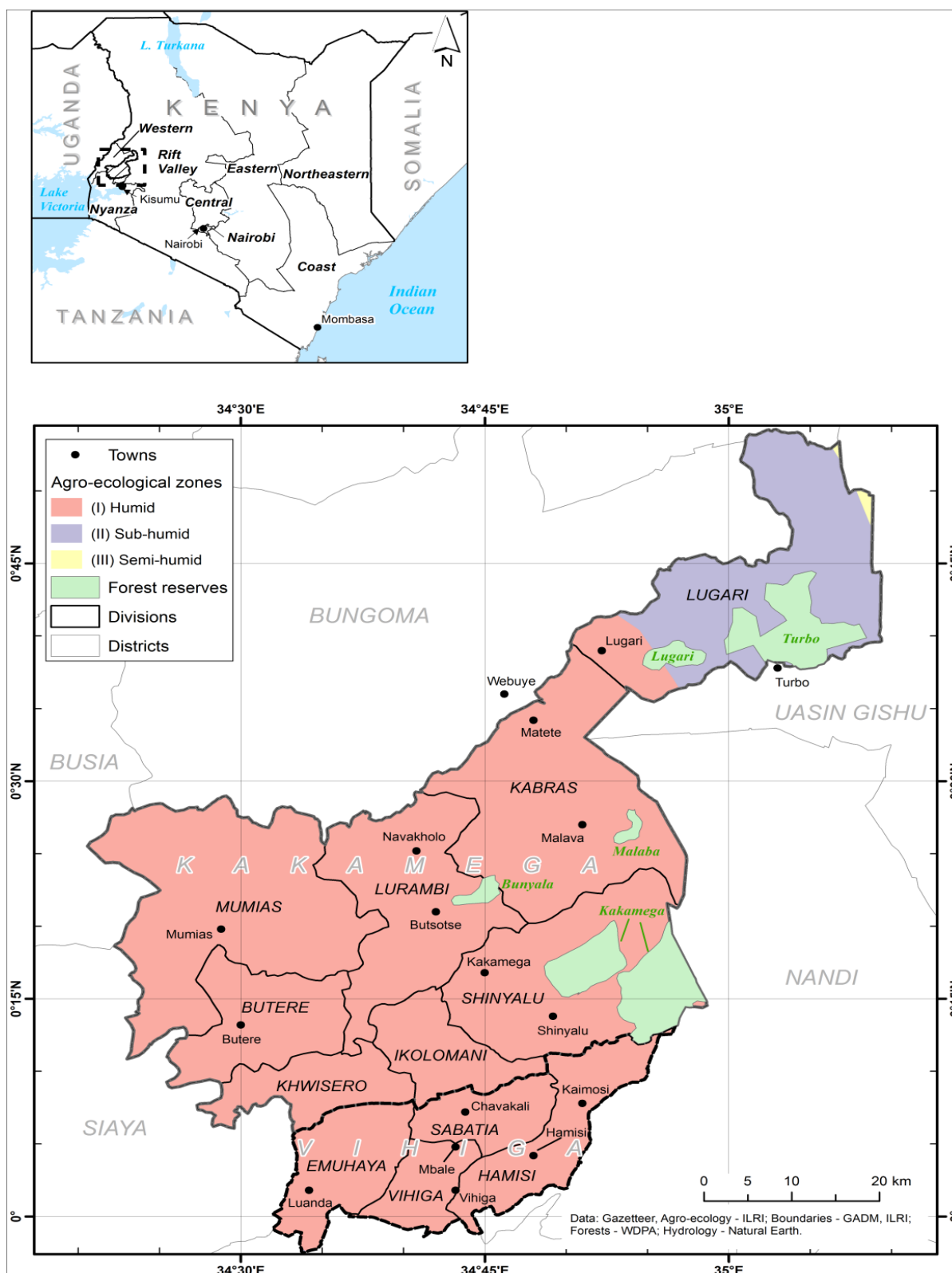
Since 2003, the dairy sector has experienced some changes that have revitalised the subsector. Changes during this period have been associated with the election of a new government in 2002. In 2003, the newly elected government came up with a new development plan, the *Economic Recovery Strategy for Wealth and Employment Creation* (2003-2007) to revive the economy that had almost collapsed during the previous regime (RoK, 2003). To realign agricultural policies with the new development Plan, the MoA developed a *Strategy for Revitalisation of Agriculture* (SRA 2004-2014) (RoK, 2004). The SRA sought to revive strategic sectors in agriculture like the dairy sector. One of the remarkable efforts to revitalise the sector was the revival of the defunct KCC as New KCC although the sector had been privatised (Kaitibie, 2010). Further reforms in the dairy industry were undertaken because the government felt that policies in the sector were no longer relevant to the context of dairy production (Muriuki, 2011). For example, the dairy policy (1958 Act) which was meant for large producers was still in place yet the sector was dominated by small producers. The 1958 Act also outlawed sale of unprocessed milk yet much of the marketed milk was sold when it was unprocessed by traders who did not have premises as required by the Act (Leksmono et al., 2006). The other problem was that the KDB interpreted its mandate to include doing away with small producers (Kaitibie et al., 2011). Despite restrictions, especially after liberalisation of milk marketing and the collapse of KCC, small traders dominated milk marketing. To address this, between 1997 and 2005, the SDP carried out research on how participation in the dairy of small producers can be enhanced to enable them improve their livelihoods (SDP, 2004). The SDP recommended policy changes for inclusion of small producers. Consequently, in September 2004, the 1958 Act, which had been revised, was updated through the Dairy Industry Regulations (Legal Notices 101, 102 and 103). The new Regulations facilitated licencing of small milk producers and traders or vendors to enable them participate in various activities in the milk value chain (Kaitibie et al., 2010). Due to these efforts, formal dairy sector handled milk almost tripled from about 144 million litres in 2002 to 423 million litres in 2007 (Muriuki, 2011). In 2010, a new DMP was drafted to realign the dairy industry to the Kenya

Vision 2030. The second DMP aims “... to develop a sustainable and globally competitive dairy value chain for wealth creation and high quality life while maintaining compliance with requirements for high standards of public and environmental health” (MLD, 2010, p. 37). The DPM recognises the crucial role of small producers, projected both milk demand and supply to increase, and plans to consolidate improvements in the dairy industry.

2.4 Research site and its agro-ecological characteristics

The research for this thesis conducted in Kakamega district, Western Kenya. Kakamega is one of the six districts where the NDDP was initiated in 1980. Kakamega district covers a total area of 1,394.8Km² of which 879Km² is arable land. In 1980, Kakamega district was divided into 11 administrative divisions, which currently make up Kakamega and Vihiga counties (Figure 2 below). In this thesis, when I refer to Kakamega district, I mean the geographical area that encompasses the current Kakamega and Vihiga counties. Kakamega is a high potential area and receives annual rainfall of 1200-2400mm although the southern parts of the district receive more rainfall compared to the northern part (RoK, 1994). The rainfall is bimodal with long rains experienced between March and June while short rains falls between July and September. Due to this, the district experiences a short dry season between December and February. Despite this, the southern part of Kakamega does not have a specific dry season that is the reason that there are two cropping seasons. The temperatures are high all the year, with slight variations in mean maximum and minimum ranges of 28-32° and 11-13°, respectively (RoK, 1997). The altitude ranges from 1250m above the sea level in the west to 2000m above the sea level in the east (RoK, 1994). The eastern and central parts of the district are characterised by undulating hills while the southern western parts like Butere have a flat topography that makes them suitable for sugarcane growing. The two major rivers that go cross Kakamega are Nzoia and Yala (RoK, 1997). The fertility of soils in the district varies. The soils are well-drained, dark brown and deep sandy loams in the north and central parts while the eastern part has well-drained soils of volcanic origin. The western part has reddish brown to yellowish brown friable clay soils. Soils in the south western parts like Mumias are poorly drained and are prone to flooding during heavy rains due to the flat topography (RoK, 1997).

Figure 2 Location and features of Kakamega district



2.4.1 Socio-economic features of Kakamega district

In 2009, Kakamega County had a population of 1,660,651 people while Vihiga County had 554,622 people (KNBS, 2009b). The population growth rate was 2.5% in 2009 compared to 2.12% in 1999 and 2.89% in 1989 (RoK, 2002; KNBS, 2009b). Population density in the district has increased over time. In 1979, a year before the NDDP started, the population density was 295 persons per square kilometre, which increased to 333 in 1989, 438 in 1997, 468 in 1999 and to 502 persons per square kilometre in 2001 (RoK, 2002). The 2009 Population and Housing Census estimated population density in Kakamega County to be 550.31 persons per square kilometre while that of Vihiga County was 982.55 persons per square kilometre (KNBS, 2009b). This high population density has resulted in small landholdings. In the southern parts of the district, average sizes of farm holdings was five acres (two hectares), while in the northern parts it was 10 acres (four hectares) which means that about 76% of the land in the district is under small holdings while the forest covers 11% of the area (RoK, 1997). The land tenure system is free hold, with owners having title deeds. There are few and isolated cases of communal and urban or peri-urban land tenure systems. Small size landholdings are becoming smaller due to continued sub division by families as grown up sons seek ownership rights. In 2005/06, poverty incidence was estimated to be 54.4% (KNBS & MPND, 2007).

Agriculture is the main source of livelihoods for most people in Kakamega. In 1997, about 70% of the people were employed in the agricultural sector (RoK, 1997). In 2002, income from agricultural activities accounted for 62% of household incomes (RoK, 2002). Major agricultural income earners are maize (northern) and sugarcane (southern). In the north, 70% of the area is under maize for commercial and home use. The then Butere, Lurambi and Kabras divisions are the main sugarcane growing areas and sugarcane is the main enterprise and cash earner in those areas. Some agro-processing industries, namely flourmills, sugarcane factories and jaggeries provide employment opportunities (RoK, 1997). The main agro based industry in the area is sugar factories. Sugarcane is the most important cash crop in Kakamega followed by tea and sunflower. Farmers in the northern divisions and the sugarcane growing areas use tractor and other farming machinery for land preparation and planting. Ox ploughing is also widely used in

the southern divisions and hand tools are mainly used for land preparation (RoK, 1997). Other crops grown include sweet potatoes, bananas and horticultural crops.

Kakamega district is largely inhabited by the Luhya ethnic community. Livestock, such as cattle, sheep and goats, formed a significant facet of the Luhya economy. They were used as a means of exchange besides serving a variety of social transactions and ceremonial functions. They were also a source of meat, milk and blood, which supplemented the people's diet. Due to the centrality of livestock in the Luhya political economy, common grazing lands were common but these are no more due to land demarcation and private ownership (Conelly, 1992). The main livestock kept in the district are cattle, sheep, goats and poultry. Herds include dairy crosses of Friesian, Ayrshire, Guernsey and jersey. Government records show that in 1980, when NDDP started, Kakamega district had 318,629 zebu cattle and 30,719 dairy cattle (RoK, 1984, p. 29). Most dairy cattle are grazed or tethered in paddocks of either natural, planted pastures or forage legumes. Pasture is most predominant in the northern parts although zero grazing is practised in other areas of the districts. Cattle feeds used in the district include Napier grass, *machicha* (brewers waste), cottonseed cake and molasses, maize stover, banana stems, sugarcane tops, pineapple waste and sweet potato vines (RoK, 1997). One of the challenges in the area is that cash and food crops have overtaken the pasture. Notably, although Kakamega district is a high potential area, milk production is lower than consumption and milk from the neighbouring districts in the Rift Valley province meets the deficit (Waithaka et al., 2000).

AI services operate on call basis at the district headquarters and Lugari divisions. The small-scale farmers do most of the dairy farming with the only large-scale dairy farms being Mukumu farm and Lugari division. Low milk production is due to poor animal husbandry (RoK, 1997). The grade and crossbred cattle in Lugari and Kabras divisions constitute respectively 62% and 21% of all the cattle in Kakamega district (Mertz et al., 1995). Compared to existing livestock, percentage use of dips is negligible. Dipping is the most effective method to control ticks. Under liberalisation, farmers were supposed to manage their own dips. However, due to sharp rise in the cost of acaricide, unaffordable charges, low concentration of acaricide being added to the dips

resulted into immunity by the ticks. Tick borne diseases have increased due to ineffective dipping and that so many other cattle near dips are not being dipped (RoK, 1994).

It would appear that investment in agricultural activities in western Kenya has experienced challenges over time. Western Kenya benefited little from government agricultural development programmes before independence (Conelly, 1998). In particular, the colonial veterinary officers were hesitant to introduce dairy cattle in the area because they felt that people in the western region (Luo and Luhya) lacked dairy cattle experience and the area had high disease incidence. Consequently, “many farmers were unable to participate in the dairy cattle industry introduced under the Swynnerton Plan, and most farmers continued to keep zebu cattle” (Conelly, 1998, p. 1744). As a result, by 1962, there were only 22 improved dairy cows in North Nyanza (Conelly, 1998). Despite government delay in introduction of dairy cattle in western Kenya, there is evidence that some farmers had bought and were keeping dairy cattle. After independence, some government interventions like Integrated Agricultural Development Programme (IADP) contributed to dairy improvement in the region. This is the reason that when the NDDP started in Kakamega, the dairy officer who was posted to Kakamega district in 1980 found that some farmers had improved dairy cattle and a few had planted Napier grass (van Helden, 1980b).

2.5 Conclusion

Dairy improvement in Kenya, which dates back over a century ago, has focused on disease control, breeding, production of improved fodder and promotion of good husbandry practices. Historical evolution of dairy policies in Kenya mirrors the agricultural policies, which reflect the national development policies of the time. During the colonial period, policies supported development of infrastructure and services for large-scale settler farmers. Due to this, during the last decade of colonial rule, areas that were close to the white highlands benefited more from the Swynnerton Plan programmes. As a result, when NDDP started in Kakamega district, dairy farming was already far more developed in Central and Rift Valley Provinces. After independence in 1963, the government supported smallholder dairy farmers. Later in the 1980s and 1990s, dairy industry policies focus on liberalisation and privatisation that adversely affected the dairy subsector. However, since 2003, the dairy sector has been revitalised through relevant

policy reforms and programmes, which have allowed participation of small producers and traders in the various activities of the milk value chain.

I have described the geographical and socio-economic of Kakamega district, a high potential agricultural area because it experiences relatively high amounts of rainfall. I have shown that due to high population density, land scarcity is a major problem that has influenced agricultural activities in the area. Despite this, most people in the district depend on agriculture for their livelihoods.

CHAPTER THREE

Methodology and methods

3.1 Introduction

The aim of this chapter is to establish this study's realist foundation, discuss the research methods that were employed and explain the research process that was followed. The first section articulates the methodological viewpoint of this study, that, essentially, methodology is not quite the same as methods. By drawing on the works of Danermark et al. (2002) and Sayer (2000; 2010), among others, I emphasise that methodology consists of research paradigm, theoretical framework as well as procedures used to collect and analyse data, and that there is no need to separate discussion of methodology and methods because the two are intricately related. The second section describes realist explanation, the methodological framework on which this research is anchored. The central argument is that there is a close relationship between the nature of what is being studied, what we can know about it and how it can be studied. To achieve this, the section discusses the role of mechanisms in explaining outcomes in realist research. Further, with reference to Pawson's (2006) realist framework in which outcomes are contingent on context, I explain how context is essential in explaining outcomes. To link mechanism to contexts and outcomes, I employ the argument that outcomes result from people's reasoning, choices and actions in response to intervention resources, based on their circumstances (Pawson, 2006; 2013).

Section three looks at the methods of conducting realist research and underscores Sayer's (2000; 2010) view that research in a realist paradigm can be conducted through extensive and intensive methods and methods should be chosen based on whether they adequately address questions being investigated. The section also discusses intensive research design and methods that I utilised. In the fourth section, I discuss the methods that I utilised to analyse data. The key analytic logic of realist research, retrodutionⁱ that I employ in this study draws from the works of Sayer (2000; 2010), Yeung (1997), Danermark et al. (2002) and Radulescu & Verssey (2009).

ⁱ Retrodution is the mode of inference "... in which events are explained by postulating (and identifying) mechanisms which are capable of producing them ..." (Sayer, 2010, p. 72).

The last section presents the research process involving exploratory, explanatory and confirmatory phases, during which data collection, analysis and report writing was simultaneous and iterative. It articulates how respondents were selected and interviews were conducted. Further, it explains how NVivo, a Computer Assisted Qualitative Data Analysis Software (CAQDAS) facilitated thematic synthesis and generation of descriptive themes. Lastly, under the research process, I explain how I identified mechanisms that explain adaptations and outcomes of the NDDP and the context in which these occurred.

3.2 Methodology not quite the same as methods

In the literature, there is a lively discussion on methodology and methods, and how they are applied in research. In a review of texts that discuss methodology, Mackenzie & Knipe (2006) found that the meaning of methodology is not provided in some texts while other texts treat methodology as methods, or that their meanings differ. They concluded, “The most common definitions suggest that methodology is the overall approach to research linked to the paradigm or theoretical framework while the method refers to systematic modes, procedures, or tools used for collection and analysis of data” (Mackenzie & Knipe, 2006, paragraph 11). Similarly, in recognition of the difference between methodology and methods Pawson (2013, p. x) argues, “Methodology provides what has been variously described as the procedures, the rules, the codes and the laws of scientific research”. To shed light on lack of clarity on the link between methodology, paradigm, and method in research, Mackenzie & Knipe (2006, paragraph 4) suggest, “It is the choice of paradigm that sets down the intent, motivation and expectations for the research. Without nominating a paradigm as the first step, there is no basis for subsequent choices regarding methodology, methods, literature or research design”. A research paradigm is the “... overall conceptual framework within which a researcher may work or the ‘basic belief system or worldview that guides the investigator’” (Guba & Lincoln, 1994, p. 105). Further,

The term *paradigm* ... refers to a set of very general philosophical assumptions about the nature of the world (ontology) and how we can understand it (epistemology), assumptions that tend to be shared by researchers working in a specific field or tradition. Paradigms also typically include specific methodological strategies linked to these assumptions, and identify particular studies that are seen as exemplifying these assumptions and methods. (Maxwell, 2009, p. 224)

The close relationship between paradigm, methodology and methods is because “The nature of what exists cannot be unrelated to how it is studied” (Archer, 1995, p. 16-17). Related to this is that “... specific *methods* of analysis presuppose particular *methodological* presumptions” (Downward & Mearman, 2007, p. 79). Therefore, it is useful to state a paradigm and theoretical framework that guides a given study in addition to describing the qualitative or quantitative methods of data collection and analysis (Mackenzie & Knipe, 2006). Furthermore, “paradigms can be philosophical positions like positivism, realism, constructivism, and pragmatism or more specific relevant to qualitative research like interpretivism, critical theory, feminism, postmodernism and phenomenology” (Maxwell, 2009, p. 224). Of the different philosophical positions, this thesis draws on the realism. In subsequent sections, of this chapter, I explain the methodological presumptions that guide this thesis. In doing so, I have followed Danermark et al.’s (2002) view that because methodology and methods are intricately related, there is no need to discuss them separately. In this thesis methodology includes research paradigm which covers analytical elements than inform explanation of how adaptations and outcomes of interventions come about, the methods that were used to collect and analyse the data and the research process that was followed.

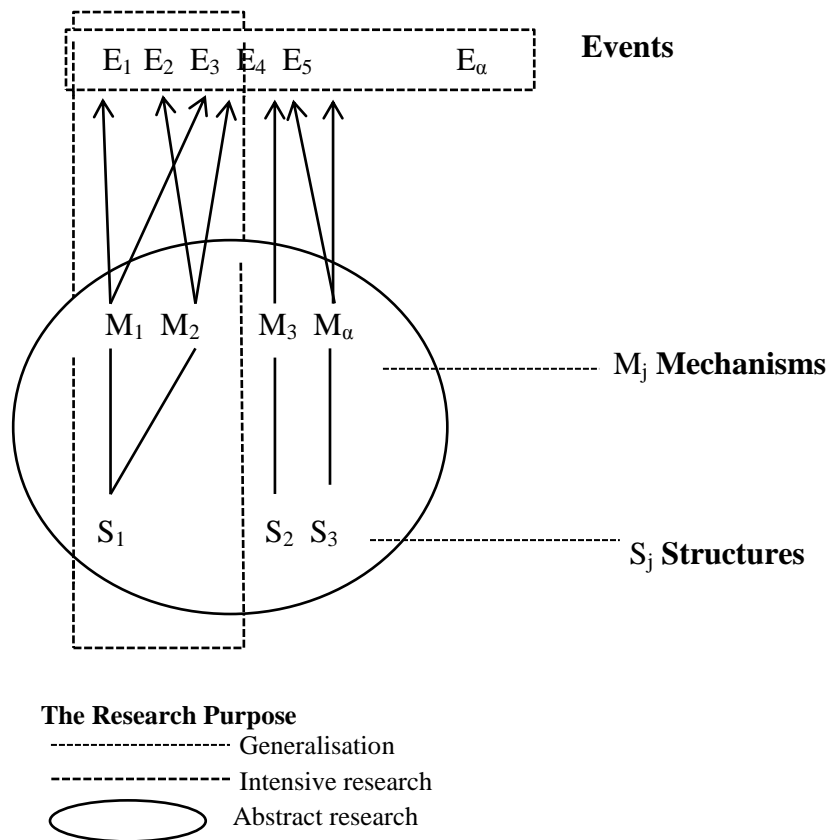
3.3 Realism and realist ontology

Although there are different versions of realism in social science like critical realism (Archer, 1995; Sayer, 2000; 2010) and realist evaluation (Pawson, 2006), realism differs from other paradigms in terms of its assumptions about the nature of reality, knowledge, causation, and explanations of events. The central claim in realism is in the existence of a ‘real’ world, which exists independent of our knowledge of it or interdependent with our thoughts, impressions or interpretations of it (Sayer 2010; Archer, 1995; Pawson, 2006). This is what is usually referred to as realist ontology. Reality has been defined as “what exists” (Danermark et al., 2002, p. 18) or “Whatever it is in the universe [that is], forces, structures, and so on) that causes the phenomena we perceive with our senses” (Schwandt, 1997, p. 133) cited in Maxwell (2009, p. 3). In critical realism “reality is structured, differentiated, stratified, and changing” (Danermark et al., 2002, p. 5). In terms of stratification:

A distinction can be made between three ontological domains: the empirical, the actual and the real. The empirical domain consists of what we experience, directly or indirectly. It is separated from the actual domain where events happen whether we experience them or not. What happens in the world is not the same as that which is observed. But this domain is in its turn separated from the real domain. In this domain there is also that which can produce events in the world, that which metaphorically can be called mechanisms. (Bhaskar, 1978) cited in Danermark et al., (2002, p. 20)

These three domains are useful in identification of research methods that are appropriate to a social phenomenon that a researcher is interested in Figure 3 shows elements of realist research and research strategies.

Figure 3 Layered ontology and research strategies



Source: Bygstad & Munkvold (2011, p. 3), adapted from Sayer (2010, p. 159)

As shown in Figure 3, realist research utilises abstract research which involves identification of mechanisms and structures and intensive methods to identify of events linked to particular mechanisms and structures. The real domain also referred to as causal level is indispensable in explaining outcomes of development interventions because “Causal processes, causal interactions, and causal laws provide the mechanisms by which the world works; to understand why certain things happen, we need to see how they are produced by these mechanisms” (Radulescu and Vessey, 2009, p. 4). Overall, the realist research approach involves abstract research which determines mechanisms which explains observed events which can be identified through intensive methods. Furthermore, in contrast to successionist explanatory frameworks where generalisation occurs at the empirical level, in realism, generalisation occurs at the level of mechanism (Sayer, 2010). However, Pawson (2013, p. 68) disputes the Bhaskarian view that “Things become real-the domain of real is actualised-only when the three levels are fused. Events and experiences only become real when they are subsumed under the action of their underlying mechanism. They are only real within the totalising, transcendental system”. Instead, Pawson (2013) argues that things can be real even without our knowledge of their underlying mechanisms or without us having to think through the three different domains as Bhaskar suggests.

3.4 Knowledge cumulation in realism

Knowledge and its generation are central in research. Realists’ view of knowledge can be discerned from the view that “Realist science standpoints have one characteristic in common: they claim that reality and things have an objective existence; but they disagree on the nature of reality and therefore also on how to attain knowledge of reality” (Danermark et al., 2002, p. 22). Realists generally agree that realism is post-positivist in its ontology and epistemology (Pawson, 2006; Radulescu & Verssey, 2009). In view of this, realism provides explanations of phenomena that are in between empiricism and constructivism. Sayer (2000, p. 45) notes that “There is little difference between the empiricist kind of identity thinking in which thoughts are presumed to mirror the things to which they refer, and the constructionist kind in which things are as they are thought, or ‘constructed’”. In other words, empiricism view is that a real world exists which can be understood through direct observation while constructivism claims that what we cannot know

what the nature of reality except that which our human senses and brain have interpreted, which is reality. On the other hand, in realism,

Reality has an *objective existence* but that our knowledge of it is conceptually mediated: facts are *theory-dependent* but they are not *theory-determined*. This in turn means that all knowledge in fact is fallible and open to adjustment. But-not all knowledge by far is *equally* fallible. (Danermark et al., 2002, p. 15)

This understanding emanates from realists view that social phenomena occur in open social systems. In a closed system, "... reality's generative mechanisms can operate in isolation and independently of other mechanisms-closed systems require non-change" (Danermark et al., 2002, p. 66). On the other hand, in an open system:

People are capable of learning and self-change. People can adapt to new knowledge and change themselves to become in a true sense new people ... People can also change more as an unintentional result of new experiences... people's behaviour and their actions constantly influence and change the set of objects and mechanisms in their environment with which they interact. More or less explicitly, people strive to change the situations and the settings of which they are part. And they are often successful, even though the changes often result in unintended consequences, in view of their initial intentions. (Danermark et al., 2002, p. 68)

The implication of this is that unlike how empiricists claim identification of regularities to explain behaviour is difficult (Pawson, 2006, p. 18) and predictions like those made in natural science are impossible (Danermark et al., 2002). Deriving from the view of systems as open social systems is that "knowledge is fallible" (Sayer, 2000, p. 4) or "Science may be wrong at any moment when it makes statements of its object and so theories in science can only be regarded as the best truth about reality we have for the moment. It is no ultimate knowledge" (Danermark et al., 2002, p. 23). Despite realism's view that knowledge at any one time can be wrong, it can be improved through modification of our ideas about reality "towards greater truth or adequacy" (Sayer, 2010, p. viii). Although fallibility of our knowledge is generally agreed upon in realism, the implication of this on how to explain reality differs between critical realists and other realists or empirical realists (Pawson, 2006). In explaining reality, critical realists argue that "... there will always be an overabundance of explanatory possibilities, that some of these will be mistaken

and that the primary task of social science is to be critical of the lay thought and actions that lie behind the false explanations” (Archer et al., 1998). Consequently, the role of researchers is to mediate between the different explanations between knowledge and its object or the transitive and intransitive domains (see Danermark et al., 2002; Sayer, 2000, p. 10). On the other hand, according to, realist evaluation or simply another realist view claims:

It is still worth trying to adjudicate between alternative explanations even in the knowledge that further explanatory possibilities remain untapped in the unrelentingly open systems in which we live. This can be attained through conceptualisation and hypothesis-making, critical comparisons, the discovery of empirical patterns and the monitoring of their scope and extent. (Pawson, 2006, p. 19)

Therefore, unlike critical realists’ suggestion that the aim is to continuously be critical of interpretations of reality, cumulation of social scientific knowledge can be attained through the process of abstraction, conceptualisation and refinements of mechanisms (Pawson, 2006). This thesis articulates Pawson’s (2006; 2013) view that the aim of realist research is cumulation of knowledge through conceptualisation and refinement of mechanisms that explain outcomes and the context within which this occurs. Therefore, knowledge results from the interplay between mechanisms and empirical observations or adaptations and outcomes in the case of development interventions, and the context within which these occur. Moreover, the open social systems view implies that the reasoning and actions of actors cannot necessarily be limited by the parameters set out by development interventions that form the basis of adaptations.

3.4.1 Mechanisms in realist explanation of events

Development interventions aim to bring about change. Therefore, explanation of change requires causal analysis (Sayer, 2010). Realism claims that outcomes occur when a mechanism is triggered, that is, outcomes are attributed to causes. However, what is a cause?

To ask for the cause of something is to ask what ‘makes it happen’, what ‘produces’, ‘generates’, ‘creates’ or ‘determines’ it, or, more weakly, what ‘enables’ or ‘leads to’ it. ...On the realist view, causality concerns not a relationship between discrete events (‘Cause and Effect’), but the ‘*causal powers*’ or ‘*liabilities*’ of objects or relations, or more generally their ways-of-acting or ‘*mechanisms*’. (Sayer, 2010, p. 71)

Causation can be successionist, configurational or generative. In a successionist model, change is explained through analysis of relationship between variables obtained through surveys or experimental trials. Further, change is captured by identifying dependent variables while causal powers are located in independent variables, isolated through experiments or by statistical means (Pawson, 2008, p. 1). In the successionist model, causation involves regularities in relationships between events (empirical domain) (Danermark et al., 2002). Configurational causation involves identifying a combination of attributes that lead to changes in society, which is organised into systems made up of attributes (Pawson, 2008). Causation is both conjunctural and multiple because attributes may combine in different ways and lead to the same outcome (equi-finality) or similar attributes may combine differently and result in different outcomes (multi-finality) (Ragin, 2009). An example of a configurational model that has been utilised in research is Qualitative Comparative Analysis (QCA). For details on its application in research and analysis of outcomes, see Lam & Ostrom (2010). In the third model of causation, generative, outcomes result from action of mechanisms (Pawson, 2006). In critique of other approaches to causation and in defence of generative causation, Sayer (2000, p. 14) asserts:

Consequently, for realists, causation is *not* understood on the model of regular successions of events, and hence explanation need not depend on finding them, or searching for putative social laws. The conventional impulse to prove causation by gathering data on regularities, repeated occurrences, is therefore misguided; at best, these might suggest where to look for candidates for causal mechanisms. What causes something to happen has nothing to do with the number of times we have observed it happening. Explanation depends instead on identifying causal mechanisms and how they work and discovering if they have been activated and under what conditions.

Therefore, realists do not think that successionist and configurational models provide a satisfactory explanation of outcomes (Pawson & Tilley, 1997). Further, utilisation of variables in successionist models cannot produce explanations of outcomes (Danermark et al., 2002). This is because “Social science explanation requires that we move on from structural analysis to causal analysis ... Causal analysis deals with *explaining* why what happens actually does happen” (Danermark et al., 2002, p. 52). In addition, variables are designed to capture any number of traits and properties and in most social situations, it is impossible to manipulate their presence or absence. Moreover, variables and attributes do not offer explanations of invisible forces which

bring about change (Pawson, 2008). Generative explanations utilise a mechanism and context explanation (Danermark et al., 2002). In this sense, “Explanation involves identifying causal mechanisms, how they work, and discovering if they have been activated and under what conditions” (Sayer, 2000, p. 14). Overall:

The advocates of mechanisms have criticized the simplistic empiricist uses of statistical methodology for ignoring the importance of causal process assumptions in causal inference ... The basic idea of a mechanism-based explanation is quite simple: At its core, it implies that proper explanations should detail the cogs and wheels of the causal process through which the outcome to be explained was brought about. (Hedström & Ylikoski, 2010, p. 50)

Thus, by focusing on mechanisms that generate empirical events and the context within which they occur, the generative model provides a more apposite framework for explaining adaptations and outcomes of development interventions. This means that explaining how outcomes come about lies in identification of mechanisms. However, what constitutes a mechanism remains contentious although the utility of mechanisms in explaining outcomes is generally agreed upon (Hedström & Ylikoski, 2010). The notion of mechanisms has been used in other sciences, from physics, sociology to economics (Hedström & Swedberg, 1996, p. 285-286). Mechanisms are referred to as causal mechanisms, generative mechanisms, and social mechanisms or simply, mechanisms. Utilisation of mechanisms and its link to middle range theorising has been traced back to works by Robert Merton “who argued for the development of middle range theory, focusing on social mechanisms and brought together the idea of mechanism with that of middle-range theorizing” (Hedström & Swedberg, 1996, p. 282). Hedström & Ylikoski, (2010, p. 49) point out that “Because the entities and processes studied by different sciences are quite heterogeneous, it is difficult to propose a mechanism definition that would both be informative and cover all examples of mechanisms”. As a result, they provide a summary of how the concept has been utilised by different authors (Table 2).

Table 2 Alternative definition of mechanisms

Author	Definition	References
Bechtel & Abrahamsen	A mechanism is a structure performing a function by virtue of its component parts and component operations and their organization. The orchestrated functioning of the mechanism is responsible for one or more phenomena.	Bechtel & Abrahamsen 2005
Bunge	A mechanism is a process in a concrete system that is capable of bringing about or preventing some change in the system.	Bunge, 1997; 2004
Glennan	A mechanism for a behaviour is a complex system that produces that behaviour by the interaction of several parts, where the interactions between parts can be characterized by direct, invariant, change-relating generalizations.	Glennan, 2002
Machamer, Darden, and Craver	Mechanisms are entities and activities organized such that they produce regular changes from start to finish.	Machamer <i>et al.</i> , 2000; Darden, 2006; Craver, 2007
Elster I	A mechanism explains by opening up the black box and showing the cogs and wheels of the internal machinery. A mechanism provides a continuous and contiguous chain of causal or intentional links between the <i>explanans</i> and the <i>explanandum</i> .	Elster, 1989
Elster II	Mechanisms are frequently occurring and easily recognizable causal patterns that are triggered under generally unknown conditions.	Elster, 1999
Hedström	Mechanisms consist of entities (with their properties) and the activities that these entities engage in, either by themselves or in concert with other entities. These activities bring about change, and the type of change brought about depends on the properties of the entities and how the entities are organized spatially and temporally.	Hedström, 2005
Little	A causal mechanism is a series of events governed by law-like regularities that lead from the <i>explanans</i> to the <i>explanandum</i> .	Little, 1991
Woodward	A model of a mechanism (a) describes an organized or structured set of parts or components, where (b) the behaviour of each component is described by a generalization that is invariant under interventions, and where (c) the generalizations governing each component are also independently changeable, and where (d) the representation allows us to see how, by virtue of (a), (b), and (c), the overall output of the mechanism will vary under manipulation of the input to each component and changes in the components themselves.	Woodward, 2002

Source: Hedström & Ylikoski (2010, p. 51)

Identification of mechanisms is an important element in mechanism-based explanation. Different authors provide steps to identification of mechanisms (see Bygstad & Munkvold, 2011, Hedström & Ylikoski, 2010; Pawson, 2006; Pawson & Tilley, 1997; Yeung, 1997). Because this thesis is concerned with development interventions, the approach employed by this study draws on the work of Pawson & Tilley (1997) and Pawson (2006; 2013) because they equally are concern with outcomes of social programmes. To identify mechanisms that explain programme outcomes, Pawson (2006, p. 24) explains:

In abstract terms one can say that programmes work only if people choose to make them work. At the broadest level of generality, one can say that programmes offer resources and whether they work depends on the reasoning of the subjects. The nature of the carrot of inducement may be different (material, social, cognitive) and the offer may include resource withdrawal (the stick). But whatever the intervention, it can only work as intended if the subjects go along with the programme theory and choose to use the resources as intended.

Therefore, in social programmes, mechanisms should not be equated with activities but they explain how events come about (Pawson, 2008). The interplay between beneficiaries reasoning and actions, and how it results in outcomes as explained above is evident in a study by Scott (1998, p. 225) who found that the Ujamaa Villages in Tanzania failed because the developers forgot that “Its efficiency depends on the response and cooperation of real human subjects. If people find the new arrangement, however efficient in principle, to be hostile to their dignity, their plans and their tastes, they can make it an inefficient arrangement”. Therefore, understanding outcomes involves explaining individuals’ relationships, actions and how this brings about outcomes (Hedström & Ylikoski, 2010).

Attempts have also been made to group, categorise different types of mechanisms or develop a typology of mechanisms (Morén & Blom, 2003). For example, building on James Coleman’s (1986, 1990) classic macro-micro-macro model of social action, Hedström & Swedberg (1996) argue that there are three interrelated types of mechanisms: situational, action-formation, and transformational mechanisms.

The essence of utilising mechanisms in research is for knowledge cumulation. It is noted that “The idea of causal mechanisms is related to broader ideas about the growth and organization of scientific knowledge” (Hedström & Ylikoski, 2010, p. 61). Mechanisms are useful in the acquisition of knowledge of events (Danermark et al., 2002). From this perspective, “scientific knowledge expands by adding items to or improving upon items already present in the toolbox of possible causal mechanisms” (Hedström & Ylikoski, 2010, p. 61). A mechanism “is thus a theory-a theory that spells out the potential for human resources and reasoning and the task of empirical research is to test, refine, and adjudicate the middle-range theories” (Pawson & Tilley, 1997, p. 124). Mechanisms have also been seen as middle range theories or building blocks for middle range theories, which can be replicated in other contexts and do not aim to offer universal explanation (Astbury & Leeuw, 2010; Hedström & Ylikoski, 2010). In this thesis, I identify mechanisms that explain adaptations and outcomes of the NDDP. In doing so, I propose these mechanisms, which I discuss in subsequent chapters of this thesis as a way of contributing knowledge and understanding of development interventions.

3.4.2 Contexts and outcomes in realist explanation

Context refers to conditions that enable or constrain choices that people make and the actions that they take in response to the resources or opportunities provided by an intervention (Pawson & Tilley, 1997). Context has micro (individual) and macro (society) dimensions that may cover individual, interpersonal, institutional, organisational, infrastructural and social conditions (Pawson, 2006). These include experiences, attitudes, resource availability, geographical settings, religion, culture, norms, interrelationships and networks, social position and their associated power (Pawson & Tilley, 1997; Pawson, 2006). Historical view of context as articulated by Archer (1995) in the morphogenetic sequence means that development interventions are implemented in societies in which target beneficiaries have pre-existing conditions. Beneficiaries:

Enjoy different pre-existing relationships that leave some well-placed and some ill placed to take up the opportunities provided by the intervention. They come to programmes with power, or a lack of it, which enables some to resist and some to embrace the ideas of the programme. There is always choice but it is never a matter of free will. Programmes are met with constrained choices, located in pre-existing conditions, and these, as well as the processes internal to the intervention, determine the balance of winners and losers. (Pawson, 2006, p. 25)

What this means is that the underlying social structures or the social networks in which social actors are embedded influence their actions (Granovetter, 1985). In cultural economics, culture-customary beliefs, values and preferences, have an influence on economic choices and outcomes (Guiso et al., 2006, pp. 23-24). However, what are outcomes?

Outcomes include the external and visible behaviours of people, systems and things that have occurred or were expected to occur. Hence, they are the change that was intended (or unintended) due to the initial action. Outcomes describe the connection or result of interaction between the steps (or processes) involved in the complex social intervention. (Hunter & Berends, 2012, p. 133)

The argument in realist explanation is that outcomes vary by context, that is, outcomes are contingent on context (Pawson, 2006). This is because different outcomes arise from a set of mechanisms due to changes in the context (Archer, 1995). Pawson (2006) propose a framework for realist explanation that links mechanisms, outcomes, and contexts which states “Interventions offer resources which trigger choice mechanism (M), which are taken up selectively according to the characteristics and circumstances of subjects (C), resulting in a varied pattern of impact (O)” (Pawson, 2006, p. 25). Therefore, realist research focuses on identifying mechanisms that explain outcomes of interest in particular contexts. As I have already indicated, in this thesis, I identify mechanisms that explain adaptation of the NDDP by project officers and farmers who were involved in the intervention and the context in which this occurred.

3.5 Methods of conducting realist research

Realism is not a research method but several realists have proposed methodological guidelines or research in this paradigm. These are the morphogenetic sequence (Archer, 1995), iterative abstraction, grounded theory and triangulation (Yeung, 1997), realist evaluation (Pawson & Tilley, 1997; Pawson, 2006), the explanatory model of social science (Danermark et al., 2002) and multi methods triangulation (Downward & Mearman, 2007). Overall, these authors agree with Sayer (2000, p. 19) that “Compared to positivism and interpretivism, critical realism endorses or is compatible with a relatively wide range of research methods”. As a follow up to this, Sayer (2010) discusses extensive and intensive research designs the difference being that “In intensive research the primary questions concern how some causal process works out in a

particular case or limited number of cases. Extensive research, which is more common, is concerned with discovering some of the common properties and general patterns of a population as a whole” (p. 163). The focus and key differences between these two research designs are shown in Table 3.

Table 3 Intensive and extensive research designs

	Intensive	Extensive
Research question	How does a process work in a particular case or small number of cases? What produces a certain change? What did the agents actually do?	What are the regularities common patterns, distinguishing features of a population? How widely are certain characteristics or processes distributed or represented?
Relations	Substantial relations of connection	Formal relations of similarity
Type of groups studied	Causal groups	Taxonomic groups
Type of account produced	Causal explanation of the production of certain objects or events, though not necessarily representative ones	Descriptive, representative generalizations, lacking in explanatory penetration
Typical methods	Study of individual agents in their causal contexts, interactive interviews, ethnography. Qualitative analysis	Large-scale survey of population or representative sample, formal questionnaires, standardized interviews Statistical analysis
Limitations	Actual concrete patterns and contingent relations are unlikely to be ‘representative’, ‘average’ or generalizable. Necessary relations discovered will exist wherever their relata are present, [for example] causal powers of objects are generalizable to other contexts as they are necessary features of these objects	Although representative of a whole population, they are unlikely to be generalizable to other populations at different times and places Problem of ecological fallacy in making inferences about individuals. Limited explanatory power
Appropriate tests	Corroboration	Replication

Source: Sayer (2010, pp. 163-164)

Because realism is compatible with intensive and extensive research methods, a research method should be selected based on the extent to which it adequately addresses the question whose answers the researcher seeks and the nature of the phenomenon being investigated (Sayer, 2000; 2010). This thesis is based on an intensive research design and employed in-depth interviews and review of documents. There is a lot of literature that supports use of intensive methods for

mechanism-based explanatory studies. For example, Bygstad & Munkvold (2011, p. 3) note that “A typical critical realist research design would be an intensive study, with a limited number of cases, where the researcher systematically analyses the interplay between the layers”. Furthermore as shown in Table 3 above, compared to extensive methods, intensive methods are more appropriate for causal explanation of events. In this sense, “qualitative methods are more appropriate for investigating ways that various parts of social phenomena are related to each other and result in possessing certain causal power” (Iosfides, 2011, p. 13). In addition, unlike quantitative methods, “interactive interviews and ethnography are necessary to abstract causal mechanisms” (Yeung, 1997, p. 57). Moreover, qualitative methods are more appropriate in the application of retrodution, the logic of inference in realist studies in which a researcher moves from “... observable phenomena at the empirical level to the deeper conditions and realities which generate them” (Iosfides, 2011, p. 15).

Therefore, in this thesis, I combined in-depth interviews and analysis of documents to understand how actors adapted the intervention, the context within which this occurred and the outcomes. In line with an intensive research design, field data were gathered through semi-structured interviews with the Kenyan and Dutch government officials, agricultural extension agents and farmers who implemented the NDDP dairy technologies in Kakamega district. Sampling of respondents was purposive throughout fieldwork and data were captured through field notes and voice recorder. Purposive sampling is consistent with an intensive research design involving intense engagement with respondents in order to establish mechanisms that explain adaptations and outcomes of the NDDP. I identified respondents during the exploratory phase of fieldwork, as explained in the section on the research process below.

3.6 Data analytic methods

Qualitative data can be analysed through categorizing strategies like coding and thematic analysis; connecting strategies like narrative analysis and individual case studies; or by use of memos and displays (Maxwell, 2004; 2012). Thematic analysis is a method for identifying, analysing and reporting patterns known as themes within data (Braun & Clarke, 2006). One of the initial steps in thematic analysis is identification of codes. “A code in qualitative inquiry is

most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data” (Saldana, 2009, p. 3). In thematic analysis, codes are identified, organised and categorised to capture patterns or themes in the data. A theme captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set (Fereday & Muir-Cochrane, 2006). Once they have been identified, themes become the categories for analysis. One weakness of coding and thematic analysis is that it may not reveal the context in which the patterns in the data occur (Maxwell, 2012).

On the other hand, connecting strategies “aim to understand the data in context and identify the relationships among different elements of the text” (Maxwell, 2012, p. 115). Therefore, such techniques treat data as coherent whole and retain as much of the raw data to capture context. Examples of such techniques include discourse analysis, narrative analysis and use of networks. A weakness of such methods is that they are not appropriate for making comparisons. Categorising and connecting analytic strategies can be combined or integrated depending on the nature of the research and questions under investigation. Combining categorising and connecting techniques involves identifying similarities and differences, and then establishing actual connections between events in the data (Maxwell, 2012).

In this research, the data, which is in the form of interview transcripts and text extracted from documents are treated as holistic and constitutes contexts, mechanisms and outcomes. This means in analysing this data, contexts within which mechanisms operate to generate outcomes are explained. This research employs thematic synthesis (Thomas & Harden, 2008) and retroduction analytical techniques. I employed the first two steps (coding text and generation of descriptive themes) of thematic synthesis discussed by (Thomas & Harden, 2008). Through thematic synthesis, during the exploratory phase of fieldwork, discussed below, I identified background of the intervention NDDP and its adaptations and outcomes both by developers and farmers. To identify mechanisms, I employed retroduction. As already explained, retroduction therefore involves moving from empirical observations to identify possible causes of the observations lying beneath appearances (Yeung, 1997). Retroduction starts with identification of events and coming

up with conjectures about how events came about (Sayer 1992). The conjectures or propositions are then modified by gathering more empirical data until they adequately explain concrete phenomena. Details of how thematic synthesis and retroduction were systematically employed are discussed under the research process in the subsequent section.

3.7 The research process

The research process describes how data were collected and analysed. The process involved three interrelated exploratory, explanatory and confirmatory phases, in which data collection, analysis and report writing was simultaneous and iterative. Fieldwork, which started in December 2011 ended in May 2013 although out of field analysis continued until September 2013.

3.7.1 Exploratory phase

This phase involved several steps in which data were collected, analytical techniques followed, and how findings were arrived. Noteworthy is that the entire research process was iterative and the steps below were not necessarily followed in that order.

Step 1: Data collection

During this step, I sourced documents from the MLD and Ministry of Agriculture offices in Nairobi and Kakamega. I obtained 87 district dairy reports from Kakamega that were written at different dates between 1980 and 1989. These reports were written by the district dairy officer on a regular basis to report progress with the implementation of the dairy improvement project to the MLD headquarters in Nairobi. Other documents that I obtained were nine reports which focus on various NDDP project planning, implementation and evaluation. Selection of documents was based on relevance, in terms of information useful to answer study questions. Another document that I obtained from farmers whom I interviewed was a visitor's book, which every farmer who registered with the NDDP was required to keep in order to record events that they considered important in their dairy activities. Farmers were also required to ask anyone who visited their farms for purposes of dairy to write down the purpose of their visit and any advice to the farmer in the book. In total, I obtained visitors books from seven farmers.

NDDP reports (MLDM, 1986; MLD, 1990; Muriuki & Wokabi, 1993) show that, NDDP staff at the national level comprised a project manager, an economist and a research and extension officer. At the district level, NDDP had two dairy officers who represented the Kenyan and Dutch governments, respectively, in each of the six districts where NDDP was initiated in 1980. In addition, each division (a district is usually made up of a number of divisions), had dairy extension officers. Kakamega district had nine divisional extension officers when the project started in 1980. I went through these NDDP documents and identified the Kenyan and Dutch government officers and dairy extension officers who worked for the NDDP. I also identified farmers who had registered with the intervention by end of June 1983. After identifying their names, I located the NDDP officers and the farmers through assistance from the current Ministry of Livestock officers and held in-depth interviews with some of them face to face. During this phase, I interviewed all the three dairy officers who worked for the project in Kakamega district and four extension officers who worked for the project in the divisions of the district. This selection of dairy officers for in depth interviews is consistent with a purposive sampling that I employed.

A dairy project report from Kakamega for August 1983 shows that by end June 1983, there were 73 registered farmers (had constructed zero grazing units and had their farm budgets approved), 36 recruited farmers (their farm budgets had been approved) and 40 interested farmers (had no concrete plan) (van Helden, 1983b). I opted to sample from the registered farmers because they were already implementing the dairy technologies by June 1983, which provides an opportunity for this study to explore adaptations and outcomes of the technologies over a long period. The 73 registered farmers included five institutions/groups, which I omitted for selection because the concern of this study is with individual farmers. Further, 44 of the registered farmers were classified as part time and the remaining 29 full time. Moreover, of the registered farmers, 14 were demonstration farmers and 58 had received financial support that ranged from KShs. 72.00 to KShs. 3732.25 (van Helden, 1983b). For this phase, I selected farmers based on their geographical location and availability. In terms of geographical location, I interviewed farmers from four of the nine divisions in Kakamega district. Further, I interviewed farmers who I met during my visit. This was appropriate because the aim was to establish ideas about aspects of the

intervention like technologies that farmers had implemented, adaptations, and outcomes, and to modify the interview guides to reflect the key issues of the study. During this exploratory phase, I interviewed 11 farmers.

Although I had planned to interview farmers who were listed on the NDDP records, this was not always the case because some of them were heads of households but had not usually engaged in the actual dairy activities in that household. In such cases, I interviewed a household member who was involved in implementation of the dairy activities. The in-depth interviews focused on a series of themes such as cattle rearing history, NDDP dairy technologies; interactions with other farmers, dairy extension agents and other actors; perceptions and interpretations of the intervention; acquisition of farm inputs and milk marketing; adaptations of the dairy technologies and the technologies that they were implementing at that time. Each interview session lasted for about two hours and was captured by a digital voice recorder. During the interviews, I sought clarification and elaboration to gain deeper and detailed accounts of the issues discussed. I also used techniques like aided recall (Huber & Power, 1985) to reduce bias arising from the time that has elapsed since the events of interest occurred. Interviews were conducted in either English or Kiswahili. In this thesis, where I have quoted respondents who were interviewed in Kiswahili, I have translated this to English but I show the original Kiswahili quotation in Appendix 1.

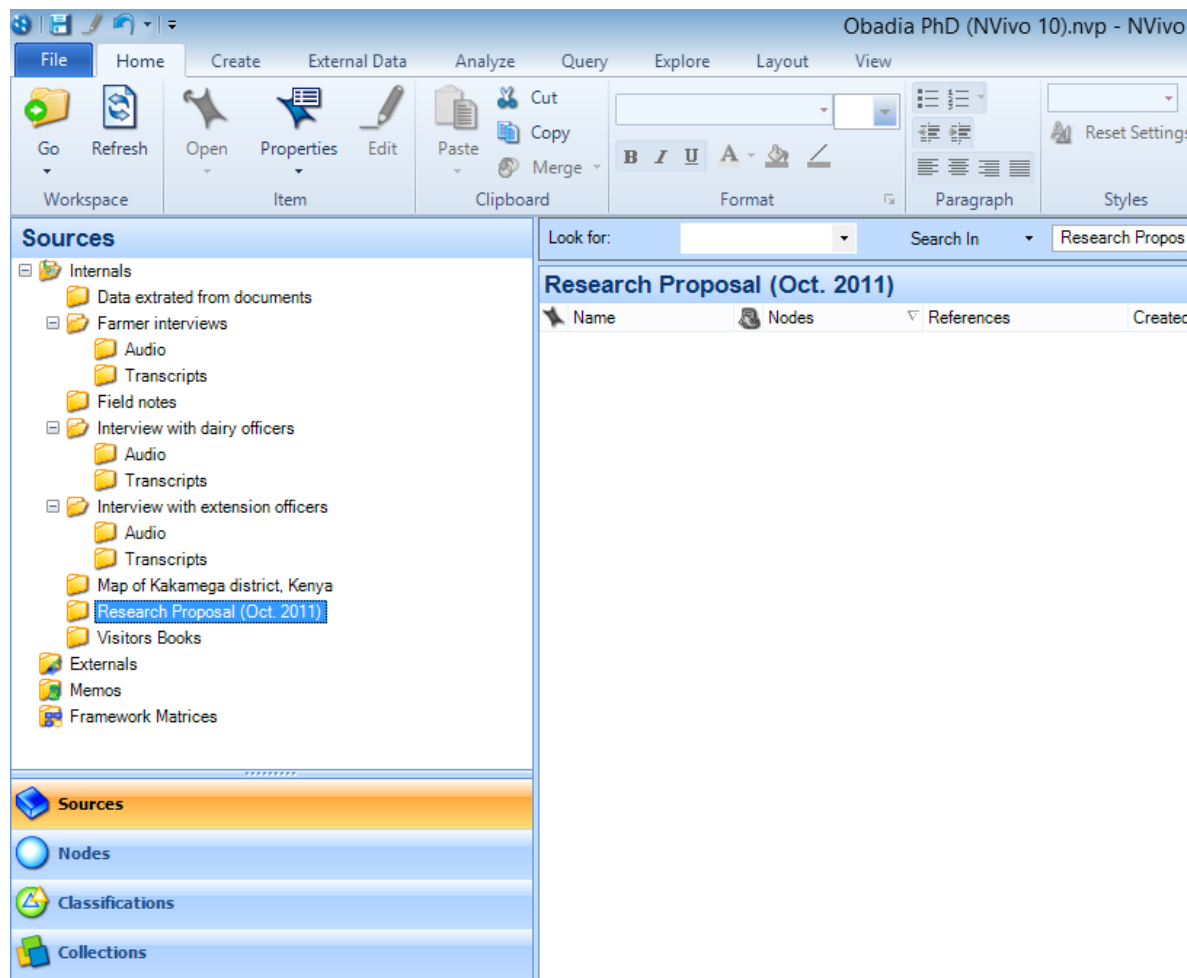
Further, I extracted data from selected documents. The data extracted consisted of sentences, paragraphs or entire pages that were relevant for questions that this thesis addresses. Extraction of data from documents followed the Context-Mechanism-Outcome framework and focused on NDDP background, dairy technologies that farmers implemented, strategies that the developers used, factors that enabled or constrained the NDDP, adaptation of dairy technologies, outcomes of the dairy technologies and how the intervention worked.

Step 2: Creation of a project database and data transcription

I created a project database in NVivo, uploaded the voice recorded interviews in MP3 format and transcribed them verbatim. I then edited the transcripts for errors made during transcription. I also typed field notes and information in the visitors books in MS Word and imported them into the

project created in NVivo. Lastly, I uploaded data extracted from documents onto the project database. In some cases, this data included entire documents that were in Portable Document Format (pdf) or Word versions. Below is an NVivo screen that shows various sources of data uploaded onto the project database that I created (Figure 4).

Figure 4 NVivo database showing sources of data for this study



Step 3: Description and analytic resolution

Description involves identification of a concrete event or situation for investigation while analytical resolution is about identifying the important components, aspects or dimensions of the issue under study (Danermark et al., 2002). To arrive at this, I coded the data (interview transcripts, data extracted from documents, field notes and data extracted from visitor's books).

In doing so, I followed the first step of thematic synthesis suggested by (Thomas & Harden, 2008). Coding in this study was data driven and I coded at the level of meaning. To achieve this, I identified segments of text in the data assigned them a code based on their meaning. A code represents a sentence or entire paragraph with similar meaning. I coded in NVivo where codes are entered as free nodes. Thereafter, I examined all the text which had a given code and checked the consistency of the codes and to determine whether additional levels of coding were needed. I modified the code names until I was satisfied they captured the meaning in the data. For example, Figure 5 shows a code, tethering, organised in a hierarchical structure as explained in the next step and the section of the transcript it captures.

Figure 5 Tethering code in NVivo

The screenshot displays the NVivo 10 interface. The left pane shows a hierarchical tree of nodes under 'Nodes', including 'Contexts', 'Dairy officers', 'Extension officers', 'Farmer adaptations', 'Mechanisms', and several 'NDDPF' nodes. The 'Dairy officers' node is expanded, showing a list of sub-nodes: 'Feeding before NDDP', 'Free grazing', 'Inadequate fodder', 'Poor yielding forage', 'Tethering', and 'Underfeeding'. The 'Tethering' node is selected, and the right pane shows its details. The 'Look for:' field is set to 'Dairy officers'. Below the node list, a table shows the number of sources and references for each node. The 'Tethering' node has 1 source and 2 references. Below the table, the 'Tethering' node is selected, and the text of the references is displayed. Reference 1 is from 'Internals\Interview with dairy officers\NDDPO6' and has a coverage of 0.37%. Reference 2 has a coverage of 0.15%.

Name	Sources	References
Feeding before NDDP	2	6
Free grazing	1	1
Inadequate fodder	1	1
Poor yielding forage	1	1
Tethering	1	2
Underfeeding	1	1

Tethering

<Internals\Interview with dairy officers\NDDPO6> - § 2 references coded [0.53% Coverage]

Reference 1 - 0.37% Coverage

And when we went to the farms, we saw those smallholder farms have a cow tied to a tree, yeah and sometimes they throw napier grass or whatever to the animal.

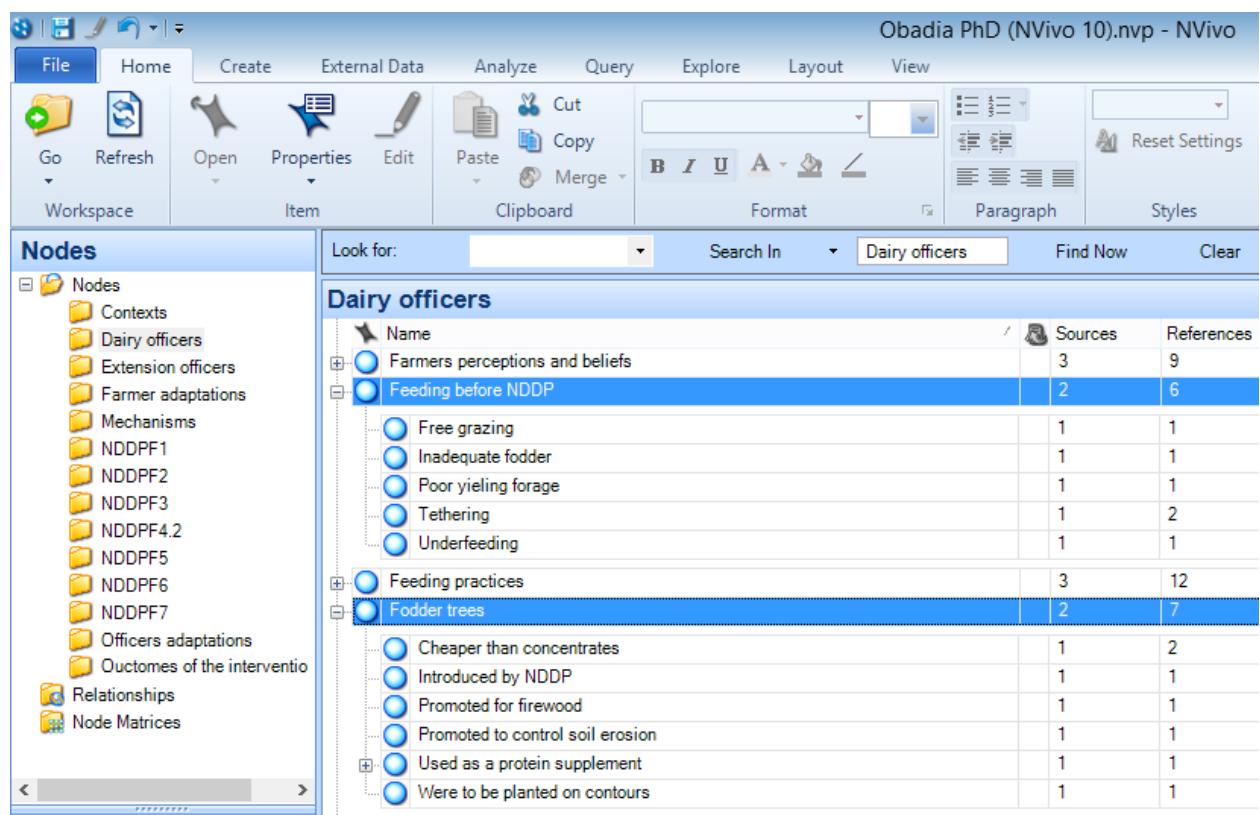
Reference 2 - 0.15% Coverage

Because you find as I told you the cow just tied to the the tree

Step 4: Generation of descriptive themes (tree nodes in NVivo)

Descriptive themes were generated by organising the codes into related areas by creating new codes or merging others as appropriate. To achieve this, I looked at similarities and differences between the codes and grouped them into a hierarchical tree structure based on related meanings. NVivo has an interface that allows for merging and reorganising codes (free nodes in NVivo) in a tree hierarchical structure (Figure 6).

Figure 6 Nodes organised into a hierarchical tree structure



For illustration purposes, Figure 6 shows hierarchical codes selected (Feeding before the NDDP and Fodder trees). These are hierarchical level nodes and the initial codes generated during step 3 above are shown under each of the hierarchical tree nodes. For example, the child nodes for Fodder trees (hierarchical node) are: cheaper than concentrates, introduced by NDDP, promoted for firewood, promoted to control soil erosion, used as a protein supplement and were to be planted on contours.

Next, with reference to the data, I generated the descriptive themes, which formed the preliminary findings of this exploratory phase of the research process. These themes are a synthesis of combined data interview transcripts and data extracted from documents, hence thematic synthesis. This was achieved through an NVivo radio buttons for sorting text and organising the codes across all sets of data. I then organised the descriptive themes are organised under the following titles.

- How farmers viewed dairy cattle and farming before NDDP
- How dairy officers perceived dairy farming
- Rationale of the NDDP
- Reasons that motivated the farmers to join the NDDP
- Dairy extension strategies- tours and visits, demonstration, training, and field days
- Breeds and breeding practices (before, during, and after the intervention)
- Dairy cattle feeding practices (before and during NDDP, and current ones)
- Zero grazing units (before and during NDDP, and current status)
- Access to dairy inputs, veterinary and clinical services
- Dairy cattle disease control (before, during and current)
- Calf rearing practices (before, during, and current status)
- Household and hired labour in smallholder dairy farms
- Manure and fertilizer application of Napier grass
- Roles of different actors in the dairy intervention
- Fodder preservation through silage making
- Beneficiaries of the NDDP
- Financing of dairy cattle farming activities
- Dairy records, materials and resources
- Fodder trees, shrubs and legumes
- Milk demand, production and sales
- Cultivation and management of Napier grass
- Other farm enterprises

- Safety of dairy cows
- NDDP research station

As an example of the findings, below are the descriptive themes under the first title above: Farmers ideas, thoughts and perceptions of dairy cattle and farming.

1. Death of a dairy cow reinforced farmers' beliefs that dairy cattle would not survive in the area.
2. Dairy cattle farming was associated with white farmers and dairy cows were usually referred to as *ngombe za kizungu* (English cows).
3. Farmers wondered if cows could survive on Napier grass only.
4. Initially, farmers thought that cows served with AI would die and it was a government strategy to make their animals die so that they become poor.
5. Because zero grazing units were rare in the area, farmers wondered how and whether cows could survive when confined in units.
6. Farmers hesitated to construct zero grazing units, which were to be permanent structures made of cemented floor and iron sheet roofed yet they lived in houses made of grass thatch or iron sheet roof and mud walled.
7. Farmers who did not feed their cows on *machicha* (brewers waste) did so because they thought that the cows would get drunk.
8. It would be difficult for one can earn a livelihood by keeping dairy cows only without cultivating maize.

Notably, these findings are a synthesis of data from all sources. The descriptive themes under the topics above are very close to the data. The next step was to examine the themes closely in the context of the data in order to identify mechanisms that explain adaptations and outcomes.

3.7.2 Explanatory Phase

This phase involved identification of mechanisms to explain adaptations and outcomes, as well as more data collection and analysis.

Step 5: Identification of mechanisms that explain adaptations

Identification of mechanisms to explain adaptations and outcomes means ‘going beyond’ the descriptive themes. As already discussed, explanation should be movement from the concrete to the abstract and back to the concrete (Yeung, 1997). In this thesis, the concrete refers to the adaptations and outcomes of the NDDP. Notably, both the farmers as well as the project officers adapted the NDDP. However, unlike the line taken by realist evaluators who examine intervention mechanisms (Pawson, 2006; 2013), the aim of this thesis is not to examine how these mechanisms worked, rather, in recognition that interventions do not roll out as planned, I look at their adaptations by actors. I explore mechanisms that explain adaptation of the zero grazing components by project officers and farmers. I draw on but adapt realist evaluation explanatory framework that links outcomes to mechanisms in context. Similarly, realist evaluation is largely utilised in reviews based on secondary data. In this thesis, I combine primary data, in-depth interviews with project documents. In this sense, the initial logic in extension characterised by seeing is believing and capacitation mechanisms did not apply, in the case of adaptation as will become evident in the next chapter.

Mechanisms that explain adaptation of the NDDP by developers

From descriptive themes, I identified that developers (project, dairy and extension officers) adapted the dairy improvement project in the following ways. They:

- Changed the focus of extension from individual farmers to farmer groups, and from being staff driven to demand driven
- Introduced printed and audio-visual resources for extension
- Involved other actors in the NDDP extension programme
- Started to assist farmers to identify and select dairy cattle as part of extension
- Introduced a new criteria to register farmers for the project
- Established a fodder research unit
- Introduced fodder preservation techniques like ensiling Napier grass
- Introduced fodder trees and legumes to increase protein intake as Napier supplement

Again going through the data, I realised that some of these adaptations involve similar broad themes. I categorised these adaptations into two thematic areas.

1. Adaptations linked to resources (human and financial) that were at the disposal of the NDDP at that time. developers:
 - Changed the focus of extension from individual farmers to farmer groups
 - Changed extension focus from being staff driven to demand driven
 - Involved other actors in the NDDP extension programme
2. Adaptations linked to farmers' context. Developers:
 - Started to assist farmers to identify and select dairy cattle as part of extension
 - Introduced a new criteria to register farmers into the project
 - Introduced fodder preservation techniques like ensiling Napier grass
 - Introduced fodder trees and legumes to complement Napier grass
 - Introduced printed and audio-visual resources for extension
 - Established own fodder research unit

In close reference with these adaptations, I explored the data and inferred that project officers adapted components of zero grazing: First, to ensure that the components of zero grazing were relevant to the context of the smallholder farmers so that the farmers could implement them, that is, effectiveness mechanism. I use effectiveness mechanism to describe the reasoning of project officers evident in their attempts to make the components of zero grazing more relevant to the context of farmers in order to meet the planned objectives of the intervention. As an intervention, NDDP had objectives and the project officers had targets that they had to meet within given timeframes. Extension and project officers were to report this to the project managers, who were to in turn report progress to the donors, Kenyan and Dutch government officials. The government had committed itself to the project and did not want to fail or to be seen to have failed, which was well communicated to the project officers. Yet they could not continue with the implementation of the intervention because the context in which it was to be implemented was inconsistent with some of the components. In this sense, to continue the intervention, they realised that the only

alternative was to adapt some of its components to be relevant and reflect the needs and interests of smallholder farmers who were to implement them.

Further analysis of project documents and interviews with dairy and extension officers revealed that they were keen to enhance the effectiveness and continuity of the intervention due to the incentives that they received. One of the objectives of the NDDP was to “strengthen extension service” (MLD, 1990, p. 6-7), which involved training of the staff who were involved in the project. Project documents show that the project operated more in a semi-autonomous way in the Ministry of Livestock. The staff were seconded from the MoA and were paid by the project and received allowances and other benefits, unlike other extension staff who were not involved in the project. The officers were facilitated to reach farmers through provision of transport in form of motorcycles for extension staff and vehicles for dairy officers, which were fuelled by the project. Some of the motorcycles and vehicles are in the districts although not all are in good working condition. Interviews conducted revealed infighting and quarrels among staff during selection of those who were to be awarded scholarships to study overseas when others felt that other officers were favoured. Indeed, when the project ended, one of the outputs was the many officers who had been trained and promoted to senior positions under the intervention (Bauman, 1993). The incentives continued even when the government stopped subsidising the sector and extension at the Ministry was almost grounded. The staff were the envy of the other staff at the ministry and it was prestigious to work for the NDDP. Secondly, for continuation of project activities by promoting components that were consistent with the resources that were at the disposal of the project, that is, matching mechanism. In this thesis, I use matching mechanism to describe implementation of project activities that were consistent with the financial and human resources that were available to project officers.

Therefore, due to the incentives, the project officers were motivated to enhance the effectiveness and continuity of the project. They did not let the inconsistency between project components and the context of farmers or budgetary constraints halt the project because it could mean the end of their incentives. The project officers both at the national, district and divisional levels were at the forefront in advocating for its adaptation. They therefore adapted the intervention. In their

endeavour to meet project targets in terms of registering a given number of farmers, as it will be discussed in Chapter Five, some extension officers registered farmers who had not met all the requirements in order to meet their targets (MLDM, 1990). They allowed some farmers to start as they were and even changed the size of the units without consultation with their headquarters. Therefore, incentives, budgetary constraints and continuity pressures underlined the project officers focus on effectiveness and continuity, which explains their adaptation of the intervention.

Therefore, to contribute to knowledge and understanding of how project officers adapted zero grazing, in this thesis, I employ effectiveness and matching mechanisms. Through examples extracted from the data, I illustrate how I came up with effectiveness mechanism. In an interview one of the dairy officers who was involved in the project, he acknowledged that because they found the initial technologies inconsistent with the needs of the smallholder farmers, they had to adapt them so that farmers could implement them. He stated:

NDDP arose out of dairy technologies that were researched in Naivasha. So, it was only when we went to the field that we realised that these are not the technologies that the farmers really needed. So, although the initial plan was just extension work by taking the technologies that were already available in the research station to farmers, this did not work. It was expected that the farmers would use them especially the relatively poor farmers. Nevertheless, when we visited the farmers in the first few days, we realised that it was a mistake. We went back to the drawing board and started to research on new technologies. (Author's interview with Kirwa, 2013)

In another case, one of the constraints that threatened continuity of the NDDP was the high cost of constructing a zero grazing unit, a key component of the zero grazing technical package. To overcome this constraint and for farmers to continue implementation of the project, project officers allowed farmers to use own and locally available materials, which were cheaper in the construction of zero grazing units. An officer who was interviewed said:

You see, when something is not very much accepted by farmers or farmers are finding it difficult, then you have to look for other ways. You know with the technical package, with our zero grazing unit, there is a standard. The measurements have to be like that anyway. The top had to be *mabati* (iron sheet) but we went on and realised that not every farmer can afford *mabati*. So we said that if it is like that then those farmers can even use polythene papers or we can use *makuti* (pam tree leaves) and so on. Such adjustments were there and so on. Also with the unit, there was adjustment because there was a section that was to be constructed using concrete, which was expensive. Maybe if the farmer had some bricks, he could just lay them very nicely on the floor to reduce the cost. Therefore, we were reducing the cost to the farmer and those are the things that changed mostly. Still on housing, we were using *drums*ⁱⁱ instead of concrete water troughs. (Author's interview with Odhiambo, 2012)

As further evidence of effectiveness mechanism, NDDP project documents reveal that project officers adapted the intervention in recognition of regional diversity. As an example, of this, the third evaluation mission of the project in 1986 recommended utilisation of “a flexible, diversified approach in extension because: the regional problems for DDP differ greatly; the actual situation of DDP differs greatly per district” (Woersem et al., 1986, p. 20). This adaptation of extension to a flexible and diversified approach was in recognition that the standardised extension approach was not working in all districts that the project covered. In varying the extension approach in different geographical areas, the aim was to enhance effectiveness of the technical package which had been threatened by the diverse contexts of farmers in different districts.

The other mechanism that explains adaptation of the NDDP by project officers is matching. To illustrate matching mechanism, interviews with officers who were involved in the intervention revealed that although the project focused on individual farmers during the initial stages, this was later adapted to focus on farmer groups. This was because the number of farmers had increased and extension officers could not be able to attend to all farmers individually. Because they wanted to continue advising and training farmers of zero grazing, they started to organise group of farmers to reach more farmers who were interested in the intervention. During an NDDP senior staff meeting in 1993, the team leader asserted that “due to limited resources (finance and personnel) the group approach [was] introduced to reach

ⁱⁱ Containers that were previously used to transport liquid substances cheaply available in the local markets

more farmers” (Bauman, 1993, p. 15). Therefore, the project officers changed focus of extension from targeting individual farmers to groups of farmers due to limited resources that they had which could not enable them to reach farmers as individuals.

I would like to note that the choice to utilise effectiveness and matching mechanisms to explain adaptation of the intervention by actors emanates from the data. These mechanisms were underlined by incentives that the project officers received and project budgetary constraints. As already explained, the findings reveal that the adaptations by project officers were linked to the farmers’ context and project budgetary constraints. It is from the analysis of data that effectiveness and matching mechanisms were identified to explain the adaptations. This should not be interpreted to mean that they are the only mechanisms that explain adaptations but based on the data that I gathered, they provide an explanatory framework for adaptation of the intervention by the officers. Having illustrated how intervention effectiveness and matching mechanisms were manifested, in Chapter Five, I will discuss the contexts in which they operated and utilise them to explain adaptation of the intervention by project officers. I will also explain the interaction between project officers and farmers and how this influenced adaptation of the intervention and its subsequent outcomes.

Mechanisms that explain adaptation of the NDDP by farmers

Before identifying mechanisms, I first identified how farmers adapted components of the zero grazing technical package. From descriptive themes, the farmers:

- Rotated Napier grass on different plots and/or replanted it in same field.
- Intensified cultivation of Napier grass on road reserves and footpaths.
- Started to feed their cows on *machicha* (brewers waste), crop residues and natural pasture.
- Replaced dairy cows that were heavy feeders with breeds that consumed less fodder.
- Used dairy cow manure for other crops in addition to Napier grass.
- Applied manure on the soil surface in Napier grass fields instead of working it into the soil.
- Started to make compost manure.

- Directed slurry to flow from zero grazing unit directly to Napier grass plots instead of transporting it there.
- Used their own or locally available materials to construct zero grazing units.
- Kept bull calves unlike the NDDP advice that they kill or slaughter bull calves at or a few days after birth.
- Removed poles that subdivided zero grazing unit cubicles that the NDDP officers designed.
- Kept newborn calves in their houses and not in the calf pens, part of the zero grazing unit as recommended by the NDDP.

A closer look at these adaptations with reference to the data gathered reveals that they are related closely to the context of the farmers characterised by inability to produce adequate fodder, financial resource constraints and dairy farming perceptions or values that differed from those of the project officers. For example, the data shows that because the zero grazing unit designed and promoted by the NDDP required expensive materials to construct, farmers used their own materials or those that they could obtain in their neighbourhood, which were cheaper than those prescribed by the NDDP. Therefore, by going through the data, I postulated that farmers adapted zero grazing to make it fit their context, in this case the economic context characterised by resource constraints. There are also cases of cultural fit when farmers implemented components of zero grazing in ways that were consistent with their values. I use fit mechanism to describe farmers' selective choice and implementation of zero grazing components in ways that were consistent with their context characterised by land scarcity, inadequate financial resources and labour shortage. Below, I briefly illustrate how this mechanism was manifested in the dairy farming practices of farmers. One of the components of intensive dairy cattle management promoted by NDDP was calf rearing. NDDP recommended that farmers construct a calf pen as part of a stable and keep calves in the pen. However, a farmer who did not keep a newborn calf in the calf pen as recommended by the NDDP said:

We were trained that a calf should be kept in the calf pen. However, during cold or rainy seasons, if you keep a newborn calf in that thing, it can catch pneumonia or even die. It is just like a human being. During a cold season, I keep the calf in the house to keep it warm. In the past, we lost calves when I kept them in the pen during the cold season. (Author's interview with Nanjala, 2012)¹

From this interview, it would appear that keeping a newborn calf in the calf pen was not appropriate for the weather context of the farmer, especially the rainy or cold season. It could be argued that the calf pen designed by the NDDP could not provide adequate warmth for newborn calves. In this case, keeping a newborn calf in their houses, unlike the NDDP recommendation was appropriate for their context. Furthermore, in response to why she did not apply slurry to Napier grass as recommended by the NDDP but composted it and used it on other crops as well, the same farmer who kept newborn calves in the house said:

I compost all the manure in a pit. I mix manure with other things and then during the planting season like now, I prepare it and use part of it when planting maize, and use some of it on Napier grass. In the past, we used to apply slurry on Napier grass but I realised that applying slurry does not benefit me in other ways. It is only Napier grass that benefits. I then decided to compost it. (Author's interview with Nanjala, 2012)²

Therefore, this farmer saw slurry as an opportunity to fertilize other crops and vegetables and not just for Napier grass, which reflects the mixed livestock and crop system that smallholder dairy farmers practice. The notion of context fit is consistent with the reflections of an officer who was at one time the project leader with regard to farmers implementing technologies in ways that differed from recommended ones. The officer said:

So, when you come and say that these technologies were not accepted but were rejected, they were not really rejected but were redesigned and come up with something different. And as much as you want to belief that these people should have adopted the technologies, it is not about adoption. It is about how have they redesigned these technologies to fit into their situation depending on the financial capacity, knowledge, markets and many factors. So, they keep on changing and redesigning. So, if you come to evaluate, you may come and condemn a project that it has achieved nothing or what it was to achieve. But this is not true because they have achieved. They have redesigned and come out with another result, which will be different. (Author's interview with Kirwa, 2013)

The other mechanism that explains adaptation of the intervention by farmers is resistance. Analysis of data shows that some of the dairy technologies that farmers implemented reflected resistance to the dairy practices promoted by the NDDP. Resistance mechanism describes when farmers declined to implement some components of zero grazing recommended by NDDP by ignoring them and continuing to implement their previous technologies, a reflection of their view of appropriate dairy farming practices. At this stage, I provide two examples to illustrate this and leave detailed discussion of resistance mechanism and how it explains adaptation of the NDDP by farmers. The first example involved zero grazing unit cubicles. Because during the initial stages, project officers supervised construction of zero grazing units according to the recommended design, farmers who joined NDDP at that time did not object to the size and structure of the zero grazing units. However, after the construction was complete, farmers adapted the unit as they wished including removing the poles that divided the unit into cubicles because they felt that the cubicles were very small and the cows would be stressed when confined to the small cubicles. This allowed the cows to roam freely in the units but this made the cows to fight for fodder, which made farmers to tether them in the units against the NDDP recommendation. Interviews revealed that to avoid being asked why they adapted the zero grazing units, farmers went away from their farms when they heard the officers coming to the farms. Farmers seem to have played hide and seek with the officers. Secondly, as shown in the findings above, farmers continued to keep bull calves, which was against the recommendation by the NDDP. A project officer recognised this resistance during a senior staff seminar in 1990. The officer stated:

To avoid unprofitable rearing of bull calves, NDDP has for a long time recommended the slaughter of these animals soon after birth, unless the farmer has a special purpose for it as breeding or draught animal. In most areas, this message is not very well accepted by farmers because of social-cultural reasons. (MLD, 1990, p. 64)

The idea that farmers resisted implementation of some of the zero grazing components that NDDP promoted led project officers to persuade the farmers to implement the technologies. An officer who was interviewed expressed frustration that although he had spent a lot of time to advice farmers and persuaded them to implement all the components of zero grazing as

recommended, but that was all he could do. He could not coerce them to do so. He acknowledged that the farmers tended to implement technologies that they liked and in their own way. Furthermore, in 1994, during a senior staff seminar, an officer reported, “It is worth noting that there’s always a widespread resistance to radical changes in farming techniques, especially where these require a high input of labour. For obvious and entirely rational reasons, farmers tend to prefer small, gradual changes” (Chibudu, 1994). However, what motivated the farmers to adapt the components of zero grazing to fit their context or resist implementation of other components as NDDP recommended? Analysis found that farmers were keen on the benefits of the intervention in terms of increased milk production to generate income through sales and consumption in their households. Other farmers started implementation of the intervention as a means to maintain their leadership status in their area or to be seen to be development conscious and of a higher economic status. Keeping dairy cows was associated with *maendeleo* (development) and high economic status. Furthermore, through seeing is believing and capacitation mechanisms, farmers became aware of the costs and benefits of implementing various components of zero grazing. Farmers wanted to benefit by implementing zero grazing but were constrained by contextual factors which is the reason that they adapted the intervention. Therefore, fit and resistance mechanisms were underlined by farmers expected social, economic and cultural benefits and their awareness of the costs and benefits of implementing various components of zero grazing.

Having demonstrated how fit and resistance mechanisms were manifested in farmers’ dairy farming practices, in Chapter Five, I will employ them to explain adaptation of the intervention by farmers. Further, I will explain the contexts in which the two mechanisms brought about adaptation of the intervention by farmers. The choice to utilise these two mechanisms derives from analysis of the data, which reveals that the context mediated adaptation. In particular, the study reveals the socio-economic motives, which underlined the fit and resistance mechanisms. I will show the central role that farmers’ context played in their adaptation of the intervention.

Step 6: Identification of mechanisms that explain long run outcomes

The last concern of this thesis is to identify and explain long run outcomes of the. Long run outcomes describe the dairy technologies that farmers who had joined the NDDP by 1983 were implementing at the time of this research. From the data gathered, farmers who were involved in the NDDP were either implementing a combination of indigenous and modern dairy technologies or where not implementing any of these dairy practices and technologies at all. Through further analysis, I inferred that coexistence of modern and indigenous dairy technologies and non-implementation of any of the dairy technologies are a reflection of diminished intensive dairy cattle management promoted by the NDDP. I refer to this as the diminishing effect mechanism. By the diminishing effect, I describe decline in the implementation of zero grazing components promoted by the NDDP. Farmers were expected to implement intensive dairy cattle management practices characterised by improved animal husbandry practices, keeping of high quality dairy cattle, complete confinement of dairy cattle in stables, killing or slaughtering of bull calves. In Chapter Six, I will explain how instead of implementation modern technologies or those that the NDDP promoted as project officers had expected, farmers were implementing a combination of modern and indigenous technologies or not implementing any of the technologies.

In addition to identifying mechanisms during this phase, I conducted more in-depth interviews with developers and farmers, gathered more documents and extracted data from them. I held in-depth interview with six more farmers, two Napier grass sellers and three dairy officers. Further, I obtained 41 documents with information of the NDDP. The aim of data gathering during this phase was to build on and refine the mechanisms and the contexts within which they occurred. Selection of farmers during this phase was based on variation with regard to geographical location whereby I selected farmers from different divisions of the district and in terms of different outcomes identified above. To achieve variation, I visited farmers who were registered with NDDP by 1993, in different divisions and established outcomes of the technologies that they implemented. I then selected some farmers to interview based on different outcome categories. Selection based on variation was essential to explore how mechanisms led to different outcomes due to context.

Step 7: Concretisation and contextualisation

Concretisation involves examining how different structures and mechanisms manifest themselves in concrete situations (Danermark et al., 2002, p. 110). In step six above, I have discussed adaptations and outcomes of the intervention and mechanisms that explain how they occurred. With reference to the mechanisms identified in step six above, during this step, I explored the context in which the mechanisms operated to lead to the adaptations and outcomes shown above. During this step, I identified context by searching for conditions that enabled or constrained the mechanisms above to lead to adaptations and outcomes. To identify context, I went through the data and identified circumstances that enabled or constrained farmers' choices in response to intervention. I identified them as financing dairy cattle farming activities; change in the farmer's household demographic characteristics; household and hired labour in smallholder dairy farms and liberalisation and privatisation of dairy and agricultural sector. To illustrate how these circumstances were manifested, I use examples of how hired labour and inability to purchase additional fodder led to adaptation of the intervention and brought about outcomes that differed from those that project officers anticipated. With regard to hired labour in smallholder dairy farms, a farmer who was interviewed said:

Although cow dung is very helpful on Napier grass, I put it on vegetables that are closer here because it is difficult to carry cow dung to the Napier grass plot. That was a bit difficult. Therefore, I planted vegetables and hires someone to apply slurry on vegetables. Hired workers do not like to carry slurry as they did in the past. They say that if you carry slurry, your clothes will smell no matter how you wash. (Author's interview with Nanjala, 2012)³

From this interview, difficulties with hired labour constrained application of slurry on Napier grass fields. Project officers recommended that farmers transport all the slurry to Napier grass fields in addition to supplementing with mineral fertilizers for high quality and quantity Napier grass yields. However, due to challenges with labour to transport slurry to the Napier grass yield, further interview with this farmer revealed a reduction in Napier grass yield and quality, evidence of diminishing intensification of dairy cattle management. Another contextual factor that contributed to diminishing of the NDDP was farmers' inability to produce adequate fodder for their dairy cattle as commodification of grazing in the context of inadequate fodder. Farmers who

could not produce adequate fodder from their farms supplemented their fodder through purchase. This means that only those farmers who could afford bought additional fodder. Below, a farmer explains how difficulty with purchase of additional fodder influenced coexistence of indigenous and modern dairy practices in the form of diminished intensification of dairy cattle management.

Napier grass from the farm is inadequate. When you have cut all the Napier grass in the farm, and it has not regrown to the height appropriate to harvest, you have to get it from others. The amount of Napier grass that neighbours have is very little. Napier grass is now very expensive. It gets worse during the dry season when you cannot find Napier grass around and you have to go to the market. (Author's interview with Ndombi, 2012)⁴

These two examples above on difficulties with hired labour and inadequate fodder illustrate how I identified contexts that influenced adaptations of the intervention by project officers and farmers as well as influenced long run outcomes of the intervention. I provide details explanations of contextual factors that influenced adaptations and long run outcomes in Chapter Five and Chapter Six respectively. Overall, during this explanatory phase, I identified the mechanisms that explain adaptations and long run outcomes of the intervention and the context within which the mechanisms brought about the adaptations and outcomes.

3.7.3 Confirmatory phase

This involved assessment of the explanatory power of the mechanisms generated in the previous phase. The epistemic interest was to ensure that the mechanisms identified explain adaptations and outcomes of the intervention and the context within which this occurred. Mechanisms should be assessed to ensure that they offer the strongest explanatory power based on the empirical evidence gathered (Sayer, 2000). To achieve this, I went through the data and confirmed whether the mechanisms identified explain the evidence in the data. Because there are many mechanisms in an open system, the aim of analysis is not to find as many mechanisms as possible but to identify key mechanisms that explain the phenomenon under investigation. This would be the mechanism with the strongest explanatory power related to the empirical evidence and explains best the events observed (Sayer, 2010). A proposed mechanism should be treated as a candidate explanation, and the data collection and analysis should be repeated until closure is reached

(Bygstad & Munkvold, 2011). Thus, the research process was an iteration involving extracting data from documents and use of the descriptive themes to infer mechanisms then to documents, and back to the interviews to test and refine the mechanisms to ensure that they explain adaptations and outcomes of the intervention.

3.8 Conclusion

In research, methodology includes a research paradigm. Articulation of a research paradigm within which a study is anchored is crucial and provides guidelines on the methodology for that study. Realism provides appropriate methodological guidelines for this thesis, focusing on mechanisms that explain observed events. Through intensive research methods involving in depth interviews with farmers and project officers and review of documents, relevant data were gathered. Intensive methods are useful and appropriate in the identification of mechanisms that explain adaptations and outcomes. This is through the rich and detailed data that was gathered through this method particularly in postulating mechanisms with reference to the reasoning and actions of actors in response to interventions.

By employing realist analytical techniques, in this chapter, I have identified five mechanisms, namely effectiveness, matching, fit, resistance and the diminishing effect that explain adaptation of the NDDP and its long run outcomes. I have shown that effectiveness and matching mechanisms that explain adaptation of the intervention by project officers were underlined by the incentives that they received, project budgetary constraints and continuity pressures. Further, due to the benefits that farmers expected to gain in terms of increased income from milk sales and milk for family consumption, prestige, and heir awareness of costs and benefits of implementing the components of zero grazing, farmers adapted the intervention to fit their context or resisted some of its components. Farmers were motivated by the social and economic benefits of the intervention but due to contextual factors that constrained implementation, they adapted various components of zero grazing. I have identified two long run outcomes of the NDDP as coexistence of modern and indigenous dairy technologies and non-implementation of any dairy technologies. With close reference to context, I employ the diminishing effect mechanism to explain how and why in the long run, intensification of dairy cattle management diminished.

CHAPTER FOUR

The National Dairy Development Project

4.1 Introduction

This chapter explains the background of the NDDP in terms of its establishment, objectives and the rationale of its initiation, which reveals the problems that the developers wanted to solve. In this chapter, I describe the components of zero grazing, an intensive dairy cattle management intervention. Another section looks at extension, the strategy that developers used to promote the zero grazing among farmers and the “seeing is believing” and “capacitation” mechanisms, which reveals its theory of change. As it will become evident in this chapter, by failing to incorporate the entire context of farmers who were to implement it, developers decontextualized NDDP and designed it as a standardised intervention that farmers in different high potential areas were to implement. In the last section, I explain how although the project officers thought that farmers would unambiguously interpret the NDDP, farmers interpreted it in multiple ways.

4.2 Establishment, organisation and objectives of the NDDP

The NDDP, named the Dairy Development Project (DDP) until 1986, was initiated in January 1980 as collaboration by the Kenyan and Dutch governments and wound up in 1995 (Ministry of Livestock, Development and Marketing [MLDM], 1986). The NDDP was based at the Ministry of Agriculture Livestock Development, and Marketing (MALDM) headquarters in Nairobi. Within MALDM, it was based at the Animal Production Division, department of Livestock Production at the Dairy and Beef branch. The project staff consisted of Dutch and Kenyan nationals. A Kenyan manager and a Dutch (expatriate) team leader collaboratively coordinated the intervention from its headquarters. At the level of districts, the District Agricultural Officer (Kenyan) who was advised by a Dutch expatriate staff member managed the intervention activities. Kenyan technical assistants usually referred to as extension officers based at divisions did extension activities of the intervention. The NDDP also had a Dutch agricultural economist who was based at the research station in Naivasha. As already stated, the Dutch and Kenyan governments jointly funded the NDDP although the Dutch governments agreed to contribute a

higher percentage of the funds and provide technical support, as part of its contribution to development efforts in the country. The monetary contribution by the Kenyan and Dutch governments is shown in Table 4.

Table 4 Budgetary allocation for the NDDP (KSh)

Contribution	Kenya	Netherlands	Total
1984	3,224,720	10,939,815	14,164,535
1985	3,563,800	11,932,840	15,496,640
1986	3,783,320	12,065,920	15,849,240
1987	2,217,820	22,199,450	24,417,270
1988	2,329,140	15,256,150	17,585,290
1989	2,552,880	16,020,550	18,573,430
1990	2,681,360	13,536,250	16,217,610
1991	6,640,000	41,728,500	48,368,500
1992	7,640,000	44,023,500	51,663,500
1993	9,080,000	43,753,500	52,833,500
1994	10,880,000	34,776,000	45,656,000
Total	54,593,040	266,232,475	320,825,515

Source: Compiled from MLDM, 1990; MLD, 1986; Woersem et al., 1986

Table 4 shows that the amount allocated to the project varied during each phase. Notable is that the proportion of contribution from the Kenyan government increased while that from the Dutch government decreased during the fifth phase. For example, in 1991, the Kenyan government contributed 13.73% of the project budget compared to 23.83% in 1994. This was part of the agreement by the two governments to prepare the Kenyan government to take over the funding of the project when the collaboration ended in 1995.

Analysis of project documents shows that the DDP aimed “To contribute to meet the nationwide demand for milk by introducing improved intensive dairy management practices on smallholder farms in high potential areas” (Ministry of Livestock Development [MLD], 1990, p. 15). The objectives of the NDDP were to “improve dairy management practices on mixed smallholder farms in a number of high potential areas, assist in the practical training of extension staff, execute applied research on fodder production, conservation and utilization and transfer these research findings to the extension staff and farmers” (Woersem, Mosi, Bootsma & Mwangi,

1986, p. 5). Documents show that these objectives did not change between 1980 and 1990. However, in addition to these objectives, during phase three (1987-1990), as part of its objectives, the NDDP focused on integration of its activities to government extension, expansion of its activities, group formation and addition of new elements to zero grazing (Woersem et al., 1986, pp. 18-19). Further, during the last phase (1990-1994), NDDP focused on sustainability of project activities, collaboration with other agencies and research on the impact of dairy improvement (MLD, 1990). In the long-term, implementation of the NDDP was expected to lead to “self-sufficiency in dairy products, contribute to a balanced diet, increase employment opportunities in the rural areas, increase the family income of poor small-scale farmers, strengthen governmental extension services, and to realise sustainable high output per acre of scarce land” (MLD, 1990, p. 15). Notably, although the NDDP was planned to cover two phases of two years each and therefore end in 1983, an evaluation mission in 1983 recommended extension of the project for another three years until December 1986 (Woersem et al., 1986, p. 2). This was because the farmers required more guidance in implementation of the components of zero grazing and they had not acquired adequate skills and knowledge during the previous phases. In 1986, the project was further extended up to 1994. The major activities during each of the five phases of the intervention are discussed below (See a summary of main activities in Appendix 2).

4.2.1 Phase one, orientation (1980-1981)

During this phase, project personnel were recruited with a team leader in Nairobi and six Dutch officers in each of the six districts where its activities were initiated. Another officer was stationed in Naivasha for monitoring (MLDM, 1986). The project staff identified hindrances to dairy improvement in smallholder farms one of which was shortage of land. Consequently, zero grazing, an intensive method of dairy cattle management was conceptualised as a means to increase land productivity (Woersem et al., 1986). Extension as the strategy to promote the technical components for zero grazing was designed and a system to monitor project activities was developed (MLD, 1990). Thereafter, activities of the intervention commenced in demonstration farms in each of the six districts, namely Kilifi, Kiambu, Meru, Kericho, Kakamega, and South Nyanza (Woersem et al., 1986). Initial activities were advising farmers on good animal husbandry practices based on the NDDP technical package (van Helden, 1980a).

4.2.2 Phase two, introduction (1982-1983)

The project expanded into another district, Taita Taveta and a research unit for the intervention was established in Naivasha. Project officers established bulking plots for Napier grass to enable farmers to obtain Napier grass planting materials easily (MLD, 1990). The project held workshops and field days during which extension officers trained and advised farmers how to implement the technical package for zero grazing (MLDM, 1986). NDDP established a grant through which demonstration farmers were supported to start implementation of the zero grazing components. The team leaders started discussions with the Agricultural Finance Corporation (AFC) to establish a credit scheme to enable farmers implement the project. The project reached 553 farmers by end of this phase (MLD, 1990).

4.2.3 Phase three, consolidation (1984-1986)

The focus during this stage was for farmers to acquire knowledge, skills and experience in areas like maintenance of soil fertility in Napier grass fields and estimation of adequate concentrates for their dairy cattle. This was seen as a means to maintain implementation of the components for a longer period. Project officers thought that use of inputs like fertilizers and concentrates, which were essential to keep the zero grazing system viable on the long run, required experience. Training and advice especially on fertilization of Napier grass was based on recommendations from the research station which had conducted field trials (Panafcon Development Consultants [PDC], 1994, p. 59). Extension officers utilised resource materials, which included pamphlets and booklets with information of the various components of zero grazing, and some were distributed to farmers who attended field days, training and agricultural shows. During this phase, active recruitment of new farmers was stopped because of staff shortage and limited finances for extension officers to reach all project farmers (MLDM, 1986). The project grant scheme was stopped but the team leaders continued to negotiate with AFC to provide credit to farmers (MLD, 1990). Due to encouragement by project officers, farmers started to form self-help groups and zero grazing clubs. When this phase ended, the project had 2020 farmers (Woersem et al., 1986).

4.2.4 Phase four, expansion (1987-1990)

Project activities were intensified in the initial six districts and the project expanded into another seven districts, namely Kwale, Embu, Kirinyaga, Muranga, Nandi, Kisii and Siaya. To facilitate expansion, in 1987, the role of the Dutch experts who were district dairy officers changed from coordinators to regional advisors. Focus shifted from extension farmers to well-performing farmers. Well-performing farmers were those who extension officers deemed to have implemented components of the zero grazing technical package excellently and the officers chose to use them as extension points. The research station produced more resource materials for extension in the form of stickers, posters and video on various aspects of zero grazing like clean milk production, calf rearing, fodder establishment and management and judging of cattle.

Because team leaders failed to make headway in discussions with the AFC to provide credit to farmers, the whole idea was discontinued (MLD, 1990). Following a meeting with NGOs in May 1990, NDDP started to work with NGOs and other organisations that were involved in similar activities especially at the district level. “When this phase ended extension was being provided to 4500 farmers and about 200 farmer groups” (MLD, 1990, p. 9). Based on the recommendations of an evaluation of the project in 1994, the project was extended for four years.

4.2.5 Phase five, integration (1991-1994)

The focus of this phase was sustainability of project activities and integration of its activities back into the extension system of the MoA. The keen interest on sustainability arose from the 1990 evaluation, which was concerned with what would happen to project activities when the intervention ended (MLD, 1990). The several dimensions of sustainability that were emphasised were institutional, socio-cultural and financial. To achieve this, decision-making was decentralised to the district level and farmer groups were strengthened, training and extension were standardised, and the government started to gradually take over financial responsibilities of the project (MLD, 1990). Decision-making to districts was viewed as a change to bottom-up plan preparation unlike the previous phases when plans were prepared by the head office in Nairobi (MALDM, 1994).

During this phase, the project expanded into another 15 districts. The project also started to focus on the role of women in zero grazing and gender in extension after which a gender desk was established in 1992 (MALDM, 1994). The discussion and focus on gender in the zero grazing intervention was driven by donors (Bauman, 1994). In January 1992, the position of the research officer was abolished when all research activities were taken over by KARI. As shown in Table 5, the number of registered farmers increased such that in 1994, the intervention was operating in 27 districts and the project had 7,800 registered farmers (MALDM, 1994).

Table 5 Registered farmers per district

District	1983	1986	1992	1994
Kakamega	117	247	374	-
S. Nyanza	52	231	601	-
Kiambu	249	401	1153	-
Meru	208	271	751	-
Kilifi	35	89	205	-
Taita	16	31	213	-
Kericho	104	248	341	-
Vihiga			521	-
Bomet			376	-
Embu			190	-
Kirinyaga			175	-
Kisii			293	-
Kwale			54	-
Muranga			270	-
Nandi			201	-
Nyamira			298	-
Siaya			130	-
Nyeri			111	-
Lamu			10	-
Nakuru			40	-
Nyandarua			12	-
Baringo			31	-
Total	781		6350	7,800

Source: Compiled from various NDDP documents

In addition to registered farmers, other farmers were categorised as recruited and interested. It would appear that the number of farmers who were reached by the project remains unclear (PDC, 1994) despite the compilation from various sources shown in Table 5 above. The number of farmers in some districts as shown in district reports differs from the number of farmers shown in the national reports for that district over the same period. Because the site for this study was Kakamega district, in Table 6, I show the number of farmers who were involved in the project over time categorised as registered, recruited or interested.

Table 6 Farmers who were participated in the NDDP in Kakamega district

Month/Year	Number of farmers				
	Demonstration	Registered	Recruited	Interested	Total
October 1980	9	-	-	-	9
April 1981	15	-	-	-	15
Aug. 1982		-	-	-	59
Aug. 1983		84	43	47	174
April 1984		124	64	60	248
Dec. 1984		156	74	177	407
Dec. 1985		235	79	165	479
July 1987		382	142	142	666
Dec. 1990		680	-	-	680
Dec. 1992		418	116	130	664

Source: Compiled from Kakamega district dairy records and other NDDP reports, various years

From Table 6, in 1980 and 1981, the project started by recruitment of demonstration farmers, which was consistent with NDDP's strategy to provide support to few farmers from whom other farmers could learn. Thereafter, the number of farmers who were involved in NDDP in the district increased and seems to have reached the peak at the start of the fifth phase in 1990. The decline towards the end of the project is evidence that some farmers were no longer implementing the technologies that were promoted by the project.

When phase five ended in 1994, there were calls for the project to be continued. In the handing over report in 1994, the outgoing team leader recommended that the project be continued for another five years up to 1999 (Bauman, 1994). Similarly, evaluators of the project in 1994 suggested continued support to project activities because intensive agricultural practices were still

relevant among farmers (MALDM, 1994). Further, during the 1994 senior staff seminar, the Provincial Commissioner (PC) for Rift Valley province who was the chief guest stated, “I am told that the current project phase is coming to an end in December this year...We in Rift Valley province, however, would want the project extended and also expanded to cover more districts” (Chellanga, 1994, pp. 201-202). However, the proposal for project continuation was declined. Instead, financial support was granted for one year (1995) for smooth integration of project extension back into government extension. By July 1995, NDDP activities had been merged into a new government extension project the National Livestock Extension Programme (NLEP).

4.3 Rationale for initiation of the DDP

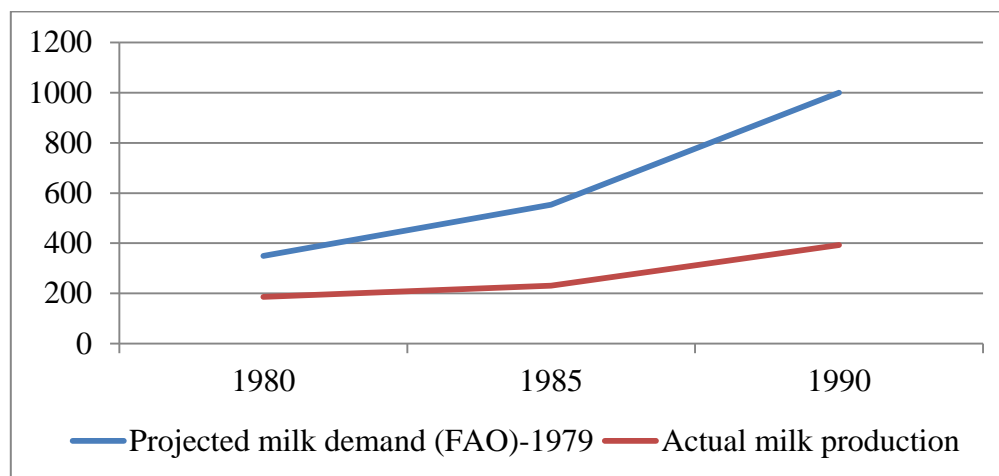
Developers justified initiation of the NDDP on land scarcity due to population pressure, the expected increase in the demand for dairy products and generate income for farmers from milk sales (MLD, 1990; Woersem et al., 1986). Below, I discuss each of these reasons.

4.3.2 Expected increase in demand for dairy products and income generation

The other justification of the NDDP was to meet the demand for milk that was expected to increase by training farmers on good research based animal husbandry practices (Woersem et al., 1986). Proceedings of the 1993 senior staff seminar on sustainability of the NDDP activities reiterated that the intervention “... has always strived to improve milk production in the country through intensification of dairy farming in the smallholder sector in the high potential parts of Kenya” (Muriuki & Wokabi, 1993, p. i). This was also emphasised in 1994 when the director of Livestock Development said, “the dairy sector is expected to contribute towards the national objectives of broad self-sufficiency in supplies of milk” (Wachira, 1994, p. 1). At the time NDDP was initiated, the widely held view was that milk demand was higher than production and that it would increase due to population growth and increase in milk consumption by people in rural areas (Woersem *et al.*, 1986; MLD, 1990; MLDM, 1986). A 1979 Food and Agricultural Organisation (FAO) study cited in the implementation document (MLDM, 1986) projected the demand for milk to increase to 350 million litres in 1990 from one hundred million litres in 1980. This was due to high population increase of four percent per year, implementation of the school

milk programmeⁱⁱⁱ in 1979 and increase in milk consumption in rural areas. Figure 7 shows the 1979, FAO projected milk demand and the actual milk production.

Figure 7 Projected demand and actual milk production (Million litres)



Source: FAO (1979) cited in MLDM (1986); Kenya Statistical Abstracts, various years

From Figure 7, although milk demand which was projected to be higher than milk production turned out to be correct, there are doubts about the accuracy of milk demand and production estimates in Kenya. The widely held view is that of an unmet milk demand which is the position articulated the first and second Kenya Dairy Master Plans (MLD, 1991a; 2010). Estimates of milk production and demand are based on average yield production per cow and average per capita milk consumption respectively (FAO, 2005; Karanja, 2003; MLD, 2010). As a result, projections of unmet milk demand are based on the view that the population is growing and that increase in average incomes would lead to increase in per capita milk demand. For example, the second DMP stated, “The 2009 Kenya population is 38.6 million people and is estimated to hit 58 million in the next 20 years. The current per capita milk consumption is estimated at 110 litres, which is projected to increase to 220 litres by 2030 ...” (MLD, 2010, p. ix).

However, the view that there is an unmet milk demand in Kenya is not generally agreed upon. This is because of difficulties in estimation of milk production and demand due to lack of reliable

ⁱⁱⁱ Under this programme, the government intended to regularly distribute milk to all primary school going children for free as a way to improve their nutrition, improve enrolment and to maintain school completion rates.

data on key determinants like cattle population, herd growth, and income elasticity of milk (Karanja, 2003). For example, although estimates are based on the average yield of 1300lt/cow/year, yields in all production systems are higher than this and range between 1500lt/cow/year to 3000lt/cow/year (Karanja, 2003; Omore et al., 1999). A study by the SDP in 2005 also found that cattle numbers have been underestimated due to the methods used and lack of a cattle census and that this had implications on estimates of milk production and consumption (SDP, 2005). The last cattle census was done in 1988 and since then cattle numbers used to determine levels of milk production and demand are estimates (Omore et al., 1999). As a result, “There is therefore [cause] to belief that milk production in the country is higher than reported in official statistics. This may explain the observation shared by many in the dairy industry that the country is increasingly faced by milk glut situations” (Karanja, 2003, p. 5). Furthermore, “Milk demand is estimated to remain below production up to the year 2008” (Karanja, 2003, p. 6). Similarly, in 2002, FAO (2005a) cited in FAO (2005b, p. 11) estimated that milk production was higher than consumption during that year. The conflicting milk consumption and production figures has also been noted by Muriuki (2011, p. 11) who argued, “There are conflicting projections of the likely future of milk supply and demand in Kenya. Some predict a possible surplus that allows exportation, while others predict a deficit”. Overall, the projections which show milk demand to be higher than production are based on the view that population growth and economic growth will fuel demand for milk. However, in 2009, the KNBS produced livestock numbers based on a Population and Housing Census, although some have suggested that these numbers needs to be corroborated with a livestock census. As justification for initiation of the NDDP, it is not entirely clear that farmers had problems with milk production that the intervention was to address through intensive management of dairy cattle management.

Related to increase in milk production to meet increasing demand was the increase in milk production in smallholder farms as a means to generate self-employment and income through increase in household incomes through milk sales (MLDM, 1986). Concerns over low incomes low income among subsistence farmers were already evident in the National Development Plan 1979-1983. The Plan noted that:

The integrated rural survey of 1977 disclosed that 41% of families engaged in smallholder agriculture, a group that represented about 80% of Kenya's total population had incomes including subsistence production of less than KShs. 2000 per family in the year 1974/75. Another 14% of those families had incomes in the range of KShs. 2000-3000 per family. Incomes of even that order of magnitude are not sufficient to provide more than the basic necessities of life. Clearly, the Plan must focus much of its effort on increasing the incomes of smallholder families. (RoK, 1979, pp. 10-11)

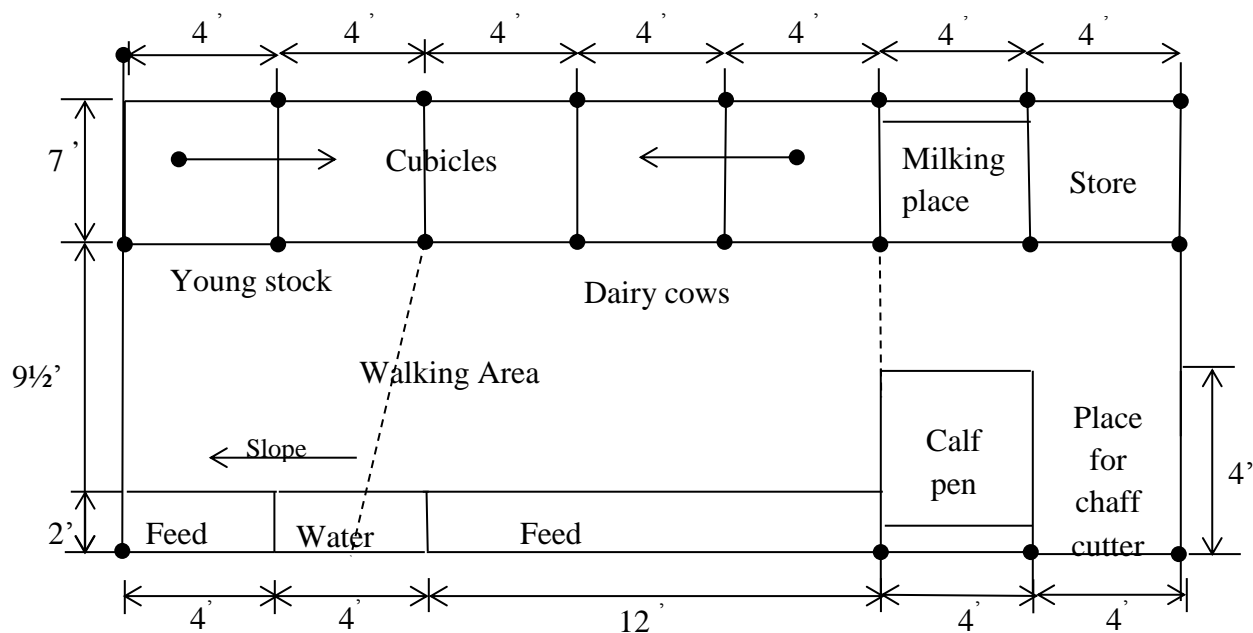
Because as the NDDP implementation document shows that milk contributed to employment creation, implementation of the NDDP was seen as a means to "... absorb the large labour force entering the market" (Woersem *et al.*, 1986, p. 1). In 1994, a senior staff seminar was held to discuss *Feeds and Feeding for Increased Milk Production* due to realisation that farmers produced lower milk due to inadequate feeding. One of the dairy officers who presented a paper during a senior staff seminar in 1994 stated, "It has been pointed out that thousands of smallholders depend on milk sales as one of their main source of income. Most of these smallholder units represent the rural male and female farmers" (Wachira, 1994, p. 2). Therefore, as already explained, the justification of NDDP to increase incomes and generate employment among smallholder farmers in rural areas reflected the context of the farmers at that time.

4.4 The components of zero grazing

The NDDP involved intensive dairy cattle management through introduction of a technical package for zero grazing. Project documents show that the technical package consisted of several components for intensive dairy cattle management, which farmers were, expected to implement (MLDM, 1986). These components were "housing of dairy cattle in zero grazing units (stables), Napier grass management, calf rearing, fertility, feeding, fodder conservation, clean milk production and group formation" (Bauman, 1993, p. 15). Central to zero grazing was acquisition of improved dairy cattle. Below, I discuss each of these components.

The first component was construction of a zero grazing unit. Zero grazing involved complete confinement and feeding of dairy cattle in a particular place like a zero grazing unit (Wouters, 1991, p. 1). The NDDP zero grazing unit was a cowshed with cubicles for calf rearing, milking, young stock rearing and a milking place (Figure 8).

Figure 8 NDDP zero grazing unit plan



Source: MLD (1991b, p. 10)

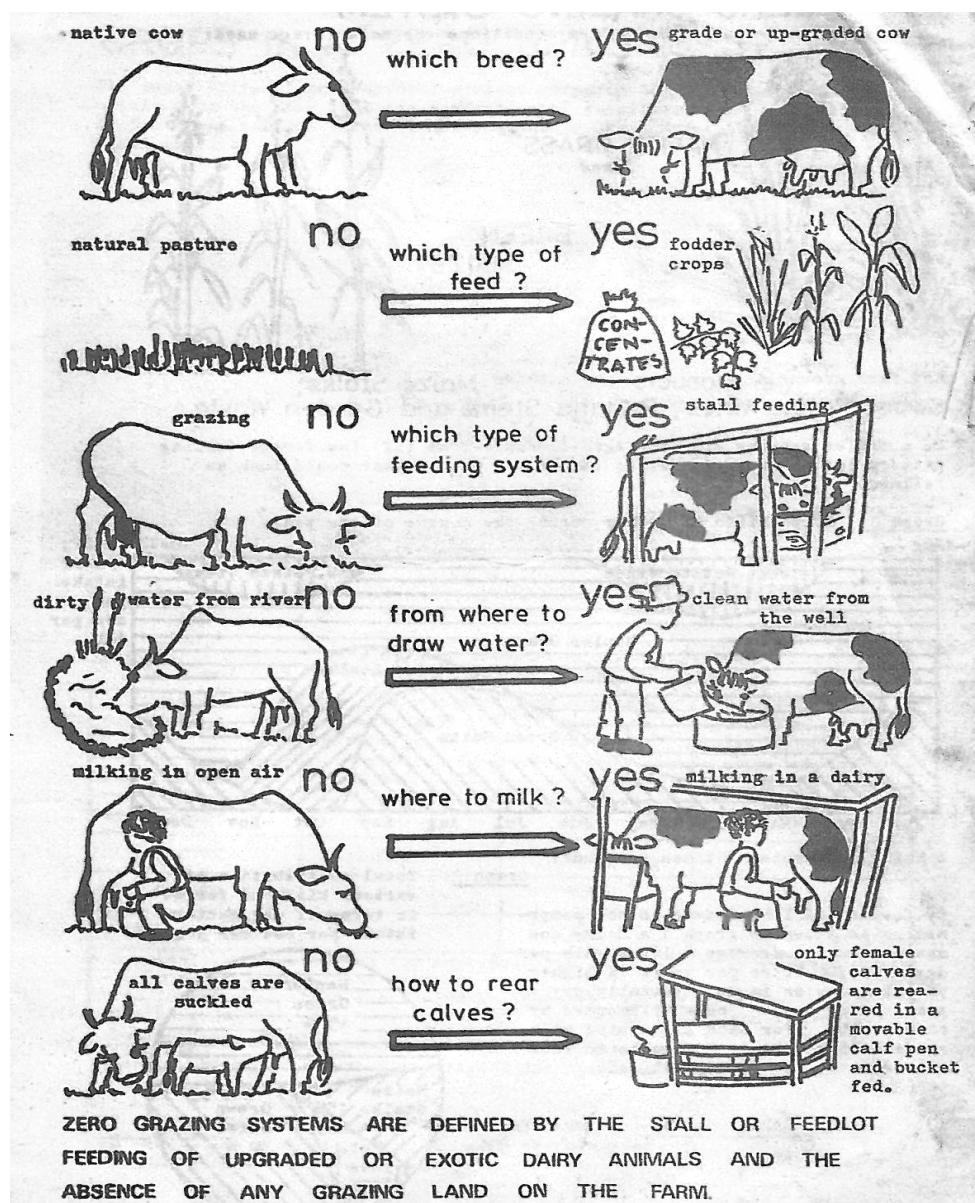
Farmers could include a store and a place for chopping fodder (MLD, 1991b). Zero grazing units were to benefit farmers through increased comfort to cattle, reduction in disease incidence, less fodder wastage, better observation of cattle, clean milk production, more efficient manure collection and storage and higher security for their cattle (MLDM, 1990; 1991b). The second component, fodder management, focused on provision of sufficient quantity and quality fodder through the year. It also aimed at production of the highest yield per acre for energy and protein requirements and to maintain this yield over a long period. Napier grass was the main fodder (roughage) because it produces high dry matter of reasonable to good quality, it is very suitable for cutting and it remains green during the dry season (MLD, 1991b, p. 56). The third component was feeding whose aim was to obtain the most economic production. This is because the costs of the feed are large amount of the total milk production costs and dairy cattle kept under zero grazing conditions depend completely on what and how much the farmer feeds them. Feeding was to focus on nutritional requirements for dairy cattle including supplementing Napier grass and other roughages with minerals and concentrates, and provision of adequate water (MLD, 1991b; MLDM, 1986). The fourth component was calf rearing. Calf rearing was an important

aspect of dairy farming because “Today’s calf will be tomorrow’s cow” (MLD, 1991b: 15). The aim was to reduce calf mortality and to produce better breeding stock. Proper calf rearing focused on proper housing with slatted floor, good feeding schedule, bucket feeding of calves, calf pen and providing them with high quality fodder (MLDM, 1986). Fifth component was fertility management and good breeding where farmers were to acquire an improved dairy cow (at least 50% genes of pure bred) and to keep a tool fertility card to guide herd fertility (MLDM, 1986). A fertility card was designed and issued to farmers who were to record information for generation of annual fertility reports (MLD, 1990).

Lastly, were other management practices included clean milk production and record keeping (milk recording books, cow cards, milk-recording books and a fertility calendar) (MLDM, 1986). Production of clean milk was to safeguard against health risks through farm hygiene practices and proper milking, unit with a strong floor and dry resting areas to help prevent the spread of infectious diseases and clean milk utensils. Record keeping was important for efficient breeding especially by production records (MLD, 1990).

These components of the technical package for zero grazing were the means through which the project intended to change farmers’ dairy practices and technologies and thereby attain dairy improvement. Figure 9 below shows features of zero grazing which indicate how farmers’ practices were to change from previous practices. They may be viewed as modern dairy practices when contrasted to the practices of the farmers at that time. Through this thesis, I use modern dairy technologies to describe NDDP’s zero grazing components explained above and indigenous technologies to describe farmers’ dairy technologies and practices before initiation of the NDDP. In doing so, I acknowledge that the indigenous technologies were a culmination of changes that had occurred over a long time and incorporated practices that farmers had initially implemented based on their knowledge, imitation or learnt from government officials or other farmers.

Figure 9 Features of zero grazing systems



Source: MoA (1979, p. 1)

4.5 The NDDP extension strategy and inherent mechanisms

Project officers used extension to promote zero grazing among farmers. In the Kenya MoA, extension is “The process of disseminating new technologies and improved management practices to dairy farmers. However, in some programme areas the chief strategy is to introduce dairy cattle to the farmers and to convince them that it is possible to keep grade cattle in the

prevailing environment” (Skytta, 1993, p. 131). Project documents show that NDDP extension involved a series of steps (Bauman, 1993, p. 15). The first step was awareness creation during specific extension activities. Second was technical assistance to interested farmers through individual farm visits. Third, preparation of a farm liquidity budget form (farm plan). The fourth step was technical assistance to farmers. Lastly, extension involved training and advising farmers during workshops and field days and following them up after registration. However, like an officer interviewed stated, actual processes did not necessarily go as per the recommendations.

The first thing was calling the farmers in a meeting or in a demo, where there was a field day. During the field days, they were taught and then all those who would like or have found the enterprise to be good were asked to forward their names. Then, the extension worker, the divisional officer, was to take the initiative of visiting the farmer and to sit down with them. Mind you during that time, you were not just sitting with a farmer sometimes you can even call that farmer to a hotel or to a place where you can discuss that issue of dairy when you are taking a cup of tea or something like that. Then you make clear to the farmer all the requirements including accessing a loan from AFC and other financing institutions. During those old days, there was that opportunity of the farmer taking a seat with you in a hotel and then you discuss. Then you had to go to the ground and you start doing things on the ground. You know they had a feeling that when you happen to have something small together with a farmer, you enjoy together, you will be very close to that farmer will also have a feeling that he should not let you down. So, he will try as much as possible to implement what you tell him so that friendship could continue. Yeah, they had that feeling and I believe it played a very big role. (Author’s interview with Muriuki, 2012)

From this narration, the officer took own initiative to encourage farmers to join and implement the technical package. Extension officers used the zero grazing manual to guide them in their extension work. At various stages of extension, officers distributed information pamphlets covering various components of the technical package some of which were translated into Kiswahili to farmers. Extension officers also used a zero grazing film as a teaching aid to demonstrate implementation of the various components of the technical package like establishment and fertilization of Napier grass, proper milking, spraying cattle with acaricides, construction of zero grazing unit and good calf rearing practices.

In addition to extension, of interest to this research is the reasoning of developers about how extension was to bring about dairy improvement. In other words, what mechanisms were inherent

in the extension which reveals how developers expected the intervention to work to lead to intensive dairy cattle management? Through analysis of project documents and interviews conducted, I inferred that through extension, project officers wanted farmers to be convinced that it was possible to keep cattle dairy cattle in the area (“seeing is believing” mechanism) and improve their knowledge, information, skills, capabilities and competences on intensive management of dairy cattle (capacitation mechanism). Therefore, developers expected extension to bring about improved intensive dairy cattle management through seeing is believing and capacitation mechanisms.

4.5.1 “Seeing is believing” mechanism

By use of seeing is believing mechanism to as a way to understand NDDP extension, I mean that developers thought that farmers could become convinced that the components of zero grazing technical package were viable, embrace and start to implement them after they saw successful implementation of these components by demonstration farmers. Thematic synthesis of data gathered revealed that extension aimed to prove that intensive management of dairy cattle based on the modern technologies and practices was viable in the area and beneficial to those who practised it. This was based on the perception of the project officers that farmers’ cattle management practices and technologies were inappropriate in the context of small land sizes and that farmers were hesitant to use intensive methods. Through extension, extension officers were letting farmers know that their cattle breeds and animal husbandry practices were inappropriate and that there was a better alternative, that of keeping dairy cows under zero grazing system, which was viable and would yield better returns. These benefits were emphasised in a paper that was presented during a senior staff seminar in 1994. A project officer reiterated that implementation of the intervention was expected to give “... households’ access to milk, offspring, manure, sometimes biogas...” (van der Linden, 1994, p. 125). To achieve this, extension focused on demonstration, tours and farm visits. Interviews analysed revealed that developers expected farmers to join the DDP after they had seen demonstration farmers successfully keep dairy animals. In this respect, extension seems to have succeeded in creating interest among potential farmers. The district dairy report for Kakamega in May 1980 documented that after DDP’s participation in an agricultural show “Several farmers showed

interest in the zero grazing system and many more [were] asking for Napier grass cuttings” (van Helden, 1980e, p. 5). The role of demonstration was underscored by one of the project reports.

The successful registered farmers will have a major demonstration effect (and therefore an impact) on the surrounding farms. A proper introduction of zero grazing on a relatively limited number of farms is a prerequisite for a future spread of the message. Therefore, the NDDP strategy is based upon an intensive support to a relatively small number of farmers. Time and money invested in the registered farmers (early adopters) will really “pay-off” through the spread/diffusion of the zero-grazing message later on. (MALDM, 1994, p. 19)

This is similar to the DDP implementation document, which stated, “A limited number of project farmers do play an important role as extension and diffusion points for surrounding farmers” (Woersem et al., 1986, p. 5). Furthermore, as part of extension, during tours and visits to other farmers, agricultural shows and field days, dairy officers wanted the farmers to ‘see’ successful implementation of intensive dairy cattle farming and learn how to implement zero grazing from the experience of other farmers. For example, the district dairy reports for Kakamega district document how dairy and extension officers used the Kakamega agricultural trade fair for extension purposes. During the show, in 1980, NDDP constructed two zero grazing units on the ground where the show is held explained details of zero grazing those who attended. In 1981, officers prepared silage and stored it in a pit, and the zero grazing unit was modified to include a calf pen and biogas unit (van Helden, 1981a). In 1982, officers demonstrated silage preparation and distributed leaflets to interested participants. In 1983, officers demonstrated feeding animals on Napier silage, which left participants very surprised (van Helden, 1984a). Moreover, field days were to convince farmers that exotic dairy cattle could be kept in the area using intensive methods. An officer interviewed reported that during a field day,

We could demonstrate on spraying for tick control, how you can spray your animals well to avoid tick-borne diseases or demonstrating how you can plant high yielding grasses, practically. That is practically, how you can put up a crush for spraying the animal, those kinds of things. They are called demonstrations, so we could hold those demonstrations on a willing farmer and others come then we train from the site. (Author’s interview with Maina, 20212)

The third evaluation mission of the project noted that demonstration, as a method of extension was quite effective among registered and recruited farmers (Woersem et al., 1986, p. 14). It

was also pointed out “Demonstrations are envisaged to stimulate farmers to try-out innovations themselves. These include both results demonstrations ([for example] utilization of manure or fertilizers) and method demonstrations where a technique is shown ([for example] spraying of animals for tick control)” (Skytta, 1993, p. 132). Analysis of project documents shows that demonstration of actual implementation of the various components of zero grazing was utilised during workshops, field days and *barazas* (public meetings). Common to all these project activities and central to this mechanism was that project officers wanted farmers to “see” for themselves how actual implementation of the zero grazing components took place in the area as a means of convincing them that zero grazing was a better alternative. A farmer who joined the project became convinced that keeping dairy cattle was beneficial and continued to keep dairy cattle based on the benefit explained as shown below. In this case the farmer resolved to keep dairy cows and not to keep indigenous ones when the first dairy cow he kept produced a lot of milk. Because of high milk production, he was convinced of the viability of dairy cattle, which made him to continue to keep dairy cattle. The result of this was that the farmer was convinced of dairy cattle farming.

My mother was still alive when I bought that cow. When it calved, I went and milked it and put the milk in a big cooking pot like this (gestures the size). I milked and asked her to carry the milk. She was surprised. She had never seen a cow produce so much milk like this. Is this milk or water? She carried the milk and took it to the house exclaiming is this milk or water! Yet she was seeing that it was milk. This shows that she was very happy with a grade cow which had good output. I learnt that a dairy cow is good. My mother was very surprised whether this is milk or water. Yet she was seeing that the colour resembled that of milk and she had seen me milking and not any other person had milked. My mother’s happiness encouraged me to continue keeping dairy cows. Because she had never seen something like that from birth and she had never seen so much milk like that day. I sold milk in this entire area. Some people with bad attitude say that the cows will die. That it is a loss keeping these cows. I heard all that but it did not discourage me. Until this minute, I decided I will keep dairy cows whether it dies or it remains alive. But will never keep an indigenous cow. I decided that I will keep only dairy cows throughout my life because I saw how my mother behaved when she carried the milk in a cooking pot and took it to the house. In addition, she was surprised what it was. It encouraged me. (Author’s interview with Shiemi, 2013)⁵

4.5.2 Capacitation mechanism

By use of capacitation mechanism, I mean that farmers started implementing zero grazing components when they became competent through acquisition of information, knowledge and skills about the NDDP intensive dairy cattle management. This derived from the developers' view that prior to NDDP, farmers' dairy technologies and practices were inappropriate and they needed different sorts of competences for successful implementation of the zero grazing technical package. Analysis of the data gathered revealed that developers had the following views of farmers' practices and technologies prior to the DDP. First, feeding was not systematic and was geared towards merely feeding cattle rather than nourishment based on adequate nutritional requirements. Second, although Napier grass was already being grown, it was not managed as a fodder crop. Three, cattle were fed on poor yielding forage and farmers hardly planted fodder. Four, adequate feeding of animals was a challenge during dry season. An officer who was interviewed described dairy cattle farming before NDDP as follows:

Farmers used their own skills on dairy production. So they were just feeding them without taking care of nutrition part of it, proper nutrition and they did not have a particular way of milking. Very good way of milking was not also there and people were also not very much keeping time for milking. So then one person would milk at five in the morning, the other one would milk at eight in the morning. So, it was a mix up kind of thing. The other thing is that they did not know is the right type of animal to give them more milk. So they were just keeping, it was more of prestige. The more animals you have the better, the richer or better off you are than the other person but they were not looking at the production aspect. They are actually using the animals for ploughing and even the manure was just being lost. You see, with our African traditions is that you must have at least a local animal. Even if you try to tell him that you can sell this animal and replace with a grade animal, they would not agree with that. So, they would still keep the local animal besides the grade one. They say that, okay, my son will be getting a wife and I have to take this one to them or this one was given to me by the money for my daughter, a reward for my daughter, dowry. Another thing is that they used calves to stimulate milk production. But by just going to suckle you might not know the amount that it is suckling. So, they were allowing the calf to suckle and then tied next to the mother. What they used to do, sometimes they do not milk one teat, so they leave for the calf to just suckle that. Of course, after knowing that this one produces so much, so they estimate before leaving for the calf to suckle. You see, you find also poorly managed animals, so poorly managed animals. Therefore, some farmers would cut Napier grass and pace it on the ground and so on. The animals were trampling on them and soiling them with the urine and dung. Therefore, they were going at a loss. (Author's interview with Odhiambo, 2012)

Project officers were expected to enhance the capacity of farmers both to understand the components of zero grazing and to acquire skills on how to successfully implement those components. In the context of extension, which involved advice and training, an officer described his role as follows:

My role was to educate the farmers, demonstrate activities like fodder production, clean milk production and teach them about the breeding system so that they can leave the old, that old way of inbreeding and go to the modern one using the AI services. Because the AI services were also available but they were not ready to use. They were saying that animals when served with AI will just die in fact there was that traditional belief that AI was meant to remove all their animals so they become poor. So we were at the same time trying to campaign for the AI services, the use of AI services. (Author's interview with Murikuki, 2012)

Further, the developers believed in the ability of the technical package, which they viewed superior, to bring about dairy improvement. In response to why he thought the technical package would succeed, a dairy extension officer who was involved in the project said:

The technical package was appropriate in that when we applied it, it was giving better outcome. So like feeding for example, we told them this type of feed can give this amount of milk before the supplement and when you add this one on top of it, it will give you this amount of milk on top of it. So, you see it was actually bringing a lot of success. It was giving manure to the farmers, it was giving income to the farmer, because the production was now increased and disease aspects were lowered. So, it had a lot of benefits to the farmers that's why we say that it was, it was really good and the packages were relevant. (Author's interview with Odhiambo, 2012)

Project officers' assumption that their technology was superior compared to that of farmers' which they intended to change is similar to sentiments by Scott (1998) on the colonial agricultural improvement in Tanzania.

The premise was that the practices of African cultivators and pastoralists were backward, unscientific, inefficient and ecologically irresponsible. Only close supervision, training, and, if need be, coercion by specialists in scientific agriculture could bring them and their practices in line with a modern Tanzania. They were the problem to which the agricultural experts were the solution. (Scott, 1998, p. 241)

Although in this study, there is no evidence that developers used coercion, the NDDP intervention was based on the idea that practices and technologies of farmers were inappropriate and that farmers need to change through training and advice. As it will become evident in the subsequent section, the problem of developers' believe that their intervention consists of superior components is that they fail to acknowledge the context in which farmers' practices implemented. This brings about a mismatch between the components of an intervention and the context in which it is to be implemented. Relatedly, the dairy officers who were involved in the project thought that before NDDP, farmers were not managing dairy as an enterprise. They therefore thought that farmers were not making profits from cattle and that knowledge and skills on how to transform cattle farming and manage it to generate higher returns was important. In relation to this, an officer interviewed stated:

I think at that time, farmers never saw it as an economic enterprise. Because you find as I told you the cow just tied to the tree, the calf is somewhere neglected. They do not treasure the calf. Calf mortality was very high and production per cow was very low and management was not like you say this cow actually is a business that I am having, you know. So, they had no fodder crops, they were growing just maize in some areas, they have tea, other areas coffee. What can you say! Their management was just haphazard. So what if it is drought. *Wanaambia ngombe pole, hakuna chakula leo* (they say to the cow, there is no fodder today). (Author's interview with Helder, 2012)

Therefore, extension involved training and advising farmers on various aspects of dairy cattle farming during farm visits, workshops, field days, tours and trips and demonstrations. Through extension, farmers were expected to acquire knowledge, skills, information and competences on dairy farming and to start implementation of the technical package. In 1986, "The Mission discovered in the field tour that farmers who attended these courses feel that they benefited and were able to apply practically the knowledge they gained" (Woersem et al., 1986, p. 14). In addition, the revised technical manual for zero grazing pointed out "Applying zero grazing means that the animals depend completely on the farmer concerning the amount and quality of the feed. Therefore, sufficient knowledge and skill by the farmer on how to feed the animal in the correct way will be needed" (MLD, 1991b, p. 1). During a senior staff seminar in 1993, a project officer said "The educational aspect is the most important element in the programme. Apart from the regular extension education the strategy focuses on organizing training courses at FTC's and

arranging field days and on-farm demonstrations on various topics” (Skytta, 1993, p. 132). To achieve this, developers organised seminars and workshops to train farmers on zero grazing components. Further, NDDP used diverse media and approaches including videos during training. During interviews, farmers revealed that they believed that training on the zero grazing components was essential for successful dairy farming. A farmer interviewed said:

Many people laughed at me while others just looked at me. One needs to be trained before starting to keep dairy cattle. You are required to follow their guidelines before you starting to keep grade cattle. You know, other just buy dairy cattle. You cannot keep dairy cattle just like that. You must be trained. You need to know their fodder, where they are kept and their water requirements. But if you just wake up and start to keep dairy cattle, you cannot. Dairy cattle should not lack fodder and water. Dairy cattle should sleep in a clean place. You need to keep its sleeping place clean. (Author’s interview with Nyukiri, 2012)⁶

This should not be interpreted to mean that farmers always implemented components of zero grazing according to the information and knowledge they received during seminars and workshops. For example, a farmer who found some of the information from the training contrary to his dairy practices reported:

We did not adhere to killing bull calf but did it in our own way. During training, they told us to kill bull calves. We decided not to do so. If the calf is alive and good, why kill it? We kept it and sold it alive to anyone who needed it. I can say we did the opposite of what they told us. (Author’s interview with Mugonyi, 2012)⁷

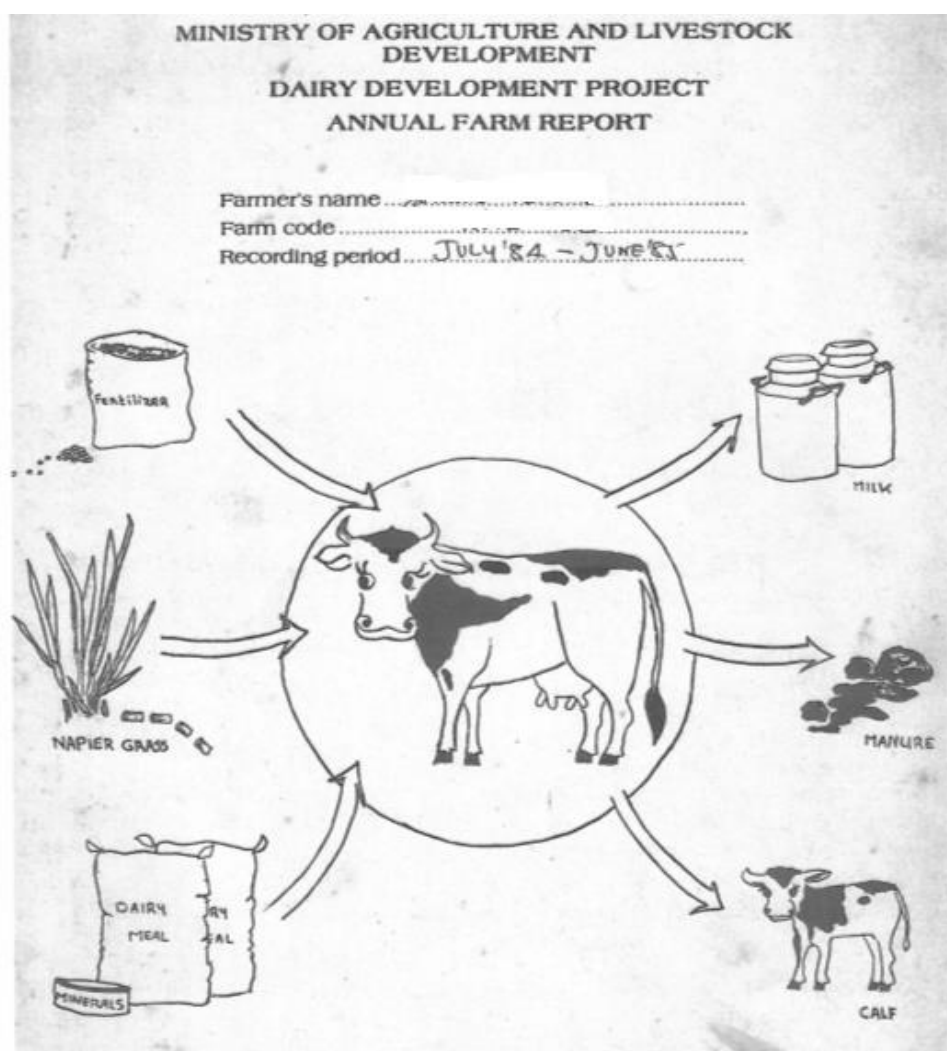
Overall, developers thought that through extension which involved training and advising farmers, and use of demonstration farmers for peer support, inherent in which were seeing is believing and capacitation mechanisms, farmers would start implementation of zero grazing. However, by failing to take into consideration the diverse context of farmers who were to implement it, developers conceived NDDP as a standardised intervention.

4.6 Standardised dairy intervention

The NDDP was a standardised intervention for dairy improvement because farmers in different high potential areas were expected to implement same components and developers assumed that they would all benefit from the intervention. Figure 10 below shows an annual farm report that

NDDP used to collect information from farmers about the progress in implementation of the zero grazing components. This can be interpreted to mean that farmers regardless of their context were to acquire an improved dairy cow, feed it on Napier grass maintained through fertilizer application and supplement feeding with concentrates like dairy meal and minerals. In turn, the improved dairy cow was to produce, manure and a calf, all of which were expected to benefit project farmers.

Figure 10 Standardised inputs and outputs of the NDDP



Source: NDDP Annual farm report for Alwanga, July 1984-June 1985

Related to this was how the technical hand out for zero grazing which extension officers used as a guide in their work described the benefits of the intervention. The technical manual indicted that the intervention was to be beneficial to farmers who had small pieces of land especially in highly populated areas because it would help them to increase productivity of their land (Wouters, 1991). The manual further stated that implementation of zero grazing would enhance reduction of fodder wastage compared to when farmers placed fodder on the ground under previous farming practices and that farmers would benefit from the cultivation of high yielding fodder especially Napier grass, which would ease their fodder shortage. The intended benefits above were similar to those that were stated by the MoA in a manual for Dairy Farm Management Service prepared in August 1977 for small-scale dairy farmers located in high potential areas. These were:

Zero grazing is a means to higher milk production per unit of land.

Zero grazing absorbs abundant farm labour and provided better pay for more people and families.

Zero grazing raises the land productivity, releases pressure on land and leaves more land for growing cash crops.

Zero grazing means more milk for home consumption and for sale.

Zero grazing means an equal milk production throughout the year and free from unpredictable effects of weather and season. (MoA, 1979, p. 8)

By conceiving the intervention as a collection of inputs that would generate outputs for farmers as shown above, project officers did not recognise the diverse context which influenced farmers' technologies and practices in high potential areas in Kenya where the project was implemented. Conceptualising improvement schemes without recognition of the context in which it is to be implemented involves simplification and standardisation processes (Scott, 1998), depoliticisation (Ferguson, 1994) and rendering them technical (Li, 2007). In particular, rendering technical occurs when developers design programmes that ignore the political and economic processes that lead to the problems that they wish to improve which means that such interventions are "partial-both skewed and incomplete" (Li, 2007, p. 154). In conceptualising the NDDP, project officers assumed that the zero grazing technical package would unambiguously be interpreted and implemented by farmers with little regard of their context. In so doing, they decontextualized the dairy improvement. I use the notion of decontextualized to describe conceptualisation of the intervention and how it was expected to bring about change without recognition of the entire

context in which it was to be implemented. Decontextualization is evident in the standardised components for intensification of dairy cattle management that were to be implemented by farmers in the different districts in which it was initiated. The challenge of a decontextualized intervention is that its effectiveness and continuity become a problem during implementation because what an intervention promotes is not relevant in context of beneficiaries.

In recognition of the conceptual weakness of the standardised technical package, a diffusion study at the end of phase five concluded that low adoption of some technologies in all districts “... means that they are on average inappropriate, or problematic in implementation or simply of little consequence to the overall outcome of the zero grazing system” (Metz et al., 1995, p. 39). For example, in some areas, slurry and its transportation were viewed as repugnant, which made it difficult for farmers to hire labour and that this led to low quality and quantity Napier grass yields. In 1993, during senior staff seminar, Bauman, the team leader, cast further doubt on whether the developers understood smallholder farmers’ context. He stated:

Zero grazing is capital intensive and the project does not push farmers into accepting the zero grazing practice. The NDDP has not yet considered the dairy goat for milk production. The integrated small livestock project, run from Nyeri and covering Central and Eastern Provinces is addressing itself to this. It is however worth to note that the dairy goat has been introduced earlier with little success. A closer look as to why dairy goats have not been successful with the small-scale dairy producers should be done before introduction of the same. (Bauman, 1993, p. 17)

In support of these assertions on the importance of learning from failure of previous related projects and particularly how the context of smallholder farmers influences such outcomes, Suda (2000, p. 244) found that “farmers in Kakamega district were not particularly enthusiastic about a new goat enterprise either, but most of them were quite ambivalent about the idea. This ambivalence should be understood against the background of farmers’ resource endowment and constraints”. Constraints that were seen to have contributed to these were land scarcity and shortage of labour. Furthermore, during the final phase of the project, concerns arose about the sustainability of the project. Due to this, in 1993, it was noted,

As a matter of policy, the zero grazing system under the NDDP has been accepted by both the Kenya and the Netherlands governments who support the project. But will this development hold for the future? Taking for granted that zero grazing system is simple to innovate on small farms with limited space and that the approach is: plant, cut and bring Napier to the cow then milk-finally dump the slurry back on the plot hoping nature will reconcile. This may create even more problems than what is being solved. (Mukolwe, 1993, p. 2)

In the above statement ‘taken for granted’ implies that developers based the DDP on assumptions that were far from the reality of smallholder farmers’ context. Below, I provide further evidence that developers conceived NDDP as a decontextualized intervention.

4.6.1 Advice based on research on conditions of average farmers

One of the ways in which the intervention was decontextualized was that the NDDP research station conducted research and recommended technologies based on average conditions. For example, the research station estimated the economics of dairy production and its results were the basis on which developers concluded that implementation of the technical package was profitable among smallholder dairy farmers. Maina et al. (1994) estimated economics of feeding dairy cattle in Kenya under NDDP’s technical package. In their study:

A high standard of management is assumed. In this case a farmer is assumed to have three cows with a milk production per lactation of 3,000 litres. A calving interval of 405 days is assumed which means that 2704 litres of milk are produced per year. Annual cost of land is assumed to be the same as the rent paid on hired land which is set at Kshs. 1,000 per acre. Cost of capital is also assumed to be equal to the prevailing average interest rate of 19 percent. Opportunity cost of family labour is assumed to be equal to the prevailing price paid for casual labour (estimated to be Kshs. 60 per man day of 5.6 hours). (Maina et al., 1994, p. 141)

There are many assumptions in their study that did not reflect the actual context of smallholder farmers. Because one of the central components of the NDDP was acquisition of an improved dairy cow, I will use the assumption on the number of dairy cattle. The economics of feeding were calculated based on a farmer who had three herds of cattle. In estimating costs of feeding dairy cattle, “The number of cows is an important factor because when the costs are divided by a smaller quantity of milk the production cost increases. At two cows the production cost is Kshs.

15.42 while at eight cows it is Kshs 7.01” (Maina et al., 1994, p. 142). This means that the cost of feeding was much higher for farmers who had one of two cattle. It is estimated that on average, smallholders have between one and three dairy cows (Muriuki, 2011). This raises questions about the profitability of zero grazing for such farmers.

Another assumption was high level of management of the various components of the technical package in by smallholder dairy farmers. One aspect of management was Napier grass which developers assumed farmers would practice high level of management for high yields. However, it was later realised through research that the nutritional value of Napier grass varied by level of management in different smallholder farms. One such a study found that “There are numerous reports on the nutritive value of Napier grass; it is evident from these reports that the nutrient composition is dependent on the management” (Wouters, 1985, p. 59). However, farmers did not practice or always practice high levels of management as will be discussed in Chapter Five.

Generally, recommendations from research in trial and demonstration farms, which are based on what developers view as conditions of an average farmer, may not reflect the reality of dairy to day live of farmers like Scott (1998) reminds us. Evidence that farmers were diverse was demonstrated by NDDP’s categorisation of farmers as part-time, full time, institutions or groups (van Helden, 1983b). Yet, advice on implementation of zero grazing was based on research of an average farmer. In this sense, NDDP was a decontextualized intervention, similar to projects described by Ferguson (1994) and Li (2007) which were depoliticised and rendered technical.

4.6.2 Diversity of high potential areas

Farmers in different high potential areas in Kenya were expected to implement the project. In doing so they assumed that implementation of the zero grazing would be affected by similar conditions. The developers failed to recognise many factors that influence fodder and milk production in different high potential areas in Kenya. A desk review of the project in 1994 revealed that high potential is not synonymous with high milk production. The review stated “We note exceptions [for example] Kakamega with high forage output but low average milk yield.

Such an exception can be expected when a trait is determined by many factors” (PDC, 1994, p. 11). In terms of annual rainfall, the consultants pointed out:

Although some districts were classified as high potential, differences in annual rainfall differed, [for example] Kisii and Kakamega are much wetter than South Nyanza or Lamu. The amount of fodder obtainable from farms is proportional to annual rainfall hence the possibilities of attaining the research predicted results were very low in some *districts* while in others it was quite high. (PDC, 1994, p. 10)

The desk review also found that farmers which the project targeted had different experiences with dairy cattle farming, perception of loans and credit for farming activities, resource base which was influenced by farming systems, and the profits from milk sales (PDC, 1994). As an example, farmers in deficit milk producing areas and those who marketed their milk directly to consumers made higher profits than those who sold milk to the KCC (MALDM, 1994). In addition, a study conducted by Wandera (1994) whose results were presented during the senior staff seminar in 1994 found that fodder was of varied significance in different districts yet at inception its inception, the NDDP had promoted Napier grass as main fodder in all project districts. Moreover, at inception, the developers did not consider farmers’ knowledge of dairy cattle or livestock farming. However, they later acknowledged that farmers’ knowledge was essential and decided to use Participatory Rapid Appraisal (PRA) to incorporate the knowledge of farmers in the extension process in different regions (van der Linden, 1994, p. 129). During phase five, the project team leader acknowledged that they had decontextualized the dairy improvement project. In response to whether zero grazing was sustainable, he replied, “Zero grazing is a sustainable practice and has been accepted in principle. The recommendations however should be flexible and take into consideration different and diverse regions of the country, alternative methodologies and costs involved” (Bauman, 1993, p. 16). Another variation was that “The role of livestock in communities, especially in securing livelihoods, varies a lot in small-scale mixed farming households. Dairy production has to be regarded as a component in the farming system” (van der Linden, 1994, p. 127).

Due to all these differences that the developers had not initially taken into consideration, evaluation of the intervention in 1986 recommended that project officers adopt a flexible,

diversified approach in extension. This was because “the regional problems for DDP differ[ed] greatly; the actual situation of DDP differs greatly per district; the project is in different phases in the existing districts; and the potential for further development of the DDP differs greatly per district” (Woersem et al., 1986, p. 20).

4.3.1 Intensification of land use due to population pressure and land scarcity

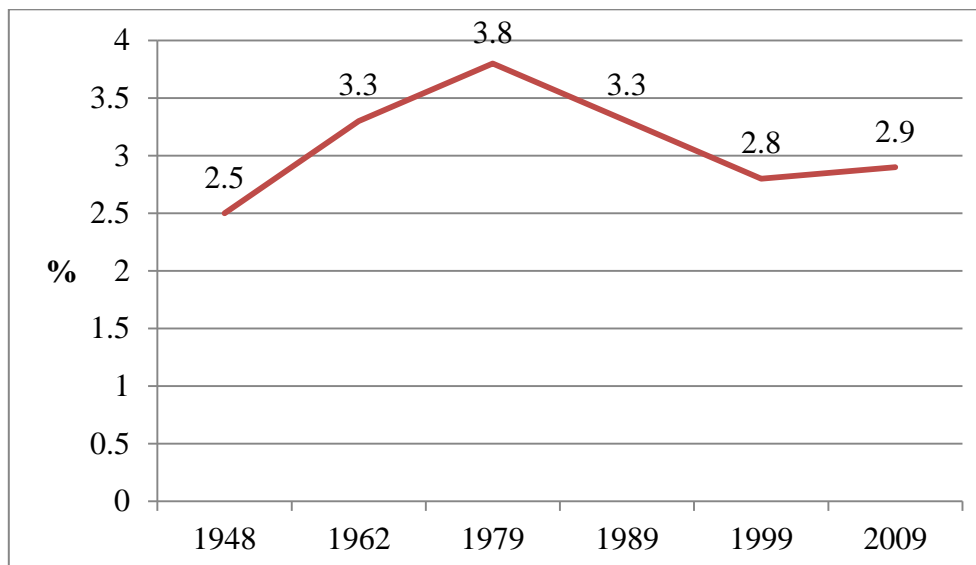
One of the rationales of the NDDP was intensification of land use to increase productivity, which was conceived as a solution to low production due to fragmentation of holdings among smallholder farmers. In support of this, the NDDP plan of operations for phase four reiterated that “The introduction and further improvement of the zero grazing system was a timely solution to land scarcity and overstocking which had led to low production and reproduction and deteriorating soil fertility” (MLD, 1990, p. 8). Land scarcity in Kenya, especially in high potential areas has a long history. Although land scarcity dates back to the pre-colonial period era, it became worse after the colonists forcefully acquired land from indigenous people largely in high elevation and potential areas, which came to be known as “white highlands”. This also marked disruption of indigenous systems of land tenure, which were based on communal ownership. Land scarcity persisted during the colonial period. In a report to the colonial government, Parker (1952) noted that interventions to address soil erosion, overgrazing, and landlessness among indigenous people in order to improve their husbandry practices had failed. One of the observations was that “Animal fertilizer [was] wasted and scientific breeding [was] rarely practiced” (Parker, 1952, p. 129). In 1954, the Swynnerton Plan, which focused on intensification of land use to improve productivity among indigenous farmers pointed out:

Two common fallacies must be laid. The one is that vast areas of Kenya remain to be settled. In general it may be said that any land naturally suited for settlement has already been occupied, often very densely. There are certain exceptions, [for example] in Masai, Mau-Narok and Trans Mara, not fully or agriculturally occupied for political reasons. (Swynnerton, 1955, p. 7)

At independence in 1963, the newly independent government resettled some of those who had lost their land to colonial settlers by subdividing large tracts of land that had been occupied by the colonists. To support the needs of the increased number of landowners, the land had to be made

more productive per unit area. As a result, after independence in 1963, there was a policy shift towards intensive land use in order to produce maize, milk, and meat (MLDM, 1990). Intensification of land use was also deemed necessary due to population growth, which was considered rapid. The population growth rate was 3.5% in 1978/79 up from 3.2% in 1963 and was expected to increase (RoK, 1979). The trend of Kenya population growth rate is shown in Figure 11. Related to this was a previous research, the Dairy Cattle Research Project (DCRP) that implemented at the NAHRS between 1969 and 1976 which found that rapid population growth had contributed to pressure on land through fragmentation of land holdings, overstocking, low production, and productivity, and soil fertility had deteriorated (MLD, 1990, p. 16).

Figure 11 Kenya population growth rate



Source: KNBS (2009b)

Due to the increase in population, production of adequate food in the context of declining land sizes required application of technology. The 1979-1983 Kenya Development Plan stated, “In these circumstances, it is the policy of the government to increase the productivity of all types of land during the planning period” (RoK, 1979, p. 243). Because smallholder farmers whose farm sizes were being fragmented dominated milk production, intensification of dairy production was seen as the solution to increase milk production (MLDM, 1986). To achieve this, “Particular

attention [was to] be paid to facilitate the gradual change toward minimum and zero grazing systems in high population density smallholder areas” (RoK, 1979, p. 243). Government officers also viewed intensification of land use as a solution to land scarcity. In 1984, a District Commissioner (DC) who visited one of the project farmers wrote in the farmer’s visitors book:

I visited the farm while on tour of the location. I was very very impressed by the development of the farmer who is practising zero grazing. This is the best way of utilising the little pieces of land which farmers here have. He has set out excellent example which should be emulated by all. More farmers should visit here to learn. DC, Kakamega, 7/9/1984. (Visitors Book for Alwanga, 2013)

Further, a dairy officer who was interviewed expressed similar sentiments. In response to why the intervention was initiated, he said:

When we saw this cow tied on a tree, we concluded especially when we looked at the land size that the smallholder cannot afford to graze cows. They just do not have the land. So in order to release the cow from the tree, we said, let us teach them to grow high yielding fodder crops with the cow in a stable. Under the tree, there must be some shade some time but in higher rainfall areas, the cow is rained on. We said let us try to create an ideal environment for the animal so we decided the zero grazing unit. (Author’s interview with Helder, 2012)

Therefore, initiation of the DDP was expected to address land scarcity among smallholder farmers by increasing land productivity through intensification of dairy cattle management. Noteworthy is that although efforts promote smallholder dairy farming started in the 1950s (Swynnerton, 1955; Conelly, 1998), the DDP was the first attempt to improve dairy cattle management among smallholder dairy farmers in Kenya since research on dairy improvement started in the early 20th century.

4.6.3 Availability and access to dairy cattle support services and inputs

In coming up with the technical package, developers did not take into consideration accessibility and availability of services that are essential in dairy cattle farming. An evaluation report of the project in 1986 noted, “The improvement of the dairy management practices on mixed small farms has been heavily influenced by external factors. The effectiveness of supportive services

showed great regional differences” (Woersem et al., 1986, p. 6). Table 7 below shows regional differences in access to supportive services in project districts, which affected implementation of the technical package in those districts.

Table 7 Status of access to services and inputs in project districts

District	Veterinary services	AI	Milk marketing	Farm input supply	Availability of dairy animals	Availability of credit facilities
Kakamega	0	-	+	+	0	0
S. Nyanza	-	-	-	0	-	+
Kiambu	0	0	+	+	+	0
Meru	0	0	0	+	+	0
Kilifi	-	-	0	+	-	+
Taita	0	-	-	+	-	0
Kericho	-	-	-	0	+	0

Legend: + = good; 0 = average; - = poor

Source: Woersem et al. (1986, p. 7)

In 1994, the PC who made closing remarks during one of the project seminars regretted that “The project has operated with an assumption that other services such as AI, clinical services, disease control, [and so forth] are available” (Chelanga, 1994, p. 199). This is recognition that in coming up with the technical package, developers had not taken into consideration regional variations in provision of dairy services and inputs and how this would affect implementation of the technical package. Therefore, because NDDP advice was based on research assumptions of which were based on conditions of an average farmer, failed to acknowledge diversity of farmers’ context in in different high potential areas in Kenya and did not consider variations in availability and access to dairy cattle services and inputs, developers decontextualized dairy improvement. As Li (2007) demonstrates through ethnographic study of projects in Sulawesi, Indonesia, the result of rendering technical and in this thesis decontextualization is that a stage was set for unintended outcomes due to lack of fit between what the intervention promoted and the context of farmers who were to implement it.

4.7 Multiple interpretations of the intervention by farmers

Farmers who were involved in the intervention rationalised the intervention differently, which was a reflection of the different objectives that they sought to achieve through involvement in the intervention. For farmers who were in formal employment, they viewed their involvement in the intervention and implementation of the zero grazing as a means to demonstrate leadership to others in their community. They desired to be seen as being development conscious individuals who embraced new ideas in the form of dairy improvement. This was particularly common with public and civil servants and teachers. This is evident in the response of one of the project farmers explaining why the household joined the intervention.

When my husband was alive, he was a councillor for this area. At that time, I remember he was the councillor for North Kabras, which is the present Malava division which ranges from Malava to Shimanyuri. As a leader, if any project is to be implemented in your area a project seen by the government is appropriate, if you are a good leader you have to be involved. As a councillor, he joined the project to be an example to others. Many people visited us to see our progress. (Author's interview with Namalwa, 2013)⁸

For such farmers, their objective was not just to implement components of zero grazing but perceived entry into NDDP and implementation of zero grazing as a means to maintain their social status and to continue benefiting from similar projects initiated in the community. Other farmers saw entry into the NDDP and implementation of the technical package as another livelihood activity. A farmer who joined the project in this way said:

After I migrated back home from where I worked, I needed something to do. I could not just sit. I thought of keeping dairy cattle. Because I had no idea how to go about it, I inquired how they got their cows from other farmers. They informed me that I needed to go through the government because the livestock department assists those who want to start dairy. Then, I approached the department of livestock. They told me that if I wanted to start dairy, there was a project on zero grazing for farmers who have small land sizes and it would provide for ones needs. I then started to work with Helden who assisted me to start dairy. (Author's interview with shiemi, 2013)⁹

Related to implementation of the intervention as a livelihood activity were farmers who joined the project to benefit from increased milk production. Increased milk production was one of the reasons that farmers kept dairy cattle. One such a farmer said:

First, I needed milk and with indigenous cows, it would take a long time of feeding them before they calve and even then they produce little milk. You cannot provide milk for your family and I had a big family at that time. I got advice from other farmers who had grade cattle around here. My sister-in-law in Lugari assisted me a lot. She even gave me a dairy cow in 1985. I bought another one and had two cows. (Author's interview with Nanjala, 2012)¹⁰

In addition, other farmers joined the project to continue keeping cattle, a livelihood activity which they were already engaged in. Therefore, farmers looked at NDDP as continuation of their livelihood activities through rearing of dairy cattle. One such a farmer said:

I admired and really wanted to keep dairy cattle. No one had dairy cattle in this neighbourhood and I thought I would be very happy to keep them. Many people laughed at me and said that I could not keep dairy cattle and wondered, if you keep indigenous cattle that graze from here to Mbale or wherever, how can you manage dairy cattle? However, with assistance from Ambole, and the white man, Mr. Helden, I was able to keep dairy cattle. I sold the indigenous ones and continued with dairy cattle. It was like a drama and many people visited to see how dairy cattle feed in the unit. (Author's interview with Nyukiri, 2012)¹¹

Clearly, farmers rationalised the intervention in different ways, based on their needs, interests and context. Due to the different ideas and objectives that developers and beneficiaries had about the NDDP dairy improvement intervention, this set the stage for its adaptation during implementation, a discussion that I pick on in the next chapter.

4.8 Conclusion

In this chapter, I have discussed the background of the NDDP, its objectives, where it was implemented and what it sought to address. I have shown that although the NDDP was initially designed to last two phases covering four years, it evolved and was implemented over 14 years. I have explained how even after it ended, project activities were integrated into a new extension system within the MoA. Evidently, as the intervention expanded to cover several districts, the roles of some project staff especially the Dutch experts changed due to reorganisation of its activities to enhance its coordination and implementation.

This chapter has also addressed the rationale for establishment of the NDDP. The rationale was to intensify dairy cattle farming due to population pressure and land scarcity, to meet increase in demand for milk and generate employment through increase in income from farms. I have shown that the problem of land scarcity had long been identified during the colonial period as a hindrance to agricultural production. I have noted that interventions dating back to the colonial era did not adequately address land scarcity and intensification of dairy cattle farming through zero grazing was viewed as a way to solve this. I have also shown that extension, the strategy that NDDP employed to promote zero grazing had two inherent mechanisms, namely seeing is believing and capacitation. These mechanisms may be useful to explain developers' logic in interventions that employ demonstration as a strategy and those that focus on knowledge, skills, and competences as a means to bring about change.

The developers designed NDDP as a standardised intervention because extension and components of the zero grazing package did not incorporate the entire context for farmers who were to implement it. In doing so, NDDP was a decontextualized intervention. Evidence of this was recommendations of zero grazing components based on average conditions of farmers, yet in reality farmers' conditions were far from average. I have also shown ways in which high potential areas in Kenya were diverse yet farmers in all these areas were expected to implement the same zero grazing components. In addition, I have demonstrated that availability and access to dairy services and inputs varied in different areas. Moreover, I have shown that farmers rationalised the intervention in different ways such that while others perceived it as an opportunity to generate income, others saw it as a means to maintain their social status. Because the zero grazing technical package was decontextualized and farmers interpreted it in different ways, in the next chapter, I explain how during implementation, its adaptation became inevitable.

CHAPTER FIVE

5.1 Introduction

In this chapter, I explore adaptations of the intervention by project officers and farmers, mechanisms that explain them and the context in which this occurred. In the first section, I explain the transition from first generation to second generation farmers, who started to adapt the intervention. The components of dairy improvement that they adapted were the NDDP extension strategy, housing of livestock, fodder management, milk marketing, calf rearing and management of soil fertility. I show that the adaptations by project officers and farmers were interrelated and explain how this influenced each other in adapting the components of the intervention. Due to this, co-adaptation occurred when the project officers and farmers together adapted a component of zero grazing or supported each other in coming up with an adaptation.

As noted in Chapter Three, effectiveness, matching, fit and resistance mechanisms explain adaptation of the intervention by project officers and farmers. In this chapter, I utilise effectiveness and matching mechanisms to explain how project officers adapted the intervention when they realised that some of its components were not relevant for context of farmers who were to implement it. I explain how incentives that the project officers received, budgetary constraints and continuity pressure to report progress underlined effectiveness and matching mechanisms in adaptation of the intervention. I also utilise fit and resistance mechanisms to explain how farmers selected and implemented those components of zero grazing that were consistent with their context of inadequate fodder, limited finances to invest in intensive dairy management and labour shortage. I show how fit and resistance mechanisms reveal farmers anticipated economic and social benefits of involvement in the intervention and their awareness of the costs and benefits of implementing the NDDP. Through this Chapter, I show that rather than outright rejection of zero grazing, farmers adapted it to enable them to keep dairy cattle in their context. I claim that adaptation was an attempt to bring context back into the intervention.

5.2 The transition from first to second generation farmers

To understand how adaptation of the intervention started, it is important to bear in mind the transition of the intervention from first to second generation of farmers. NDDP started by extension officers identifying and recruiting demonstration farmers. In Kakamega district, the extension officers discussed with potential farmers and selected those who expressed interest in dairy farming and had finances to invest in the implementation of the various components of zero grazing (see van Helden, 1980b,c,d). This was not a straightforward exercise. The dairy officer who was posted to Kakamega district to spearhead implementation of the project reported delays in identification and recruitment of demonstration farmers (van Helden, 1980c; 1981b). For example in the Kakamega district dairy report for February 1981, the dairy officer regretted that although he had made many visits to farms, he had failed to recruit demonstration farmers because farmers were busy with their other activities and others did not have finances to invest in zero grazing (van Helden, 1981b). Interviews with farmers revealed that before the NDDP, most of those who had ventured into dairy farming lost their cows, mostly to ticks. This made the farmers to believe that dairy cattle could not survive in the area. However, this did not apply to all farmers. Indeed, the Kakamega District Development Plans show tick borne diseases as one of the challenges to livestock farming in the area due to the warm climate. One farmer, a high school teacher, who had venture into dairy cattle before the NDDP realised this and he confined his cattle in paddocks to prevent them from mixing with other indigenous cattle, which is the reason that they survived. He reported:

At that time, we did not know about unit as we know it today. The animals just slept outside and we cut grass we threw it on the ground and the animals ate. We did not have this shelter the way it was designed by the programme. Therefore, the fear of losing animals was there. But then I overcame it because I knew the reason that animals were dying. Animals were dying because farmers brought them from Kitale. These exotic animals that were not used to this climate around here and we had ticks that brought ECF. I knew very well once we fenced off the place because those days we had paddocks and them just put them there. So long as they were confined into the paddocks and sprayed them once every week, we would eradicate all the ticks in the neighbourhood. Therefore, we prepared ourselves for that. The loan that we took we budgeted for all those materials. The fence then wires the posts. We made sure that the animals were confined and all the food was brought in one area. However, if you let them off to graze outside away from the enclosure, they will pick up ticks and that is what killed the animals. I knew we would confine them and that is why I had no reason to fear. (Author's interview with Khasewa, 2013)

It would appear that before entry of the NDDP, few farmers were knowledgeable on use of paddocks and regular spraying for tick control. This is the reason that their dairy cattle died and they hesitated when asked to join the NDDP as demonstration farmers. To encourage farmers to start implementation of zero grazing as recommended, NDDP provided financial and material support to demonstration farmers (van Helden, 1980b). This support was in form of a grant that covered 50% of all the costs of starting implementation of the zero grazing components (Woersom et al., 1986). Usually, dairy officers worked with the farmers to develop a farm plan that included all costs of the zero grazing components that farmers were to implement. After preparation of a farm plan, the NDDP provided half of the costs in the form of materials to construct zero grazing units or paid for the purchase of dairy cattle. In addition to financial and material support, extension officers advised and trained demonstration farmers intensively on implementation of zero grazing especially good dairy cattle husbandry practices. Moreover, extension officers pegged units for demonstration farmers and enforced its construction as recommended. As a result, demonstration farmers worked so closely with extension officers especially in the initial period of the intervention as a farmer who I interviewed reported.

I informed you we were connected to dairy officers. The dairy officers are the ones who advised us to build units. They are the people who measured the units and we were asked do you want a unit made up of four, two or six cubicles? Therefore, someone would choose what he or she wants to construct according to his capacity. (Author's interview with Natasha, 2012)

Interviews for this thesis also revealed that dairy officers and extension officers supervised demonstration farmers, who had to plant the required amount of Napier grass of one acre per cow before allowing them to acquire dairy cows. Farmers had to meet some conditions before they were registered by the project. A farmer explained conditions that one had to meet to join NDDP.

First, you had to plant Napier grass so that it is ready for use when you bought a cow. You had to plant adequate Napier grass even if that was in stages so that when you feed the cow on Napier grass from one section, grass in the other section continues to grow. Then you had to construct a zero grazing unit, which officers had to assess whether it meets their recommendations before they allowed you to bring in a cow. Three, the spraying kit, you had to have it. We used to go through the Ministry, which could provide us with the spray pump, a foot pump that looks like the one used to add pressure bicycle tyres. Therefore, there were conditions. (Author's interview with Namalwa, 2013)¹²

Because the first generation farmers were the point of contact to demonstrate successful implementation of zero grazing, project staff spent a lot of time to ensure that they succeeded. Therefore, during the initial phase of the project, demonstration farmers implemented all the components of zero grazing as recommended due to enforcement pressures by dairy extension officers who regularly visited them to enforce compliance. Adaptation of the intervention started when second generation farmers joined the project. The NDDP did not provide financial or material support to second generation farmers. When many more farmers joined the intervention, the officers could not get to all the farmers to train and advise them on how to implement zero grazing. As a result, the new farmers started to implement the intervention in their own ways. The project officers were also under pressure from their superiors in Nairobi to report progress and meet project targets even. This is the context in which adaptations of the NDDP extension strategy and components of zero grazing started as explained below.

5.3 Evolution of NDDP extension

To understand the evolution of the NDDP extension strategy, I start with how the NDDP got to farmers in Kakamega district. When NDDP started in Kakamega district in January 1980, the extension officers sought to understand the status of livestock and dairy farming in the district through tours and visits to cattle farmers (van Helden, 1980a). During that time, the NDDP policy was to recruit those farmers who had cattle and expressed interest in zero grazing although the project later considered those who expressed interest but had no cattle (Bauman 1993). The design of NDDP extension was to identify and recruit 20 demonstration farmers in each of the six districts where it started (Muriuki 1990). The extension approach was intensive and geared towards individual farmers (Bauman 1993). Therefore, in 1980, NDDP started through individualised extension and training of farmers on the components of zero grazing. Extension focused on individualised farm visits to demonstration farmers. However, over time, the focus of the extension changed in the context of project budgetary constraints, rural development discourses and continuity pressures. As already mentioned elsewhere in this thesis, incentives the project officers' adaptation of the intervention. The incentives that the officers received underlined their efforts to seek effectiveness and match the project resources to the intervention activities.

5.3.1 Change from commodity to farming systems and participatory approaches

When the DDP started, extension involved information flow from officers to farmers and officers were seen as "... a helper (advisor) guiding and assisting individual or groups of farmers gain skills and knowledge so as to be rational in farm decision making" (Mukolwe, 1993, p. 5). At the same time, extension was based on a commodity approach "... where extension component [was] geared to special commodities, [for example] cash crops: coffee, tea, pyrethrum, [and so forth] and now milk under the zero grazing system" (Mukolwe, 1993, p. 4). In this case, extension focused only on management of dairy cattle. However, developers realised that a commodity approach to extension could lead to problems. For example, a commodity approach did not take into account other farm activities, which enabled farmers to maintain soil nutrients, generate income and produce food (MLD, 1990). Because farmers practised both livestock and crop farming, overemphasising dairy cattle farming would compromise their livelihoods. It was also realised that in different high potential areas, "dairying could be very important but [was] not the main enterprise except for the dairy based system" (MALDM, 1994, p. 25). What this meant was that effectiveness and continuity of the intervention was constrained. Developers wanted the intervention to continue and at the same time ensure that farmers benefit from it. However, this could not have been achieved if extension focused on only dairy cattle farming without recognising its place in smallholder farmers' livelihood context. Consequently, project officers changed the focus of extension from a commodity approach to a Farming Systems Approach (FSA) during the consolidation phase (1984-1986). The NDDP team leader defined a farming system as "... the totality of production and consumption decisions of the farm-household, including the choice of crop, livestock and off farm enterprises, and food consumed by the household" (van der Linden, 1994, p. 127). When a review of the sustainability of project activities was done in 1993, it was resolved that the intervention would provide extension messages consistent with the farmers' complex farming system (Bauman, 1993). Therefore, effectiveness and continuity of the project were central to the change of extension strategy from a commodity approach to a FSA. An officer acknowledged this during a senior staff seminar in 1994 about the sustainability of the intervention. He said:

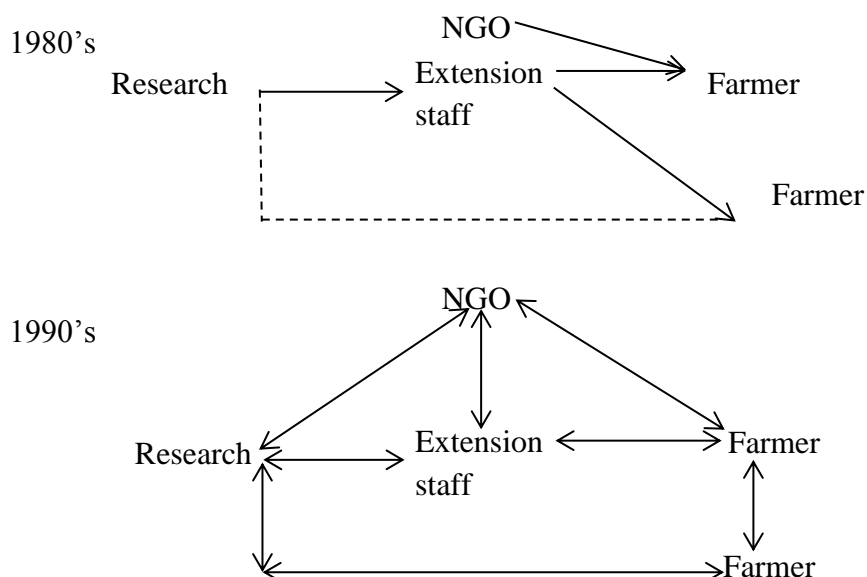
We are increasingly becoming aware that households are having very good reasons for doing things, but also for not doing them. If we want to understand these, we have to understand and consider the farming system, even when we are professionally mainly interested in the milk production component or livestock. An example given by one of our colleagues who is in this audience: When visiting a household, which usually experiences a dry season feeding constraint, he found that the grass in the compound was cut. The grass was just lying there and our colleague was really surprised that this grass had not been stored as hay. Why does this household not make hay? To get such an answer one has to take a birds-eye view of the farming system, which most likely will give the household's reason for leaving the grass where it is. Other things need to be done on the farm and the labour is to be distributed amongst these activities. There might be maize to weed, vegetables to tend, chickens to cull, [and so forth]. These now result in the family having simply no extra time available for hay making, or that hay making ranks low on their priority list. Again, money available to spend on farm inputs and/or hiring labour has to be distributed over the various household activities. By understanding the farming system, the rationale of the farming family in leaving the grass where it is will be understood. It would possibly take extra labour, not readily available, to conserve the grass as hay. Hiring off-farm labour requires cash, which could have been put aside for buying drugs for the chickens. (van der Linden, 1994, pp. 126-127)

Therefore, extension focus on a FSA "... sought to pull together and strengthen linkages to other production sectors and services like crops, livestock, forestry, research, education, for better analysis of on farm issues in order to achieve productivity, security by minimising risks, continuity and identity" (Mukolwe, 1993, p. 5). In addition to search for effectiveness as the reason for adaptation from a commodity to an FSA approach, by focusing on farming as a system, developers were possibly influenced by the Farming Systems Research (FSR) rural development narrative. The FSR was an influential guiding framework for intervention in rural development in the 1980s (Ellis & Biggs, 2001). As will be evident in subsequent sections, the FSR influenced developers who adapted the intervention in response to the context of farmers who were involved in the intervention. For example, understanding of smallholder farmers' complex farming system influenced the developers' research and extension on utilisation of MPTs and fodder legumes and making compost from cow dung and fodder left overs.

Findings also reveal that over time, concerns arose over sustainability of project extension activities. This led to a senior staff seminar on sustainability in 1993. During this seminar, the team leader Bauman (1993) recognised the need to change their advice and training to focus on

the farmers' context. In doing so, sustainability of the project was linked to the context of the farmers. While responding to the question of whether zero grazing was a sustainable practice, the team leader stated, "Zero grazing is a sustainable practice and has been accepted in principle. The recommendations however should be flexible and take into consideration different and diverse regions of the country, alternative methodologies and costs involved" (Bauman, 1993, p. 16). One way that developers sought to make recommendations flexible and to become relevant to the context of farmers was change in information flow from the officers to the farmers (Figure 12).

Figure 12 Changing information flow in NDDP extension



Source: Bauman (1993, p. 16)

The change portrayed in Figure 12 was seen as a change from an approach where the officers' advice was supreme and dominated farmers' practices to those where farmers participated in extension activities. Participatory approaches also included other actors especially NGOs that were involved in agricultural extension in the NDDP. In participatory extension:

The beneficiary (the farmer) of the extension message really participates in the "translation" of the message into farmer's reality (principle of "learning by doing"). The farmer remains fully responsible for the effects of the decisions taken at farm level ("optimal involvement" in training and extension). (MLD, 1990, p. 43)

Active involvement of farmers in the extension system was to enable project officers understand farmer households' in order to "...enhance the effect of extension advice and making it more appropriate for the varying scale of household situations" (van der Linden, 1994, p. 132). During phase five, participation of farmers in extension was a means to enhance sustainability of dairy activities. This was by enabling farmers to get used to seeking advice and services that they needed from dairy officers (demand driven) rather than being mere recipients. Participatory extension was also seen as a means to utilise local knowledge of farmers in order for extension to better meet farmer needs (van der Linden, 1994). Notably, shift to utilisation of participatory approaches in NDDP extension was consistent with the wider rural development narrative at that time. Utilisation of participatory approaches like Rapid Rural Appraisal (RRA) in developing countries started in the 1980s when participation was an influential narrative in rural development (Ellis & Biggs, 2001; Li, 2007). Notably, the shift to participation in development projects was evidence of failure of state interventions to change people's lives (Li, 2007), which supports the argument that developers adapted the intervention due to effectiveness mechanism. They did not wish to see the intervention fail for failing to incorporate the views of farmers who implemented the various components of zero grazing.

As a result, developers involved farmers or learnt from them while implementing the intervention. Due to the developers' recognition that farmers had to participate in the NDDP extension and their voice was crucial in implementation of the components of zero grazing, in subsequent sections, I discuss how developers took into consideration the voice of farmers in extension of some components of zero grazing. Further, the NDDP researcher asked the extension officer not to criticise farmers' practices but try to understand why they did so and identify such practices for research and appropriate extension. However, the downside of focus on participation was that "The approaches directed people to turn to their own communities to solve their own problems, presumed to be pre-eminently local in origin" (Li, 2007, p. 134), which ignored the wider and macro context influence on local problems.

5.3.2 Extension in the context budgetary constraints

NDDP was donor funded and the financial resources that were available to the project managers were limited. Due to concern over resources, the developers came up with two adaptations in extension focus, which enabled them to continue with implementation of the project and to enhance its effectiveness. The first adaptation was that developers changed extension from focus on individual farmers to concentrate on groups of farmers. Although during the initiation phase, extension was based on individualised farm visits, this changed to group extension during the second and subsequent phases of the intervention (Metz et al., 1995). Individualised extension was limited in terms of the number of farmers who extension officers could reach. During a senior staff seminar in 1993, the team leader stated, “The extension approach which has been developed is intensive and geared towards individual farmers. Sustainability may be reached if the approach is geared towards farmers groups, whereby greater number of farmers is reached” (Bauman, 1993, p. 16). Interviews with officers revealed that adaptation of extension strategy to focus on groups was associated with increasing number of farmers who had joined the project without increase in project staff and limited financial resources that were available to the project. Because extension involved officers, training and advising farmers on implementation of the technical package for zero grazing, staff were central to the intervention. Indeed, as early as in 1981, Voskuil (1981) noted that because many farmers were interested in the project, the future of the project depended entirely on the availability of extension officers to follow up with the farmers in different areas. From time to time “Many of the districts were understaffed and the most affected districts were Kiambu, Kericho, Western and all the new districts” (Gichungu, 1991, p. 22). In a project progress report in 1981, one of the Dutch experts expressed concern over few visits by extension officers. The report reads:

So far 74 “second phase” farmers are constructing a zero grazing unit, after they contacted the project. But it is felt that there are several more who get a plan and are doing it on their own. After 13 field days were held, it was felt that the contacts with the visiting farmers remaining too shallow. At the moment each demonstration farmer is visited once a month. On this occasion, he is asked to invite a rather small number of really interested farmers farm his area. After a more deep discussion of the set-up and several management-aspects, the interested farmers are visited individually. Then a farm layout plan is discussed and a unit pegged out. This set-up works quite satisfactorily, although it makes once more clear that enough TA’s should be available to have a sufficient impart. (Voskuil, 1981)

Developers wanted to continue advising and training farmers in the context of limited human and financial resources. There was also fear among extension officers that if farmers were not trained and advised properly, they would implement zero grazing without the requisite knowledge. Extension officers pointed out cases where some farmers had bought pedigree dairy cows, which ended up dying due to improper spraying while some farmers resorted to semi zero grazing because they had not planted sufficient Napier grass. The Kakamega district dairy officer regretted how a high school teacher motivated by successful implementation of zero grazing by a demonstration farmer obtained a loan from KFC and bought six dairy cows, which he sold after one month he had no more fodder and two of the cows had already died (van Helden, 1980d). The dairy officer argued that such farmers would spoil the reputation of the project. Therefore, focus on groups was a means to reach many farmers to prevent inappropriate implementation of zero grazing among farmers. Furthermore, due to government liberalisation and privatisation policies, cost sharing was being implemented in the provision of dairy services and inputs but extension services could not be provided under cost sharing. To continue provision of extension activities, project officers came up with an extension approach, group extension, which was possible with fewer resources-evidence of matching mechanism. A dairy officer who was interviewed expressed similar sentiments.

We had extension officers on motorbikes when we started with individual farm visits. That is very expensive because of the increasing number of farmers, if you want to visit them all individually, you cannot afford. We had to start on an individual basis because we wanted them to put up demonstration units. From there, we encouraged farmers to come together. Now the exercise becomes cheaper for the Ministry. Because we always said when the project was running it was impossible for the Kenya government to take over this project the way we ran it. So we had to change our approach. Individual approach was good for the start and necessary and then we moved to the group approach. You know the end of the project more or less came at the time when they started liberalising the economy. So they were privatising AI including veterinary services. Extension services are very difficult to privatise because no farmer will pay you. So that was left hanging with the Ministry and they could not afford. (Author's interview with Helder, 2013)

Therefore, during phase five, extension involved "Increased emphasis on training of farmers by farmers via group activities and farm competitions" (MLD, 1990, p. 43). What was analysis

revealed that project officers were expected to meet their targets especially increase in the number of farmers who were implementing zero grazing despite limited resources.

The second adaptation that developers came up with in the context of limited resources was collaboration with other actors in extension. In particular, the developers involved other actors in training and advising farmers during field days, workshops, seminars. Other actors also assisted NDDP in pegging zero grazing units. These actors included Christian Development and Education Services (CDES), Kaimosi Rural Service Programme extension services, Catholic Church through their DELTA programme, Kenya Wood Fuel and Agroforestry Project (KWAP), Draught Power Development Programme, the Special Energy Programme, and Heifer Project International (HPI). As already stated, although the purpose for collaboration and work with these actors varied, it related to training and advising farmers on implementation of the technical package for zero grazing. For example, NDDP collaborated with CDES which trained farmers during workshops, measured and pegged units for farmers and conducted farm visits in 1982.

Collaboration with other actors was aimed at enhancing effectiveness of the project while at the same time enable continuation of project activities in the context of limited resources. For example, NDDP collaborated with CDES because CDES had contacts in Kaimosi, one of the areas of Kakamega district where NDDP was planning to introduce zero grazing. In this case, NDDP project officers wanted to enhance effectiveness of project activities so that many more farmers could implement zero grazing by taking advantage of the knowledge and networks that CDES already had. In another example, NDDP worked with KWAP to train and advice farmers when it introduced use of MPTs to supplement protein intake in smallholder farms. KWAP was already working in some areas to promote agroforestry using MPTs in smallholder farms (MALDM, 1994). As shown in the response of an officer who was interviewed below, collaboration with KWAP was a means that they sought in order to achieve the objective of training project farmers using experienced officers without incurring additional costs. KWAP was already established in some areas and experienced in MPTs. The officer interviewed said:

The KWAP was promoting trees which can be fed to animals and if you want to feed those trees to animals you don't let them grow tall. So, our staff were trained by Kenya KWAP on the trees because they are high in protein, lucerne, calliandra, sesbania. They are rich in proteins. And we said, if you have your zero grazing units here, we can plant those trees around in the form of a hedge. You let them grow up to two metres, chop them up to one metre and they will sprout again. You harvest the trees and you use it to feed your cows. It is like dairy meal. Then when the tree is old, you have your wood fuel. So, they were trying to establish wood lots in famers then we said those farms are so small especially in Maragoli there is no space for woodlots. We can use them as a hedge or fence. Still have trees and have firewood and on top of that get a very nutritious feed for the animal. So that is actually making use of advantage of the project which just happens to start with the aim of providing with firewood but we said very good because on the situation side, our smallholders are very short of proteins and proteins is what you find in those trees and it is very cheap. (Author's interview with Helder, 2013)

In other cases, some actors sought collaboration with NDDP. For instance, HPI asked NDDP staff train and advise farmers on various aspects of dairy cattle farming before they could receive support from HPI to start dairy cattle farming (Gichungu, 1991). In this case, HPI benefited because it did not spend money to train the farmers and the training would enhance successful rearing of dairy cattle. On the other hand, NDDP benefited because it based training and advice on their technical package and recruited the farmers for extension, which was easier because the farmers already had financial support from HPI. They increased the number of farmers registered, which contributed to meeting their targets. Extension officers also worked with other local political and administrative leaders who assisted the officers to mobilise farmers to attend planned NDDP meetings or group activities. This was an adaptation because the technical manual did not indicate that officers were to work with local leaders. An extension officer said:

I worked with councillors, mainly councillors not MPs. Because the councillors were able to meet more people, so when there is a meeting, they could also tell these farmers to join the project because it has this kind of benefit and then the farmers could also look for me. So, in a way it was also trying to make my work easier. You know one has his own ways of survival and I had learnt that by bringing the councillor closer to me or the chiefs, my work was becoming even easier. Because I remember, there was a DC during that time who would always wish that whenever he went to any visit, field visit, he would like to see whatever councillor or a chief was doing. So, if you are doing nothing at your farm level, you were no longer a friend of that DC. So, they were also trying as much as possible to do something whereby when the DC visits or happens to visit, they have got also something to show this is what we are doing and we are also trying to advise our farmers to do the same. (Author's interview with Muriuki, 2012)

Local leaders benefited from mobilising farmers for NDDP activities because they reported their involvement as contribution to development activities to legitimise their jobs. On their part, extension officers saw involvement of local leaders essential to reach farmers and convince them to join the project. An officer who was interviewed said, “In mobilizing people and especially when you want to organize a field day, you have to use them. The administrators have to be present because they are the ones who inform the people to come and attend meetings” (Author’s interview with Odhiambo, 2012). Therefore, the extension officers on the ground came up with their own ways of ensuring that they succeeded without necessarily sticking to the laid down procedures especially in terms of mobilising farmers and encouraging them to join the project.

5.3.3 Change of extension in search of intervention effectiveness and continuity

The developers came up with three adaptations of the intervention to enhance its effectiveness and ensure its continuity. The first adaptation was that the project introduced printed and audio-visual resources for extension. During the first three phases of the intervention, NDDP operated without an extension blue print. The challenge of this was that extension officers did not have a systematic guideline to follow in extension activities but did what they considered appropriate in their context. However, the project team leaders considered such an approach weak in providing opportunities for improvement by learning from mistakes especially when expanding to new districts. To address this, the third evaluation mission of the project recommended use of diverse extension materials.

The use of extension aids, [for example] pamphlets and booklets in the extension service, should be developed and encouraged jointly by the Research and Monitoring Units of the Project, the Agricultural Information Centre, and the Office of the Chief of Livestock, Development Division. The Joint Mission fully supports the recently conceived idea of the Project to make a film on zero grazing system in Kenya. The Project should also develop posters, films and other aids for teaching illiterate farmers, who actually form the majority of the DDP’s target group. (Woersem et al., 1986, p. 14)

Consequently, NDDP developed a zero grazing manual for front-line extension workers. The original version was revised several times to include more information and simplify the extension messages. This was in line with earlier evaluation missions that had recommended that the zero

grazing manual be simplified (PDC, 1994). To channel research findings to staff and farmers, the NDDP research unit produced leaflets, pamphlets, videos and films in 1988. Information pamphlets provided guidelines for specific component of the technical package for example the zero grazing units, Napier grass production and calf rearing. However, interviews with extension officers who were involved revealed that they did not use or entirely follow the recommendations as was laid down in the project manuals and booklets. They attributed this to constraints that farmers faced when implementing zero grazing and farmers expected them to come up with immediate and practical solutions. As a result, in a number of occasions, extension officers worked with what was possible for farmers to implement based on their context. For example, extension officers could reduce the size of zero grazing unit cubicles to reduce the costs of construction for farmers who were constrained by finances. In addition, a general film on the advantages and disadvantages of zero grazing and focusing on different components of the technical package both in English and Kiswahili (LDM, 1991). It was thought that use of the film would be more effective in demonstrating various components of zero grazing. During interviews, although the farmers who had watched the film when the project was ongoing said that they were impressed by how they saw the various components of zero grazing being implemented, they had reservations about how they could implement the components. For instance, some of the farmers did not think that it was possible to implement the components as shown in the film because it would require many financial resources that they did not have. However, in an attempt to practice the technologies they had seen in the film, they did not implement the technologies exactly as they had seen but did so in their own way.

The second aspect of extension that NDDP officers changed was the criteria that they used to register farmers in the project. When the project started, farmers were only registered after they constructed a zero grazing unit according to the NDDP design, established a Napier grass plot of a recommended size and practised complete confinement dairy animals in a zero grazing unit (MLDM, 1986). However, over time, farmers implemented some aspects of the intervention before others according to their financial ability and degree of conviction and not all the components of the technical package like developers had anticipated (Metz et al., 1995; Chibudu & Maarse, 1993). Related to this was that farmers who became interested in the project were

recruited at different stages of implementation of the zero grazing components, which made a common standard registration criteria difficult. This threatened the effectiveness of intervention because extension officers found it difficult to recruit farmers who met all the conditions or felt that it took a long time to do so (PDC, 1994). In response, extension officers in a number of districts relaxed the rules that guided registration of farmers without informing the project managers. For example, NDDP staff at the coast province had among their registered farmers, many who had neither zero grazing units nor Napier grass planted (PDC, 1994). When the project management realised this, during the later phases of the project, regional relaxations for the registration conditions were introduced, in order to account for the different agro ecological zones and prevailing farming systems. Under the new criteria, farmers were registered when they had “at least one dairy cow or heifer on the farm, a unit with milking and feeding facilities, on-farm fodder production (no minimum required) and zero grazing practice for at least 25% of the time” (Metz, 1993, p. 22). Therefore, due to diversity of farmers in different regional which influenced the components that they could implement at a given time, NDDP relaxed the criteria they used to register farmers in the project to enable farmers to join the project and implement zero grazing components.

Lastly, dairy and extension officers assisted farmers to look for and select dairy cattle. Interviews with farmers and officers who were involved in the project found that when NDDP started, there were very few improved dairy cattle in Kakamega district. As a result, improved dairy cows in the district were very expensive especially when compared with similar cattle from neighbouring districts in the Rift Valley province. Consequently, implementation of the technical package was slow and it took longer to recruit demonstration farmers (Voskuil, 1981). Similarly, an evaluation of the intervention in 1986 found low availability of grade cattle in some project areas a constraint to implementation of the project (Woersom, et al., 198). Developers had not anticipated such a situation and the third evaluation mission recommended that the project should continue “... to make grade animals available to DDP farmers in some selected project areas” (Woersom, et al., 1986, p. 22). Therefore, dairy officers started to assist farmers to look for and select good quality dairy cattle from breeders and farmers in neighbouring districts. They

organised selection tours for interested farmers and through collaboration with their counterparts in neighbouring districts. A farmer who benefited from a selection tour said:

The livestock people helped us to get dairy cows from Kitale. We were with them when we selected the cows. We did not know about dairy cattle. They ask us to go together and identify the cattle. They even provided the lorry that was used to transport the cattle up to here in Elwunza. (Author's interview with Awuor, 2012)¹³

Moreover, in view of the centrality of assisting farmers to acquire dairy cattle in implementation of the technical package and continuity of dairy improvement, the annual report for 1991, with regard of purchase of breeding stock, acknowledged:

This type of activity is not included in the plan of operations, the staff however found it necessary due to unavailability of good breeding stock in many of the districts where NDDP operated. The NDDP staff was fully involved in, searching for, selection and coordinating all farmers in need of breeding stock and also offered financial assistance in the transportation of the animals. (Gichungu, 1991, p. 15)

Based on analysis of documents and interviews, farmers in Kakamega are convinced that their dairy cattle are of a lesser milk production potential compared to those in the surrounding districts especially in the rift valley province. As a result, they prefer to buy dairy cattle from neighbouring districts because they believe that they produce more milk. Yet, according to a dairy officer who was interviewed, milk production results from a combination of breed quality and husbandry practices and not just the genetic potential of an animal. The officer pointed out:

Some people call me and tell me I want to buy a cow producing 40 litres of milk, how much is it going to cost me? What do I tell such a person? I always tell farmers you can buy a cow but you cannot buy the milk. I mean that you can buy the cow if you have the money but the milk depends on your management. If you do not feed the cow, even if it has the potential for 40 litres per day, you will not get it. Then you will say that you have been cheated or the farmer who sold it has cheated you because you have got the records which show that when it was in that farm it was giving 40 litres *na sasa hapa nyumbani inatoa tano* (and it produces five litres here at home). So I always tell them, the cow is available but the milk you have to take care like you have enough fodder, minerals and feed the cow properly. And the farmer will say *unajua hii ngombe yangu si mzuri* (my cow is not good) but you know if you look at the animals genetically, it is good. (Author's interview with Helder, 2012)

Therefore, by assisting farmers to acquire improved dairy cattle as part of the zero grazing components, the project officers contributed to enhancing effectiveness of the intervention especially in meeting its objective of increased milk production. Clearly, from the foregoing the project officers sought to enhance effectiveness and continuity of the project, which explains why they from time to time adapted it. Because adaptations were to make the zero grazing components relevant to the context of smallholder farmers who were to implement them, adaptation of the intervention by project officers could be viewed as a means through which they attempted to bring context back into the intervention. As already explained in the previous chapter, the developers decontextualized the intervention by not considering how implementation of the standardised zero grazing system would be affected by the context of the smallholder farmers. For example, they did not consider how lack of financial resources to invest in the construction of zero grazing units would influence implementation of the standardised package. However, by responding to challenges that arose during implementation, these developers differed from those who were involved in conservation projects in Sulawesi, Indonesia who “... had no new techniques to offer” (Li, 2007). As I have discussed above, the project and extension officers had something new to offer when challenges arose in the implementation of the intervention especially when effectiveness and continuity of the intervention was threatened.

5.4 Fodder establishment and management

In Kenya, fodder establishment started when the colonial government introduced it as part of the interventions to commercialize dairy cattle farming. As already pointed out, NDDP recommended confinement of animals in sheds or units and use of Napier grass as the main basal feed (MLD, 1991b; Maina et al., 1994). This is the reason that when the project started, distribution of Napier planting materials or cuttings was one of the major activities in all the initial districts. Because in zero grazing systems, fodder makes up 70% of milk production costs, the NDDP introduced proper management and conservation of fodder to increase milk production (MALDM, 1994). Consequently, the NDDP advocated for planning of Napier grass as the main fodder under the zero grazing system as one of the components of the intervention. The aim was to provide dairy cattle with good quality and quantity fodder through the year. NDDP specified the quantity of Napier grass that farmers were to plant per cow. Indeed, farmers were required to

plant adequate Napier grass based on the number of cows they kept before they were registered (van Helden, 1980d). In areas around central Kenya, NDDP recommended "... a stocking rate of one cow per acre of Napier grass when no other roughage [was] available ... (Snyders, 1989, p. 1). An officer interviewed pointed out that "the NDDP was very particular that you plant your Napier grass on your farm and you plant the right quantity, one acre for one cow unless for a young heifer" (Author's interview Maina, 2012). NDDP also advised farmers to supplement Napier grass with concentrates and minerals in order to provide a balanced diet to their animals (MLD, 1990).

Interviews and documents analysed revealed that demonstration farmers, had adequate Napier grass for their dairy cattle in the initial days of the project. This is because they kept animals based on fodder planted according recommendations by DDP, a condition that they had to meet before registration. The other reason was that extension officers monitored them to ensure proper management of Napier grass to maintain high yields. However, over time adequate fodder became a challenge. This was similar to the view of one of the presenters during the NDDP senior staff seminar in 1993 "It appears that the first farmers who took up zero grazing practice in early 1980s are harvesting less fodder in the same unit of land area than they were when they started" (Kirui, 1993, p. 137). Analysis of Kakamega district dairy reports shows that in June 1983, "...only few farmers [had] fodder shortage" (van Helden, 1983c). In December 1983, the district dairy officer reported, "Due to fodder shortage, some animals were grazed outside as well" (van Helden, 1984a, p. 4). Further, in April 1984, the dairy officer noted that drought was a major setback and farmers had run out of grass and were feeding animals on all sorts of feed including banana leaves and stems, sugarcane tops and ordinary grass collected from anywhere (van Helden, 1984c). Therefore, fodder shortage became worse during the dry season because Napier grass was largely rain fed. In September 1983, the dairy officer was worried that "some of the members are really short of fodder and their animals, already present produce 7Kg of milk per day" (van Helden, 1983d, p. 1). Notably, feeding dairy cattle with adequate quantity and quality fodder is difficult, as an officer during a senior staff seminar on sustainability.

The farmer has a monumental task of feeding his cows day in, day out throughout the year [for example] an average dairy cow producing 3,500 kg of milk per year will consume roughly 5.5 tons dry matter of high quality roughage and concentrates. This works out to approximately 22 tons of fresh (or wet) roughage and 20 (70 kg) bags of balanced dairy concentrate, in addition to about 20 kg minerals and over 25,000 litres of water. (Muiruri, 1994, p. 40)

In recognition that adequate fodder was a problem to many smallholder farmers, during phase five, extension officers advised and trained farmers on adequate fodder and feeding, which had not achieved in the previous phases (MLD, 1990). Due to inadequate fodder, a project officer claimed that the “Kenyan dairy herd is generally underfed and is producing much below the genetic potential ... It is reckoned that the dairy herd in Kenya ranks among the top 30% genetically in the world but falls among the bottom 40% in terms of milk production” (Muiruri, 1994, p. 41). Another project officer described inadequate fodder during the dry season as follows: “Seasonal shortages of milk are clear manifestation of our failure to provide adequate feedstuffs for the dairy cows. During prolonged dry spells, dairy cows may starve to death or are sold for slaughter to otherwise prevent their certain death” (Wachira, 1994, p. 9). Further, although the concern was with quantity and quality fodder, “... the quantity aspect appears to require more attention in Kenya” (Wachira, 1994, p. 9). Overall, adequate feeding of dairy cattle was a major challenge in smallholder dairy farm and this could affect the NDDP’s objective of increasing milk production. Why were NDDP farmers unable to provide adequate fodder?

Farmers were unable to provide adequate quality and quantity fodder due to a combination of factors. The first factor was overstocking which occurred when the number dairy cattle increased because farmers kept calves without planting additional Napier. An officer explained:

You will find that farmers have no adequate fodder, we have been telling them to destock, you will find that some farmers do not want to destock. Therefore, they have so many mouths that need that fodder and yet the area remains the same. Therefore, farmers were a bit reluctant sometimes, not all of them. However, I can say some of them because when they see a calf is in good health and is growing to be a big animal, they keep it. They keep the calf even when they know very well that the cow is going to calve another time without focusing on the expansion of the fodder. Therefore, the same plot, which was feeding the one animal, is the one to feed all these other animals, which becomes very difficult. (Author’s interview with Odhiambo, 2012)

The second reason was changes in household demographics. The amount of land that was available for fodder production declined due to land subdivision for inheritance by the younger generation (Metz et al., 1995). Although land scarcity was a challenge when NDDP started, it became worse over time. A farmer interviewed confirmed that the land scarcity “has become worse due to inheritance. If you have sons, they want their land to construct their houses and that is where you had planted Napier. You see, the amount of Napier reduces when the land available decreases” (Author’s interview with Ndombi, 2012)¹⁴. This is probably the reason that during the senior staff seminar in 1994, an officer pointed out “It is not feasible to increase the area for forage production in the high potential areas due to the high human population which is also grown at a high rate” (Muiruri, 1994, p. 45). In Kakamega district, where land ownership is largely private (RoK, 2002), population density is high. As noted earlier in the thesis, in 2009, the population density of Kakamega and Vihiga Counties was estimated to be 550.31 and 982.55 persons per square kilometre respectively (KNBS, 2009b).

Seasonal variation in rainfall compounded fodder production. Kakamega district has a bimodal rainfall and experiences a short dry season as already noted. Because smallholder farmers depended on rainfall for Napier grass cultivation, yields decreased during the dry season. One of the project officers described the situation as follows: “In Kenya, the fodders produce most of the herbage during the wet seasons. During the dry season, herbage production is greatly reduced” (Wandera, 1994, p. 93). Further, in 1994, another officer reported, “Most of the dairy animals depend on fodder and arable/industrial/farm by-products; the supplies of all of which apparently decrease during drought” (Wachira, 1994, p. 9). Interviews revealed that farmers purchased additional fodder to supplement their Napier produce during the dry season. This was similar to one of the project reports in which an officer noted that “During the dry season, the smallholders rely on bought materials [for example] hay and by products” (Muinga, 1994, p. 44). However, farmers who relied on purchase of Napier grass found it difficult to buy adequate amounts during the dry season because the prices went up due to low supply.

Related to decreased fodder production during the dry season was that farmers hardly preserved fodder for use during the dry season. Reduced fodder production and feeding of dairy cattle made

NDDP officers to visit farmers to assess the situation during the dry season. As a follow up to this, the project managers convened a seminar to discuss sustainability of the project activities. During the seminar, an officer pointed out “One worrying revelation is that the majority of the farmers visited have shortages of feed during the dry season and none of them conserve the excess Napier available during the wet season” (Wandera, 1993, p. 40). This officer further regretted that “Unfortunately, much of the excess herbage produced during wet seasons is wasted and is never available during the dry seasons” (Wandera, 1994, p. 93). Table 8 shows the extent to which farmers conserved fodder for use during the dry season.

Table 8 Extent to which farmers conserved fodder

Province	Percentage of farmers conserving	
	Hay or silage	Standing hay/ Napier grass
Western	3.8	13.7
Nyanza	0.9	6.8
Rift Valley	4.6	15.2
Central	2.4	35.5
Eastern	5.5	24.0
Coast	8.8	10.8
Average	4.3	17.7

Source: Muinga (1994, p. 83)

Findings in Table 8 were presented in a senior staff seminar on feeds and feeding for increased milk production in 1994 in recognition that milk production was affected by poor quality and quantity fodder. It is apparent from Table 8 that although fodder preservation varied by province, few farmers conserved fodder for use during the dry season. This was because farmers did not know how to preserve and conserve fodder, they did not produce surplus fodder which could be preserved, they did not have financial resources to buy requisite inputs for example polythene sheet and pay for labour to chop fodder for preservation (Muinga, 1994, p. 84).

The other reason for inadequate fodder was that the cost of supplementary feeds especially concentrates and minerals were beyond the reach of many farmers. Although the cost of supplementary feeds varied, better quality feeds like minerals and concentrates were more expensive (MLD, 1990). Due to this “cost of supplements available at the market made it difficult

for farmers to supplement at will” (Maina & Chibudu, 1994, p. 37) and “... the trend on animals that receive concentrates was likely to go down in future if the trend continues in the same manner” (Kimani & Chibudu, 1994, p. 32). As discussed elsewhere in this thesis, the cost of dairy feeds and agricultural inputs generally increased due to implementation of neoliberal policies by the government, which started in the 1980s and continued in the 1990s. Previously, from independence in 1963 and to the late 1970s, the government subsidised agricultural inputs and dairy concentrates and minerals were distributed through the government’s Kenta Farmers Association (KFA) which also ensured that high quality feeds were produced (Omore et al., 1999; Omiti et al., 2009). However, due to liberalisation and privatisation of the dairy subsector, many players came in to provide dairy inputs and in addition to difficulties with monitoring the quality of feeds by the government, the prices increased.

Lastly, poor management of Napier grass fields contributed to low yields. Napier grass yield is high when it is properly managed through regular weeding and application of adequate amounts of manure and supplementation with mineral fertilizers (MLD, 1991b). Decline in soil fertility due to inadequate fertilization of Napier grass was cited as a challenge in the senior staff seminars in 1993 and 1994. During the 1993 senior staff seminar, as a way forward to improve Napier yields, an officer pointed out that, “NDDP [was] therefore addressing itself to the concern of depletion of soil nutrients which [led] to declining harvest of fodder and [was] working out future plan of action (Kirui, 1993, p. 137). The challenge of adequate feeding affected both the project and farmers. Inadequate feeding of dairy cattle was a challenge to NDDP’s objective of increasing milk production. The developers wanted the project to continue by farmers implementing the components of zero grazing including adequate feeding. On their part, farmers wanted to continue keeping dairy cattle in the context of inadequate fodder because of the economic and social benefits of doing so. Farmers were also aware of the costs and benefits of implementing the various zero grazing components. Below, I discuss how the project officers and the farmers adapted fodder and feeding component of zero grazing.

5.4.1 Establishment of a fodder research unit

One of the initial responses by developers to challenges of fodder was establishment of a fodder research unit. When implementation of the project commenced, project officers realised that one of the challenges to high milk production was inappropriate fodder among smallholder farmers who were to implement zero grazing. Inappropriate fodder and feeding therefore threatened the effectiveness and continuity especially in terms of meeting its objectives. Consequently, developers were faced with the challenge of fodder and messages that were relevant for extension to meet the needs of smallholder dairy farmers. In search of intervention effectiveness and continuity, developers established a "... fodder research unit in 1982 at NAHRS so that extension could work hand in hand and be based on research" (MALDM, 1994, p. 26). The research unit conducted applied research by testing components of the zero grazing and identified those that were relevant to the smallholders (MALDM, 1994). Thereafter, the unit recommended extension messages and materials that assisted extension officers in their work. For example, in 1984, the research unit in collaboration with extension staff prepared a document on fertilization of Napier grass, which extension officers followed while training and advising farmers (MALDM, 1994). Despite extension messages from the research unit, extension officers did not always give the recommended advice. The research officer from the NDDP research station at NAHRS, Naivasha, in a letter both to dairy officer Kakamega district and the provincial dairy officer of Western province, questioned the advice by an extension officer in Kakamega district.

The dairy supply calculated has an error. The livestock roughage plan is largely out of balance. The inclusion of roughage supply from maize may not be necessary once the dairy matter balances the requirement. The advice to the farmer may not be realistic. The long-term plan is already made and acceptable by the farmers. Why should he increase the Napier when the need arises yet the plan is balanced and the number of cows is to be maintained? Is it possible to advise the farmer to sell the heifer and only rear one at the time of destocking? This could be a way out of the problem. Where does the farmer and his family live if he accepts your advice? How is the family's subsistence provided for? Why don't you advice two cows and a calf only. Maize cannot be main roughage. Advice not reflected is the plan. Overall, the advice is not of high quality, not specific and does not reflect on the plan. (Muma, 1991)

This is evidence that developers assumed that the staff that who had been trained at the research station would provide extension messages from the research unit unambiguously. Further,

different officers from the district or from the headquarters did not necessarily offer similar advice to farmers. For example, after examining a farmer's visitors book, the Kakamega district dairy officer decried conflicting advice given to farmers by different project staff and officials. Notably, there is no evidence that this conflicting advice from different project officers influenced farmers in particular ways. Interviews with farmers revealed that that they did not refer to visitors books for advice. This is similar to Li's (2005) argument that local practices do not necessarily conform to official design but are influenced by that design, often in unexpected ways and we cannot separate power and resistance. Improvement schemes are simultaneously destructive and productive of new forms of local knowledge and practice.

5.4.2 Fodder preservation and cultivation in smallholder farms

Both the project officers and farmers started to preserve fodder for use during the dry season, although through different techniques. Project officers started to promote fodder preservation through silage making through demonstrations. Although demonstration of silage making started earlier in the project, its emphasis as a means to alleviate fodder shortage during the dry season started when this problem became evident among farmers (van Helden, 1981b). Developers thought that ensiling Napier grass by farmers would enable them to preserve it for use during the dry season. Extension officers organised training sessions especially during agricultural trade fairs and in demonstration farms. During such sessions, extension officers brought the equipment for chopping Napier grass, and demonstrated how it can be preserved in pits as well as in plastic bags. Analysis of project documents shows that farmers were not keen on ensiling Napier grass. Farmers seemed to have resisted this approach as a means to alleviate fodder shortage during the dry season. For example, a survey conducted among project farmers by Wandera (1993) found that none of the farmers who experienced food shortage preserved fodder in the form of hay or silage due to high labour requirement (69%), lack of machinery (19%) and lack of time (12%). A farmer explained why he could not ensile napier or maize as extension officers had demonstrated.

It involves many processes. You know if you plant maize and cut it to make silage when it is ready, you will be seen as a mad. Therefore, silage making is like a dream to us. First, we do not have land. In addition, if you ensile the small amount maize you have planted, you will be referred to as mad. So I did not try that system (Author's interview with Shiemi, 2013)¹⁵

In addition, analysis of project documents reveals several challenges of making silage among smallholder farmers. In particular, the revised manual for zero grazing notes:

Silage making of tropical grasses like Napier grass has never become a common practice although fodder surpluses and shortages are experienced. The main reasons for this are the disappointing results due to losses of fodder and poor quality product. The disappointing results with silage making are related with the characteristics of tropical grasses ... To obtain a good product from grasses the added nutrients in the form of molasses seems to be needed. Another characteristic of tropical grasses which makes it difficult to ensile is the structure of the plant. Grasses like Napier grass are very coarse and difficult to compact. In order to compact, chopping of tropical grasses is often required. Another problem is that the fodder surplus is experienced in a time with often poor weather conditions (every day a shower). Pre-wilting of the grass becomes difficult and the result is that a product is ensiled with a very low dry matter-content [...] The chopping of Napier grass is, if done by a hand-driven chaff cutter a too labour intensive affair. This is one of the major constraints for smallholders to silage. Another problem is the availability of molasses and transport of molasses to the farm. (MLD, 1991b, p. 71)

Therefore, although due to threat to intervention effectiveness, the developers responded to fodder shortage among farmers during the dry season by promoting fodder preservation especially by ensiling Napier grass, this practice did not become widespread. The plan of operations for phase five noted this and as a way forward pointed out “Fodder conservation is only viable in areas with a long dry season. Therefore, it has not taken off in most areas except for silage making at the Coast. However, continued attention will be given to the practical possibilities of low cost high quality conservation methods” (MLD, 1990, p. 55). Despite developers’ promotion of fodder preservation through ensiling Napier grass or maize, farmers seem to have resisted this. In the context of requirements and difficulties associated with silage preparation including labour, time and hiring of equipment to chop fodder, farmers resisted fodder preservation techniques that were promoted by the NDDP. A farmer that I interviewed reported that “Hii watu walikuwa wanataka tupee ngombe mahindi. Nikashangaa. Ukipea ngombe mahindi, watoto watakula nini?” (I was shocked that these people wanted us to feed cattle on maize. If you feed cattle on maize, what will the children eat?). Thus, farmers found the idea of ensiling maize unrealistic as shown above and as an officer interviewed explained.

Because the only high yielding fodder crops we found were Napier grass and maize, we taught them how to ensile them. However, farmers do not want to feed maize to the cows because they eat the maize. Therefore, if you tell farmers you grow maize for silage, they will not do it. They know that maize is for *ugali* (maize meal). You end up achieving nothing. They will just look at you and do nothing. (Author's interview with Helder, 2012)

Having resisted fodder preservation through ensiling Napier grass or maize because this was involving, unrealistic and expensive, farmers preserved fodder in their own way. Analysis revealed that farmers preserved crop residues especially dry maize stovers for use during the dry season. During interviews, farmers stated that preservation of maize stovers was easy and straightforward. It only involved cutting dry maize stovers and storing them in a dry place for any period a farmer wanted to store them (Figure 13).

Figure 13 Preservation of dry maize stovers



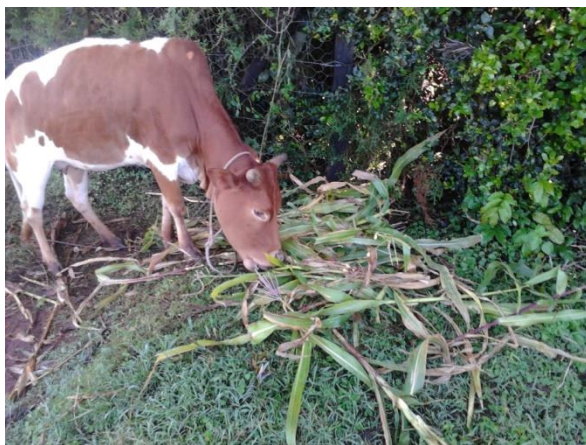
Farmers narrated that the only labour required was cutting them and transporting them to a dry place and checking them from time to time to ensure that they remain dry so that they would not rot. Therefore, preservation of maize stovers required less labour and costs compared to preservation of Napier grass through silage preservation. The other reason was that during maize harvest, maize stovers were plenty in the area and some farmers sold them to those who kept dairy cattle at a low price. Notably, farmers who preserved maize stovers were those who planted a lot of maize from which they could get stovers after maize harvest or those who could buy stovers from other farmers. Storage space also a factor in the storage of maize stovers and only

those who had space were able to do so. A farmer who preserved maize stovers and sugar cane tops said:

Every year around December, I harvest maize, however little. I stock all the maize stovers. I even keep the maize cobs. In addition, when farmers start to harvest sugarcane, if the tops are available, I may sometimes buy three or four tonnes of sugarcane tops. I stock all that to push on with feeding for some time. (Author's interview with Namalwa, 2013)¹⁶

The project officers did not like the way farmers preserved maize stovers. This was because of their view that dry maize stovers which farmers preserved without any treatment offered inferior nutritional value for dairy cattle. The officers also stated that most farmers did not use supplements like molasses to increase the palatability and nutritional value of the stovers, which made the stovers to be of little value for milk production. In addition, in response to fodder shortage, and because they did not ensile Napier grass or maize for use during the dry season, farmers started to feed their dairy cattle on different feeds that included whatever feed that they could access despite recommendations by the NDDP. These feeds included ordinary grass that they cut from the roadside or river valleys, machicha that they mixed with grass and crop residues like maize thinnings, green or dry maize stovers, sugarcane tops, banana leaves and stems and sweet potato vines. Similarly, in 1993, a survey that was conducted by a project officer among farmers who were involved in the NDDP found that “for the farmers who experience feed shortages the majority (71%) get extra feed by cutting grass along road sides and by feeding by-products. The remaining farmers graze their livestock directly in fields formally planted with crops” (Wandera, 1993, p. 36). Farmers who were involved in the intervention and indeed smallholder farmers in high potential areas in Kenya practice mixed crop-livestock farming. Due to this, from time to time, they harvest their crops and feed residues of crops to their cattle. Although some farmers bought or sold crop residues, they were readily available. This implies that due to shortage of fodder, farmers utilised feeds that were available in their context. For example, “Although there are many crop residues that represent a considerable potential forage resource where land is mainly devoted to human food production, the only by product used to any considerable extent is maize stover” (Wouters, 1985, p. 59). Therefore, the most common crop residue that farmers fed their cattle was maize stovers (Figure 14).

Figure 14 Tethered cow feeding on green maize stovers



Moreover, although the quality of fodder like roadside grass is poor and resulted in low milk production, feeding cows during the dry season was not just for milk production but also for survival of the cattle. Using these feeds for dairy cattle was due to inability to produce adequate Napier grass, yet they continued keeping dairy cattle which they had to feed as a farmer who was interviewed stated.

You know, we resort to banana stems during the dry season line now when there is no other feed. From the start of the year until the rainy season, you cannot see anything but soil and patches of grass around here or there. There is no fodder for cattle and we look for anything to feed them and to sustain them. Whatever you find even dry sugarcane tops, we chop, add salt, sprinkle it with some water and place it there for cattle. This is because we lack any other fodder. That is why you allow a worker to do so instead of the cow going without feeding at all. It does not matter what you give it because without any feed, can a cow really drink water? (Author's interview with Namalwa, 2013)¹⁷

Another adaptation that farmers came up with in response to inadequate fodder was extensive cultivation of Napier grass on roadsides, village paths or on whichever land that was available. When the intervention started, extension officers advised farmers to plant Napier grass close to the zero grazing units for easier management. The assumption was that if Napier grass field was closer to the units, farmers would find it easier to carry it to the units and also easily transport slurry to the field to maintain soil fertility. However, over time, due to fodder shortage, the extension officers advised farmers to increase area under Napier grass. Because the land that was

available for Napier grass had declined due to land fragmentation for inheritance and competition for land with other farm enterprises, some farmers did not have land to plant Napier grass. Some farmers started to plant Napier grass in whichever land and space they owned or could access including along village tracks or main roads (Figure 15).

Figure 15 Cultivation of Napier grass on the roadside



An officer who was interviewed associated Napier grass planting along roads to declining land sizes due to “land pressure and farmers realize the animals can feed a lot and they are not having enough space, there’s a space left outside and it was not the intention of the NDDP” (Author’s interview with Maina, 2012). Interviews also revealed that some farmers leased land to plant Napier grass. However, cultivation of Napier grass on leased land had its challenges. In particular, transportation of Napier grass to zero grazing units or slurry to Napier fields especially when the leased land was far from the farmer’s household and zero grazing unit was a problem. The result of this was that farmers either incurred more labour expenses to transport Napier grass or slurry. Farmers who did not have money to spend on labour and transport expenses for Napier grass and slurry risked having less fodder transported for their cattle or poor quality yields of Napier grass due to low soil fertility.

The last adaptation that farmers came up with in response to fodder shortage was planting of Napier using methods that led to higher yields. The NDDP zero grazing manual recommended

use Napier grass splits as the most appropriate method to plant Napier grass. The manual stated that the splits should “Be planted firmly in individual holes or furrows. Splits with roots and some soil attached give the best results” (MLD, 1991b, p. 58). Napier grass splits were to be planted on rows of two feet by three feet. However, farmers used different methods to plant and establish their Napier grass fields, some of which they thought resulted in higher yields. One method that they used which they said resulted in higher Napier grass yields is known as *tumbukiza* (put in a hole). Under *tumbukiza* method, farmers planted Napier grass in well-manured holes unlike recommendation by NDDP where farmers were to plant Napier grass in rows of two feet by three feet. Farmers used *tumbukiza* because they felt that it led to higher yields compared to other methods and Napier grass lasted longer. Although it was not clear when and how farmers came up with *Tumbukiza*, this method became popular and is used by many smallholder dairy farmers in Kenya. An officer interviewed confirmed:

I do recall when we were establishing Napier grass, we were saying that, you were to plant between the rows should be three feet and between the stems to be two feet. It was supposed to be two by three feet. Therefore, farmers decided to change that so their holes were bigger. They learned that *tumbukiza* method was yielding more than the usual method of three by two so the farmers adopted that method and they changed from three by two. They also learned that when you intercrop desmodium, desmodium is a leguminous crop. If you intercropped it with Napier grass in the old system of three by two, the chances were that the desmodium was eliminated during weeding unlike when it is planted in *tumbukiza* because in *tumbukiza* you just uproot the weeds, the plants that you consider to be weeds and you leave that one just there in the hole. Therefore, they adopted the *tumbukiza* and started leaving the three by two. (Author’s interview with Muriuki, 2012)

When extension farmers realised that farmers were using *tumbukiza* method, they informed the researcher who was based at the NDDP research unit. The researcher sought to find out if the method translated to higher yields like the farmers had claimed. This also came at a time when due to a paradigm shift in rural development, the participation of beneficiaries in development projects was in vogue. The research unit took the view of the farmers seriously. The researcher mobilised extension officers and they set up fields experiments on Napier grass planting using different methods including *tumbukiza* at the Naivasha research station and in other areas where the project was implemented. The research unit tested Napier grass yields from different field sites and found that, like the farmers had claimed, yields from Napier

grass planted using the tumbukiza method were higher. After this, the research unit asked extension officer to promote it as one of the methods planting Napier grass. Evidently, this was an adaptation by farmers that was then picked up, researched on and promoted by developers as part of the NDDP zero grazing components.

5.4.3 Protein gap and its supplementation

Another challenge that arose with regard to feeding dairy cattle was inadequate nutrient intake. In particular, studies conducted by the NDDP research station found that farmers could not provide their dairy cattle with adequate protein requirements. When the project started, extension officers advised farmers to supplement Napier grass with minerals and concentrates for balanced feeding and high milk production. In advising farmers so, they had assumed that farmers would feed their dairy cattle on not just adequate quantity but also quality fodder according to nutritional requirements. However, over time, extension officers found that farmers did not supplement Napier grass with minerals and concentrates at all or that the amount they provided was insufficient (Metz et al., 1995). Another study among demonstration farmers found that “33% of demonstration farmers did not supplement Napier with legumes or concentrates” (Wandera, 1993, p. 36). This was a problem for the project because other farmers were to learn from them yet the demonstration farmers could not feed their cows as recommended. Realisation that farmers did not feed their dairy cattle on adequate proteins led the project leaders to commence research on why farmers could not do so and alternative solutions. One of the findings of the situation analysis of the protein gap was that “the amount of protein which could be offered by the roughage system was inadequate” (MLD, 1991b, p. 7). The reasons for inadequate protein supply among smallholder dairy farmers were that the:

- a) grasses and by-products which are fed to cattle usually have low levels of crude protein
- b) farmers delay cutting Napier grass till later age when crude protein is low
- c) conventional protein sources such as dairy meal, cotton seed cake and fish meal are very costly
- d) lack of appropriate protein sources in some areas
- e) low use of concentrates by farmers and
- f) poor management of fodder stands. (MALDM, 1991, p. 6)

Situation analysis of the protein gap further found that low supplementation of was because minerals and concentrates were not readily available and where they were available, they were

unaffordable. It also found that Napier grass alone was inadequate to provide essential nutritional requirements for dairy cattle produce high milk (Wandera, 1993). Because feeds rich in protein were essential for increased milk production, the protein gap was a challenge to the objectives of the NDDP especially increase in milk production through which farmers could generate income from sales. Evidently, in the 1980s, the KFA, which was the sole supplier and distributor of minerals and concentrates, did not regularly provide the supplements and when availed, their quality was sometimes unknown.

To fill the protein gap in order to increase protein intake for dairy cattle in smallholder farms, from September 1987, NDDP started to promote legumes and Multi-Purpose Trees (MPTs) for fodder (MLD, 1991b). The assumption was that farmers could plant and feed the dairy cattle on fodder trees such as Lucerne, which offered a cheaper alternative to commercial protein supplements. Interviews with officers revealed that they thought this could work because commercial supplements were expensive and sometimes not easily available. An officer interviewed added:

Few farmers used concentrate feeds in addition to Napier grass. Most of the farmers were not feeding the concentrates as recommended. So, we were looking for a way for a farmer who does not want to spend money on buying concentrates because he has to pay school fees. Is a cheaper way available for him to get the protein that he is looking for in the concentrates? Therefore, now, the fodder trees came up and there were other projects, which were promoting such kind of trees for firewood, and we started promoting them for fodder. (Author's interview with Berita, 2013)

However, utilisation of MPTs for fodder trees by farmers to supplement protein seemed not to have worked in the way that developers had intended. A study on utilisation of MPTs presented during the 1994 senior staff seminar found that “While the acreage on MPTs and herbaceous legumes plus the number of farmers has increased from the year 1990, to date the utilization in terms of feeding to dairy animals has not increased proportionately” (Chibudu, 1994, p. 121). A related study on utilisation of MPTs among project farmers found that among those interviewed:

The proportion of farmers who used fodder trees was only 34.1% compared to 52.2% who did not use them while 13.7% did not know what fodder trees are. The recent DEAF survey indicated that Nyanza and Coast regions are using MPTs to a higher extent while MPTs are not very popular in Central Province” (Kimani & Chibudu, 1994, p. 33).

Hence, although for effectiveness and continuity, developers adapted feeding through introduction of MPTs and by giving farmers seeds and seedlings to plant in their farms, this did not solve the fodder gap. This is because few farmers planted the trees and legumes and even among those who planted, they did not regularly feed their dairy cattle on the MPTs and legumes. By contrast, as an alternative to commercial concentrates or use of MPTs, farmers started to feed their cattle on *machicha* (brewers waste). They believed that *machicha* was rich in protein and that it increased milk production. Farmers preferred *machicha* because it was cheaper and readily available. It came to the notice of the extension officers and the NDDP research unit that farmers were using *machicha*. Although developers did not conduct any research on the nutritional benefits of supplementary feeding with *machicha*, project staff advised farmers to continue using it. Interviews with officers who were involved in the project also revealed that during in service trainings, the NDDP researcher asked the extension officers not to criticise farmers who fed their dairy cattle on *machicha*. Further, *machicha* was included as one of the feeds that the project recommended. Inclusion of *machicha* as recommended fodder was partly due to the NDDP’s extension, which had changed focus from being researcher led to participatory, and farmers ideas were incorporated in the intervention. One dairy officer said:

We were not against it and we promoted it. I remember there was a time that it made us include brewers waste in our in serve trainings. You know we used to have training for staff. Therefore, whatever farmers were coming up with we had to update the staff on the same. Therefore, it meant that we had the information on these aspects that the farmers were bringing in to make the staff to be updated. (Author’s interview with Berita, 2013)

Farmers obtained *machicha* from a Kenya Breweries plant that was based in Kisumu, a nearby town. However, when the plant closed down, farmers who depended on *machicha* from the plant had challenges in access to supplementary feed. A farmer who used *machicha* during that time and experienced challenges after the closure of the brewery said:

I used to get machicha from Kisumu, mix it with Napier grass and place it in a feed trough. After a month, the cow produced a lot of milk. It produced a lot of milk. Machicha is very rich in milk production. Very rich. We have not had any feed like that. We experienced a very big setback when they closed the Kisumu brewery. (Author's interview with Shiemi, 2013)¹⁸

Utilisation of machicha to supplement protein intake is evidence that their context was important in influencing their choices of fodder and feeding. Interviews revealed that farmers were aware of the MPTs, which were involving, and commercial concentrates, which were costly. To utilise MPTs, farmers had to obtain seeds, which were sometimes a problem, plant and wait until the trees are ready, cut and feed to cattle. Machicha was ready for use in feeding cattle and only needed to be mixed with other fodder like Napier grass compared to MPTs. They decided to go for machicha that was cheaper and less involving, in so doing addressed the protein gap and enjoyed higher milk output. Therefore, farmers' preference of machicha was appropriate to their context characterised by limited resources to purchase dairy fodder supplements and lack of labour yet they needed protein supplements.

5.5 Housing of dairy cattle

Although before independence in 1963, farmers had cowsheds of different kinds, these were to secure animals at night, which was different from the NDDP's idea of zero grazing of complete confinement and feeding of animals in zero grazing units. The NDDP zero grazing package included housing of dairy animals in a zero grazing unit that consisted of cubicles (resting area), walking area, feed and water trough, milking place, calf pen, fodder chopping area, store and manure storage area (MLDM, 1990, P. 68). Construction of a zero grazing unit was an essential requirement for complete confinement of cattle. However, due to material requirements, construction of a zero grazing unit was capital intensive (MoA, 1979; MLDM, 1986). It also "... [required] an investment from the farmer, an investment which will be there even if the farmer wishes to change to another enterprise" (MLD, 1991b, p. 2). This is the reason that the project provided a grant of 50% of the costs of implementation of the technical package to demonstration farmers. Notably, due to financial constraints among farmers, construction and completion of zero grazing units in Kakamega district delayed during first and second phases of the project (van Helden, 1982a). Because of the delay, construction of the first NDDP unit started in January 1981

and by the end of 1981, 11 units were ready (van Helden, 1980c; 1981d). Raising requisite funds for the construction of zero grazing units was made worse because farmers had to pay for other household expenses like school fees for their children (van Helden, 1983a). Therefore, high costs of constructing a zero grazing unit posed a challenge to the effectiveness and continuity of the project yet due to anticipated benefits of dairy cattle farming, some farmers had expressed interest to join the project. Consequently, in the context of resource limitations among farmers, to reduce costs of unit construction and make it affordable to smallholder dairy farmers, the developers allowed farmers to use their own or locally available materials in the construction of the zero grazing units. Local materials were cheaper compared to the more expensive ones that the project recommended that included use of cedar posts. A dairy officer confirmed that:

For the zero grazing units, the drawings were to scale done by an architect and the quantities were known. When we started building the units, we had demonstration units. We wanted something to be durable and smart. Therefore, we had cedar posts, mabati roofs, and concrete floor was necessary otherwise, you get problems with foot rot and things like that. And the food trough was either made of bricks or concrete cemented. Therefore, it was high tech thing. Then we told the farmer look, in many areas, you have a lot of stones, so you don't have to buy ballast, you can make it. Sand is in the river and you do not have to go and buy. You have gum trees by the river. Because our drawing was cedar posts, which were expensive, if you have your own posts, use them. So we advised farmers to look at what materials they have themselves to reduce the cost. Then farmers were asking now can we use half drum for water. I said yes, why not. *Na mimi niko na miti hapa* (I have trees), can I use them as posts. Yeah. A farmer asked me, can I put grass on the roof? I said yes it is a good idea but put it high enough because when you do not feed the cow it will eat your roof. Therefore, I had some zero grazing units in Kabras with grass roof and it was very comfortable inside. Therefore, from the smart nice units, the farmers rather preferred to use local materials. So through the discussions with the farmers we were able to build eventually some very cheap zero grazing units. (Author's interview with Helder, 2012)

By asking farmers to use own or locally available materials, this recommendation resonated with the views of the farmers who wanted to join the project but could not raise requisite funds to construct a zero grazing unit. A farmer who was interviewed narrated his conversation with a dairy officer who had encouraged him to start dairy. "The white man asked if I had poles and I said yes. Can you get poles for the roof? I said yes. Then he brought mabati. He helped me with mabati but not the poles, cement and construction of fodder trough" (Author's interview

with Shiemi, 2013)¹⁹. Later, during phase five of the project, changing the design of the NDDP zero grazing unit to reflect the context of farmers was considered one of the means to make the intervention relevant to farmers. In relation to this, during a senior staff seminar in 1994, a presenter said “The project can [be more relevant to farmers] by redesigning the housing unit and developing specific design for different regions taking into consideration the land size, material availability and the costs involved” (Chelanga, 1994, p. 99).

Another aspect of the zero grazing unit that extension officer adapted was its size. This occurred when during field visits the officers realised that farmers preferred small size mature dairy breeds like Ayrshire. Farmers did not want to construct zero grazing units with large cubicles, which they considered unnecessarily expensive. Some of the farmers therefore resisted the NDDP zero grazing unit design, which was based on large size mature dairy breeds like Friesians. To overcome resistance from farmers and to ensure that farmers joined the project for them to report progress and meet targets, while pegging out units, they reduced the size of cubicles according to the requirements of farmers. A project officer who was interviewed explained:

The design that NDDP was for Friesian animals, the large animals but here in our communities, we could get smaller animals that could not occupy the entire cubicle. The cubicle was too big for the animal. The animal is now small. The first design was designed for big animals but now we had to modify that unit depending on the breed. Farmers did not want to construct big cubicles. The structure may look the same but in between the partitioning, we partition according to the type of breed, the animal that one we had to modify. When technicians go to the farm, we do with what the farmer has. We designed the housing according to the way the farmer wanted, what the farmer has like materials and size of animals. (Author’s interview with Nyongesa, 2012)

Further analysis revealed that some adaptations like change of the zero grazing unit dimensions took place at the intervention’s head office by the project team leaders as well as at the field level by extension officers who adapted it without informing the project management team at the national headquarters. As a result, although the intervention comprised standardised components for zero grazing according to the manuals and guidelines, its actual implementation did not reflect this. At the field level, extension officers promoted the components that were relevant in ways that farmers could implement them. In addition to allowing farmers to use locally available

materials to construct zero grazing units, semi-zero grazing became a common practice among farmers against the recommended practice of complete confinement of dairy cattle in zero grazing units. In 1984, data from Dairy Extension Advice Form (DEAF) reports showed that fewer animals were kept in units, high number of cattle kept outside the unit and that the units were being used as night *bomas* (sheds) only (van Helden, 1984b). The challenge was that although developers recommended complete confinement of dairy cattle, this was not always possible due to difficulties with providing adequate fodder and farmers allowed their cows graze on natural pasture in addition to stall-feeding. In response to this, developers recommended semi-zero grazing especially in areas where farmers had more difficulties producing adequate fodder.

Interviews with farmers also revealed two components of the NDDP zero grazing unit that they resisted. The first one was that some farmers did not include a calf pen, a structure in the unit that provided a specially sheltered separation for the calf with its own feeding facility, while constructing zero grazing units. This was because farmers felt that calves, especially newborn calves would be kept better in warm areas like their living rooms or kitchen, a practice, which is common until today. They therefore did not see the need of including a calf pen that they would not use. Other farmers believed that it was against their culture to construct a calf pen before a calf was born. The belief was that such construction would be a bad omen and the spirits could harm the cow or the unborn calf. Further, for some farmers, who could not raise adequate funds, they did not consider a calf pen important and did not include it. The second component that farmers adapted was the cubicles. Some farmers whose units had been constructed with supervision by extension officers removed the poles that separated the unit cubicles after construction was completed. Because the cubicles were constructed in such a way that cows could not turn around, the farmers felt that the cubicles were small and the cows would be stressed while in the cubicles.

5.6 Milk marketing

The NDDP focused on milk production through improved fodder, improved breeds and management in smallholder farms. Over time, project farmers in some areas had challenges marketing their milk because NDDP focused on milk production and not its marketing. Before milk marketing was liberalised in the early 1990s, farmers were expected to deliver their milk to

KCC through dairy cooperative societies or other collection agents. Sale of unprocessed milk without licence from KDB was illegal. However, as shown in Table 9, in 1993, 42% of all the milk was sold locally. Further, local sales played a major role in Coast, Nyanza and Western provinces compared to Central province.

Table 9 Milk sales, calf feeding, and home consumption (l/day)

Province	District	Local sales (%)	Society sales (%)	Fed to calves (%)	Home consumption (%)
Coast	Kilifi ^{iv}	65	9	8	19
	Kwale	72	0	4	24
	Lamu	51	0	1	48
Eastern	Taita-Taveta	60	4	8	27
	Embu	38	25	8	29
	Meru	39	22	9	30
	Tharaka-Nithi	34	22	6	38
Central	Kiambu	21	46	8	25
	Kirinyaga	34	22	14	31
	Muranga	22	44	7	27
	Nyandarua	5	61	4	30
	Nyeri	26	42	5	27
Rift Valley	Baringo	28	32	11	30
	Bomet	21	33	8	38
	Kericho	26	27	7	40
	Keiyo-Marakwet	36	17	5	41
	Nakuru	38	24	6	32
Nyanza	Nandi	33	25	6	36
	Homa-Bay	50	24	15	11
	Kisii	55	6	9	30
	Migori	58	17	6	18
	Nyamira	48	12	7	33
Western	Siaya	60	8	9	23
	Kakamega	66	1	7	27
	Vihiga	59	7	8	27
Province					
Coast		63	6	8	24
Eastern		38	23	8	31
Central		24	42	7	27
Rift Valley		30	27	7	37
Nyanza		54	13	9	25
Western		63	3	7	27
All		42	22	8	29

Source: Metz (1993, p. 29)

^{iv} The total is 101% in the original document

In Kakamega district, some farmers refused to deliver milk to KCC because KCC paid little for their milk, due to inaccurate weighing of milk especially when children delivered the milk to collection centres and late payment for milk delivered (van Helden, 1984c). An evaluation of the project in 1986, found that “The farmers who sold their milk through KCC or Dairy Cooperative Societies received a lower milk price (KSh. 2.29/litre against KSh. 3.81 for local sales” (Woersem et al., 1986, p. 9). Milk marketing in many areas was affected by “poor infrastructure (roads), inefficient management and inadequate facilities of the existing dairy societies...” (MLD, 1990, p. 27). The trend of high prices for local milk sales was also evident in the 1993 survey among project farmers which found average milk price for local sales to be KSh 10.27 per litre while the price paid by the dairy societies was KSh 7.04 per litre (Metz, 1993).

Local milk sales posed challenges to the project because farmers who sold milk locally without licence risked arrest by KDB officers. For purposes of hygiene, the KDB through the public health outlawed sale of unprocessed milk without licence. The KDB prescribed milk handling and marketing procedures. For example, farmers who had licenses were expected to carry milk in aluminium containers and put on uniforms (white dustcoat) while handling milk. A farmer interviewed explained his experience with local milk sales without licence from the KDB.

I refused to sell my milk to KCC. You get more money by selling direct from the farm. People came to my farm to take milk. All the milk that I produced was just consumed by all the members around. I remember there were lot restrictions in milk sales. We had a lot of them and once in a while I would take milk to the town to the Asian community and my boys would be arrested. But I explained to them that the dairy co-operative here has not been functional or active so I would explain. These people would arrest my boys then they would come to school, you see the school was in town then I would explain my case and they would leave me alone. The Dairy Board had an office here and they had an office from Eldoret and had a pickup, small Nissan. They go around here patrolling and they are the ones who would track my boys. They wanted me to get through that system but the system was not working well, they were not paying people properly so I would not take my milk there. (Author’s interview with Khasewa, 2013)

Arrest of farmers for selling milk locally threatened the effectiveness and continuity of the project. It was pointed out that “in some project areas milk marketing situation is very poor, what makes the zero grazing system hardly economical viable. This is often due to poor management

and inadequate facilities of existing co-operative dairy societies” (MALDM, 1994, p. 12). Project officers were concerned that farmers would be discouraged from implementing zero grazing if they were not able to sell their milk. The dairy officer, Kakamega district in the district report for June 1980 described this threat as follows:

Police arrested two farmers with the assistance of the dairy inspector. The farmers were accused of selling milk without a licence and were fined KShs. 400 and KShs. 500 respectively. At the moment the farmers are being discouraged and a solution has to be found to solve this problem, otherwise the dairy progress, in this area, will be reduced to the minimum. Now the farmers do not know where to sell their milk, as they are afraid of being caught again. For the time being, the only solution is to licence those two farmers until more milk is available so that an organised and economical collection system can be established. (van Helden, 1980e, p. 4)

The problem of milk marketing in Mumias, one of the divisions of Kakamega district was acute because it is largely a sugarcane growing area and KCC (Kakamega dairy) did not have milk collection centres because few farmers kept dairy animals. Because farmers who kept dairy cows did not have any other market, they continued to sell their milk in local market centres (van Helden, 1980e). Milk marketing was made worse when another farmer was arrested in Mumias for lack of a uniform (van Helden, 1982b). In response, NDDP officers assisted farmers in Mumias to apply for licences from the KDB so that they could sell milk locally. The dairy officer also negotiated with the KDB and the police to allow farmers who had been arrested to be released on bond and give other farmers time to comply with the requirements of the KDB. Assisting farmers to get licence was in line with the third evaluation mission of the project that recommended that the project should continue, “To play a stimulating role in the identification, appraisal and financing in the field of milk marketing, if deemed necessary” (Woersom, et al., 1986, p. 22).

In addition, in areas where KCC did not have milk collection centres, NDDP assisted farmers by linking them to established dairy cooperatives or assisting them to form dairy groups. An example was Kiambiri, Ikolomani division. KCC did not have milk collection centres in Kiambiri and farmers sold milk locally (van Helden, 1980f). Local milk sales became a challenge when milk production increased in the area and farmers could not sell all their milk. NDDP officers

facilitated the farmers to contact Kakamega dairy, which after discussions agreed to establish a milk collection centre in the area. The centre became operational and milk was transported to the dairy by *matatus* (public transport vans). However, although NDDP officers promoted formation of groups to sell milk, in areas where farmers had adequate local market for their milk the groups failed. This is because farmers did not see the need to pay dairy group expenses or incur labour expenses to deliver milk to collection centres. A farmer who was interviewed reported:

I did not experience difficulties selling milk. You know, I used to milk about 80 litres in the morning, and all of it was bought. In the evening, we milked about 60 litres, all of which we sold. I did not see any need to join a milk-selling group. (Author's interview with Alwanga, 2013)²⁰

Notably, sale of unprocessed milk at higher prices than those that KCC paid did not start with NDDP project farmers. In 1956, a report of inquiry into the dairy sector found that “In addition, each town, there [were] producers who [delivered] fresh (unpasteurised) milk and also producer/retailers [sold] fresh milk, including Channel Island milk, which [commanded] a slight premium” (Blundell, 1956, p. 8). The report further raised safety concerns over unprocessed milk sold locally “The Tetrapark system ensures a high degree of cleanliness as the containers are automatically sterilized and they are non-returnable. This would also seem to reduce the opportunities for adulteration, which constitute a major problem, particularly in the house-to-house distribution” (Blundell, 1956, p. 13). Interestingly, sale of unprocessed milk and the concerns over safety remains. In August 2013, the KDB as it has done several times before banned the sale of unprocessed milk due to concerns over public health risks.

Therefore, due to assistance from officers, farmers were able to sell their milk locally after they obtained licences from KDB. This is the reason that the project succeeded in areas where farmers preferred to sale their milk locally. Otherwise, without access to local markets and lack of KCC collection facilities, project farmers would have had trouble in selling milk. This would have threatened effectiveness and continuity of the intervention that did not focus marketing at all. Hence, in the context of higher prices for local milk sales, developers assisted farmers to obtain

licences which enabled them to sale their milk and continue with the implementation of zero grazing components.

5.7 Calf rearing

As part of calf rearing, NDDP advised farmers to kill or slaughter bull calves at birth or soon after in order to reduce rearing costs. Fertility report of 1987 cautioned “keeping male young stock just for the sake of selling it later on will usually not give any profit to the farmer...farmers should still be encouraged only to keep male young stock if they have a special purpose for it” (van de Valk, 1988, p. 15). This was similar to how project officers who visited Alwanga, one of the project farmers in 1985 advised him. They wrote in his visitors’ book:

12/2/1985

We visited the farm today as visitors from Naivasha. We are impressed by the standard of management. The cows are in good shape. The Napier grass looks good. The farm is well maintained and well weeded. The cows show regular heats ... The farmers should consider to dispose of the bull calves as the bull calves are a loss especially with the high milk prices the farmer gets. Keep up the good standard.

A.P. Wouters, S.P. Okuro, Y. S. van der Valk, S. J. H. Onyango, DDP Naivasha

The extension officers further demonstrated how to slaughter a newly born bull calf, cook and eat it. This was done in one of the demonstration farms. A farmer who had attended the demonstration and ate the meat who I interviewed said the meat had no taste and the whole demonstration looked like drama. However, farmers resisted this advice and continued keeping bull calves. Because developers viewed rearing bull calves as a loss, a practice which they wanted to discourage, they thought of a beneficial way to discourage farmers from rearing them. The dairy officer for Kakamega district came up with an arrangement whereby farmers could sell bull calves for veal, which he described as follows:

I started with some of the farmers to produce veal, calf meat. There were few farmers who had Friesians and they produced five big calves and when that cow calved and it had a bull calf, I would tell the farmer to feed it proper for a few weeks, and then we slaughter it and sell it at good price. (Author’s interview with Helder, 2012)

Despite the officer's alternative to sell bull calves for veal, farmers continued to keep bull calves and ignored advice by extension officers. One of the reasons for this was religious and cultural beliefs. A farmer said, "My husband refused and had mercy on the calves. Officers did not want farmers to keep bull calves. My husband asked them why one should kill a calf. Leave it alone. So he did not kill any" (Author's interview with Asamba, 2012)²¹. An officer interviewed reported that in response to the advice that farmers should kill bull calves, "Others said you don't slaughter children" (Author's interview with Helder, 2012). Equating a calf with a child shows that farmers did not look at their involvement in dairy farming just as an economic activity but part of their lives. This could be interpreted to mean that farmers had their own models of what farming and in this case, dairy cattle farming should be like, ideas that were reflected in the kind of components that they implemented or resisted. Another farmer interviewed added:

They told us that bull calves consume a lot of milk, consumes a lot of fodder and has no profit. But as Christians, we saw it as unfair to kill bull calves from time to time just like that. Our cattle did not give forth many bull calves but had a bull calf after two or three years. Most of them were heifer calves. I told the officer that I did not think it was good to just kill a bull calf and feed it to dogs. And I continued to keep bull calves. (Author's interview with Nanjala, 2012)²²

Other farmers viewed bull calves as an opportunity to make money especially for those who kept cross breed cattle. Such farmers considered bull calves an investment and did not see it a problem like NDDP officers advised. Keeping bull calves reveals differences of how developers and farmers rationalised calf rearing, one component of the zero grazing components. From the perspective of developers, farmers were to benefit by selling bull calves to avoid losses of milk and fodder consumed by the bull calves. Farmers resisted this and kept bull calves, from which they could benefit by selling them later and feeding them on less milk and fodder to minimise costs associated with keeping them. The farmers quoted above:

It is not a problem keeping a bull calf and I do not take it as a problem although according to officers, it is a problem. I did not look at it as a problem because the calf will help me sometime. Bull calves used to sell a lot although the economy is now so bad. People used to come from far to buy bulls from here because they believed that the bulls were pure graded animals. I used to sell even bulls that could serve heifers. (Author's interview with Nanjala, 2012)²³

To minimise costs of rearing bull calves, farmers fed them less milk than the recommended, weaned them earlier and sold them when they were much younger. They also fed them on less fodder. The DEAF survey for 1993, farmers treated heifer and bull calves differently. For example, “Of the female young stock, 67% were kept inside the unit, whereas of the male young stock only 49% were kept inside” (Metz, 1993, p. 25). In addition, “fewer bull calves than heifer calves are fed milk and the amount they receive per day is also less... 23% of the heifer calves and 12% of the bull calves until the age of [six] months received concentrates (Metz, 1993, p. 26 & 27). However, as evident in this response by an extension officer who was interviewed, NDDP officers interpreted this as mistreatment of bull calves especially when compared to how the same farmers treated heifer calves.

You get the farmers were still keeping bulls but now what they were mistreating them. They were not giving them the milk they were supposed to take. They give them less, so you will get very emaciated bull calves in the compound. It was not a very good impression. (Author’s interview with Nyongesa, 2012)

From the foregoing, farmers saw it inhumane to kill a bull calf for veal or to feed it to dogs. They saw it as an opportunity to generate income by selling it when it matured. This is the reason that they even after the Kakamega district dairy officer arranged to have farmers sell of bull calves for veal, farmers continued to keep bull calves. It would appear that the project officers’ model of intensive dairy cattle farming for maximising profits differed from how farmers’ model. Although farmers were willing to implement the modern dairy practices and technologies, they only did so to a certain extent like evident in resistance to killing of bull calves. Arguably, keeping bull calves and feeding them on less milk and fodder was more consistent with their context. The farmers’ model differed from that of developers in terms of how they viewed rearing of bull calves although both had the same objective of making money. Therefore, farmers resisted this and continued to keep bull calves but came up with several ways to reduce costs associated with rearing the bull calves.

5.8 Management of soil fertility

NDDP promoted Napier grass as the main fodder but its management and intensive land use in the zero grazing system raised concerns over depletion of soil nutrients. To replenish soil fertility in Napier grass fields for high yields, the revised zero grazing technical manual recommended that farmers were to take all manure produced to their Napier grass fields.

At least twice a day the manure on the walking area should be removed. The best system is to bring this straight back to the field with Napier grass and work it into the soil. In this way the losses of nutrients in the manure are kept to a minimum [...] If no recycling is practised, the soil will be exploited, soil fertility will decline and the yield of Napier grass and other fodders will be reduced very much. (MLD, 1991b, p. 6)

In addition to manure, farmers were to apply mineral fertilizers in Napier grass fields. The project recommended that farmers use "... at least 4 bags (200 kg) of compound fertilizer (20:10:10) per acre of Napier per year. With respect to manure use, the project recommendation is to return all the manure to the Napier grass" (Metz, 1993, p. 7). In recognition of the challenge to maintain soil fertility, the third evaluation mission of the project in 1986 stressed,

As Napier is a high yielding fodder, the mineral subtraction is in most cases not fully replaced by fertilizers or manure. One of the main tasks of the extension staff will be to stress the importance of applying adequate fertilizer or manure on the Napier field. (Woersem et al., 1986, p. 10)

However, farmers did not adequately fertilize their Napier grass fields. A survey conducted among project farmers in 1992 found that

About 53% of the farms were returning most or all the manure to the Napier. Most of those farmers were using fewer fertilizers than advised. For the entire project about 93% of the manure is returned to either the Napier (54%) or to other crops (39%) (...). About 31% of the registered NDDP farmers [were] using mineral fertilizer, at about a quarter of the rate recommended by the project. (Metz, 1993, pp. 8-9)

Interviews conducted further revealed that farmers did not regularly apply manure on Napier grass despite heaps of cow dung next to the units. Some farmers heaped cow dung next to the unit and transported it to the Napier grass field when they had time and labour. However, keeping the

dung next to the unit for longer led to loss of nutrients through evaporation and leakage. To avoid this, NDDP had advised farmers to mix cattle urine and dung and take the resultant slurry to Napier grass fields. However, instead of working the slurry into the soil, farmers applied manure on the soil surface, sometimes when weeding had not been done. The other reason for inadequate application of fertilizers was that during the initial stages, this was because farmers had not fully understood the importance of manuring Napier grass. For example, when the project started and the dairy officer was posted to Kakamega held discussions with farmers on the importance of applying mineral fertilizers on Napier grass, farmers wondered, “How can we buy fertilizer to apply on grass given to us by God?” (Author’s interview with Helder, 2012). Further, a survey among project farmers found that management of Napier grass involving manure and fertilizer application, weeding and so forth was influenced by the financial ability of the farmers as well as their schedule (Wandera, 1993). Financial ability did matter because “Unfortunately, commercial fertilizers are costly and most smallholder farmers may not afford them” (Wandera, 1993, p. 41). Project documents show that during a staff seminar in 1993, high cost of fertilizers was identified as one of the factors that constrained sustainability of the project because it affected Napier grass yields for farmers who could not afford to pay the high prices.

Poor fertilization of Napier grass was also due to labour shortage. Fertilization of Napier grass especially application of manure or slurry on Napier grass fields required a lot of labour. Slurry is bulky to transport especially for farmers whose Napier grass fields were far from their zero grazing units. Independent consultants who assessed the impact of the project at the end of phase five pointed out “The adoption package results in more manure production at a central place. In most circumstances, the manure is more than the labour can cope with and in certain areas, cattle are almost sinking in their manure” (PDC, 1994, p. 17). Related to this was that people in the area perceived slurry as repugnant, which made it difficult for farmers to hire labour for dairy activities. As a result, hired workers who accepted to transport slurry demanded to be paid a lot of money, which increased costs of implementing zero grazing as recommended. A farmer who was interviewed narrated how a hired worker made it difficult to fertilize Napier grass.

I had a farm worker. Sometimes, they refused to take slurry to Napier grass fields. You know, it is not a problem to carry cow dung but carrying slurry is a problem. They refused to carry slurry from the unit to the Napier. First, you have to mix cow dung with the urine and carry it to the Napier using a bucket. They refused to do so. They could carry but not every day. They refused. He saw it as a lot of work. I used to work in a nearby school. When I got back, he informed me that he had a lot of work. And you can see that it is mere pretence. Yet you can carry slurry with a bucket thrice a day after mixing. But he does not want to do so. You inform him to apply slurry where he cuts Napier. He does not want to do so. He sees it as a lot of work. He completes cutting Napier where you asked him to cut. Then he sets aside another day to weed and a different day to transport slurry. He takes about three days. Yet you should weed and apply slurry on the same day that you cut grass. (Author's interview with Nafla, 2012)²⁴

The ability of farmers to manage Napier grass fields was made worse by meagre income from dairy farming activities. This became difficult when farmers had to hire labour for dairy activities especially management of Napier that included fertilization of Napier grass fields. According to the third evaluation mission of the project,

Milk prices tended not to compensate for labour, costs of supplements and costs of land. While labour can be assumed to be family labour, and land to be free, as well as the capital to be interest free, the farmers appeared to accept low prices so far as they got a price not less than 50% of the cost price. (Woersem et al., 1986, p. 21)

Because farmers were also involved in other farming activities in addition to dairy, when they hired labour to assist in all farming activities, such workers demanded a lot of money that farmers could not always afford. This is clearly illustrated by the response from a farmer interviewed with regard to changes in hired labour over time.

In the past, you could stay with an employee for even up to six years without problems. Nowadays, they are cunning and lazy. Secondly, they love money and want to get more money than work. Now, that is the problem. Don't you see even the one I now have, if I do not reduce the working hours, he will just run away. But you did not see him now. He left after finishing watering the cows. He went to do his work. But during that time, I had workers who lived with me. This one is a wage earner. There is a very great difference because those who were hired those days were serious with work while current ones are not. Further, these days, if you are not around, they will do nothing. They cannot even inform you when a cow becomes sick. If you do not observe, you will regret. They do not care. That is how they are. Previously, it was easy to find workers. (Author's interview with Ndombi, 2012)²⁵

It would appear that manuring Napier grass was a problem in the country at the time when DDP was instigated. In 1981, an investigation into the status of dairy and beef sectors did not find evidence that farmers applied fertilizers on pasture, fodder crops and trees, yet this was essential to improve fodder yields (RoK, 1981). Because farmers continued to keep dairy cattle, they had to produce Napier grass that they relied on to feed their dairy cattle. Due to the challenge of inadequate fodder in the context of inadequate labour provision, poor management of Napier grass and lack of finances to purchase commercial fertilizers, both the developers and farmers came up with adaptations to deal with declining soil fertility.

Concerned with declining Napier grass yields due to loss of soil fertility, the NDDP researcher started conducting research on manure. Findings revealed that farmyard manure which farmers utilised had poor nitrogen content compared to manure produced in Europe. Based on this, the researcher recommended proper storage and transportation of manure to Napier grass fields (PDC, 1994). Farmers were advised to transport manure to Napier grass fields after every two days to avoid loss of nutrients. To make it easy for manure to accumulate, developers introduced a manure pit, a facility to collect and store liquid manure, which is directly connected to the zero grazing unit which was a hole in the ground in most farms. However, farmers had difficulties transporting manure to Napier grass fields regularly due to labour shortage.

To ease transportation of slurry, developers introduced manure bags. However, farmers did not use the manure bags to transport manure because the major problem was with labour to transport the manure. On their part, to address labour shortage, farmers dug shallow canals from their zero grazing units so that slurry to flow directly to the Napier grass fields by gravity. However, this was utilised only by those farmers whose Napier grass fields were near their zero grazing unit. Others transported manure by use of wheelbarrows, oxen driven cart or carried it to Napier in buckets by use of household or hired labour. In addition, to ensure Napier grass continued to produce high yields after failing to apply recommended amount of fertilizers, farmers started to rotate or replant Napier grass in different or same fields. A farmer who practised this said, “After a long time, you renew the Napier again. You obtain planting materials through splits and pant them afresh. We sometimes do crop rotation. You have to change it otherwise it is difficult to

grow it in the same place” (Author’s interview with Makhoka, 2012)²⁶. Farmers replanted Napier grass or rotated it when yields decreased to ensure that yields remained high for them to feed their cattle. Project officers noted this adaptation and discussed it during a senior staff seminar on sustainability of the project when a presenter said that “the majority of the farmers had uprooted and replanted Napier grass due to the low productivity that is associated with continuous production and use” (Wandera, 1993, p. 38). Therefore, farmers adapted Napier grass management to fit in their context characterised by labour shortage and limited finances. Farmers did not have finances to pay for labour but they wanted higher yields of Napier. However, developers criticised this method because they considered it an unsustainable means of replenishing soil fertility. In relation to this, in 1993, an officer pointed out:

Low productivity of Napier on most of the farms visited is a danger that threatens sustainability. The problem cannot be curbed by rotating Napier in different plots or use of manure from the zero grazing unit alone. Additional nutrients must be imported from elsewhere to boost the productivity of the plots. (Wandera, 1993, p. 41)

However, interviews revealed that farmer continued to replant and rotate Napier in different fields. Another adaptation that farmers came up with regard to management of soil fertility was composting manure and applying it on other crops. NDDP advised farmers to apply all the slurry on Napier grass and even top dress Napier with mineral fertilizers. However, farmers chose to make compost manure from cow dung and other farm organic matter (Figure 16).

Figure 16 Composting cow dung and other organic matter



Nafla's farm, 2012



Natasha's farm, 2012

Composting enabled them to use manure not only on Napier grass but also on other crops, as an alternative to commercial fertilizers. It also helped the farmers to utilise the waste generated from fodder waste. In addition to making compost manure, some farmers applied slurry on vegetables, which were usually grown closer to the dwelling units. Applying compost manure on other crops and slurry on vegetables implies that other farm enterprises competed for manure with Napier grass (MLD, 1990). When extension officers found that farmers were making compost manure, they informed the NDDP researcher. Although extension officers thought that making compost manure was relevant in the farmers' mixed crop-livestock context, they were concerned with low Napier grass yields due to inadequate fertilization. At the same time, one of the dairy officers criticised the intervention because composting as a technology for recycling organic matter had not been given weight and there was no mention of compost as a technology for extension (Mukolwe 1993). The researcher investigated processes of making compost manure from cow dung and fodder waste among project farmers. From the findings, the researcher recommended training of farmers on making compost manure from cow dung and fodder left overs be included in the project extension. Thus, during phase five, extension officers included training of farmers on making compost manure and its proper application on Napier grass and other crops for high yields. Developers did this in recognition of the farmers' context and due to influence from the FSR, which encouraged holistic farming at the time. A survey among project farmers in 1993 which confirmed use of compost manure by farmers on other crops concluded that "This is an indication that the manure is considered a valuable output of the dairy enterprise widely used for other crops" (Metz, 1993, p. 9).

The findings that farmers had difficulties maintaining soil fertility especially in Napier grass fields differ with findings by Conelly (1992) on utilisation of manure. Conelly (1992) found that farmers in Hamisi, one of the divisions of Kakamega district applied manure to the extent that they experienced shortage of its supply. By contrast, fieldwork for this thesis found that farmers did not apply adequate manure on Napier grass or their crops and this was not because of shortage of manure. From field observations, many farms had heaps of manure because they lacked labour to transport it to their Napier grass fields.

5.9 Conclusion

This chapter has explained adaptation of NDDP by developers and farmers. I have shown that by supporting demonstration farmers with finances and materials to construct zero grazing units, providing them with consistent and regular advice, enforcement of extension messages on zero grazing, farmers initially implemented components of zero grazing as NDDP had recommended. Adaptation of the components started mostly with second generation farmers. When project officers realised this, they started to adapt the intervention by coming up with components that were relevant to the context of the farmers. I have explained how and why the developers and farmers adapted the intervention and how their interactions in the course of intervention sometimes informed how developers adapted some zero grazing components that therefore changed the intervention.

I have explained how the NDDP extension strategy evolved due to changing context. The focus of extension changed from a commodity approach to farming systems and participatory approaches due to changing rural development discourses in the course of the project. The project officers did not coerce the farmers into implementing the NDDP but used demonstrations, incentives and persuasion to promote the project. This was partly informed by the development discourses of the time through recognition that the project could only succeed through the actions of farmers hence the need to involve them. Furthermore, in the context of budgetary constraints, and few staff yet the number of farmers was increasing, developers changed the focus of extension from individualised visits to focus on groups of farmers. I have explained how in search of intervention effectiveness and continuity, developers introduced printed, audio and visual materials and resources for extension, changed the criteria they used to register farmers and assisted farmers to identify and obtain good dairy cattle breeds.

By emphasising that adaptation was an attempt to bring back the context into the intervention, I have shown how in the context of inadequate fodder, financial resource constraints among farmers, difficulties in milk marketing and declining soil fertility, both the developers and farmers adapted the intervention. In response to inability of farmers to provide quantity and quality fodder to their dairy cattle, developers established a fodder research unit to provide a

scientific basis for extension messages. Based on the findings from the research unit, developers introduced farmers to fodder preservation through silage making and MPTs to supplement protein intake. However, farmers found silage-making involving in terms of labour and finances required. As a result, they fed their dairy cows on ordinary grass from the roadside and river valleys, and utilised crop residues like maize stovers, sweet potato vines and sugarcane tops, banana leaves and stems. Although these are poor quality feeds and resulted in low milk production, I have argued that these are the feeds that they could obtain in their context in order to continue keeping dairy cattle and benefit in doing so. Farmers also fed their cattle on machicha as an alternative to commercial concentrates like dairy meal and MPTs. Further, farmers intensified cultivation of Napier grass along the roads or on whichever space that was available and leased land for Napier. Lastly, farmers used tumbukiza method to plant Napier because yields were higher and Napier lasted longer. Moreover, I have shown how project officers learnt from farmers and in some cases researched of farmers' practices and made them part of the intervention.

I have explained that because construction of a zero grazing unit required a lot of finances and in the context of limited finances among farmers, developers agreed with farmers that they use locally available materials that were cheaper. Extension officers were also flexible and reduced the size of the zero grazing units according to the desire and financial ability of farmers. I have also shown how farmers resisted some aspects of the unit by declining to include a calf pen and removed poles that subdivided the zero grazing units into cubicles. Farmers also resisted NDDP's recommendation of slaughtering or killing of bull calves and instead continued to keep them for sale. Resistance had economic angle. Farmers wanted to continue gaining because they were aware of the costs and benefits of implementing various components of zero grazing and they utilised what was available to keep costs at a minimum. They did not just implement or resist any component for the sake but due to how it would benefit them.

In addition, I have explained how due to inability of farmers to maintain soil fertility in Napier grass fields in the context of labour shortage and lack of cash to buy mineral fertilizers, Napier grass yields declined. Although developers responded to this by advising farmers to make manure

pits to collect manure, introduced bags for carrying manure, farmers rotated and replanted Napier grass in different fields and directed slurry to flow directly from zero grazing units to Napier grass fields. I have also described how in the context of mixed crop and livestock farming, farmers made compost manure which they applied on other crops in addition to Napier grass. In addition, developers researched on compost manure and started to advise and train farmers on making compost manure from cow dung and fodder left overs.

Evidently, despite adaptation of the intervention by project officers to enhance its effectiveness and continued implementation, this chapter has revealed that there were limits to what they could achieve. This was evident in introduction of MPTs and rearing of bull calves, which did not succeed as the project officers had expected despite having assisted farmers to generate income through sale of veal. On the other hand, farmers did not resist the intervention in its entirety but some components, which they adapted to enable them keep dairy cattle. They had livelihood needs like income generation through milk sales. This may be interpreted to mean that the intervention was not always powerful to bring about change no matter how well intentioned the developers were by adapting its components to be more relevant to the context of farmers. Farmers had their own ideas through which they implemented some components and resisted others. Overall, adaptations were ubiquitous during implementation of the intervention and I argue that understanding these adaptations enhances our knowledge of development interventions and their outcomes. Therefore, studying adaptation by both developers and farmers provides a comprehensive framework to explain the divergence between intended and actual outcomes of interventions. Furthermore, with close reference to context and in adaptations occurred, intervention effectiveness, matching, fit and resistance mechanisms can be useful in explain adaptation of dairy improvement by actors.

CHAPTER SIX

The diminished intensification of dairy cattle management

6.1 Introduction

In this chapter, I explain how in the long run, NDDP's intensification of dairy cattle management has diminished. This is evident in coexistence of modern and indigenous dairy technologies implemented by farmers who were involved in the NDDP or non-implementation of any dairy technologies and practices. One of the features of this coexistence is semi-zero grazing, where farmers combine stall-feeding of dairy cattle with grazing on natural pasture. This is unlike what project intended to achieve, intensification of dairy cattle management. Further, I illustrate the context in which intensive dairy cattle management diminished. In particular, I explain how in the context resource constraints like inadequate finances, labour shortage in smallholder dairy farms and inadequate fodder, intensification of dairy cattle management has diminished. Further, as it will become evident structural reforms in the dairy subsector led to market provision of dairy services and inputs, which resulted in escalation of costs of dairy farming and difficulties accessing dairy services,

6.2 Long run outcomes of the NDDP

As already discussed in Chapter Four, the NDDP consisted of several components for intensification of dairy cattle management. The developers intended that implementation of the zero grazing components would lead to intensification of smallholder dairy cattle farming which would address the underlying problems of land scarcity, poverty among smallholder farmers and increased demand for milk. Because components of zero grazing were central to intensification of smallholder dairy cattle management and subsequent objectives of the intervention, I look at the dairy cattle technologies and practices that farmers were implementing after a long period. I use the notion of long run to describe the dairy farming technologies and practices that farmers were implementing during fieldwork for this thesis (2011-2013).

Analysis shows that in the long run, farmers who had registered with the NDDP were either implementing a combination of indigenous and modern dairy technologies or where not implementing any of the dairy practices and technologies at all. Non-implementation of dairy technologies describes farmers who were involved in the NDDP and implemented the zero grazing components but no longer implement any of those technologies. Under coexistence, farmers implement a combination of their indigenous technologies (technologies before the NDDP) and those that were promoted by the NDDP (modern). The central feature of coexistence is that farmers keep indigenous cattle breeds based on some of the NDDP technologies and practices, or keep improved dairy cattle breeds (crosses/exotic) based on some indigenous technologies and practices. As an example, farmers tethered (an indigenous practice) grade cattle (crosses or exotic dairy cattle breeds). Another example is where farmers who keep exotic breeds allow them to graze on natural pasture in their compounds, commonly known as semi-zero grazing in which “Grazing is supplemented with stall feeding of Napier grass and other fodders and is practised with grade cattle” (Maina et al., 1994, p. 134). In 1993, over half of the first generation farmers did not practise zero grazing (Wandera, 1993). There are also cases where farmers keep dairy and local breeds in the same compound but under different management practices like feeding, breeding, housing and disease control regimes. Some project farmers had practised coexistence for a long time. A farmer who kept local and dairy cattle since he joined the project said:

From that time until now, I have always kept indigenous cattle. The good thing is that I do not keep them in the same place and I regularly spray them because I know that they are carriers. I keep them but I know that they are carriers. So, I spray them regularly. (Author’s interview with Ndombi, 2012)²⁷

Another aspect that diminished was the level of dairy cattle management. Low level of dairy farm management was characterised by poor animal husbandry practices, which contributed to low milk production (RoK, 1997). Evaluation of the project during the last phase linked amount of milk production to the level of management. As I have explained elsewhere in this thesis, high level of dairy cattle management that is associated with high milk production involves feeding of dairy cattle on high quality fodder, providing clean water through the day, supplementing Napier

with concentrates and mineral salts, maintaining a clean zero grazing unit, practising tick control and timely treating of dairy cattle. A report on evaluation of the project in 1994 stated:

Milk production depended on the management level, the better the management at the start of recording (1983-84) the higher the milk yield. The Old Districts as a group registered less milk production with time. This may indicate that there were problems with the zero-grazing package. No Old District showed a continuous increase in milk yield. This situation may have been brought by the mixing of new and old farmers within a district. Within the old districts group, over the years, Kiambu, Kericho had much higher averages 15% -20% higher) than the Kakamega, Kilifi and South Nyanza. Some of these differences were caused by difference in general management. Fodder availability was a problem in Kilifi and not in Kakamega. One wonders whether there is not a significant relaxation among farmers and extension staff. Otherwise, it is difficult to explain the apparent declining trend. (PDC, 1992, pp. 13-14)

Therefore, although there are many other long run outcomes of the intervention like extension and dairy officers who were trained by the project, I have focused on outcomes that involved implementation of zero grazing. This is because the objectives of the NDDP were predicated on implementation of zero grazing by farmers. Having identified the long run outcomes dairy improvement and how they were manifested, what remains is the context in which intensification of zero grazing diminished. The section below discusses a combination of contextual factors that led to diminished implementation of the NDDP in the long run. I show that the two long run outcomes are evidence of the mediation role of context in explaining outcomes.

6.3.1 Inadequate finances for intensive dairy cattle management

NDDP's zero grazing system was capital intensive especially purchase of dairy animals, construction of zero grazing units, planting and maintenance of fodder, purchase of farm inputs and supplementary feeds (RoK, 1979; MLDM, 1990; van Helden, 1982b; Woersem et al., 1986). Analysis of data gathered shows that farmers who joined the NDDP financed implementation of zero grazing components from own or household sources including sale of local cows, support from groups or through loans. An extension officer who was interviewed reported that when they introduced the intervention, one of the challenges they faced was that "Not so many farmers could afford to put up such structures, because you can imagine a farmer putting up a very strong structure *na yeye analala kwa nyasi huko* (yet he sleeps in a grass thatched house). It was very

illogical again, so that was one hiccup” (Author’s interview with Maina, 2012). During the introduction phase, a dairy officer who worked with the project reported that “As the AFC is not giving any loans at the moment, a good number of farmers find it very difficult to start as a second phase farmer” (van Helden, 1982b, p. 5). Due to farmers’ inability to raise requisite funds for implementation of zero grazing, selection of demonstration farmers delayed in Kakamega district (van Helden, 1980c). This is partly the reason that DDP offered demonstration farmers a grant that covered 50% of their farm budget to establish the zero grazing system (Woersom et al., 1986). NDDP officers realised that even with the grant, it was still difficult for most farmers to their 50% share of the farm budget to implement the technologies. As a result, DDP officers started to assist farmers to obtain loans from financial institutions especially the AFC and operated an own credit scheme during the first three phases. Even when the AFC granted some farmers loans, the challenge was that “As AFC loans Shs. 2000.00 per cow farmers find it very difficult to buy good animals” (van Helden, 1982c, p. 6).

In addition to initial financial requirements to invest in intensive dairy cattle management, funds are also requires to maintain high level of dairy cattle husbandry practices including purchase of essential inputs. In 1993, it was observed that “Although the majority of pioneer NDDP assisted farmers (56%) do not practice zero grazing, all farmers still have their zero grazing units intact” (Wandera, 1993, p. 38). In addition, during fieldwork, I observed several farms in which zero grazing units were in a bad state of repair with damaged floors, roofs and walls. Due to lack of finances to repair the units, farmers whose units were unusable have constructed cow sheds next to the damaged unit to keep the cows at night or tethered the cows in their compound during the day and at night. Hence, over time farmers changed from complete confinement of dairy cattle to entirely keeping them outside the units or using the unit only during the night. This was because farmers who are unable to raise finances to maintain zero grazing units but continue to keep dairy cattle opted for semi-zero grazing instead of complete confinement of the cattle, which is cheaper or does not require any additional resources. As shown in Figure 17 below, Shiemi whose unit was damaged especially the feed trough which was unusable, choose to have the cow graze on natural grass in his compound and use the unit as a night boma only. When he feeds it on Napier grass, he chops it and places it on the ground instead of the feed trough.

Figure 17 Zero grazing unit and a cow grazing on natural grass



Shiemi's farm, 2013

Further, farmers who did not have cash were not able to buy supplementary feeds, pay for clinical and AI services. Inadequate finances meant that farmers could not implement appropriate husbandry practices, which lead to decline in productivity especially milk output. Inadequate income was made worse by changing household expenses especially when they had to pay school fees when their children joined secondary schools. This applied to farmers who joined NDDP when their children were younger, attending primary schools where they did not have to pay any school fees. Interviews revealed that income from dairy farming did not adequately cover dairy expenses and farmers used money obtained from other farm and non-farm activities to maintain implementation of the technical package. A farmer with such experience said:

I finance dairy farming from income that I get from sale of milk or calves. If that is inadequate, I use money from other sources. Remember, you found me saw milling when you came. If I lack something, I finance it from such sources. I do not care whether the source is from cattle or not, no! (Author's interview with Ndombi, 2012)²⁸

To maintain implementation of the zero grazing components, farmers also received material and financial support from their children. As a result, maintenance of dairy farming was difficult when a household experienced shocks as evident with two farmers interviewed. When Nyukiri, one of the farmers who were involved in the intervention had a case in court with a neighbour over trespass of his animals, he had to sell all the dairy cattle to pay for the expenses and

remained with Napier grass, which he now sells. Later he bought an indigenous cow that he now keeps. In another case, after the death of her husband, Asamba, one of the project farmers interviewed sought legal representation to protect her land from the brothers'-in-law who had obtained a court order to bar her from using it. She continued to keep dairy cattle because her daughter came to her aid and paid part of the legal expenses and she paid the rest of the expenses from sale of part of the land. Another farmer reported how his eldest son supports her.

My eldest child assists me a bit. When Napier grass is not ready to harvest, he brings me hay. Last year in 2010, he planted an acre of maize which he harvested and brought when it was ready. He brought molasses and we made silage by preserving it in polythene tubes. He helped me a lot in January, February and March 2011. I was not troubled and my cows just fed on that. Yes, my son is the one who helped me. But last year, he was far in Garissa for fieldwork and it was difficult for him to assist me. If you want his support and you ask him to buy drugs, he will buy and bring them to me, he will buy feed like dairy meal when it runs out, he will do so. If the cows need water and he is around, he will pour water into the trough. (Author's interview with Nafla, 2012)²⁹

Inadequate financial resources also mean that farmers have difficulties replacing their dairy cattle with exotic or very high quality breeds. This was made worse by lack of good dairy cattle breeds in Kakamega district and farmers who desire exotic breeds have to buy them from neighbouring districts, which is prohibitive due to added costs of transportation and obtaining licences to move the cattle across regions. As a result, farmers purchase crossbreeds which are cheaper. An officer who was interviewed explained why dairy improvement diminishes due to financial limitations.

Farmers were implementing the technical package but of course, in every farm, there are limitations. For example, we recommended what the animals will eat and the animals will be sprayed to control ticks. You get a farmer has got some financial commitments, he may not have the resources to put all those facilities in place. So, you will get that the farmer was not doing what he was told to do not because he has refused or he does not know, but because he is limited in finances. Somehow, he has been doing it but that is when the children were still in primary school. Now they have gone to colleges, now the commitment for his finance is a bit demanding. So, you find in a given season he is not able to purchase what is to be given to the animal. So, he will tell you. He will be frank that I know what I am supposed to do but because of abcd I am not able to do so. Even today, you go to a farmer, he is not doing what he knows and he will tell you actually am supposed to be doing abcd but am not able to do it. So NDDP did the best, they trained them over and over but now their finances are down. (Author's interview with Nyongesa, 2012)

After NDDP ended, some farmers were involved in other dairy interventions. In cases where such interventions continued to provide financial and other support especially through formation of dairy groups, farmers have tended to maintain implementation of some components of zero grazing. Overall, over time, due to lack of finances, farmers resorted to implement technologies that were consistent with their financial ability or adapted them to enable implementation within their financial abilities. Evidence that smallholder dairy farmers relied on remittances, other farm and non-farm activities and other dairy interventions to finance and maintain dairy cattle farming has implications on the widely held view that smallholder dairy farming provides employment to many people. As explained above, because other economic activities and remittances support smallholder dairy farming, employment in dairy cattle value chain activities result from other economic activities and remittances. This means that other farm and non-farm income generating activities and remittances, by extension provide employment opportunities through smallholder dairy farming. Therefore, attempts to understand dairy improvement and its role in poverty reduction through employment creation should focus also, on how smallholder dairy cattle activities are financed.

6.3.2 Demographic changes in households

Two changes in household demographics influenced long run outcomes of dairy improvement. First, farmers who were involved in the NDDP are now older and not able to work as much as they did and some are not able to engage actively in economic activities particularly dairy cattle farming, which is labour intensive. Due to this, some farmers no longer implement any of the NDDP zero grazing components. There has been concern over the increase in average age of farmers in Kenya. During the Third Agricultural Sector Development Forum in 2012, the opening remarks read:

It is a matter of concern, that the average age of the Kenyan farmer is 60 years, and yet the vast percentage of our population is under 35. The youth are neglecting Agriculture in a big way. If this trend continues, the Agricultural sector will experience a decline in the years to come, and we will continue to struggle with high unemployment. (Agricultural Sector Coordination Unit [ACU], 2012, p. 3)

In cases where older farmers are engaged in dairy activities, they only practice and implement the technologies that they can. One such a farmer reported this being due to age and poor quality dairy cattle over time.

We have broken many rules because they wanted cows to be kept in the zero grazing units. However, because we have become weak and there is grass in the homestead, we tether it outside to graze instead of cutting the grass. We are weak and we do not have good cattle. Our cattle are now mixed up, the quality of grade cattle has gone down due serving with inferior quality bulls. So, you may be deceived that these are grade cattle by their look but they don't produce any milk. The breed quality has gone down. But we have become weak and we have damaged it. (Author's interview with Lugonzi, 2013)³⁰

Evidently, there are households where intergenerational transmission of dairy livelihoods has occurred. In such households, children of NDDP project farmers have taken over dairy farming from their parents or have built on the dairy practices and technologies of their parents who are no longer involved in dairy. This young generation of dairy farmers inherited some assets that included zero grazing units, Napier grass, dairy cows and dairy farm equipments from their parents who were NDDP farmers. Interviews with these new generation dairy farmers revealed that their dairy technologies and practices are a combination of skills, knowledge and information that they learnt from their parents, other dairy farmers, their friends, extension officers and what they think is appropriate. As a result, their dairy technologies and practices consist of various forms of coexistence of indigenous and modern ones. Like their parents and other farmers in the area, they practice mixed crop-livestock farming. The land available for Napier grass, which is the main fodder, is much smaller due to subdivision for inheritance. This is the reason that adequate fodder remains a challenge especially during the dry season for this new generation of dairy farmers.

The second demographic change that has had implications on dairy improvement is subdivision of land for inheritance. This occurred when children grew older, started their own households and land had to be subdivided. Due to subdivision of land, some farmers could not continue with dairy cattle farming because the portion of land they owned was too small to support dairy activities especially Napier grass production. Although in 1997, average farm sizes in the district

were estimated to be 5 acres (2 hac) (RoK, 1997), this varied in the district. With high population densities of 550.31 and 982.55 persons per square kilometre in Kakamega and Vihiga counties respectively (KNBS, 2009b), farm sizes have been fragmented to a point where they cannot be subdivided any more. As a result, intensive dairy cattle management under zero grazing either has been abandoned or adapted to coexistence of indigenous and modern zero grazing technologies. This may mean that there are limits to intensification as a means to increase land productivity especially through zero grazing. The NDDP introduced intensive dairy cattle management as a means to improvement land productivity and address land scarcity. Instead, further decline in land sizes is one of the factors that constrained implementation of zero grazing. In other words, the very purpose that the zero grazing system was initiated to address, small land sizes, is the very reason that explains why it has diminished over time.

6.3.3 Labour shortage in smallholder dairy farms

The NDDP zero grazing system was labour intensive. In addition to household labour, farmers hired labour to assist in dairy activities like transporting of fodder and water to the zero grazing unit, chopping Napier grass into small pieces for dairy cows and management of Napier fields through weeding and fertilization (MLD, 1990). A survey conducted among project farmers in 1993 found that “Farmers who quit zero grazing complained that the zero grazing farming system requires too much labour and 24 hour attention from the farmers and the activity therefore does not allow them to attend to other commitments including social functions is a serious concern” (Wandera, 1993, p. 38). Consequently, high labour requirement is the reason that “More than half of the pioneer NDDP farmers interviewed have opted to practice semi-zero grazing, graze their animals or have no animals” (Wandera, 1993, p. 42). Thematic synthesis of data gathered revealed that although labour for dairy activities was a challenge among smallholder farmers during the NDDP it has become worse. During the initial stages, families were younger and children provided labour for dairy activities. A farmer whose experience resonated with this said:

Children used to help a lot but as they grew up, they all migrated to town. Only my wife and I remain. The children used to help in cleaning the unit where the animals sleeps, removing cow dung from the unit, even when a hired worker was sick, they helped feed the animals. They went for Napier grass and fed it, they did not just idle. (Author’s interview with Ndombi, 2012)³¹

With children now grown up and no longer available, farmers have to hire additional labour. Unlike in the initial days, over time, hiring labour became difficult because of alternative income generating activities that offered higher returns and viewed as clean. In particular potential farm workers prefer employment in sugarcane milling firms or run *boda boda* (bicycle or motorcycle taxi) services. Interviews found that young men prefer *boda boda* because of higher income. A farmer who no longer keeps dairy cattle explained:

With the coming of motor cycles in this neighbourhood, most of the young men who would work in the farms withdrew. It is easier to make money through a motorcycle than working in a farm. So, to hire labour today is very difficult. That is the main reason I quit dairy. You cannot get labour. All labour has gone to ride motorcycles. I have seen them, hundreds of boys on the road, making money. Every day they may make about 1,000 shillings. If they stayed in the farm, every day they make 100 or 200 shillings. Today, they are paid between three and four thousand per month in the farm. Plus breakfast and lunch on the farm and if they live with you, they even eat dinner. So, if you value that then it is about 6,000 shillings. But on the road they make more than double that and the work is not strenuous and they enjoy riding. I do not want to be struggling at my age like my neighbour who let his cattle from the unit to roam in the compound. (Author's interview with Khasewa, 2013)

The implication is that dairy cattle farmers have to pay hired workers more money to keep them, which is expensive. Farmers unable to pay higher wages have opted for less labour intensive semi-zero grazing or no quit dairy cattle farming altogether. Interviews further revealed that hired workers did not always follow all instructions and guidelines from their employers when they performed dairy activities but also relied on their own experience. Workers had their own ideas of how implementation of zero grazing components should be done. This included cutting the entire Napier before applying slurry and did not see the sense of applying slurry daily on the section where they had cut Napier grass as instructed by owners. Hired workers considered doing so a lot of work and they said it was difficult to accomplish and could sometimes decline to do other activities. A farmer who gave up asking the worker to follow the recommend guidelines whose Napier grass is shown in Figure 18 below with overgrown weeds said, "I have told them, I have told these people working on it. However, they have got their own management and they say *huyu mzee anajua nini? wacha sisi tufanye nanma hivi* (what does this old man know? we will do it our way). Such things, so you keep on talking until you say let them do what they want" (Author's interview with Wafula, 2012).

Figure 18 Management of Napier grass

Napier grass field with overgrown weeds



Namalwa's farm, 2013

Manure applied on the soil surface



Wafula's farm, 2012

Related to this, Wafula's farm, which shows that manure, was applied on the soil surface due to challenges with labour. Wafula applied cow dung and not slurry and put it on the soil surface instead of infusing it into the soil as NDDP recommended. The NDDP recommended method was digging shallow canals in between Napier grass rows, pouring slurry into the trenches and covering them required a lot of labour and time. Therefore, poor management of Napier grass was characterised by inadequate or non-application of manure, improper application of manure, weeding after the weeds have overgrown, all of which resulted in low quality and quantity of Napier grass. Due to inadequate fodder, farmers prefer semi-zero grazing, a form of coexistence of indigenous and modern dairy technologies and practices. Another farmer whose Napier grass yield has reduced due to poor management by a worker said:

I planted this Napier grass in 2006 and it served me well until 2010. To manage it, the one I ask to weed after grass is cut does not weed where they just cut Napier grass. Yet he should weed and remove the weeds so that Napier grass grows. Now, it has started to die. But I know that if I had someone who weeds properly, and I have an old man, in fact he is there. He comes daily and he has been working here from 2006. But he got to a point where when I ask him to weed for Napier grass to grow properly, he says no. If you weed that way, Napier grass would die. We have just been arguing until now the grass is dead. (Author's interview with Namalwa, 2013)³²

For dairy farmers who were also engaged in other occupations, described by NDDP as part-time farmers, hired labour was more challenging. Part-time farmers who were busy with other occupations could not effectively supervise dairy cattle farming activities on day-to-day basis. As a result, they delegated all dairy cattle activities to the workers who they hired. However, hired had not received any training on dairy farming save for instructions and guidelines from the owners on how to carry out dairy activities. It is the farmers who attended trainings, seminars and workshops, which were organised by extension officers. Consequently, hired workers could not handle dairy activities effectively even if they desired to due to lack of capacity. An officer interviewed highlighted the difficulty for smallholder farmers who he described as “telephone farmers” due to hired labour. The challenge with telephone farmers was essentially that they could not monitor implementation of zero grazing by workers that they hired. The officer described challenges that telephone farmers faced as follows:

You know when I say telephone farmers. This is a guy who has cows but does not know how to milk the cows and is completely dependent on his workers. He could be even be living in Nairobi phoning Eldoret and asking *habari gani ya maziwa* (news about milk). They are not really milking the cow themselves. They buy dairy cattle, investing in zero grazing units and other facilities but are busy and working in towns or secondary school teachers. They depend on workers. If you are a worker and you get a small salary, if the cow had mastitis, would you mention it to your boss and say the cow had mastitis? No. Because the boss will think it is you who cannot milk the properly. Our farmers who say they are farmers, are they really farmers? (Author’s interview with Lambert, 2012)

Shortage of labour was a serious problem in smallholder dairy farms and several NDDP reports attributed abandonment of complete confinement of dairy cattle to labour shortage (Wandera, 1993; Metz, 1995; PDC, 1994). Findings of a survey which was conducted among project farmers in 1993 recommended:

For smallholders who practice mixed farming, perhaps they should be advised to practice semi-zero grazing. This can allow the farmers to invest less since they only need to build temporary feeding structures. The animals can be grazed in paddocks enabling the farmer to have some time to him/herself to attend to other activities. (Wandera, 1993, p. 41)

By hiring workers, farmers had to generate money to pay them, purchase of farm inputs as well as pay for household expenses, or move out of dairy and keep local breeds that produced less milk but required less intense labour and management. Therefore, although one of intentions of the intervention was to generate jobs through intensification of dairy cattle management activities in smallholder farms and absorb labour, due to factors discussed above including workers who opted for jobs that paid higher, this objective has not been realised in the long run. Instead, labour shortage has contributed to the diminishing of intensive management of dairy cattle.

6.3.4 Structural reforms in the dairy subsector

Privatisation and liberalisation of the economy, which started in the 1980s and continued in the 1990s has influenced long run outcomes of dairy improvement. In the dairy subsector, structural reforms led to challenges in availability of dairy services and inputs and increase in their costs. The evaluation mission for phase five pointed out, “NDDP is not paying much attention to AI, marketing development and veterinary services. These services could perhaps be taken for granted in the past, but with the present emphasis on privatisation, these services are rapidly becoming bottlenecks in the production system” (MLDM, 1994b, p. 107). Similarly, the concluding remarks of a senior staff seminar in 1994 highlighted the assumptions that the developers had with regard to the provision of services that are crucial in dairy cattle farming. A presenter said “The project has operated with an assumption that other services such as AI, clinical services, disease control ... are available. The current situation is that the government is tending towards reduced subsidies on these services which have in turn affected their availability” (Chelanga, 1994, pp. 200-201). Provision of such services seemed to have been effective during earlier phases of the NDDP as a farmer who benefited acknowledged.

Because previously, I was a good farmer under the project, they visited me all the time. Whenever I informed them, they would come with drugs to see how my cattle were fairing on. This was also because they used to bring visitors to my farm from abroad. Veterinary officers were ready to bring drugs and conduct deworming without delay. They provided a timetable which showed the month that deworming would be conducted. It was the responsibility of the livestock officer who was in charge of zero grazing. We need to inject this with a certain drug. There was no problem with regard to drugs. Had it not been that they worked closely with us, the cattle would have died after a short time. The unit also helped me to control ticks. I did not see ticks and that is why I survived. (Author's interview with Alwanga, 2013)³³

However, due to privatisation of services in agriculture generally and the dairy sub sector especially, farmers who were implementing zero grazing had difficulties in access to veterinary and clinical services as well as dairy inputs. Due to this, the level of management of dairy cattle and adherence to good dairy cattle husbandry practices was adversely affected. During an NDDP senior staff seminar on feeds, Maina et al., (1994: 145) concluded “Other factors such as the availability of capital, AI, veterinary services, concentrates and fertilizers also influence the level of management a farmer can achieve”. Below is an extract from a farmers’ visitors book which shows how ineffective AI services made him incur a lot of expenses.

01/12/2000: I visited the farm on call and inseminated 3 animals. Bwibo-bull 135 Ayrshire; Knight-bull 341 Friesian; Mary-bull 495 Guernsey. (Chisala for MOCO AI).

16/12/ 2000: I visited the farm on call again and repeated the insemination of Bwibo. Used Friesian No. 253. Note: There was no Ayrshire semen as it was out of stock. (Chisaka MOCO AI).

28/01/2001: I visited the farm on AI call and reserved Knight. Used bull 352 (Seeway) Friesian. (Chisaka MOCO AI).

16/02/2001: I visited the farm again and served Knight used bull 132 (Rocket) Ayrshire. (Chisaka MOCO AI).

02/03/ 2001: I visited the farm on AI call and served Bwibo second AI set used bull 358 (Gordon) Friesian. (Chisaka MOCO AI).

12/01/2003: I visited the farm on AI call and served Bwibo used bull 363 (Kahawa) Ruto Friesian. (Majimbo for MOCO AI).

05/02/2003: I visited the farm on AI call and served Bwibo used bull no 352 (Seaway) Friesian. Majimbo for MOCO AI

03/04/2003: I visited the farm on AI call and served Knight used bull 137 (stoo) Ayrshire. NB Mary was also presented for service but I suspected it incalf. Majimbo for MOCO.

25/4/2003: I visited the farm on repeated Bwibo used bull 342 (Lyle) Friesian. (Chisaka MOCO AI).

13/05/2003: Visited the farm on call and inseminated two animals as follows; Bwibo with bull 347 Friesian; Knight with bull 127. However, Bwibo did not show very clear signs. She is to be observed closely for any heat signs. (Chisaka MOCO AI).

24/06/03: I visited the farm on AI call and reserved Knight used bull no. 152 and no. 334 respectively. Majimbo for MOCO AI.

10/06/03: I visited the farm on call to inseminate Bwibo. However, she appeared to have been on heat much earlier; hence beyond service time. She was not inseminated. The farmer is advised to be more keen and detect heat on time on order to have her served next time. (Chisaka MOCO AI).

29/06/03: I visited the farm on call and inseminated Bwibo with Friesian bull no. 334. She discharged clear mucus (it was a repeat). (Chisaka MOCO AI).

Source: Natasha's visitors book

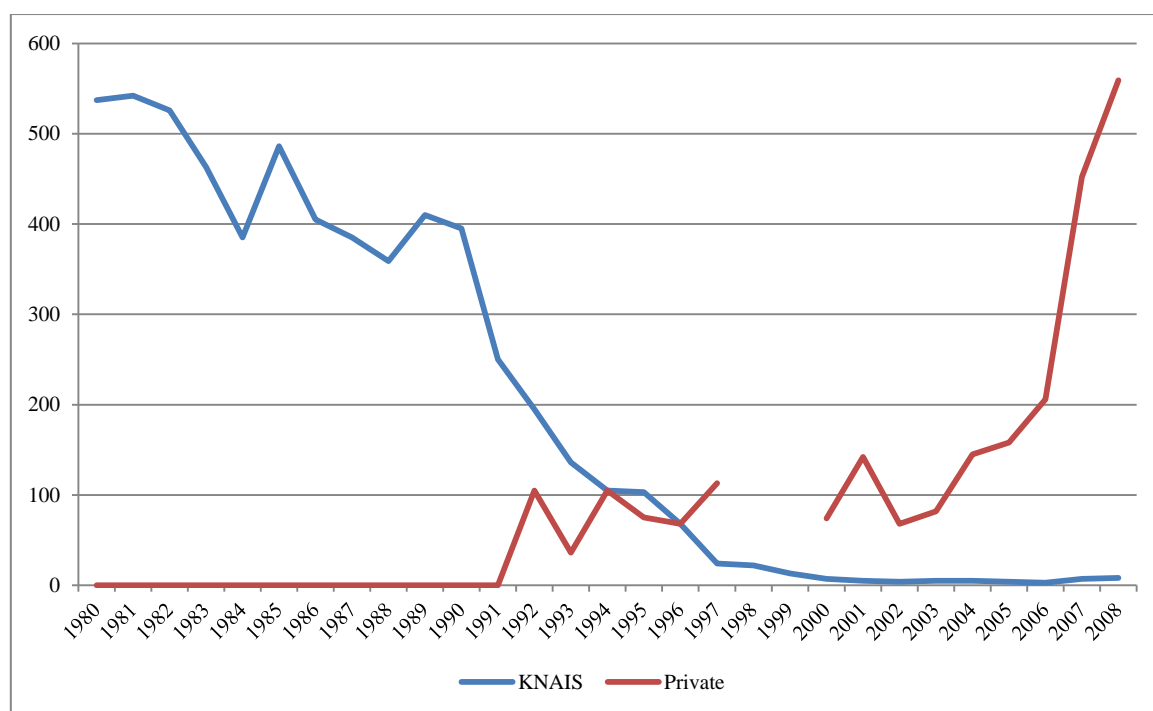
From this extract, in 2001-2002, two of the three cows, Bwibo and Knight were inseminated twice within a period of about four months meaning that first insemination had not lead to pregnancy. It was worse in 2003 when one of the cows, Bwibo, was served five times and Knight three times, within six months. This shows how ineffective AI service was and the farmers had to pay for repeat AI service. This is evidence that provision of some dairy services like AI by private providers was challenge because effectiveness of their services was questionable. The government did not effectively regulate AI services and private providers were not fully accountable to farmers. Officers who were interviewed attributed this to private providers of AI services who were not keen to detect and confirm heat signs before serving cows with AI. They did not want to make losses of transport expenses incurred by going away without insemination a cow. They therefore, served cows even when the optimum time had lapsed. The other reason was that due to decline in extension and training, farmers were not able to detect heat signs at the appropriate time and asked vets to inseminate their cows when appropriate time had lapsed. Prior to privatisation, the government subsidised AI service costs and provided government vets with transport and the vets would report back to their stations the number of cows that they had inseminated and any follow ups required. As a result, government vets were keen and could only serve cows with AI at the appropriate time. Due to high costs of AI that increased when farmers paid for repeat service, some farmers resorted to use of bulls whose genetic potential was unknown. This has led to decline in breed quality. In 1991, "Many of the project districts reported poor breeding situation. Artificial Insemination (AI) which many of the farmers rely on was

unreliable due to frequent fuel shortages” (Gichungu, 1991, p. 3). A farmer who was interviewed expressed similar sentiments.

You know, previously we used AI but now people use any bull to serve their cows. If you use bulls like those that have horns, you will not get milk compared to when you use grade bulls or AI. These days, I do not trust AI. A cow is served but you do not get milk, I do not know why. You can feed a cow properly according to how we were taught, feed it well with Lucerne, give it dairy meal, it continues to feed when it gets to eight months but when it calves, you do not get milk as we used to get when we used AI service in the past. What is AI these days? Where do they get the breeds? It does not do well. I have tried AI many times. I do not get it. Although this calf and the other one inside the unit are an outcome of AI service, they do not look good at all. (Author’s interview with Awuor, 2012)³⁴

To demonstrate how privatisation affected provision of AI services, Figure 19 shows pattern of AI provision by KNAIS (government) and private providers between 1980 and 2008.

Figure 19 Provision of AI Services by KNAIS and private sector (1980-2008) (in thousands)



Source: Muriuki (2011, pp. 31-31)

What is evident in Figure 19 is that due to government declining resources to the agricultural sector, which started in the 1980s up to the early 1990s when the sector became fully liberalised

and AI services privatised, AI runs were affected. Government provision through KNAIS declined and it took a while before the private sector AI runs surpassed reprivatisation level.

Another dairy service that was affected by government withdrawal from the agricultural sector was tick and disease control. This is because the cost of treatment escalated and treatment was not always successful. As a result, livestock diseases have made it difficult for farmers to continue implementation of zero grazing components as recommended. Dipping it touted a more appropriate means for tick control. Due to government withdrawal dipping declined due to poor management and increase in user fees, which led to increase in tick borne diseases (RoK, 1994). Interviews revealed that effective treatment of cows and tick control, which were a problem before NDDP remain a challenge to farmers. There are cases where farmers lost their dairy cattle to disease. In response to death of cows, some farmers replaced them but with either crossbreeds or local ones to reduce chances of death because, pure breeds are more vulnerable to diseases. Other farmers discontinued implementation of zero grazing components when their dairy cattle died. One of the farmers interviewed, Shiemi, registered with the NDDP and implemented zero grazing to a point that he participated in farm competitions that he won (Figure 20).

Figure 20 Changing dairy technologies and practices

Certificates awarded after winning farm competition



Damaged zero grazing unit



Indigenous cow tethered in the compound



Source: Shiemi's farm, 2012

Winning farm competitions is evidence of excellence in implementation of the technical package according to recommendations and practice of high level of dairy cattle management. However, after he lost his cows to disease and as shown in one of the photos above, the zero grazing unit is damaged and is no longer in use. He has an indigenous cow that he feeds on sugarcane tops and tethers it to graze on natural pasture in his compound.

6.3.5 Commodification of grazing and sale of fodder in local markets

Napier grass is the main fodder that farmers continue to plant and feed their cattle. Although Napier grass was being cultivated before the NDDP was initiated in 1980, it was popularised by the intervention. This is the reason that during the 1994 senior staff seminar, a presenter noted, “NDDP is largely responsible for popularization of Napier grass and zero grazing” (MLDM, 1994, p. 158). Through field observations, in addition to using Napier from their farms, farmers purchased not only concentrates and minerals as they did previously buy also bought Napier and other crop residues, which were sold in local markets like other commodities. The sale of Napier grass and other crop residues in local markets resulted from a series of processes, which had implications of access to fodder and diminishing intensification of dairy cattle management. Over time, farmers could not provide adequate quantity Napier for their cows from own sources through the year. They started to buy additional Napier from their neighbours who had surplus. A farmer who was interviewed explained how and why he had to purchase Napier grass.

Napier grass from the farm is inadequate. When you have cut all the Napier grass in the farm, and it has not regrown to the height appropriate to harvest, you have to get it from others. The amount of Napier grass that neighbours have is very little. Napier grass is now very expensive. It gets worse during the dry season when you cannot find Napier grass around and you have to go to the market. (Author's interview with Ndombi, 2013)³⁵

Further, some farmers who were not able to replace their cows after sale or death but continued to cultivate Napier grass, sold it to others. Interviews also found that some farmers tended to specialise in Napier grass cultivation for sale especially those who lost their dairy cattle but also others who thought they could make money through Napier grass sale. A farmer who no longer kept cattle but maintains Napier grass, which he sells said:

I have Napier down there. To maintain it, I ask my brothers or other farmers who are ready to buy it and I weed after they have cut it. It covers about an acre or three quarters of an acre. Because I do not have cattle, I saw it was not good to uproot all of it. I uprooted part of it and planted about two acres of coffee. Previously, Napier covered this entire area when I had six cows. Now, I have divided it into sections for other things. I have even sugarcane. (Author's interview with Alwanga, 2013)³⁶

Demand for Napier grass surged when some people in local market centres started to keep dairy cows without planting Napier grass and relied on purchase while others started zero grazing without planting the recommended amount of Napier grass per cow. This led to widespread purchase of Napier grass and some individuals started to sale fodder in local markets (Figure 21).

Figure 21 Sale of fodder in local markets

Napier grass



Sugarcane tops



It is not just Napier that was sold but also crop residues like sugarcane tops and maize stovers or thinnings. Sale of fodder was common in Khayega, Luanda and Butere markets. A trader who sold fodder in one these local markets explained what prompted him to start doing so.

I went to a certain place when I worked for a particular company. There were a lot of sugarcane tops that cattle were feeding on yet my cows lacked fodder. My wife had suggested that we sell one cow because of lack of fodder. I did not want that. I brought some sugarcane tops and gave my cows and in the evening the cow produced milk. The day after we fed it on the sugarcane tops that was left from the previous day. When my neighbour saw that, he said that he wants that as well. I gave him some. He then told me that I should go back buy more sugarcane tops and we share the expenses. I went back and brought more with my pickup. When he bought from me, another neighbour who saw that told me it would be better for me to take the sugarcane tops to the market for other farmers from around not to suffer. When they came and saw that, they were happy. I was the first person to start selling. Then, they started to buy. (Author's interview with Lugonzi, 2013)³⁷

Related to sale of fodder in local markets was the emergence of fodder transportation services. This came about because fodder has to be transported from farms to local market centres as well as from these markets to farmers for buyers who do not have their own transport. Fodder was transported by use of wheelbarrows, handcarts, bicycles, motor cycles and motor vehicles as shown in Figure 22 below.

Figure 22 Transportation of fodder

Sugarcane tops on boda boda



Napier grass on hand carts



Napier grass on push cart



Green maize stovers on boda boda



Photos taken at Khayega and Luanda markets

The implication of sale of fodder especially in local markets and its transportation was that the cost of fodder increased. As a result, the cost of dairy farming in terms of implementation of the technologies promoted by the NDDP increased especially because the cost of fodder is the single largest cost in smallholder dairy farming as noted elsewhere in this thesis. This increased the cost burden in the implementation of NDDP technologies among farmers especially among resource poor farmers. In support of the view that resource poor farmers were more adversely affected, when asked who his customers were, a Napier grass seller replied:

Although farmers who rely on farming for income buy Napier grass, we do not largely depend on them because they buy twice a week or so and their cows rely on roadside grass. We depend on teachers and government workers who keep pure dairy cows. Further, the youth who operate boda boda services who recently bought heifers and ventured into farming. Therefore, they buy a lot. We largely rely on them. They come with their boda boda, buy once, twice, thrice, and go away. (Author's interview with Lugonzi, 2013)³⁸

Notably, it is not merely the purchase of Napier grass in local markets and related transportation services that adversely affected implementation of the NDDP technologies among farmers who could not afford to buy fodder. Analysis reveals that inability to produce fodder resulted from other contextual factors like land fragmentation for heritage and competition of Napier grass with other farm enterprises among others as discussed elsewhere in this thesis. What is evident is that

sale of fodder aggravated implementation of zero grazing among resource poor farmers while those who could afford especially those who earned income from non-farm activities to invest in dairy continued to implement NDDP technologies. The result of this as observed during fieldwork was that resource poor farmers were not able to effectively participate in milk markets. In particular, implementation of NDDP technologies among resource poor farmers has diminished due to increase in the cost of fodder, which they previously obtained from their farms or more cheaply from their neighbours. This is due to the filtering effect of the market. Those who have more resources are able to participate in markets unlike those who do not have the requisite resources who no longer participate in milk markets.

From the foregoing, intensification of dairy cattle management diminished in the long run. This was due to escalation of dairy services and input costs when the government withdrew from their provision, inability to produce adequate fodder due to land fragmentation, financial resource constraints like income to buy inputs and pay for dairy services and expenses associated with purchase of good breeds from distant locations. The diminished intensive dairy cattle management is similar to Lam & Ostrom (2010) findings on the long-term impact of performance of irrigation systems in Nepal. They found that

The effects of intervention on the technical aspects of irrigation management [were] conspicuous in the short run. Due to improved infrastructure, the size of irrigated area increased and the technical efficiency of the irrigation systems also improved. Yet, these positive effects dissipated, or levelled off, in the long run. (Lam & Ostrom, 2010, p. 13)

Similarly, while pointing out that farmers in Rusinga Island in Kenya quit implementation of intensive agriculture, a process he describes as “disintensification”, Conelly (1994, p. 146) explained this to be a result social and political context of the farmers. Perhaps the diminished intensification of dairy cattle management is evidence that in addition to new challenges in the sector, some challenges that settlers sought to address about a century ago like inadequate fodder, tick borne diseases and maintenance of improved breeds remain. This may be evidence of serious challenges in improving land productivity among resource poor smallholder farmers who rely on

market provision of dairy services and inputs, including market oriented or demand driven dairy extension services.

6.5 Conclusion

Although developers assumed that implementation of zero grazing components would lead to intensification of dairy cattle management and thereby solve land scarcity, increase milk production and reduce poverty through income from milk sales, this chapter has demonstrated that this has not been the case in the long run. Instead, the long run outcomes of zero grazing are implementation of a combination of indigenous and modern dairy technologies and non-implementation of any of the NDDP technologies. Therefore, intensification of smallholder dairy cattle management has not occurred in the long run but has diminished.

Intensification of dairy cattle management diminished because farmers' decisions and actions were constrained by inadequate finances, land scarcity, labour shortage, inadequate fodder and structural reforms in the dairy sub sector. The diminished outcomes were due to contextual constraints which farmers were not able to effectively address. As shown, one of these factors was escalation of the costs of implementation of intensive dairy cattle management. This occurred especially due to withdrawal of government subsidies and privatisation of dairy services and inputs. This was compounded by sale of fodder in local markets which contributed to increase in the cost of feeding dairy cattle, the major cost in zero grazing. Overall, the changing context of smallholder dairy farming adversely affected the smallholder dairy farmers and led to the diminishing intensification of dairy cattle management.

CHAPTER SEVEN

Conclusions

When development is understood as intentional endeavours to improve people's livelihoods and reduce poverty, this is actualised through development interventions. Consequently, development interventions are viewed as a solution to societal challenges that range from climate change, conflicts to extremes of weather conditions. Development agencies seem to have taken for granted that interventions would alleviate human suffering, and at the same time bring about prosperity. In the literature, on the one hand, some have argued that developers design development interventions as a means to promote their interests or interests of others, which may have little to do with the problems that target beneficiaries face. Such interventions, they argue, are inherently flawed because they are decontextualized, do not benefit target beneficiaries but instead adversely affect their relations and it is not useful to implement them. On the other hand, it has been claimed that developers are not all powerful and their intention to transform societies is a project that is not always accomplished. This is because developers do not always have their way due to the agency of target beneficiaries and other actors, and to the mediating role of contextual factors. As a result, development interventions may be resisted or adapted leading to outcomes that differ from those that were anticipated by developers. It is in this regard that this thesis set out to understand how actors adapt development interventions and long run outcomes of the interventions through a case study of the NDDP, an intensive dairy cattle management intervention, referred to as zero grazing that was implemented in Kenya between 1980 and 1995.

The NDDP was instigated with a view to improve land productivity due to population pressure and land scarcity, meet increasing demand for milk and reduce poverty among smallholder farmers through income generation from milk sales. In this thesis, through analysis of NDDP documents and in-depth interviews with project officers and farmers who were involved, I have explained adaptations and outcomes of the intervention by focusing on mechanisms, contexts and outcomes. This thesis has shown, in many ways, how adaptation is central to understanding of development interventions and their outcomes, which may differ from the intended ones. As it

has been shown in a plethora of studies and literature, conceptualisation of development interventions is rarely informed by the entire context in which they are implemented. Policies, programmes and projects that view intervention in purely technical terms, divorced from the social and political context of their implementation, are quite likely to fail for this reason. In this thesis, I have used the concept decontextualization to describe processes that led to the design of the NDDP without taking into consideration of the farmers' and wider social and economic context which influenced implementation of the intervention. Decontextualization of the NDDP was evident in its implementation as standardised zero grazing technical package. In Chapter Four, I have shown how through decontextualization, developers thought that farmers would implement zero grazing despite diversity among farmers and in different high potential area in Kenya. This was reflected in the project officers' research and recommendations of zero grazing packages that were based on average farmer conditions yet actual conditions of farmers differed from average. I have shown that availability and access to essential dairy support services and inputs differed in high potential areas where the project was implemented. Farmers in different high potential areas differed in terms of milk production potential, levels of experience and knowledge of dairy cattle farming, attitude to loans, resource base and the importance of fodder. This led to a mismatch between the zero grazing intensive practices that project officers recommended and the context of farmers who were to implement them. As a result, and because farmers interpreted the NDDP in multiple ways, its adaptation by developers and farmers became inevitable during implementation. I would like to however note that by describing the NDDP as a decontextualized intervention, I do not mean that the NDDP team leaders conceptualised the dairy improvement project in total isolation of context but that they did not take into consideration some contextual factors that influenced dairy improvement.

In line with the central question in this thesis, I have shown how through their interaction in context, developers and farmers adapted the intervention. Because NDDP was decontextualized, its adaptation became inevitable when its implementation started. Adaptation was to enhance its effectiveness and continuity in response to the evolving context of farmers during implementation which shows that adaptations of the intervention by project officers and farmers were interrelated. In this thesis, I have explained how the developers adapted extension, the

strategy they employed to train and advice farmers on how to implement zero grazing components. Although inherent in extension were seeing is believing and capacitation mechanisms, during implementation, developers adapted extension. Due to the rural development discourses at that time, the developers adapted the extension strategy from a commodity approach to farming systems and participatory approaches. They also introduced printed and audio-visual materials, relaxed the criteria that they used to register farmers and assisted farmers to identify and select good dairy cattle breeds. Due to budgetary constraints and shortage of staff, they involved other actors in extension. In the context of fodder shortage, they trained and advised farmers on fodder preservation techniques and introduced fodder trees to fill a protein gap because farmers fed their dairy cattle lacked sufficient protein. Developers also established a fodder research unit to research on fodder that would be appropriate for smallholder dairy farmers under zero grazing conditions.

On their part, farmers did not preserve fodder through silage making but in order for them to continue keeping dairy cattle, they fed them on crop residues, maize thinnings, banana stems, roadside grass, grazed them on natural pasture, all of which are poor quality feeds and resulted in low milk production. Farmers also intensified cultivation of Napier along the roads, footpaths, or on whichever space that was available, and even leased land for Napier grass cultivation. In addition, they planted Napier grass using different methods that included tumbukiza, which yielded higher returns, and Napier grass would last longer. Lastly, farmers started to preserve fodder in their own way. For example, they preserved maize stovers by keeping them in a dry place for use during dry season instead of making silage. Further, instead of planting fodder trees and using them as protein supplement, farmers used machicha as an alternative to dairy meal due to lack of finances to by commercial concentrates like dairy meal, which was the most commonly recommended concentrate. Further, when the developers realised that farmers could not raise requisite funds to construct zero grazing units, they allowed farmers to use their own materials or those that were locally available and cheaper. When farmers had challenges marketing their milk, the project officers started to link farmers to milk markets or assisted them to obtain milk-selling licences. Farmers resisted implementation of some components of intensive dairy cattle management. In particular, farmers were not willing to kill or slaughter bull calves which

according to developers was a loss because farmers could not recoup expenses that they had incurred to keep the calves when they sold them later on. In response to this, developers introduced an initiative to sale bull calves for veal. However, farmers continued to keep bull calves but fed them on less milk and fodder to reduce the cost of keeping them. Management of soil fertility was also a challenge among smallholder who implemented zero grazing. Due to labour shortage to transport manure to Napier fields and high cost of fertilizers, farmers did not adequately manure their Napier. Unlike the NDDP recommendation that they transport slurry to Napier after every two days, establish a manure pit to collect slurry and introduction of manure bags for carrying manure to Napier fields, soil fertility in Napier grass fields deteriorated. As alternatives, to maintain Napier grass yields, they rotated or replanted it in different fields and directed slurry to flow directly from their zero grazing units to Napier grass fields. Farmers found it distasteful to apply slurry on Napier grass, especially mixed cow dung with urine and transporting it to Napier grass fields although developers promoted this as a means to maintain soil fertility for high Napier grass yields. In its place, farmers composted manure, which they applied on Napier grass and other crops as well. When developers realised that farmers were composting manure, they conducted research on how best to compost cow dung and fodder left overs and made composting manure and fodder left overs part of the zero grazing components. Thereafter, farmers started to train farmers on making compost manure.

Therefore, in contrast to studies which tend to associate adaptation largely with beneficiaries only (Mango, 2002; Buttolph, 1992; Ansari et al., 2010), I have shown that developers are also engaged in adaptation of interventions. Interestingly, as discussed, some of the adaptations that the project officers and extension officers recommended were those that they learnt from the farmers, evidence of flexibility of the project officers and their willingness to learn. Therefore, the developers adapted zero grazing to enhance the effectiveness and continuity of the intervention in response to farmers' context and matching their activities to the resources that were available to them. From this, it could be argued that although through development interventions developers aim to improve lives of beneficiaries, the beneficiaries may change developers' views of the intervention and thereby influence what the intervention becomes.

Thus, despite how profitable or useful developers thought some components of zero grazing were, farmers could only go so far to implement them.

This thesis has shown that in the long run, intensification of dairy cattle has diminished. This is evident in coexistence of indigenous and modern dairy technologies and non-implementation of any dairy technologies. The result of this is that semi-zero grazing where farmers combine stall-feeding and grazing cows on natural pasture in their compounds is common among farmers who were involved in the NDDP. Implementation of intensive dairy cattle management has diminished in the context of lack of finances to invest in dairy among farmers, land scarcity due to fragmentation of holdings for heritage, labour shortage in smallholder farms and high costs of dairy cattle inputs and services due to privatisation and liberalisation of the dairy subsector and agricultural sector. Lack of finances to pay for labour was particularly a challenge due to the labour intensive nature of the NDDP zero grazing system. Thus, in addition to household labour, farmers hired labour to assist with various activities like transporting of fodder and water, chopping fodder and management of Napier plots. This led to escalation of labour costs in smallholder farms, which made it difficult for resource poor farmers to hire labour resulting in diminished implementation of the NDDP dairy technologies among these farmers.

The emergence of Napier grass as the main fodder and sale of fodder, largely Napier grass in local commodity markets contributed to diminishing of intensification of dairy cattle management in the long run. Because over time, farmers could not provide adequate quality and quantity fodder for their cows from own sources over the year, they started to buy additional fodder from those who had surplus fodder. Due to fodder shortage, farmers started to utilise crop residues as fodder and the crop residues were sold like other commodities among households or in local market centres. This led to some form of specialisation among farmers who cultivated Napier grass for sale but did not keep any cattle or kept indigenous breeds which they did not feed on Napier grass. In addition, sale of fodder necessitated emergence of transport services for movement of fodder from farms to markets and vice versa. This led to increase in the cost of

fodder which adversely affected resource poor farmers. Although intensification of zero grazing has diminished, sale of fodder in local commodity markets remains prevalent. Another market related factor, which adversely affected resource poor farmers, was unavailability and high cost of good dairy cattle breeds in Kakamega district. As a result, farmers who wanted good quality dairy breeds had to obtain them at higher cost in Kakamega or incur transport costs or obtain them from neighbouring districts in the Rift Valley province at a cheaper amount. Therefore, although NDDP aimed to improve land productivity, this is yet to be achieved. Further, despite developers' response by adapting the intervention to make it possible for farmers to implement it, they could not address all constraints that farmers faced.

I emphasise that adaptation of development interventions by actors is more common than may have been recognised by researchers in development studies and is useful to explain the divergence between intended and actual outcomes of interventions. As I have explained in the thesis, it is due to the adaptations by developers and farmers that implementation of the NDDP continued but this resulted in outcomes that were different from those that developers intended. I argue that adaptation was an attempt to bring context back into the NDDP. This is because all of the adaptations by the developers and the farmers were in response to the context. Evidently, whereas developers adapted zero grazing to make its components to be more relevant to the context of farmers and to match it to their resource context, farmers adapted the intervention to fit their context. Because context is dynamic, actors may engage in continuous adaptation of interventions to maintain their relevance to the context in which interventions are implemented.

This thesis contributes to knowledge and understanding of development interventions through identification of mechanisms to explain adaptations and outcomes. I propose that two mechanisms, namely effectiveness and matching, are useful in explaining adaptations of zero grazing by the developers. Related to this is that incentives that the project and extension officers received underlined the effectiveness and matching mechanisms. The incentives motivated project officers to continue with the project through adaptation to continue drawing the benefits from the project even as farmers also implemented the zero grazing components. I claim that because these mechanisms link the reasoning of developers and events, in this case adaptations,

from a realist explanatory perspective, they can be built upon and be utilised to explain how developers adapt development interventions. The other mechanisms that explain adaptation of the adaptation by farmers are fit and resistance. These mechanisms underlined by the economic and social benefits that the farmers anticipated gaining through implementation of the intervention, and their awareness of costs and benefits of involvement in the intervention. I claim that fit and resistance mechanisms, which means that farmers implemented components of zero grazing in their own ways which reflected context, offers a way to explain how development interventions are adapted by beneficiaries. Lastly, the diminishing effect mechanism can be utilised to explain outcomes of development interventions in the long run. I wish to note that these mechanisms should not be considered ultimate but can be improved upon.

It might be argued, then, that, there are limits to what development interventions can achieve. This is partly due to decontextualization of interventions by developers during conceptualisation but also due to conditions that are beyond the knowledge or control of developers because interventions are implemented in societies which are complex and dynamic. Failure of some zero grazing components like maintenance of soil fertility through application of slurry and rearing bull calves reveals flaws in conceptualisation of the intervention. Developers' assumption that labour was abundant or could not be a problem in smallholder dairy farms proved inaccurate. Related to this was failure by developers to consider the link between farm and non-farm activities in smallholder farms, which had implications on the intervention. This thesis has shown that land scarcity and withdrawal of government funding of the dairy and agricultural sector, part of the reasons that led to diminished of zero grazing were beyond the control or influence of developers. Further, due to changing farmer, farming and other contexts, over time, there is no certainty that development interventions will be relevant to the context in which they are implemented even if initial conceptualisation was consistent with the context. Indeed, in this thesis, although intensification of dairy cattle management was to increase land productivity, due to continued fragmentation of land holdings, lack of resources among farmers to invest in dairy and increased costs of dairy services and inputs, zero grazing was an inappropriate intervention. Therefore, zero grazing should not be viewed as a panacea to land scarcity. When farmers do not

have finances, costs of inputs are high, land sizes decline and shortage of labour prevails, it can be expected that intensification of dairy cattle management will diminish.

Diminishing long run outcomes and variation between planned and actual outcomes of development interventions should not mean that development interventions are of no value. In conceptualising development interventions, through this thesis, developers may become aware of the problems, they might expect in their endeavour to improve people's livelihoods and reduce poverty. Therefore, understanding, acknowledging how context and the choices and actions of actors influence adaptations and outcomes may aid decision making in designing and implementation of development interventions. Despite this, there it should not be assumed that future interventions would evolve and have outcomes similar to previous ones.

References

1. Documents

Bauman, J. M. (1993, June). Sustainability of NDDP activities. In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. 12-31). Seminar held at Whitesands Hotel, Mombasa.

Bauman, J. M. (1994). *National Dairy Development Project Handing Over Report*. Nairobi: Ministry of Agriculture Livestock Development and Marketing.

Chellanga, I. (1994). Annex 2, Speech by Mr. I. Chelang'a, the provincial commissioner, Rift Valley Province. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 196-202). Seminar held at Hotel Kunste, Nakuru.

Chibudu, A. N. & Maarse, L. M. (1993). The Wheels of dairy development at the Kenya coast. Paper proposed for the *Fourth Dairy Cattle and Poultry Research Programme meeting at Coast* held by the Kenya Agriculture Research Institute Regional, Research Centre, Mtwapa, 26-28 October 1993 at Bamburi Beach Hotel, Mombasa.

Chibudu, A. N. (1994). Performance and utilization of Fodder trees and Herbaceous Legumes and their adoption by Dairy Farmers. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 111-124). Seminar held at Hotel Kunste, Nakuru.

Gichungu, G. N. (1991). *Annual Report 1991*. Nairobi: Ministry of Agriculture, Livestock and Marketing, Livestock Production Department.

Kimani, P. M. & Chibudu, A. N. (1994). Current Project Situation and Existing Strategies. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 21-39). Seminar held at Hotel Kunste, Nakuru.

Kirui, A. (1993). Case study on Farmers Self-Help Groups. In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. 137-143). Seminar held at Whitesands Hotel, Mombasa.

Maina, O. W., waithaka, M. M. & Kiptarus, J. K. (1994). Economics of Dairy Cattle Feeding in Kenya. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 134-150). Seminar held at Hotel Kunste, Nakuru.

Metz, T. (1993). Dormancy of farmers registered with the National Dairy Development Project. In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. 20-31). Seminar held at Whitesands Hotel, Mombasa.

Metz, T., Kiptarus, J. & Muma, M. (1995). *Diffusion of Dairy Technologies in Six Districts in Kenya: A Survey of Smallholder Dairy Farmers in Kakamega, Uasin Gishu, Nandi, Kiambu, Nakuru and Nyeri Districts*. Nairobi: NDDP Monitoring and Evaluation Unit.

Ministry Livestock Development and Marketing (1986). *Implementation document: Dairy development project: For the Period 1984-1986*. Nairobi: Author.

Ministry of Agriculture (1979). *All about milk production in a zero grazing system*. Nairobi: Dairy Ministry of Agriculture Livestock Recording Centre.

Ministry of Agriculture Livestock Development and Marketing (1991). *The Protein Gap-The Fodder Tree Option*. Proceedings of a seminar organized to discuss the bridging of the protein gap through fodder trees held in Nakuru 26th- 28th August 1991.

Ministry of Agriculture Livestock Development and Marketing (1994). *Report on the evaluation mission of the National Dairy Development Project and the National Poultry Development Programme (Phase 5)*. Nairobi: Author.

Ministry of Livestock Development (1990). *Plan of operations of the National Dairy Development Project. Phase V (1st January, 1991-31st December 1994)*. Nairobi: Author.

Ministry of Livestock Development (1991b). *Zero grazing: A hand out on technical aspects*. Nairobi: Author.

Muinga, R. W. (1994). Use of On-farm fodder by-products in formulation of complete dairy rations. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 55-74). Seminar held at Hotel Kunste, Nakuru.

Muiruri, H. K. (1994). Matching of the dairy cattle feed requirements using both on-farm and Off-farm feed and fodder resource. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 40-54). Seminar held at Hotel Kunste, Nakuru.

Mukolwe, M. (1993). Key note address on National Dairy Development Activities. In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. 1-11). Seminar held at Whitesands Hotel, Mombasa.

Muma, M. A., (1991). *NDDP Report, 24 June 1991*. Nairobi: Ministry of Livestock Development.

Muriuki, H. G. & Wokabi, A. (1993). *Annex 4: Proposed position Paper in preparation of the Evaluation of NDDP*. In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. 156-168). Seminar held at Whitesands Hotel, Mombasa.

Muriuki, H. G. & Wokabi, A. (1993). *Preface*. In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. i-ii). Seminar held at Whitesands Hotel, Mombasa.

Muriuki, H. G. (1992). Kenya National Dairy Development Project. In J. A. Kategile and Mubi, S. (Eds.), *Future of livestock industries in East and southern Africa* (pp. 149-155). Proceedings of a workshop held in Kadoma Ranch Hotel, Zimbabwe, 20-23 July 1992. Addis Ababa: ILCA (International Livestock Centre for Africa).

Omore, A., Muriuki, H., Kenyanjui, M., Owango, M., & Staal, S. J. (1999). *The Kenya Dairy Sub-sector: A rapid appraisal*. Smallholder Dairy (Research & Development) Project Report. Retrieved from <http://www.ilri.org/InfoServ/Webpub/fulldocs/InvestingInDairy/DOX/Omore%20et%20al-1999-Kenya%20dairy%20sector%20rapid%20appraisal.pdf>

Panafcon Development Consultants (PDC) (1994). *Desk study: National Dairy Development Project*. Nairobi: Royal Netherlands Embassy.

Republic of Kenya (1981). *Dairy and beef production projects for smallholders*. Nairobi: Ministries of Agriculture and Livestock Development.

Skytta, M. (1993). Kenya-Finland Livestock Development Programme. In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. 129-136). Seminar held at Whitesands Hotel, Mombasa.

Smallholder Dairy Project (SDP) (2004). *The policy environment of Kenya's dairy sector. SDP Policy Brief No. 6*. Nairobi: Smallholder Dairy (R&D) Project. Retrieved from <http://cgspace.cgiar.org/bitstream/handle/10568/1750/SDP%20Brief%206.pdf?sequence=1>

Smallholder Dairy Project (2005). The uncertainty of cattle numbers in Kenya. *SDP Policy Brief No. 10*. Nairobi: Smallholder Dairy (R&D) Project. Retrieved from <http://cgspace.cgiar.org/bitstream/handle/10568/1785/SDP%20Brief%2010.pdf?sequence=1>

Snyders, P. J. M. (1989). *Feeding and fertilizer requirements of zero grazing under good management. NDDP/R10/158*. Naivasha: National Dairy Development Project.

van der Linden, S. (1994). Enabling and stimulating farmers to look for solution. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 125-133). Seminar held at Hotel Kunste, Nakuru.

van der Valk, Y. S. (1988). *Fertility report 1987. DDP/M29/144*. Naivasha: National Dairy Development Project.

van Helden, T. A. (1980a). *Report No. 1 February/March 1980*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1980b). *Ref: Report No. 2, April 1980*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1980c). *Report No. III May 1980*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1980d). *Ref: Report No IV-June 1980*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1980e). *Ref: Report No. V -July 1980*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1980f). *Ref: Report IX, November 1980*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1981a). *Ref: Report XXI-November 1981*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1981b). *2nd November, 1981. DDP/2/K38/109/TC/1*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1982a). *Ref: Report XXII-December 1981*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1982b). *Ref: Report XXVII-May 1982*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1982c). *Ref: Report XXVIII-June 1982*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1983a). *Ref: Report XXXV-January 1983*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1983b). *Ref: XLII - August 1983*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1983c). *Ref: Report XL-June 1983*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1983d). *Ref: report XLIII-September 1983*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1984a). *Ref: Report XLVI-December 1983*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1984b). *Ref: Report L-March*. Kakamega: Ministry of Livestock Development.

van Helden, T. A. (1984c). *Ref: Report LI-April 1984*. Kakamega: Ministry of Livestock Development.

Voskuil, G. C. J. (1981). *Report No. 7, 3rd October, 1981*. Nairobi: Ministry of Livestock Development, Dairy Development Project.

Wachira, D. (1994). Management and Feeding of Dairy Animals, for Higher Milk Production: some considerations. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 1-23). Seminar held at Hotel Kunste, Nakuru.

Waithaka, M.M., Wokabi, A, Nyangaga, J., Ouma, E, de Wolff, T., Biwott, J., ... Mudavadi, P. (2000). *A participatory rapid appraisal of farming systems in western Kenya*. Nairobi: Smallholder Dairy (R&D) Project. Retrieved from <http://cgspace.cgiar.org/bitstream/handle/10568/1780/Waithaka%20et%20al-2000-PRA%20Western%20Kenya.pdf?sequence=1>

Wandera, J. L. (1993). Current status of Napier production and utilisation on farms assisted by the National Dairy Development Project (NDDP). In MALDM (Sept. 1993), *Senior staff seminar proceedings: Sustainability of National Dairy Development Project (NDDP) Activities* (pp. 32-48). Seminar held at Whitesands Hotel, Mombasa.

Wandera, J. L. (1994). Suitable fodder crops for production and utilization in different regions of Kenya. In MALDM (July 1994), *National Dairy Development Project 1994 senior staff seminar proceedings* (pp. 88-110). Seminar held at Hotel Kunste, Nakuru.

Woersem, B. L. M., Bootsma, A., & Mwangi, Z. J. (1986). *3rd Joint Kenya/Netherlands Evaluation Mission*. Naivasha: Ministry of Agriculture and Livestock Development.

Wouters, A. P. (1985). *Uninterrupted growth of Napier grass (var Bana) at two levels of Nitrogen application*. Naivasha: Ministry of Agriculture and Livestock Development.

Wouters, A. P. (1991). *Zero grazing: A Hand out on technical Aspects*. 2 May 1991. Naivasha: Ministry of Livestock Development.

2. Secondary Sources

Aarons, A. G., Miller, E. A., Green, A. E., Perrott, J. A. & Bradway, R. (2012). Adaptation happens: A qualitative case study of implementation of The Incredible Years evidence-based parent training programme in a residential substance abuse treatment programme. *Journal of Children's Services*, 7(4), 233-245.

Agricultural Sector Coordination Unit (2012). Official Opening of the 3rd Agricultural Sector Development Forum: Opening remarks by H.E. the President of the Republic of Kenya Hon. Mwai Kibaki, CGH, MP. *Proceedings of the ASD Forum Today: Moving Towards Agribusiness for a Globally Competitive Agricultural Sector* held at the Safari Park Hotel, Nairobi 14-17th October 2012 (pp. 3-4). Retrieved from <http://www.ascu.go.ke/DOCS/ASDF%20Program%2018-9-12-1.pdf>

Ahorro, J. (2008). *The waves of post-development theory and a consideration of the Philippines*. Edmonton: University of Alberta. Retrieved from <http://www.cpsa-acsp.ca/papers-2008/Ahorro.pdf>

Annan, K. (1999). Intervention. *Whitehall Papers*, 48(2), 37-53.

Ansari, S. M., Fiss, P. C. & Zajac, E. Z. (2010). Made to fit: How practices vary as they diffuse. *Academy of Management Review*, 35(1), 67-92.

Archer, M. (1995). *Realist social theory: The morphogenetic approach*. Cambridge: Cambridge University Press.

Astbury, B. & Leeuw, F. L. (2010). Unpacking black boxes: Mechanisms and theory building in evaluation. *American Journal of Evaluation*, 31(3), 363-381. Retrieved from

Bebe, O., Udo, H., Rowlands, G. and Thorpe, W. (2003). Smallholder dairy systems in the Kenya highlands: Breed preferences and breeding practices. *Livestock Production Science*, 82:117-127.

Benders, J. & van Veen, K. (2001). What's in a fashion? Interpretative viability and management fashions. *Organization*, 8, 33-53.

Berg, E. (2007). Post-development theory in Africa. *Peace Review*, 19(4), 541-554.

Bernstein, H. (1992). Agrarian structures and change: Sub Saharan Africa. In H. Bernstein, Crow, B. & Johnson, H. (Eds.), *Rural Livelihoods: Crises and Responses* (pp. 65-82). Oxford: Oxford University Press.

Blundell, M. (1956). *Colony and Protectorate of Kenya report of the Committee of Inquiry into the dairy industry 1956*. Nairobi: Government Printer.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.

Buttolph, D. (1992). A New Look at Adaptation. *Science Communication*, 13(4), 460-470.

Bygstad, B. & Munkvold, B. E. (2011). In Search of Mechanisms: Conducting a Critical Realist Data Analysis. In D. F. Galletta & T.-P. Liang (Eds.), *Proceedings of the International*

Conference on Information Systems, ICIS 2011. Shanghai, China: Association for Information Systems. Retrieved from <http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1073&context=icis2011>

Castro, F., Barrera, M. & Martinez, C. (2004). The cultural adaptation of prevention interventions: resolving tensions between fidelity and fit. *Prevention Science*, 5(1), 41-45.

Conelly, W. T. (1992). Population pressure and changing agropastoral management strategies in western Kenya. In C. M. McCorkle (Ed.), *Plants, Animals, & People: Agropastoral Systems Research* (pp. 155-174). Oxford: Westview Press.

Conelly, W. T. (1994). Population pressure, labour availability, and agricultural disintensification: the decline of farming on Rusinga Island, Kenya. *Human Ecology*, 22, 145-70.

Conelly, W. T. (1998). Colonial era livestock development policy: Introduction of improved dairy cattle in high-potential farming areas of Kenya. *World Development*, 26(9), 1733-1748.

Corbridge, S. (1998). Beneath the pavement only soil: The poverty of post-development. *Journal of Development Studies*, 34(6), 138-48.

Cowen, M. & Shenton, R. (1996). *Doctrines of development*. London: Routledge.

Danermark, B., Ekström, M., Jakobsen, L. & Karlsson, J.Ch. (2002). *Explaining society: Critical realism in the social sciences*. London: Routledge.

Davis, P. (2010). Exploring the long-term impact of development interventions within life-history narratives in rural Bangladesh. *IFPRI Discussion Paper 00991*. Retrieved from <http://www.ifpri.org/sites/default/files/publications/ifpridp00991.pdf>

Douthwaite, B., Keatinge, J. D. H. & Park, J.R. (2001). Why promising technologies fail: The neglected role of user innovation during adoption. *Research Policy*, 30, 819-836.

Downward, P. & Mearman, A. (2007). Retrodution as mixed-methods triangulation in economic research: reorienting economics into social science. *Cambridge Journal of Economics*, 31, 77-99.

Ellis, F. & Biggs, S. (2001). Evolving themes in rural development 1950s-2000s. *Development Policy Review*, 19(4), 437-448.

Emirbayer, M. & Mische, A. (1998). What is agency? *The American Journal of Sociology*, 103(4), 962-1023.

Escobar, A. (1995). *Encountering development: The making and unmaking of the third world*. Princeton: Princeton University Press.

Esteva G. (2010). Development. In W. Sachs (Ed.), *The development dictionary: A guide to knowledge as power (New ed.)* (pp. 1-23). London: Zed Books.

Everett, M. (1997). The ghost in the machine: Agency in 'poststructural' critiques of development. *Anthropological Quarterly*, 70(3), 137-151.

Food and Agricultural Organisation (2005b). *Livestock Sector Brief: Kenya*. Rome, Italy: Food and Agricultural Organisation of the United Nations. Retrieved from http://www.fao.org/ag/againfo/resources/en/publications/sector_briefs/lsb_KEN.pdf

Fereday, J. & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80-92.

Ferguson, J. (1994). *The Anti-politics machine: "Development," depoliticisation and bureaucratic power in Lesotho*. Minneapolis: University of Minnesota Press.

Gamba, P. (2006). Beef and dairy cattle improvement services: A policy perspective. *Tegemeo Working paper 23*. Nairobi: Tegemeo Institute of Agricultural Policy and Development. Retrieved from http://www.tegemeo.org/documents/work/tegemeo_workingpaper_23.pdf

Granovetter, M. (1985). Economic Action and Social Structure: The Problem of Embeddedness. *The American Journal of Sociology*, 91(3), 481-510.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). London: Sage.

Guiso, L., Sapienza, P. & Zingales, L. (2006). Does Culture Affect Economic Outcomes? *Journal of Economic Perspective*, 20(2), 23-48.

Hakansson, N. T. (1994). Grain, cattle, and power: Social processes of intensive cultivation and exchange in pre-colonial western Kenya. *Journal of Anthropological Research*, 50, 249-276.

Hedström, P. & Swedberg, R. (1996). Social mechanisms. *Acta Sociologica* 39(3): 281-308.

Hedström, P. & Ylikoski, P. (2010). Causal mechanisms in the social sciences. *Annu. Rev. Sociol.*, 36, 49-67.

Huber, G. P. & Power, D. J. (1985). Research notes and communications retrospective reports of strategic-level managers: Guidelines for increasing their accuracy. *Strategic Management Journal*, 6, 171-180.

Hunter, B. & Berends, L. (2012). Using realist synthesis to develop an evidence base from an identified data set on enablers and barriers for alcohol and drug program implementation. *The Qualitative Report*, 17(1), 131-142.

Iosifides, T. (2011). A generic conceptual model for conducting realist qualitative research: Examples from migration studies. *IMI Working Papers Series No. 43*. Oxford: International Migration Institute (IMI).

Kaitibie, S., Omore, A., Rich, K. & Kristjanson, P. (2010). Kenyan dairy policy change: Influence pathways and economic impacts. *World Development*, 38(10), 1494-1505.

Karanja, A. M. (2003). The dairy industry in Kenya: The post liberalization Agenda. *Working Paper No. 1, 2003*. Nairobi: Tegemeo Institute of Agricultural Policy and Development.

Kenya Institute of Public Policy Research and Analysis (2009). *Kenya economic report 2009: Building a globally competitive economy*. Nairobi: Kenya Institute for Public Policy Research and Analysis.

Kenya National Bureau of Statistics & Ministry of Planning and National Development (2007). *Basic Report on Well-Being in Kenya: Based on Kenya Integrated Household Budget Survey-2005/2006*. Nairobi: Kenya National Bureau of Statistics.

Kenya National Bureau of Statistics (2009a). *Statistical Abstract 2009*. Nairobi: Kenya National Bureau of Statistics.

Kenya National Bureau of Statistics (2009b). *2009 Kenya Population and Housing Census Volume 1B: Population and Housing Census*. Nairobi, Kenya National Bureau of statistics.

Kenya National Bureau of Statistics (2012). *Statistical Abstract 2009*. Nairobi: Kenya National Bureau of Statistics.

Klitgaard, R. (1997). "Unanticipated consequences" in anti-poverty programmes. *World Development*, 25(12), 1963-1972.

Kumpfer, K., Smith P, Bellamy, N. (2002). Cultural sensitivity and adaptation in family-based prevention interventions. *Prev Sci*, 3(3), 241-246.

Lam, W. F. & Ostrom, E. (2010). Analyzing the dynamic complexity of development interventions: Lessons from an irrigation experiment in Nepal. *Policy Sci*, 43, 1-25.

Li, T. M. (2005). Beyond "the State" and failed schemes. *American Anthropologist*, 107(3), 383-394.

Li, M. T. (2007). *The will to improve: Governmentality, development and the practice of politics*. Durham, NC: Duke University Press.

Li, T. M. (2010). Revisiting the will to improve. *Annals of the Association of American Geographers*, 100(1), 233-235.

Lund, C. (2010). Approaching Development: an Opinionated Review. *Progress in Development Studies* 10(1): 19-34.

Mackenzie, N. & Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues In Educational Research*, 16. Retrieved from <http://www.iier.org.au/iier16/mackenzie.html>

Mango, N. A. R. (2002). *Husbanding the land: Agricultural development and technological change in Luo land*. Published PhD Thesis, Wageningen University, Netherlands.

Mathews, S. (2004). Post-development theory and the question of alternatives: A view from Africa. *Third World Quarterly*, 25(2), pp. 373-384.

Maxwell, A. J. (2004). Causal explanation, qualitative research, and scientific inquiry in education. *Educational Researcher*, 33(2), 3-11.

Maxwell, A. J. (2009). Designing a qualitative study. In Bickman, L. & Rog, D. J. (Eds.), *The SAGE Handbook of applied social research methods* (2nd Ed.) (pp. 214-253). Sage Publications Incorporated.

Maxwell, J. A. (2012). *A Realist approach for qualitative research*. London: Sage.

Minakawa, N., Dida, G. O., Sonye, G. O., Futami K. & Kaneko, S. (2008). Unforeseen misuses of bed nets in fishing villages along Lake Victoria. *Malaria Journal*, 7(165), 1-6.

Ministry of Livestock Development (1991a). *Kenya dairy master plan*. Nairobi: Ministry of Livestock Development.

Ministry of Livestock Development (2010). *Kenya national dairy master plan, Volume II: Action plan and implementation strategy*. Nairobi: Ministry of Livestock Development.

Mkandawire, T. (2011). Running while others walk: Knowledge and the challenge of Africa's development. *Africa Development*, 36(2), 1-36.

Morén, S. & Blom, B. (2003). Explaining Human Change: On Generative Mechanisms in Social Work Practice. *Journal of Critical Realism* 2(1): 37-61.

Muraghe, A. W. & Ilatsia E. D. (2011). Factors that determine use of breeding services by smallholder dairy farmers in Central Kenya. *Trop Anim Health Prod* 43: 199-207.

Muriuki, H.G. (2011). *Dairy development in Kenya*. Rome: Food and Agriculture Organization of the United Nations. Retrieved from <http://www.fao.org/docrep/013/al745e/al745e00.pdf>

Nustad, K. G. (2001). Development: The devil we know? *Third World Quarterly*, 22(4), 479-489.

O'Connor, C., Small, S. A. & Cooney, S. M. (2007). Program fidelity and adaptation: Meeting local needs without compromising program effectiveness. *What Works, Wisconsin Research to Practice Series, 4*. Madison, WI: University of Wisconsin-Madison/Extension.

Omiti, J. & Muma, M. (2000). Policy and institutional strategies to commercialise the dairy sector in Kenya. *IPAR Occasional Paper No. 006*. Nairobi: Institute of Policy Analysis and Research.

Omiti, J., Staal, S., Kaguango, W., Kariuki, E., Nin Pratt, A., & Wanyoike, F. (2008). Dairy development in Kenya. S. J. Staal, A. N. Pratt & M. Jabbar (Eds.), *Dairy development for the resource poor Part 2: Kenya and Ethiopia dairy development case studies* (pp. 2-25). *PPLPI Working Paper No. 44-2*. Rome: ILRI, FAO. Retrieved from http://www.fao.org/ag/againfo/programmes/en/pplpi/docarc/wp44_2.pdf

Omore, A., Kurwijila, L. & Grace, D. (2009). Improving livelihoods in East Africa through livestock research and extension: reflections on changes from the 1950s to the early twenty first century. *Tro Animal Health Pro*, 41, 1051-1059.

Owango, M.O., Staal, J.S., Kinyanjui, M., Lukuyu, B., Njubi, D. & Thorpe, W. (1998). Dairy co-operatives and policy reform in Kenya: Effects of livestock service and milk market liberalization. *Food Policy*, 23, 173-185.

Parker, G. G. (1952). British policy and native agriculture in Kenya and Uganda. *Agricultural History*, 26 (4), 125-131.

Pawson, R. & Tilley, N. (1997). *Realistic evaluation*. London: Sage Publications.

Pawson, R. (2006). *Evidence-based policy: A realist perspective*. London: Sage.

Pawson, R. (2008). Causality for beginners. In: *NCRM Research Methods Festival 2008*. Retrieved from <http://eprints.ncrm.ac.uk/245/>

Pawson, R. (2011). From the library of ... *Evaluation*, 17(2), 193-196.

Pawson, R. (2013). *The science of evaluation: A realist manifesto*. London: Sage.

Pawson, R., Greenhalgh, T., Harvey, G., & Walshe, K. (2005). Realist review-a new method of systematic review designed for complex policy interventions. *Journal of Health Services Research & Policy* 10(1): 21-34.

Quarles van Ufford, P., Giri, A. K. & Mosse, D. (2003). Interventions in development: towards a new moral understanding of our experiences and an agenda for the future. In P. Quarles van Ufford and A. K. Giri (Eds.), *A moral critique of development: In search of global responsibilities* (pp. 3-43). London: Routledge.

Radulescu, C. & Vessey, I. (2009). Methodology in critical realist research: The mediating role of domain specific theory. In AMCIS 2009 Proceedings. *15th Americas Conference on Information Systems AMCIS 2009*, San Francisco, California, U.S., (1-12). 6-9 August, 2009. Retrieved from <http://aisel.aisnet.org/amcis2009/433>

Ragin, C. (2009). Reflections on casing and case-oriented research. In D. Byrne and C. Ragin (Eds.), *The Sage handbook of case-centred methods* (pp. 522-534). London: Sage.

Republic of Kenya (1965). *African socialism and its application to planning in Kenya: Sessional Paper No. 10 of 1965*. Nairobi: Government Printer.

Republic of Kenya (1979). *Statistical Abstract 1979*. Nairobi: Central Bureau of Statistics.

Republic of Kenya (1984) *Kakamega district development plan 1984-1988*. Nairobi: Office of the Vice President and Ministry of Planning and National Development.

Republic of Kenya (1994). *Kakamega district development plan 1994-1996*. Nairobi: Office of the Vice President and Ministry of Planning and National Development.

Republic of Kenya (1997). *Kakamega district development plan 1997-2001*. Nairobi: Office of the Vice President and Ministry of Planning and National Development.

Republic of Kenya (2002). *Kakamega district development plan 2002-2008*. Nairobi: Government Printer.

Republic of Kenya (2003). *Economic recovery strategy for wealth and employment creation 2003-2007*. Nairobi: Government Printer.

Republic of Kenya (2004). *Strategy for revitalising agriculture 2004-2014*. Nairobi: Ministry of Agriculture & Ministry of Livestock and Fisheries Development.

Republic of Kenya (2007). *The economic recovery strategy midterm review: Popular version*. Nairobi: Government Printer.

Republic of Kenya (2008). *Vision 2030 medium term plan 2008-2012*. Nairobi: Ministry of Planning, National Development and Vision 2030.

Sachs, W. (Ed.). (2010). Preface to the new edition. In Sachs (Ed.), *The development dictionary: A guide to knowledge as power* (New ed.) (pp.vi-xiv). London: Zed Books.

Saldana, J. (2009). *The coding manual for qualitative researchers*. London: Sage.

Sayer, A. (1992). *Method in social science: A realist approach* (2nd ed.). London: Routledge.

Sayer, A. (2000). *Realism and social science*. London: Sage.

Sayer, A. (2010). *Method in social science: A realist approach*. (Rev. 2nd ed.). London and New York: Routledge.

Scott, J. C. (1998). *Seeing like a state: How certain schemes to improve the human condition have failed*. New Haven and London: Yale University Press.

Segers, K., Dessein, J., Nyssen, J., Haile, M. & Deckers, J. (2008). Developers and farmers intertwining interventions: the case of rainwater harvesting and food-for-work in Degua Temben, Tigray, Ethiopia. *International Journal of Agricultural Sustainability*, 6(3), 173-182.

Stirman, S. W., Miller, C. J., Toder, K. & Calloway, A. (2013). Development of a framework and coding system for modifications and adaptations of evidence-based interventions. *Implementation Science*, 8(65), 1-12.

Suda, C. A. (2000). Change, persistence, and development in smallholder livestock production system in western Kenya. In R. A. Obudho & J. B. Ojwang, (Eds.), *Issues in resource management: Essays in honour of Prof. Simeon Ominde* (pp. 234-244). Nairobi: East African Educational Publishers Ltd.

Swynnerton, R. J. M. (1955). *A Plan to intensify the development of African agriculture in Kenya* (2nd. imp.). Nairobi: Government Printer.

Thomas, J. & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, 8(45), 1-10.

Yeung, W. C. H. (1997). Critical realism and realist research in human geography: a method or a philosophy in search of a method? *Progress in Human Geography*, 21(1), 51-74.

Ziai, A. (2004). The ambivalence of post-development: Between reactionary populism and radical democracy. *Third World Quarterly*, 25(6), 1045-1061.

Ziai, A. (2011). Some reflections on the concept of 'development'. *ZEF Working Paper Series 81*. Centre for Development Research (ZEF), University of Bonn, Bonn. Retrieved from http://www.zef.de/fileadmin/webfiles/downloads/zef_wp/wp81.pdf

Appendix 1 Kiswahili interviews quoted

1. Wakati ule tukifundishwa tulikuwa tunaambiwa unaweza kumweka amdakutengeneza tu hako ka nini kake, ka cage kake na umweke hapo. Lakini kuna seasons zingine zinakuwa very cold. Ukimweka akiwa amezaliwa tu na umweke tu pale bila kuju temperature ya mahali pale, anaweza kupata pneumonia au kama mvua inanyesha, akinyeshewa in that early age, anaweza kuwa mgonjwa. Ni kama binadamu tu. Sasa kuna wakati unaangalia ndama, wakati amezaliwa, unaona ile season ni baridi sana, usiku unajaribu kutengeneza mahali pale pawe warm akifika kiwango fulani. Uwe umemsaidia kwa sababu hapo nyuma, tulikuwa tunapoteza ndama sometimes kwa hiyo kama amezaliwa kama kuna baridi sana. Unaenda unamweka kwa hiyo cage, venye unamwacha tu hivyo, ile baridi inazidi kumshika alafu anapatwa na pneumonia.

2. Ninaweka nini kwa compost pit nachanganya na vitu vyengine halafu wakati wa kupanda kama huu ninatengeneza ile mbolea. Sasa nikitengeneza nachukua kiasi fulani napeleka kwa shamba ile napanda mahindi na kiasi fulani naweka kwa Napier. Na hapo nyuma tulikuwa tunaweka kama iko mbichi lakini nikaona sasa wakati tukiendelea kweka kama iko mbichi hainifaidi kwa upande mwingine, inafaidi tu Napier peke yake. Sasa ndio niliona mpaka niweke compost pit.

3. Hiyo bado iko. Sasa na hiyo kwa wingi napandia mboga kwa sababu ukiweka kwa nyasi inasaidia sana lakini kubeba kuweka kwa nyasi ni ngumu. Hiyo ni ngumu kidogo. Lakini sasa nikipanda mboga natengeneza tu siku moja nakuwa na mtu anachota akiweka kwa mboga halafu inasaidia kwa upande wa mboga. Wengi sasa sio kama siku zile, wengi hawataki kuibeba kwa sababu ukiibeba hata ukioga inakuchukua muda kutoka kwa mwili. Lakini mimi huitumia. Kwa sasa iko tu. Sasa ninapanda panda mboga kama hapa sasa nimewacha nataka kupanda mboga. Nimeweka upande mmoja Napier. Hiyo nini mbolea ya kutoka kwa shimo sasa kama hapa, zile nitapanda hapa sasa nitakuwa nikibeba. Halafu namwaga hapo. Nikimwaga hapo halafu mvua inanyesha mboga zinakuwa kwa haraka.

4. Napier haitoshei, watu watu wale tungetegemea juu yao yaani, when you finish yours and it has not grown to the level of you know, harvesting, inatakikana mpaka you move out, utoke nje, sasa na watu majirani wanapanda kidogo, na imekuwa very expensive. Hata saa hii kama umepitia huko kwangu si umeona, sijui kama umekuta kama kijana anakata.

5. Mama alikuwa hai wakati nilipoleta hii ngombe. Ilipozaa nikaenda kukamua maziwa kwa sufuria kubwa namna hii. Nikakamua maziwa nikamwambia mama beba hii maziwa. Alishangaa alikuwa hajaona ngombe ikitoa maziwa namna hii. Hii ni maziwa ama ni maji. Mwenyewe akabeba, akapeleka kwa nyumba akasema, hii ni maziwa ama ni maji. Lakini anaona ni maziwa. Inaonyesha kwamba alifurahia ngombe ya gradi ile matokeo mazuri. Sufiria huwezi kubeba namna hii. Hii ndio kitu ilinifundisha mimi kumbe ngombe ya maziwa ni mzuri. Mama alishangaa hii ni maziwa au ni maji. Lakini anaona colour ni ya maziwa na aliona vile ninakamua tena mimi mwenyewe sio mtu mwingine. Ile furaha mama alikuwa nayo iliniencourage kwamba niendeleo kufuga ngombe ya gradi. Kwasababu hajaona kitu kama hiyo tangu azaliwe na hajaona maziwa mingi kama hiyo. Karibu nchi hii yote ninawauzia maziwa.

Watu wengine wa roho mbaya wanasema si hii ngombe itakufa. Kufuga hii ngombe ni kama hasara tu. Lakini hiyo yote iliingia katika masikio yangu lakini sikufa moyo. Na mpaka dakika hii niliamua ife nitanunua nyingine iwe hai nitaendelea kufuga ngombe ya maziwa. Lakini ya kienyeji, no. Mimi niliamua nitafuga ngombe ya maziwa thought my life kwa sababu niliona vile mama alibehave nilipompea maziwa sufuria mzima akapeleka nyumbani. Na akashangaa ni kitu gani hiki. Ilinipa encouragement.

6. Watu wengine walinichekelea tu na wengine wakaningilia tu. Inataka ufundishwe ndio ufuge. Ufuate mambo ya hawa ndio ufuge ngombe za grade. Unajua wengine wanajichukulia ngombe tu. Ngombe ya kizungu sio ngombe ya kuangukia tu. Mpaka ujifundishe. Ujue chakula yake, kulala yake, ujue maji yake ya kunywa namna gani. Lakini ukiamka tu ati mimi nataka kufuga ngombe ya kizungu, huwezi. Ngombe ya kizungu haitaki kukosa chakula ama maji. Ngombe ya kizungu inahitaji kulala mahali safi. Uchunge njia yake ikiwa na mahali pa kulala.

7. Ile tulifanya kikwetu sisi wenyewe ni kutozingatia kuua ndama. Walikuwa wanatufunza tuue. Hiyo sasa tukichukulia tukasema hatuui. kwa maana ni mzima na ni mzuri, sasa tutamuua kwa nini? tumutunze ikiwa mtu atapatikana anunue kama ingali hai. Sasa hiyo ninaweza sema ni hiyo sisi tu labda tulifanya kwa kinyume.

8. Wakati mzee wangu alikuwa angali hai, yeye alikuwa ni councillor wa area. As a leader, if there is anything project ikija katika area yako. Nakumbuka by then ni yeye alikuwa coincillor wa kakamege, north kabras yenye ilikuwa imechukua the present malava division whatever mpaka malava, shimanyeti huko. So kukija project, ikiwa wewe uko leader mzuri, ambayo srikali inaona hii inaweza kufaa. At least vile alikuwa kiongozi akaonelea aiweke as a councollo tulikuwa tunapata wageni wnegi. Hata wa serikali wanakuja kuona vile project inaendelea. Halafu wale wanaokuja wakikuja wanaonea hapa. Mtu akichukua idea anaenda nayo. Kitambo usimame ukitangaza ati oo fanyezi hivi, si waje waangalie kwa boma. How do you do it and you get many visitors. sasa ikawa ndio mzee hiyo project ilipokuja ya zero grazing akawa yeye wa kwanza kuja kujenga hii nyimba, unit.

9. Niliporudi hapa nyumbani nikaamua nitafute ngombe ya kufuga lakini kwa kuwa sina shamba kubwa ya kutosha nikaingia mradi wa zero grazing unit. Na tulikua na mzungu mmoja mr helden. If i can remember very well. Na angali hai nimepata habari kwamba angali hai. Huyu mzungu ndiye alikuwa anatoka kakamega livestock na akajaribu kuzunguka sana. Na ndiyo huyo mzungu huyo helded akatuongoza kufug ngombe moja ya maziwa katika unit ya zero grazing nitakutosheleza mahitaji mazuri kwa mapato ya maziwa.

10. Kitu cha kwanza, mi nilikuwa nataka maziwa na ng'ombe wa kienyeji utachukua muda mrefu kumlisha wakati anakuja kupata ndama, amekula sana lakini hat akipata ndama, maziwa yake ni kidogo. Hayawezi kukusaidia ukiwa na jamii na mi wakati huo nilikuwa na jamii na ndio nikapata advice kutoka kwa wakulima wengine, wale walikuwa na ng'ombe za grade hapa, kama mzee Mudete, my sister-in-law alikuwa huko Lugari ndio alinisaidia sana. Hata ndio alininunulia ng'ombe wa kwanza 1985, alafunikakuja nikaendelea hivyo nikaongeza wakawa wawili, alafu sasa nikaanza kupata wangu kutoka kwa wale wa kwanza.

11. Nilikuwa nikitamani ngombe za grade. Hakuna ngombe ya kizungu ilikuwa hapa na nilikuwa nafikiria nikipata ngombe za grade nitafurahi. Na watu walinicheka sana wakasema, wewe kweli huwezi ngombe za grade. Ikiwa unafuga ngombe inatembea kutoka hapa mpaka mbale na wapi. Lakini sasa ndani ya nyumba, utaweza? Lakini usaidizi wa Ambole na huyo mzungu bwana Helden Niliweza ngombe hadi nikashinda zile za mahamba. Halafu sasa nikaanza halafu wakakuja wakazililia. Niliuza zile za kienyeji nikandelea na hizi za kizungu. Kilukuwa kitu kama mfano na ilileta watu wengi wakakuja kutazama, kuja kuona zile ngombe zinakulia ndani ya nyumba.

12. Kitu cha kwanza, ulikuwa ulime nyasi, ngombe akija apate kuna nyasi iko tayari. At least inaendelea hata ikiwa in stages, iwe ambayo anaweza kula na iko ingine inaendelea. Halafu hii unit huwe unayo tayari ambayo watakuja waangalie vile umeijenga ni vile wanataka, ndio wewe ufanye kuleta ngombe. Tatu, spraying kit. You had to have it. Hata tulikuwa tunapitia kwa ministry halafu wanakuletea spray pump hii ambayo unapuliza kama unaweka pumzi kwa baiskeli. So there were conditions.

13. The livestock people walisaidia sisi kuenda kuleta ng'ombe Kitale. Tulikuwa na hao, selection ya ng'ombe ni hao. Sisi hatukujua maneno ya ng'ombe. Hao wenyewe walienda kuselect na kuweka alama. Hata ile lorry kutoa ng'ombe kuleta huku, hao walileta tu mpaka hapa Elwunza

14. Imekuwa zaidi hivi karibuni, as the number increases, na shamba also reduces kwa hivyo we kama umezaa kijana anatakana aende huko, ajenge huko chini, na huko ndo ulikuwa unapanda napier grass, so you see the volume inanza kureduce, land volume inanza kurudi chini.

15. Naona iko process mingi sana. Unajua ukipandsa mahindii na ikifika kiwango ya kufany asilage uende ukate, utaitwa mwenda wazimu. Kwa hivyo hiyo silage ni kama ndoto kwetu. kwanza shamba hatuna. Tena ile mahindi kidogo umepanda uende kuweka kwa silage, watakuit amwenda wazimu. Kwa hivyo hiyo system sikujaribu.

16. Kila mwaka December hapo manake hapo inakuwa mimi nikiharvest mahindi yangu however small the portion is, hizo nini zote, huwa ninastock, huwa ninaweka hiyo husks, hii maganda ya mahindi yenyewe huwa ninaweka, na ninaweka hii stems. Halafu wakati sasa watu waanza kukata miwa, ikiwa kuna mahali takataka ya miwa unless watu wengine wakitoa mbegu zinabakia, i am supposed to buy maybe sometimes i buy tonnes tatu ama nne kutoka kwa shamba ya mtu. ili nije nilistock ndio inishongeze kidogo.

17. Unajua tuna resort kwa hiyo migomba ya ndizi kama sasa kiangazi ikiwako kama hakuna chakula ingine. Wakati from beginning of the year upto kitambo mvua inyeshe mahali ukitembea huwezi ona kitu bali mchanga na kanyasi kamoja tu. Hapa na plale. Ngombe haina chakula hiyo ndiyo tunatafuta anything upatie ngombe. Hili im sustain. Pengine utakuwa na hiyo hata ile imekauka ya miwa, tunakatakata tunaweka chumvi kidogo, tunanyunyisia maji ya chumvi unamtupia hapo. So huwa tunazipatia ndio, lakini amekosa kitu cha kumpatia ngombe. Ndio

hataunakubalia mchungaji kitambo ngombe akae na njaa, haidhuru mpatie hiyo ale pengine atapata kitu cha, kwasababu bila ngombe kushiba atakunywa maji kweli?

18. Nilikuwa nachukua machicha kisumu na unakuja unakata napier grass na unachanganya na machicha unaweka kwa food trough. Baada ya mwezi moja ile kiasi ya maziwa yenye utaona pale. Ilikuwa inatoa maziwa kubwa sana. Machicha is very rich katika milk production. Very rich. Hatujapata chakula ingine kama hiyo. Tukawa na a very big setback kwa vile walifunga kituo cha kisumu cha brewery.

19. Mzungu aliniambia can you have poles za kufanya nikasema yes. Unaweza kupata miti ya kuweka mabati, nikasema yes. Na akaniletea mabati. Yule mzungu Helden agricultural livestock officer alinisaidia mabati, honestly. Alinisaidia mabati. Lakini miti, simiti, kujenga ile food stalls zote ile yangu hakunisaidia

20. Sikuwa na shida kuuza maziwa. Unajua morning section, ilikuwa inatoa kama chupa themanini, na yote inakwisha. Jioni tunakama karibu sitini. Inaisha yote. Sikuona haja ya kungana na group ya kuuza maziwa.

21. Mzee mwenyewe alikuwa anakataa. Alikuwa anaonea ngombe huruma. Walikuwa wanakataa kabisa usifuge ndume. Sasa mzee akawaambia kama imezaa ndume unaua kwa nini? Si uwache tu. Sasa yeye alikuwa haui.

22. Walikuwa wanatuambia inatumia maziwa nyingi. Inatumia hata chakula kingi lakini haina faida. Lakini vile tuliendelea tukaona as Christians it is unfair kila wakati kuchinja chinja tu. Halafu tukaendelea but by then hatukuwa tunapata ndume wengi kama sasa. Tulikuwa tunapata mmoja after two or three years tunapata mwingine. Wale walikuwa wengi ni heifers na ikiwa bahati apatikane. Nikamwambia mimi sisikii ni vizuri kwa sababu when it is young na kuchinjia mbwa naona si vizuri sasa nikaanza kufuga.

23. Sio shida kufuga ndume na mimi mwenyewe sichukui kama ni shida. Lakini kufuatana na maelezo inaonekana ni shida but for me nimeichukua kama si shida kwa sababu itafika mahali na inisaidie. Na kama sasa ni vile tu economy imekuwa mbaya walikuwa wakinunuliwa sana. Watu walikuwa wanatoka hata mbali kuja kuchukua bull hapa kwasababu walikuwa wanaamini they are pure, pure graded animals. Sasa hata wale wanataka ya kuserve nilikuwa nawauzia wanaenda nayo.

24. Nilikuwa na mfanyi kazi wa shamba. Kupeleka urine kwa napier grass, saa zingine wanakataa. Unajua kwa kubeba samadi hakuna shida lakini hiyo mkojo. Mkojo walikiwa wanakataa. Kwanza lazima ukoroge halafu uchukue ndoo uweke huko unapeleka. Walikuwa wanakataa. Wanaweza beba tu lakini hawawezi beba kila siku. Wanakataa. Anaona ni kazi nyingi. Nilikuwa nakaa kwa shule. Ukija unasikia anasema mimi nilikuwa na kazi nyingi. Unaona ni kujifanya tu. Kwa maana samadi ukikoroga tu unaweza beba ndoo kama tatu kwa siku. Lakini hataki. Yani ukimwambia apeleke huko samadi unapalilia. Ukikata nyasi nenda na samadi upalilie halafu uweke. Hataki. Anaona ni kazi nyingi. Yeye anakata anamaliza mahali ulisema akate. Halafu atapalilia atafute tena siku nyingine kubeba na kupeleka huko.

Sasa anachukua kama siku tatu. Na sisi tulifundishwa siku hiyo tu akikata laini mbili apalilie achukue mkojo amwagilie.

25. Zamani, ungeweza kukaa na mfanyikazi hata six years na hana shida. Siku hizi ndio wako wakorofi, kwanza ni wavivu. Pili wanapenda na kutaka pesa nyingi kuliko kazi. Ndio shida sasa. Si unaona hata huyu ninaye sa hii, kama sipunguzi masaaa ya kufanya kazi, atatoroka tu. Lakini unaona sa hii ujamuona. Amemaliza kupea ngombe maji na ameeenda. Aende ashugulike na kazi yake. Lakini wakati ule, zamani zile, nilikuwa na wafanyi kazi wa kuishi. Huyu sasa ni kibarua. There is a very great difference kwasababu wale wa zamani walikuwa serious na kazi ilihali wa siku hizi hapana. Halafu, pia, hawa wa siku hizi usipokuwa karibu hakuna kitu watafanya. Wanashindwa hata kukuambia kama hata ngombe ni ngonjwa. Kama hauangalii, utajuta. They dont care. Sasa hawa wa siku hizi wako hivyo. Zamani, wafanyi kazi walikuwa wanapatikana kwa rahisi.

26. Baada ya muda mrefu unarenew hiyo olusi tena. Unaweka mbegu, halafu unabomoa halafu unapanda upya tena. Tena saa ingine tunatumia hii mambo ya crop rotation. Mpaka ubadilishe kwa maana mahali pamoja kila mara inakuwa ngumu.

27. Kuanzia wakati huo mpaka sasa hivi nimekuwa na ngombe za kienyeji. Kitu mzuri hawalali pamoja na ninafanya regular spray kwasababu najua hawa ni carriers. Si hata hawa ndio naleta kupe kwa boma. These are carriers. Naweka hao lakini najua ni carriers. Sasa nimechukua system ya kuspray all the time.

28. Hizi zingine nilikuwa nafinance kutoka kwa ngombe wenyewe. Halafu, zingine huwa na nikipata pesa kutoka other sources nifance tu. Kama unakumbuka ulinipata nikipasua mbao. If I am lacking something from such sources, nafinance tu. I dont care ati hizi pesa zilitoka wapi ama zingetoka kwa ngombe, hapana.

29. Mtoto wangu mkubwa ndio ananisaidia kidogo kidogo. Kwa maana kama nyasi haijakuwa namna hii, ananiletea hii hay. Last year 2010, alienda akapanda kwa shamba mahindi one acre, halafu kama ilikuwa karibu akakata yote akaleta. Akaleta molasses tukatengeneza silage kwa makaratasi alinisaidia sana 2011 January, February na March. Kama namna hii sikusumbuka ngombe ilikuwa inakula tu hiyo. Yeye ndio alinisaidia. Lakini mwaka uliopita alikuwa mbali Garissa anaenda huko fieldwork ikawa ngumu kufanya hiyo kazi. Support yake kama unataka ukimwambia anunue dawa aniletee dawa, atanunua akuletee na chakula kama dairymeal imekwisha ukimwambia hiyo niletee, hiyo atafanya. Kama ngombe iko ndani na maji hakuna kama yeye iko hapa ataweka.

30. Tumefunja sheria ambayo wale walitaka ngombe ikae ndani ya zero grazing kwa shauri sisi tumekuwa wafifu na tumeona homestead imekuwa na majani. Badala ya kuikatia hiyo majani unaifungia huko nje. Ni ufifu wa kutokuwa na ngombe nzuri. Ukitaka ngombe zetu tumekuwa mchanganyo kwa maana zile ngombe tulikuwa tunaita ngombe za grade zimeendelea zikidhoofika watu wakipandisha kwa dume sio mzuri. Kwa hivyo hata ngombe mtu akikudanganya ni ya grade haina maziwa sura tu ndio unaona. Ngombe ndizo zimeharibika. Lakini tumedhoofika tu sisi wenyewe tuliharibu.

31. Watoto walikuwa wakisaidia lakini when they grew up, wote wakahama, wameenda town. Sasa imebaki tu mimi na mama lakini kitambo walikuwa wakinisaidia by cleaning where the animals sleeps, kutoa hiyo samadi, hata saingine mfanyikazi anaweza kuwa mgonjwa, wao pia wanasaidia kufanya kazi, to feed the animals. They go for Napier grass wailishe, hawakai ndee.

32. Hii Napier grass nilipanda 2006 na imeniserve vizuri mpaka 2010. Due to management ambayo yaani mwenye ninaweka ndani kupalilia wakikata. Yeye apalilii mahali imemea. Nyasi zimemea, sasa akikuja kupalilia anapalilia tu round na anawacha hapo. Na inatakikana alime ili atoe hiyo nyasi naye napier grass ishoot. Imeanza kufa. Lakini mimi ninajua kwamba kama ningelikuwa na mtu wa kuipalilia vizuri, na ninamtu mzee tu infact hata he is there. He comes and he is there daily from 2006 upto now ningali na huyo tu. But alifika mahali yeye naye nikimwambia nataka ulime na nyasi itoke ndio napier ishoot vizuri, naye anasema hapana, ukifanya hivyo itakufa. Sasa tumeshindama mpaka nyasi yangu sasa imekufa.

33. Kwasababu hapo nyuma nilikuwa mkulima yao mzuri sana. Saa yote wananitembelea. nikienda kupiga huko report, wanaingia na madawa kuja kuona ngombe inendelea namna gani. Kwasababu walikuwa wanaleta wageni kutoka ngambo. Veterinary officers walikuwa tayari kutuletea madawa, deworming inatengenezwa upesi. Wanampa timetable wanasema mwezi fulani deworming. Na ile ofisa ya livestock ya upande wa zero grazing ilikuwa upande wake. Hii inataka tupeane sindano fulani. Sasa upande wa madawa hakukuwa na shida. Kama hawangukuwa karibu na sisi hiyo ngombe ingekufa after a short time tena unit ilinisaidia kupe. Ilikuwa sioni kupe ndio nikaendelea kusarvive.

34. Unajua tulikuwa tunatumia AI watu wakaenda kwa ndume anapata tu yeyote anapandisha, unajua zinaenda na ndume tena, ukipata ndume labda kama ile ya pembe, hautapata maziwa kama ya grade ama A.I. Even AI ya siku hizi mimi siamini. Ng'ombe inapandishwa, maziwa hupati, sijui ni kwa sababu ya unaweza tu kulisha tu vizuri vile tumefundishwa, unaipatia chakula vizuri kama lucern, unaipea dairy meal ikifika eight months inaendelea kula, lakini ikizaa hupati maziwa vile tulikuwa tunapata AI ya siku hizi ni nini, wanatoa wapi mbegu zao, hiyo haifanyi vizuri nimejaribu hapa AI mara ngapi, sioni, hata ile ndume. Ndama ni ya AI, hata ile iko ndani ni ya AI lakini maziwa hazitoki ndani mzuri.

35. Napier haitoshei, watu watu wale tungetegemea juu yao yaani, when you finish yours and it has not grown to the level of you know, harvesting, inatakikana mpaka you move out, utoke nje, sasa na watu majirani wanapanda kidogo, na imekuwa very expensive. Hata saa hii kama umepitia huko kwangu si umeona, sijui kama umekuta kama kijana anakata.

36. Napier iko huko chini nimeacha. Kitu ninafanya to maintain it napeamna ndugu zangu au wakulima wenye wako tayati kununua napalilia ndani wanakata. Hata sa hii inaweza kufika kama acre moja ama three quarters. Kwasababu saa hii sina ngombe, nikaona si mzuri ndio upande mwingine nikapanda kahawa kama acre mbili. Lakini zamani hii yote ilikuwa Napier grass shamba yote siku ngombe zilikuwa sita. Lakini sasa nimegawanya mahali ya vitu zingine. Hata miwa iko ndani.

37. Nilienda sehemu moja wakati nilikuwa nafanya na kampuni fulani. Na nikapata hizi vitu za miwa ziko huko na ng'ombe yangu ikakosa chakula. Mke wangu akasema tutoe ngombe moja kwasababu chakula ni kidogo. Sikuwa nataka hivyo. Nilipokuja na hizi vitu za miwa nikapea hiyo ng'ombe ikakula kufika jioni tukakamua maziwa. Kesho yake tukaipea zile zenye zilikuwa zimelala. Jirani alipoona akaniambia hata yeye anataka. Sasa nikampatia. Halafu akanielezea, huko penye ulitoa, si uende ununue ulete halafu tugawe hasara. Nikarudi na pick up yangu nikaleta. Aliponunua, jirani mwingine akaona hivyo akasema sasa hi vitu afadhali nilete kwa soko ili watu wengine wa karibu wasiteseke. Walipokuja walipoona walifurahia sana. I was the first person to start kuuza. Walipooona wakanza kuchukua.

38. Ingawa hawa wakulima wenye wanategemea ukulima wananunua, hatutegemei hao sana kwasababu wao wanachukua kama mara mbili kwa wiki na hao hizo ngombe za zinategemea nyasi ya kando ya barabara. Tunategemea waalimu na wafanyi kazi za serikali wenye wanafuga ngombe pure za gredi. Pia kuna hawa vijana wa pikiiki wenye wamenunua ngombe ndogo ndogo za gradi wameanza ufugaji. So, wanannunua kwa wingi. Hao ndio tunategemea sana. Wanakuja na hiyo pikipiki anachukua hiyo mbili, tatu, inne, wanaenda.

Appendix 2 Phases of NDDP implementation

Phase	Key activities
Phase one-orientation (1980-1981)	<ul style="list-style-type: none"> -Recruitment of project staff -Start of project activities in 6 districts -Identification of constraints to dairy farming -Development of zero grazing technical package -Advice to existing and interested dairy farmers
Phase two-introduction 1982-1983	<ul style="list-style-type: none"> -A seventh district added to the project -Napier grass bulking plots established -Project grant given to demonstration farmers -Discussion of credit scheme with AFC -Establishment of a research unit -Training of farmers in workshops and field days
Phase three-consolidation 1984-1986	<ul style="list-style-type: none"> -Advice by research unit on use of fertilizers and concentrates -Grant scheme discontinued -Discussions with AFC over credit ended -Issue of zero grazing extension materials -Formation of self-help groups and zero grazing clubs
Phase four-expansion 1987-1990	<ul style="list-style-type: none"> -Intensification of activities in initial districts -Expansion into seven new districts -Dutch experts who were at districts as dairy officer became regional coordinators at the provincial level -Replacement of demonstration farmers with well performing farmers -Discussions with AFC ended -Development of extension materials -National meeting between project staff and NGO's representatives
Phase five-integration (1991-1994)	<ul style="list-style-type: none"> -Focus on sustainability and integration of project activities in MoA extension -Sustainability involved institutional, socio-cultural, economic, and financial aspects -Expansion into six new districts -Decentralisation of decision making to districts-project plans made there -Researcher post ceased and activities were taken over by KARI -Inclusion of gender aspects in zero grazing-seminar on gender aspects; gender desk established

Appendix 3 Research permit

REPUBLIC OF KENYA



NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telegrams: "SCIENCETECH", Nairobi
Telephone: 254-020-241349, 2213102
254-020-310571, 2213123
Fax: 254-020-2213215, 318245, 318249
When replying please quote

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref:

Date:

NCST/RRI/12/1/SS-011/1562/4

21st November, 2011

Obadia Okinda Miroro
University of KwaZulu-Natal
SOUTH AFRICA

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "*Dairy technologies for development: Actors, contexts & outcomes in Kenya*" I am pleased to inform you that you have been authorized to undertake research in **Kakamega District** for a period ending *30th November, 2013*.

You are advised to report to the **Permanent Secretary, Ministry of Livestock Development, the District Commissioner & the District Agricultural Officer, Kakamega District** before embarking on the research project.

On completion of the research, you are expected to submit **one hard copy and one soft copy** of the research report/thesis to our office.

A handwritten signature in black ink, appearing to read 'P.N. Nyakundi'.

P.N. NYAKUNDI
FOR: SECRETARY/CEO

Copy to:

The Permanent Secretary
Ministry of Livestock Development
Kilimo House, Cathedral Road
NAIROBI

Appendix 4 Informed consent form

(To be read out by researcher before the beginning of the interview. One copy of the form to be left with the respondent; one copy to be signed by the respondent and kept by the researcher.)

My name is Obadia Okinda Miroro (student number 211559228). I am a PhD Candidate at the University of KwaZulu-Natal and I am doing research for my thesis entitled “*A realist explanation of long run development interventions: Contexts, adaptations and outcomes of dairy improvement in Kenya*”. This research is supervised by Prof. Julian May at the School of Development Studies, University of KwaZulu-Natal, South Africa. Should you have any questions my contact details are: School of Built Environment and Development Studies, University of KwaZulu-Natal, South Africa or Institute for Development Studies, University of Nairobi, Kenya. Tel: +2540202247968; Cell: +254722426515; Email: ookinda@gmail.com; 211559228@stu.ukzn.ac.za.

I would like to ask you some questions about the National Dairy Development Project (NDDP) and your involvement in the intervention. I will then put this information together so that no one is able to know who I spoke to and what each person said. Excerpts from the interview may be made part of the thesis. Your name or location will not be revealed to anyone under any circumstances. Before I start I would like to emphasize that: Your participation is entirely voluntary; you are free to refuse to answer any question; and that you are free to withdraw at any time.

Please sign this form to show that I have read the contents to you.

----- (signed) ----- (date)

----- (print name)

Write your address below if you wish to receive a copy of the research report:

Appendix 5 Interview guides

Interview guide for developers

Introduction

- Tell me about your work history with the NDDP
- What prompted initiation of the intervention?
- How did the objectives of the intervention change over time and why?
- What cattle and dairy breeds did farmers keep before the NDDP was initiated?
- What were the dairy practices among farmers before the NDDP was initiated?

Actors involved in the NDDP

- Who was involved in the initiation of the intervention and what was their role?
- Who was subsequently involved in the intervention and what role did they play?
- How did the roles of these actors change over time and why?
- What role did you play in the NDDP?
- Who did you work with, when, how and why?
- How did your role change during the time that you were involved in the NDDP?

NDDP dairy technologies

- What dairy technologies did the NDDP promote when it started and why?
- Why did you/developers consider the technologies appropriate?
- Did you/developers modify the dairy technologies that were promoted among farmers over time? If yes, when, how and why?
- What other dairy technologies were introduced in the course of the NDDP? By who and why?
- Did farmers implement the technologies according to the guidelines they were given? Explain
- What dairy technologies did you promote/were being promoted when the intervention ended?
- What dairy technologies were farmers implementing when the intervention ended? Why?

NDDP strategies

- What strategies were used to promote the dairy technologies to farmers?
- How did the extension approaches change over time and why?
- For how long were farmers supported, how and why?

Beneficiaries

- Who were the beneficiaries of the intervention and how did they benefit?
- Did the beneficiaries of the intervention change over time? Explain.

Interview guide for farmers**Introduction**

- Number of household members and changes over time
- Their education and occupation/economic activities
- Involvement in household social/economic/cultural activities
- Size of land owned/leased and whether it has increased or decreased and why?

Cattle rearing and dairy cattle history

- When did you first own cattle?
- Breeds kept, number of cattle and reasons for keeping the cattle?
- Where did you graze them or obtain feeds from?
- Did you use any other inputs or veterinary services?
- Did you have a shed/house for the cattle? How did it look like, materials it was made of, where calves were kept, what and how calves were fed;
- What were your breeding practices-bull service, AI; why did you use a specific service and where did you obtain these from?
- Did you sell any cattle products? If yes, which product, where and any benefits obtained or challenges experienced.

Involvement in the NDDP

- When did you start to keep/buy dairy cattle?
- When and how did you get to hear/know about the NDDP?

<ul style="list-style-type: none"> • How did you view or understand the NDDP? • Which requirements were you expected to meet before being registered by NDDP? • Which NDDP dairy technologies did you adopt, when and why? • Why did you join the NDDP or adopt these dairy technologies?
<p>Zero grazing unit</p> <ul style="list-style-type: none"> • Did you construct a zero grazing unit? If no, why? If yes: • What materials did you use and where did you obtain them from? • Did you construct it yourself or someone else did it for you? • What structural plan and dimensions did you follow? • In what ways did you use the unit over time and why?
<p>Dairy cattle</p> <ul style="list-style-type: none"> • Did you adopt dairy cow/s? • What breed/s? • Where did you obtain it/them from and why? • Do you still keep dairy cattle? Why or why not?
<p>Calf rearing</p> <ul style="list-style-type: none"> • Did you ever rear calves? • What did you feed them on and for how long? • Where did you keep them, when and why? • Did you let them mature or sell them? <i>Explain</i> • Do you still rear calves? How, for how long and why?
<p>Extension, training and advice</p> <ul style="list-style-type: none"> • Who provided you with advice during your involvement with the NDDP? • Did you attend seminars, workshops, field days? when, where and why? • Did you receive any extension materials-booklets/brochures etc? from who, did you use them-how? • Did you follow the advice, or information/knowledge/skills gained from the trainings? How, why or why not? • Did you obtain training or receive advice from other farmers?

<ul style="list-style-type: none"> • Did you train or give advice to other dairy farmers? • Do you still attend any training or receive advice on dairy production? From whom, when and how?
<p>Dairy inputs and clinical/veterinary services</p> <ul style="list-style-type: none"> • Did you purchase dairy inputs? Which inputs and where did you buy them from? <i>How did this change over time?</i> • Where did you obtain clinical/veterinary services from and why? <i>How did this change over time?</i> • Do you currently buy any dairy inputs? Which ones and why? • Where do you obtain clinical/veterinary services from and why?
<p>Dairy records/farm plan</p> <ul style="list-style-type: none"> • Did you ever keep records or write up a farm plan? • Which records, from when, for how long and why? • Did you use the records/plan? How? • Do you still keep dairy records? Which ones and why?
<p>Milking</p> <ul style="list-style-type: none"> • What times did you milk your dairy cows? • What equipments/tools did you use to milk the cows? • Did you use calf to stimulate milking? Why or why not? • Where did you sell milk and why? • Did you experience any difficulties in milk marketing? • Changes in milk production over time, current milking practices and selling
<p>Napier grass and fodder crops</p> <ul style="list-style-type: none"> • Did you plant Napier grass or any fodder crop/s? When and why? • Method of planting Napier grass, row-width dimensions etc and changes over time? • Where did you obtain planting materials from? • Did you know any bulking plot in your village or location? • Changes in method of growing Napier grass/fodder crops, acreage and location of farm where grown over time. • Weeding, application of manure/fertilizers and management over time?

<ul style="list-style-type: none"> • Did you have adequate feed for your dairy cows? Why or why not? • If inadequate, what did you do or how did you obtain additional feeds or go about it? • Do you still cultivate Napier or fodder crops?
<p>Use of by products</p> <ul style="list-style-type: none"> • Did you use animal slurry/cow dung/manure; biogas or any other product? <i>When, how and why?</i> • Do you still use any of these products? How and why?
<p>Expectations and disappointments</p> <ul style="list-style-type: none"> • What were your expectations on adopting the technologies? • Did you benefit by adopting these technologies? How or why not? • What challenges did you face while adopting and after adopting the technologies? • What were your disappointments through involvement with the intervention? • Do you still benefit from the technologies you adopted? How or why not?