RELATIONSHIPS OF RATION FORMULATION OBJECTIVES AMONG FEED MILLERS, DAIRY FARMERS, AND FEED POLICY REGULATORS IN NAKURU DISTRICT-KENYA

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ABSTRACT

A purposive random sampling survey of 78 respondents was conducted in Nakuru district between September 2009 and April 2010 to determine the linkages in ration formulation goals. Specifically the study examined least cost of ingredients (LCI), maximum milk profit margins (MPM) and minimum Phosphorous (P)-excretion (MPE); representing economic, production and environmental goals receptively, as perceived by actors in the feed milling industry. Interview schedules were conducted to solicit data from the feed industry actors on a 5-point Likert scale. Data were analysed for correlation and mean difference (One-way ANOVA) using SPSS for windows, Release 10.01 (1999). A post-hoc analysis (Tukey's HSD), calculated specific mean pair differences. Rank correlations were moderate and significant between (LCI and MPM); $p < 0.05$ and (MPM and MPE); $p < 0.05$, within feed millers, between (MPM and MPE); $p < 0.05$ within dairy farmers and between (LCI and MPM); $p < 0.05$ within KEBS. There were no significant correlations between LCI, MPM, and MPE within NEMA. Correlations between ingredients cost and nutrient excretion did not exist for the entire stakeholder groups. Mean differences for economic, production, and environmental formulation goals between the industry actors were significantly different ($p = 0.00$). Results revealed a lack of strong associations between the three critical ration formulation goals among industry stakeholders; representing an underlying limitation in dairy feed manufacturing decision-making process. Solutions to this limitation will include innovations towards the development of broad-based multiple ration formulation approaches that attempt to collectively optimise stakeholder needs step-wise.

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INTRODUCTION

Animal feed manufacturing influences farm business economic growth, livestock productivity, and environmental management ((Muriuki et al 2003; Technical team 2003; Muriuki 2006; MoLD&F 2007); however, there is little information regarding the association between ration formulation objectives of feed millers, dairy farmers, and feed policy regulators, mainly because such a research undertaking has not been performed in Kenya as yet. To effectively address emerging economic, production, as well as environmental challenges in the feed milling industry, determination of the relationship between critical dairy ration formulation objectives becomes important. The possible association between dairy feed manufacturing and economic, production, and environmental goals has not been quantified in earlier surveys on production and use of concentrates, policy environment and lessons on dairy development in the smallholder dairy sub-sector (Mbugua 1999; Muriuki et al 2003; Muriuki 2006). In order to better understand the associations between critical dairy feed formulation goals, this study was conducted with the objective of determining the relationships of ration formulation goals among feed millers, dairy farmers, and government feed policy regulators; representing stakeholder linkage levels in dairy feed manufacturing.

MATERIALS AND METHODS

Study area and dairy feed manufacturing

Nakuru district is a prominent dairy producing area in Kenya with the highest number of dairy cattle estimated at over 251, 000 heads (MoLF&D 2006a and MoLF&D 2007). The district is home to 26 operational feed mills (23% of total feed mills in Kenya). Only one feed miller is large scale and fairly automated. The rest range from small to medium scale capacity and are either manual and/or semi-automated. About 80% of the dairy farmers in Nakuru are smallholders (MoLF&D 2006b), representing a potentially sizeable consumer population for commercial dairy feeds, since they do not practice on-farm concentrate feed manufacturing. Feed millers implement these regulatory requirements by employing the singular objective approach to dairy ration formulation.

TABLE I- MEAN VALUE, STANDARD DEVIATION, AND STANDARD ERROR OF OPINION SCORE OF FORMULATION OBJECTIVES BY INDUSTRY STAKEHOLDER GROUPS

Formulation goals	Stakeholder group	N	Mean	Standard deviation	Standard error
Least cost of ingredients (Economic)	Feed millers	19	4.42	0.37	±0.06
	Dairy farmers	37	2.77	0.50	±0.14
	KEBS	10	3.54	0.52	±0.17
	NEMA	12	3.21	0.48	±0.16
Maximum profit margins (Production)	Feed millers	19	3.81	0.48	±0.14
	Dairy farmers	37	2.66	0.64	±0.10
	KEBS	10	3.47	0.86	±0.27
	NEMA	12	3.01	0.68	±0.07
Minimum nutrient excretion (Environmental)	Feed millers	19	4.18	0.49	±0.11
	Dairy farmers	37	2.96	0.58	±0.10
	KEBS	10	3.68	0.69	±0.22
	NEMA	12	3.41	0.42	±0.24

Survey methodology

A purposive random sampling of 78 respondents: 19 feed millers, 37 smallholder dairy farmers, and 22 feed policy officials (10 from KEBS and 12 from NEMA) was conducted in Nakuru district between September, 2009 and April, 2010. As a non-probability sampling method, it was judged to be representative of the most active, experienced and certified feed millers and relevant government feed regulatory agencies to the dairy feed industry. In addition, each feed miller was asked to identify two reliable dairy farmers and/or stockists customers depending on their monthly feed purchase volumes; an appropriate criterion that was used to recruit the most progressive dairy farmers into the survey. Dairy farmer respondents were recruited from the intensive dairy farming zones of Nakuru district including; Lanet, Kambi-Ya-Moto, Rongai, Nakuru Municipality and Ngata who were already clustered into Common Interest Groups (CIGs) under the Smallholder Dairy Commercialisation Programme (SDCP) of IFAD-Kenya Project.

Data collection

Data collection was conducted using a pre-tested, structured questionnaire which was administered to each stakeholder group on separate months and asked to respond independently. While survey instruments were delivered to the premises of feed millers and feed policy regulators, participating dairy farmers were provided with questionnaires during scheduled CIGs meetings. Those who experienced difficulties were assisted by trained dairy extension workers. Completed questionnaires were collected promptly. Since the study goal was to determine the relationship of conflicting ration formulation goals among domain feed industry stakeholder groups, the study instrument was divided into three parts of dependent variables:

- Least cost of ingredients (LCI) issue consisting of 9 items.
- Maximum profit margins (MPM) issue consisting of 9 items.
- Minimum P-levels (MPE) in manure issue consisting of 9 items.

Stakeholders' opinion score of perceived relative importance of the three dependent variables were solicited on a 5-point Likert scale of descriptive: strongly disagree (1), fairly disagree (2), undecided (3), agree (4), and strongly agree (5).

Scoring and analyses of survey responses

Opinion scores on variable items for each group of respondents were recorded and descriptive statistics (mean, standard deviation, and standard error) of each variable item (LCI, MPM, and MPE) calculated as shown in Table 1. Summative response scores (mean) for variable questionnaire items were used as raw data in the determination of spearman's rank correlations coefficient (r) within groups and also calculation of mean differences between groups for the three formulation goals as shown in Tables 2 and 3.

TABLE II - RANK CORRELATION COEFFICIENT (R) OF LEAST COST OF INGREDIENTS, MAXIMUM PROFIT MARGINS AND MINIMUM NUTRIENT EXCRETION WITHIN FEED MILLERS, DAIRY FARMERS AND GOVERNMENT FEED REGULATORY AGENCIES

Dependent variables	Feed industry stakeholders			
	Feed millers	Dairy farmers	KEBS	NEMA
Least cost of ingredients and Maximum profit margin	0.54[a]	0.13	0.64[a]	0.39
Least cost of ingredients and Minimum nutrient excretion	0.34	-0.18	0.61	0.16
Maximum profit margin and Minimum nutrient excretion	0.46[a]	0.61[a]	0.33	0.18

[a] Correlation is significant at 0.05 level (2 tailed)

Statistical analyses

Correlation between dependent variable items were determined using the spearman's rank correlation coefficient (r) method thus
:

$$r = 1 - \left\{ \frac{6 \sum d_i^2}{n(n^2 - 1)} \right\}$$ wher

e d denotes the difference between ranks of corresponding pairs of each feed formulation objective (LCI and MPM, LCI and MPE, and MPM and MPE) and n represents the number of respondents within the stakeholder groups. The statistical significance of differences in opinion responses between pairs of feed industry actors for the relative importance of economic, production and environmental goals; were determined using one way analysis of variance (ANOVA) at 95% confidence interval (CI) using SPSS for windows, Release 10.01 (1999), by fitting the ANOVA model thus; $Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$ where Y_{ij} = overall opinion responses, μ = mean response, α_i = effect of $_i$th formulation goal and ε_{ij} = error component. A post-hoc analysis (Tukey's HSD) calculated the specific mean pairs differences.

RESULTS

Rank correlations between least cost of ingredients, maximum profit margin and minimum nutrient excretion.

Spearman's rank correlation coefficients (r) of least cost of ingredients, maximum profit margin and minimum nutrient excretion within feed millers, dairy farmers, and government regulatory agencies (KEBS and NEMA) are shown in Table 2. Rank correlations coefficient (r) within feed millers were significant between LCI and MPM ($r = 0.54$; $p < 0.05$) and between MPM and MPE ($r = 0.46$; $p < 0.05$). The dairy farmers showed significant correlations (0.61; $p < 0.05$) between MPM and MPE only. Correlation between LCI and MPM ($r = 0.64$; $p< 0.05$) within KEBS was significant. The correlations between MPM and MPE within KEBS and NEMA were not significant. The LCI and MPE were not significantly correlated for all the stakeholder groups. NEMA did not show any significant relationship for any pair of the three formulation objectives.

Linkages in economic, production and environmental goals among feed industry actors.

Table 3 displays the effect of economic, production and environmental formulation goals on feed industry actors. A one-way (ANOVA) was calculated to determine the relative importance attached to the goals. The analysis was significant for economic, $F(1, 74) = 52.5$, $p = 0.00$, production, $F(1, 74) = 14.6$, $p = 0.00$, and environmental, $F(1, 74) = 21.5$, $p = 0.00$, goals. While feed millers showed (Table 1) the highest importance to economic (M = 4.42, SD = 0.37), production (M = 3.81, SD = 0.48) and environmental goals (M = 4.18, SD = 0.49), dairy farmers displayed the lowest scores (M = 2.77, SD = 0.501; (M = 2.66, SD = 0.64); and (M = 2.96, SD = 0.58) respectively. The KEBS and NEMA attached modest importance to economic (M =3.54, SD =0.52; M =3.21, SD =0.48), production (M =3.47, SD = 0.86; M =3.01, SD =0.66), and environmental (M =3.68, SD =0.69; M =3.41, SD =0.42), goals respectively.

TABLE III - THE EFFECT OF ECONOMIC, PRODUCTION AND ENVIRONMENTAL FORMULATION GOALS ON FEED INDUSTRY STAKEHOLDERS

Formulation goals	Degrees of freedom		F-value	p-value
Economic	Between groups	1	52.5	0.00
	Within groups	74		
Production	Between groups	1	14.6	0.00
	Within groups	74		
Environmental	Between groups	1	21.5	0.00
	Within groups	74		

Table 4 presents the multiple comparisons of mean differences of formulation goals between feed industry actors. Comparisons indicated that economic considerations in dairy ration formulation were significantly different between feed millers and dairy farmers (MD = 1.66; p = 0.00); KEBS (MD = 0.89; p = 0.00), and NEMA (MD = -1.21); p = 0.00 respectively. Perception of economic goals by dairy farmers was significantly different from KEBS (MD = -0.77; p = 0.00) and NEMA (MD = 0.45; p = 0.00) but not significantly different from KEBS and NEMA (MD = 0.32; p = 0.20). Rating of production goals was significantly different between feed millers and dairy farmers (MD = 1.14; p = 0.00) and NEMA (MD = 0.80); p = 0.01 respectively. Dairy farmers' perception of production issues was significantly different from KEBS (MD = -0.80; p = 0.00). Production considerations were not significantly different between feed millers and KEBS (MD = 0.34; p = 0.53); dairy farmers and NEMA (MD = -0.35; p = 0.37); and KEBS and NEMA (MD = 0.46; p = 0.35). Environmental comparisons were only significantly different between feed millers and dairy farmers (MD = 1.22; p = 0.00); feed millers and NEMA (MD = 0.77; p = 0.00); and dairy farmers and KEBS (MD = -0.72; p = 0.00. The rest were not significantly different.

DISCUSSION

Relative importance of ration formulation goals in feed manufacturing within industry actors

Feed millers, dairy farmers, KEBS, and NEMA attached varying importance to the three ration formulation goals, as shown in Table 1. In agreement with Knowlton et al 2004, the goals were conflicting and therefore had differing implications to each stakeholder group. The moderate correlation between ingredients cost and milk profit margins (Table 2) only demonstrated the opinion expressed by feed millers that they were fully aware of and adequately addressed all formulation considerations; including optimising feed cost and quality for

TABLE IV -MULTIPLE COMPARISONS OF MEAN DIFFERENCES OF FORMULATION GOALS BY PAIRS OF FEED INDUSTRY ACTORS

Formulation goals	Feed industry actors	Mean difference	Standard error	p-value
Economic	Feed millers and Dairy farmers	1.66 [a]	±0.13	0.00
	Feed millers and KEBS	0.89 [a]	±0.18	0.00
	Feed millers and NEMA	-1.21 [a]	±0.17	0.00
	Dairy farmers and KEBS	-0.77 [a]	±0.17	0.00
	Dairy farmers and NEMA	-0.45 [a]	±0.16	0.00
	KEBS and NEMA	0.32	±0.20	0.38
Production	Feed millers and Dairy farmers	1.14 [a]	±0.18	0.00
	Feed millers and KEBS	0.34	±0.25	0.53
	Feed millers and NEMA	0.80 [a]	±0.24	0.01
	Dairy farmers and KEBS	-0.80 [a]	±0.23	0.00
	Dairy farmers and NEMA	-0.35	±0.21	0.37
	KEBS and NEMA	0.46	±0.27	0.35
Environmental	Feed millers and Dairy farmers	1.22 [a]	±0.16	0.00
	Feed millers and KEBS	0.50	±0.22	0.10
	Feed millers and NEMA	0.77 [a]	±0.20	0.00
	Dairy farmers and KEBS	-0.72 [a]	±0.20	0.00
	Dairy farmers and NEMA	-0.45	±0.18	0.07
	KEBS and NEMA	0.27	±0.24	0.66

[a] The mean difference (MD) is significant at 0.05 level

maximum milk production. However, this was not the case for dairy farmers and NEMA who felt that ingredients cost did not match dairy feeds quality specifications for optimal milk profit maximisation; casting doubt on the quality status of available market dairy feeds. Feed millers are increasingly interested in low ingredient costs with the desire of manufacturing quality feeds that guarantee high income over feed costs (IOFC) (Mbugua 1999; Muriuki 2006); for the benefit of dairy farmers as well as adhere to regulatory specifications (KEBS 1990). But they are often limited by the formulation approaches (Knowlton et al 2004), currently available in the market since they are designed to optimise only one goal, least cost.

Association between ingredient costs and milk profit maximisation within dairy farmers did not exist, perhaps supporting the common dairy extension observations that commercial dairy concentrates in Kenya, are characteristically expensive and of variable nutritional quality (MoL &FD 2006b). Feed is the major cost to milk production, accounting for about 50 to 70% of total cost (Jones et al 1980; MoLD-NDDP 1995; Muriuki 2006; MoL&FD 2007). Reduced feed costs or quality feeds guaranteeing increased milk production, while maintaining minimum nutrient pollution (Dave 2004; Muriuki 2006), present an opportunity to increase farm net returns. Unfortunately, this remains a rare scenario under tropical dairy farming conditions where ingredient costs and availability throughout the year are erratic. The moderate correlation between milk profit margins and nutrient excretion within dairy farmers only represented a growing need for quality feeds adjusted to standard dairy cow nutrient requirements (NRC 2001) for minimum nutrient excretion, such as P.

Dairy farmers continue to view dairy farming as a business and hence their expectations following purchase and supplementation of dairy concentrates to lactating cows are high and immediate; hence the none-existent association between ingredient costs and milk profits within dairy farmers. While this could be attributed to excessive concentrate feeding especially when forage availability is limited during the dry spell (Mbugua 1999; Muriuki et al 2003), the concentrate feed may as well not be adjusted to meet nutritional requirements (Andkinson et al 1993; Varela Alverez and Church 1998; Knowlton et al 2004); pointing to the assumption that dairy farmers do not realise immediate satisfactory returns from milk sales to offset the feed costs.

The KEBS deal with feed millers on a day to day basis on matters regarding feed quality and standardization. However, they do not have a mechanism to monitor how the quality guidelines are transferred to the dairy farms. They may have assumed that adherence to feed quality specifications had a reflection on cost-benefits that were directly transferred to the dairy farmers; as demonstrated by the moderate correlation between ingredients costs and milk profit margins. Dairy farmers are thus expected to increase nutrient intake for guaranteed improved milk production and profits by supplementing their lactating cows with commercial concentrates (Mbugua 1999). However, KEBS was seemingly unaware of the possible harms to environmental health from excessive pollutant nutrients as shown from the lack of real relationship between milk profit margins and nutrient excretion within KEBS (Table 2).

CONCLUSION

Feed millers' opinion that available commercial feeds meet dairy farmer needs as well as satisfy government feed policy regulatory requirements is misleading. Relationships between the ration formulation objectives were generally weak; pointing to the conclusion that the current singular objective formulation approach is limited in dairy feed manufacturing.

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