

OPTIMAL FEEDING SYSTEMS FOR SMALL SCALE DAIRY HERDS IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA

By

NONZWAKAZI PATIENCE MANZANA

Submitted in partial fulfilment of the requirements for the degree of *Magister Scientiae* (Veterinary Science) in the Department of Paraclinical Sciences, Faculty of Veterinary Science, University of Pretoria

Date submitted March 2007

ACKNOWLEDGEMENTS

Great thanks are given to the **ALMIGHTY** who had given me strength and hope to do everything.

1. Prof CME McCrindle, my supervisor, for her encouragement, support, dedication and valuable guidance to make this project a success.
2. Prof L Prozesky for his support with this project.
3. Mr J P Sebei for his encouragement, support and assistance with data collection.
4. Department of Agriculture NWP (Central Region) for their funding, support, encouragement and giving me time to work on this project to make it a success.
5. Mr. J Wasserman of the Milk Producers Organisation and Dr H Geldenhuis, private veterinarian and commercial dairy farmer, for all their advice and assistance
6. NW Province Agricultural Officers (Extension officer and Specialist) for their all assistance
7. Central NWP Small-Scale Dairy-Farmers who participated in this project: many thanks for your support, commitment and patience.
8. FAO, International Atomic Energy Agency, K.Birch Fund and NRF for financial support

DEDICATION

To my dearest mother Margaret Manzana, my brother Setumo and my two lovely kids Tshegofatso and Kamogelo for their encouragement, support and also for believing in me.

SUMMARY

Title:

OPTIMAL FEEDING SYSTEMS FOR SMALL SCALE DAIRY HERDS IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA

Researcher name : NP Manzana
Study supervisor : Prof CME McCrindle
Department : Paraclinical Sciences
Degree : MSc (Veterinary Science)
Institution : University of Pretoria

Key words:

Small-scale dairy farming, Dairy cow nutrition, Feeding systems, Milk yield, North West Province

Abstract:

The North West Province (NWP) identified dairy farming as a priority as it has the potential, not only for job creation, but also as a sustainable source of high quality protein for rural communities. With the correct type of management systems, small-scale dairy farms have the potential to be economically feasible. For the purposes of this study, a small-scale dairy farm was defined as a farm which produced less than 500 litres of milk a day irrespective of the number of cows or size of the farm. The study area was Central North West Province and the study was a longitudinal observational study conducted with 15 small-scale dairy farmers from 2002-2006. Nutrition was found to be a major constraint to the production capacity of dairy cows studied. It was found that farmers were deficient in the knowledge, skills and experience required to develop an affordable and balanced feeding system based on locally available ingredients. Dairy rations were given to prevent malnutrition or starvation, rather than to increase production. It was also shown that feeding of the cattle on the farms investigated, was influenced more by availability and affordability of locally obtained feed ingredients than by planning nutrition to increase milk production. Available statistics show that there are approximately 257 000 dairy cattle in NWP, with the greatest numbers in the Central Region (175 235)

and smaller numbers in the Western (59 852) and Eastern (21 873) Regions. These cattle produced approximately 230.4 million litres of milk annually (12.5% of national production) with an estimated value of R304.1 million at R1.32/l, excluding value-added products in the form of cheese, yoghurt, milk powder, and others in 2002.

The method used was a longitudinal study conducted from 2002 to 2006 in three phases. In the first phase, situational analysis using participatory rural appraisal (PRA) and observation was used to outline the extent of the constraints and start to design appropriate interventions. Feeds used by the farmers for feeding dairy cows – both supplements and roughage - were tested and evaluated. In the second phase, three different feeding systems were designed from the data obtained from PRA, in consultation with small-scale dairy farmers, established commercial dairy farmers, state veterinary and agriculture staff, feed manufacturers and distributors and the commodity organization (MPO) to optimize the nutrition of the dairy cows. The third phase was field testing of interventions and observations of the implementation by farmers.

It was found during the PRA phase that the majority (n=9) of farmers had been in dairy farming for not more than five years, five farmers had six to ten years in dairy farming and only one farmer had 11 to 15 years in dairy farming. Dairy farming is a very highly skilled operation and farmers need to have experience and knowledge to succeed. Five years is insufficient. Therefore capacity building and training were instituted over the period 2002 to 2005. Also, 60% (n=9) of the farmers were not affiliated to any agricultural organisation, so membership of the Milk Producers Organisation was facilitated for all farmers in the study. It was also found that the cattle were not identified and neither production nor financial records were kept. Testing and evaluation of feed used showed that it was of poor quality, deficient in protein, energy and minerals and no effort was made to balance the ration.

In the second phase, three feeding systems were developed from data obtained and observations during phase one. These were A: a semi-intensive farm based ration using available crops, pastures and crop residues with minimal rations purchased; B: an intensive, zero-grazing dairy system using a total mixed ration (TMR) for farmers with smallholdings of less than 5 hectares per cow and C: Traditional, extensive or dual purpose system where the calf drank from the cow until weaning and milking was done only once a day, for farmers with more than 5 ha grazing available per cow. The last was a low-input/low output system and was implemented by a majority (n=8) of the farmers. System B was chosen by two farmers and not

adopted by any of the two farmers in the long run. System A was adopted by three farmers. Four farmers left dairy farming for various reasons during the study. By July 2006, the farmers had changed to commercially formulated rations or licks and the body condition score of the cows had improved. Milk production per cow did not increase, but this may have been due to the increased price of meat and the fact that a majority of the farmers were using a dual purpose system and selling calves at weaning for a very good price.

It was concluded that extension officers should get extra training in dairy if there are dairy farmers in their areas as this is a very specialist type of extension. They should also work closely with veterinary services including veterinarians, animal health technicians and the health inspectors. Further research should be done to optimise the traditional model as this is relatively profitable, has a lower risk and is less labour intensive. It is probably a good way to increase food security, particularly in families when only one or two members have an income from a pension or part-time employment. The prices realised from informal sales of milk and calves can give a stable income. The “community farms” should be economically evaluated in terms of each beneficiary being able to get a “living wage” out of the projected profits of the farm. The MPO and other stakeholders should give very specific training to new dairy farmers, based on the models that were used in this study. It is essential that farmers be taught to “look forward” and get a pro-active attitude. They must also understand that quality, balanced rations are the key to success – poor rations are expensive rations, because they result in unhealthy cows and poor production.

Finally, ongoing and effective monitoring and evaluation of extension is an effective instrument for project sustainability – farmers must be involved and participate in their own evaluation - extension is not all about paper work it is about measuring performance and good service delivery.

DECLARATION

I, Nonzwakazi Patience Manzana, hereby declare that the work on which this dissertation is based is original and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree at this or any other University.

SIGNATURE

DATE

TABLE OF CONTENTS

NUMBER	TOPICS / CONTENTS	PAGE
	TITLE & AUTHOR	i
	DEDICATION	ii
	ACKNOWLEDGEMENT	iii
	SUMMARY	iv
	DEDICATION	vii
	TABLE OF CONTENTS	viii
	LIST OF TABLES	xii
	LIST OF FIGURES	xiii
	LIST OF PLATES	xiii

CHAPTER 1 INTRODUCTION

1.1	Justification	1
1.1.1	Background information	1
1.1.2	Benefits arising from the research	2
1.2	Problem identification	3
1.2.1	Research questions	3
1.3	Hypothesis	3
1.4	Objective	4

CHAPTER 2 LITERATURE REVIEW

2.1	Alleviating rural poverty	5
2.2	Developing small scale dairy farming	5
2.3	Role of dairy nutrition in quality and quantity of milk	6
2.3.1	Dry Matter (DM)	8
2.3.2	Crude fibre	9
2.3.3	Protein	10
2.3.4	Minerals	11
2.3.5	Energy	12
2.3.6	Vitamin	12
2.4	Factors affecting feeding systems	12
2.4.1	Extensive grazing	14
2.4.2	Semi Intensive farming System	14
2.4.2.1	Types of semi intensive dairy systems	15

2.4.2.2	Grouping of cattle in semi intensive dairy system	15
2.4.2.3	Feed quality on semi-intensive feeding systems	16
2.4.2.4	Roughage used in semi intensive systems	17
2.4.2.5	Concentrates used for semi intensive milk production	18
2.4.3	Intensive dairy production systems in South Africa	18
2.4.3.1	Total Mixed Ration	19
2.5	Relevance of record keeping	20
2.5.1	Record keeping	20
2.6	Management of dairy herd related to feeding	21
2.6.1	Design and infrastructure of dairy farm	21
2.6.1.1	Storage capacity and infrastructure for feed management	22
2.6.1.2	The environmental influence on nutrition	22
2.6.2	Management of fodder flow and feed resources	23
2.6.3	Body Condition Scoring (BCS) systems for dairy cows	23
2.6.3.1	Description of the technique of BCS	23
2.6.3.2	When to do BCS in the herd	24
2.7	Evaluation of feed composition	25
2.8	Extension in nutrition	25

CHAPTER 3 MATERIALS AND METHODS

3.1	Introduction	26
3.2	Study area and population	26
3.3	Sampling method	27
3.3.1	Sampling framework for each farm	27
3.3.2	Feed sampling	27
3.4	Feed analysis	28
3.4.1	Physical and chemical feed evaluation	28
3.4.2	Test for feed safety and potable water	29
3.4.3	Detailed Methodology for feed analysis	30
3.4.3.1	Dry Matter (DM)	30
3.4.3.2	Crude protein	30
3.4.3.3	Crude fibre	31
3.4.3.4	Total Digestible Nutrients (TDN)	31
3.4.3.5	Mineral analysis	32
3.4.3.6	Ether extract	32
3.4.3.7	Metabolisable Energy (ME)	32

3.4.3.8	Non-structural carbohydrates	33
3.4.3.9	Salmonella	33
3.4.3.10	Aflatoxin	33
3.5	Model system and experimental design	34
3.5.1	Experimental procedure/ design	34
3.5.2	Experimental observation and analytical procedures	34
3.5.2.1	Baseline data	35
3.5.2.2	Statistic analysis of data	35

CHAPTER 4 RESULTS AND DISCUSSION

4.1	Introduction	36
4.2	Results of PRA: Demographics related to cow nutrition	37
4.2.1	Gender	37
4.2.2	Farm location	38
4.2.3	Years in dairy farming	39
4.2.4	Age of participating farmers	39
4.2.5	Affiliation to farmers association	40
4.2.6	Education	40
4.2.7	Previous training in small-scale dairy farming	41
4.2.8	Water source and infrastructure on farm	42
4.2.9	Herd information	43
4.2.9.1	Identification of cattle	43
4.2.9.2	Herd composition according to age and gender	43
4.2.9.3	Breeds of cattle used	44
4.2.9.4	Body condition score of cows	44
4.2.10	Record keeping and monitoring during PRA	45
4.2.11	Evaluation of feed quality and quantity during PRA	46
4.2.11.1	Type of grazing	46
4.2.11.2	Use of concentrates	47
4.2.11.3	Use of roughage	48
4.3	Situation analysis and feed samples 2004	48
4.3.1	Situational analysis	49
4.4	Farming systems developed: Extension Message	56
4.4.1	Nutritional data on Option A, B, C	58
4.5	Evaluation of implementation of extension on feeding	60

CHAPTER 5 CONCLUSIONS & RECOMMENDATIONS

5.1	Introduction	64
5.2	Conclusion	64
5.2.1	Identify and prioritise constraints and opportunities through PRA	65
5.2.2	Evaluation of the quality and quantity of feed over period of 12 months	65
5.2.3	Developing intervention strategies and assessing adoption	665
5.2.4	Reasons for non-compliance	66
5.2.5	Additional conclusion	66
5.3	Recommendation	67

CHAPTER 6 REFERENCES

6.1	References	68
-----	------------	----

APPENDICES

1	Questionnaire on dairy cow nutrition	74
2	Questionnaire on feeding systems	77
3	Body condition score sheet	78
4	Specifications for licks & concentrates used by small-scale dairy farmers July 2006	79

LIST OF TABLES

TABLE NUMBER	TABLE TITLE	PAGE
2.1	Variables influence Dry Matter (DM) intake	8
4.1	Training in dairy farming: Priorities according to respondents	41
4.2	Training conducted	41
4.3	Water source and infrastructure in dairy farms	42
4.4	Cattle Identification	43
4.5	Farmers herd composition	44
4.6	Breeds of dairy cattle used by farmers	44
4.7	BCS during feed sampling	45
4.8	Record keeping by farmers	45
4.9	Grazing land and farm size	46
4.10	Lands and type of grazing	47
4.11	Source and use of concentrates for feeding dairy cattle	47
4.12	Roughage and feed storage used by small scale dairy farmers	48
4.13	Situation analysis at the beginning of dry season 2004	49
4.14	Situation analysis at the end of dry season 2004	49
4.15	Laboratory results (Beginning of dry season 2004)	50
4.16	Laboratory results (End of dry season 2004)	51
4.17(a)	Deficiencies on nutrients requirement (beginning of dry season 2004)	52
4.17(b)	Deficiencies in nutrient requirements(beginning of dry season 2004)	53
4.18(a)	Deficiencies in nutrient requirements (end of dry season 2004)	54
4.18(b)	Deficiencies in nutrients requirements(end of dry season 2004)	55
4.19	Feeding systems A,B,C	57
4.20(a)	Ingredients of recommended feed for system A: Field Crops on farm	58
4.20(b)	Ration formulation for system A	58
4.21	Ingredients recommended for Feeding System B: Econo TRG by meadow	59
4.22(a)	Ingredients of recommended feed for System C: Natural Grazing (Winter & Summer)	60
4.22 (b)	Ingredients of recommended feed for system C: Licks Supplements	60
4.23	Feeding System Selected by farmers during May 2005 & 2006	61
4.24	Estimated feed costs per year per farm in 2006	62
4.25	Weekly milk production 2005 & 2006	62
4.26	Annual Body Condition Score	63

LIST OF FIGURES

FIG. NUMBER	FIGURE TITLE	PAGE
4.1	Ownership of farms and gender of individual owners 2002	37
4.2	Ownership of farms and gender of individual owners 2005	38
4.3	Number of dairy farms per district	38
4.4	Number farmers according to years in dairy farming	39
4.5	Age distribution of dairy farmers	39
4.6	Membership of Agricultural Organisation	40

LIST OF PLATES

PLATE NUMBER	PLATE TITLE	PAGE
1	Dairy farmers with poor quality feed	81
2	Field testing and intervention during farm visits by Mr Sebei (Researcher OP), Mr Matlosane (Vet Service (NWPG), Dr Geldenhys (Mentor) and Mr Sethare (Farmer)	82
3	Implementation of feeding systems	83
4	Milking Machine Evaluation at Siyaya Farm by Prof McCrindle, Ms NP Manzana and Ms L Diutlwileng	84