THE ECONOMICS OF FEEDING CONCENTRATE TO PARTIALLY-MILKED SANGA COWS IN THE DRY SEASON

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Abstract

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An experiment was carried for 120 days during the dry season of 1998/99, to assess the sustainability of dry season feed supplementation in an emerging peri-urban dairy production system in the Kumasi district of Ghana. Fifty three Sanga cows were divided into four treatment groups T1, T2, T3 and T4, and were fed 0, 1, 1.5 and 2 kg respectively, of a home-made concentrate supplement containing 18% crude protein. The treatment groups contained 12, 14, 12 and 15 cows, respectively. The cows were milked once a day in the mornings and allowed to suckle during the day. Daily partial milk yield was 1.7, 2.1, 2.6 and 2.7 L for cows supplemented with 0, 1, 1.5 and 2 kg concentrate, respectively. Cows fed 1.5 kg concentrate generated the highest net income from milk sales. They produced 53% more milk and 16% more milk revenue than the control cows. Their-daily partial milk yield was not significantly different ($P > 0.05$) from that of cows fed 2 kg concentrate supplement, but was significantly higher ($P < 0.05$) than that from other groups. It was found that feeding 2 kg concentrate supplement a day to Sanga cows in the Kumasi district may not be economical even though milk yield may be increased. It is suggested that given the large variability observed in individual cow performance, selection of more productive cows or culling of less productive ones could be used in conjunction with feed supplementation to improve the productivity of Sanga cows in less endowed environments.

1. INTRODUCTION

Most farmers in the Kumasi district of Ghana are crop farmers. In recent years, however, many of them have started rearing animals on a commercial basis, even though most of the animal enterprises in the district remain sideline activities. Cattle rearing is now becoming popular with many traders and office workers as well.

The cattle are often left in the care of hired labour, usually Fulani herdsmen. The owners usually consider cattle rearing as an additional business, which becomes important only if their main businesses run down or after their retirement from office work. They, therefore, resort to a low-input-low-out put production system and do not spend much money to improve the productivity of the animals, which is usually low.

In Ghana, the objectives of the cattle improvement programme have been to seek improvement in production of meat, manure and draught power. Milk production on any scale has never been considered to be of prime importance. The demand for milk and milk products has, however, been growing over the years due to increased urbanization. In certain communities the demand for animal protein is so high that even hides are consumed. The cattle herds in the Kumasi area are usually a combination of the West African Shorthorn (WASH), N'Dama, Sanga and Zebu types. At present most cattle in the Kumasi district are not milked. Those milked produce very little because they are essentially of beef type and are also not fed well during their lactation period. Total milk sales could however be high for herds which could easily sell milk to the Kumasi city. It is believed that substantial amounts of money could be realized from local milk production if farmers would properly feed their cows and milk them.

The N'Dama and West African Shorthorn are reported to produce between 120 and 360 litres of milk per lactation, which usually lasts between 120–300 days. The two Zebu breeds, Sokoto and White Fulani, which are used mostly for crossbreeding in Ghana produce between 450 and 1300 litres per lactation of length varying between 190–360 days [1]. The Sanga which are crosses between the N'Dama or WASH and the Zebu form the bulk of milk-cattle in the Kumai district. While the above figures would be discouraging in Europe, they emphasise the importance of the measures, which could be taken to increase productivity of cattle in Africa. In the interests of the African people and their national economies it is important that African livestock should be improved. The low milk yield of cattle being milked in the Kumasi district means that both the maintenance and production nutrient requirements could be met by feeding good quality grass without concentrate supplements. But the Kumasi cattle are free-range grazers on low quality natural vegetation or scavenges of stubble and crop residues of low nutritional value. Like much of Africa, it is usually difficult to get enough quality feed for the cattle during the dry season in the Kumasi district. Grasses grow rapidly during the rainy season and quickly lose their nutritional value as they advance in maturity [2]. The situation adversely effects productivity and may result in little or no production during the dry season.

Many of the Kumasi cattle owners do not own the land on which they rear their stock. They usually squatter on public land. The number of cattle is rapidly increasing in the area and so is the human population. The result is that grazing areas are being progressively reduced. At the moment farmers are unlikely to be able to raise money to acquire their own farm land in the area, But unless and until the cattle farmers acquire their own land and produce high quality green fodder for their stock, other, perhaps more expensive measures will have to be taken to improve the productivity of the stock, especially during the dry season.

The negative effects of dry season on cattle productivity could be reduced by maintaining small herd sizes, hand feeding calves or feeding edible shrubs or tree branches but such practices are usually uneconomical and cannot move the animal husbandry beyond the subsistence level [2]. One way of improving the performance of grazing cattle during periods of scarcity of feed would be to use concentrate supplementation. The supplements increase the feeding value of the entire diet by direct addition of nutrients over and above supplied by the pasture and other roughages. They usually increase the supply of energy from the roughage due to increased intake and/or digestibility of the herbage on offer [2]. Protein or non-protein nitrogen supplements can also prevent a decline in voluntary feed intake resulting from low protein content in the grazing diet. Improving feeding through concentrate supplementation could therefore, promote the increase in the amount of milk extracted by the stockman for human consumption and that suckled by calf in systems where partial milking is done [3]. It could also put the lactating cow in a relatively good condition, which would enhance reproductive efficiency [4, 5, 6]. Since milk sale is carried out daily and the response to supplementation is almost immediate, feed supplementation strategies could be embarked upon without a large initial capital outlay.

The positive effect of supplementation on milk production has been widely reported [5, 7, 8]. Little et al. [3] reported that cotton seed cake and sesame oil meal fed to lactating N'Dama cows in the Gambia significantly increased milk yield. It has also been reported that the use of supplementary urea molasses blocks during the cold season in China resulted in milk yield increases of 14% in black yak cows and 20% in white yak cows [6]. Concentrates have also been used to achieve improvements in milk yield [9]. However, the low genetic potential of tropical livestock and high prices of grain and oil cakes in many tropical countries call for a careful analysis of the economic implications of concentrate feed supplementation before farmers are advised to resort to such supplementation. The objective of the present study was therefore to assess the economic feasibility of supplementing lactating Sanga cows with home made concentrate during the dry season.

2. MATERIALS AND METHODS

2.1. Experimental site

The experiment, which lasted from November 1998 to February 1999 was carried out at Kentinkrono in the Kuimasi district of Ghana. Kumasi is located at an altitude of about 290 m above sea level and 06°43' N and 01°36' W of the equator. The vegetation is semi-deciduous forest, and the climate is described as hot and humid. The months of November to February inclusive, constitute the dry season. Monthly precipitation drops from November to January and starts to rise in February. The mean monthly precipitation for the dry season months is 42 mm, 23 mm, 5.6 mm and 65 mm for November, December, January and February, respectively. The respective relative humidities were 95, 89, 83 and 41% during the morning (06.00 h) and 57, 50, 40 and 41% during the afternoon (15.00 h). The mean daily temperature for the dry season is about 26°C, but may vary from 18°C in the night to 35°C in the afternoon. The duration of sunshine for the period was about 5.8 h [10].

2.2. Herd management

Sanga cows belonging to two cluster herds were used in this experiment. Each cluster herd comprised of animals belonging to different people, but kept on the same grazing land under different herdsmen. Cows in an area were treated as if they were under one person and distributed among the four treatment groups. All the experimental animals in an area were managed essentially the same way. They were grazed in the same area, usually between 08.30 and 17.00 h. The animals were provided with adequate water both in the morning and in the evening. Breeding was not controlled and occurred throughout the experimental period. Calves were grazed with their dams, although very young calves less than 2 weeks old were not grazed.

All herdsmen practiced partial milking. Under this system calves were separated from their dams in the evening to prevent suckling till the next morning. The calves were brought to suckle for a few minutes to stimulate milk let down before milking. Milking was done only in the morning, usually before 07.00 h. Milking usually started two to three weeks after calving.

2.3. Experimental design and analyses

Fifty-three Sanga cows lactating throughout over a period of four months, from November 1998 to February 1999, were used in the experiment. The cows were in two cluster herds (Herd I and Herd 2) at Kentinkrono in the Kumasi district of Ghana. Cows in each of the cluster herds were grouped into four treatments T1, T2, T3 and T4 in a completely randomized design, which took their body weights into consideration. Treatment groups T1, and T3 contained 12 cows each while T2 and T4 groups contained 14 and 15 cows, respectively. Cows in treatment T1 received no concentrate (control). Cows in treatments T2, T3 and T4 received 1, 1.5 and 2 kg concentrate per animal/day, respectively. The concentrate contained about 18% crude protein and consisted of rice bran (50%), cottonseed cake (30%), maize (16%), common salt (2%) and oyster shells (2%). The mean daily partial milk yield for the week preceding the experiment was calculated for each participating cow and used as a covariant in the statistical analysis. The recording of the daily partial milk yield was continued for each cow throughout the experiment.

Milk samples from individual cows were taken twice a week for progesterone assay. Samples were kept on ice until they were centrifuged in the laboratory at 2,000 *g* in a refrigerated centrifuge (40°C). The skimmed milk samples were kept at –18°C until assayed for progesterone. The FAO/IAEA solid-phase technique [11] was used for the progesterone assay. The intra and inter-assay coefficients of variation were 6.3% and 8.7%, respectively. Progesterone levels >2.0 nmol/L in 2 or more consecutive samples were deemed to indicate ovarian cyclicity. A cow which maintained high (> 2.0 nmol/L) progesterone levels for more than 3 weeks was considered pregnant [12].

The proximate analysis of the concentrate used was determined by the AOAC method [13]. Calves were weighed at the beginning and at the end of the study to estimate body weight gain.

The statistical analyses of the data was carried out using Systat computer statistical package [14]. The data were subjected to analysis of covariance. The terms for the covariance analysis were treatment, herd, treatment × herd interaction and the covariant was initial (first week) partial milk yield. The monthly means for daily partial milk yield were also calculated. Using the technique of regression analysis, the rate of change in monthly milk yield was determined for each cow and then for the treatments and herds. The Pearson chi-square test was used to determine the significance of proportion of cows cycling versus those not cycling as well as pregnant versus empty cows between the treatments.

3. RESULTS

Table I shows the proximate analysis of samples of the experimental concentrate. Results of the covariance analysis are presented in Table II. The overall treatment means for the daily partial milk yields were 2.62, 2.24, 2.14, and 2.24 L for November, December, January and February, respectively. The monthly mean milk yield for treatments in November was significantly ($P < 0.05$) higher than the means for the other months.

Table III presents the rate of monthly milk yield decline according to treatment and herd. The partial milk production and net income derived from the sale of partial milk extracted during the 120-day period are presented in Table IV.

The postpartum ovarian function of the cows and the body weight gain of calves are reported in Table V. Both Pearson chi-square (X2) tests on cows showing cyclic ovarian activity versus those not showing cyclic ovarian activity (X2 = 0.752; DF = 3), and those pregnant versus empty cows (X2 = 0.464; DF = 3) were not statistically significant ($P > 0.05$).

TABLE I. CHEMICAL COMPOSITION OF EXPERIMENTAL CONCENTRATE (ON DM BASIS)

Constituent	Percent
Crude protein (CP)	18.1
Ash	10.3
Acid detergent fibre (ADF)	40.9
Neutral detergent fibre (NDF)	48.8
Ether extract (EE)	5.7

Dry matter (DM) of the concentrate was 91.3%.

TABLE II. MEAN DAILY PARTIAL MILK YIELD OF SANGA COWS FED VARYING LEVELS OF CONCENTRATE SUPPLEMENT FOR 120 DAYS

Category	LS Mean (L)*	SE	n
Treatment			
T1	1.71[a]	0.11	12
T2	2.14[b]	0.10	14
T3	2.61[c]	0.11	12
T4	2.70[c]	0.10	15
Herd			
1	2.28	0.10	22
2	2.30	0.10	31
Treatment × Herd			
T1 × Herd 1	1.8	1.6	5
T1 × herd 2	1.6	1.4	7
T2 × Herd 1	2.1	1.5	6
T2 × Herd 2	2.1	1.3	8
T3 × Herd 1	2.6	1.6	5
T3 × herd 2	2.7	1.4	7
T4 × Herd 1	2.6	1.5	6
T4 × Herd 2	2.8	1.2	9

*Treatment means with different superscripts are significantly different (P <0.05).
SE = Standard Error; n = Number of observations.

TABLE III. RATE OF DECLINE IN MONTHLY MILK YIELD

Category	LS Mean	SE	n
Treatment			
T1	–0.167	0.069	12
T2	–0.143	0.064	14
T3	–0.112	0.069	12
T4	–0.064	0.062	15
Herd			
1	–0.103	0.051	22
2	–0.140	0.043	31

SE = Standard Error; n = Number of observations

TABLE IV. ESTIMATED MEAN SALEABLE MILK PRODUCTION AND INCOME GENERATED BY SANGA COWS FED VARYING LEVELS OF CONCENTRATE SUPPLEMENT FOR 120 DAYS

Treatment	Estimated milk production (L) mean ± SE *	Cost of feed +	Net income from milk ++	n
T1	203.4 ± 12.5[a]	0	162,720	12
T2	256.9 ± 11.6[b]	42,000	163,520	14
T3	314.3 ± 12.5[c]	63,000	188,440	12
T4	326.0 ± 11.2[c]	84,000	176,800	15

Means with different superscripts are significantly different (P <0.05); * SE = Standard Error; n = Number of observations; + 1 kg of feed cost Cedis 350.00 (US$ 0.15); ++ I L of milk was sold for Cedis 800.00 (US$ 0.35).

TABLE V. POSTPARTUM OVARIAN ACTIVITY OF COWS AND CALF WEIGHT GAIN WHEN FED VARYING LEVELS OF CONCENTRATE SUPPLEMENT FOR 120 DAYS

Treatment	Percentage showing ovarian activity	Percentage confirmed pregnant	Calf weight gain (kg)	n
T1	83.3	75.0	41.5	12
T2	92.9	78.6	44.9	14
T3	91.7	83.3	46.7	12
T4	86.7	73.3	45.4	15
Overall	88.7	77.4	44.7	53

4. DISCUSSION

The level of partial milk yield obtained in the present study is higher than that (1 L) reported by Ofori [15] for mix herds of local beef cattle in the same district. However, if one assumes that feed protein requirement is 1.25 times the milk protein [16], then one would expect, at least, the cows in T4 group to produce more milk than they did, assuming that the afternoon milk suckled by the calves equaled the morning milk extracted by the herdsmen. Looking at the good condition of the cows during the experiment, one cannot say that energy was limiting in their diet. The problem of the limited effect of the supplementation may be that the Sanga cow partitions less of its energy for milk production. The fact that supplemented cows produced significantly ($P < 0.05$) more milk than non-supplemented cows suggests the need for improved feeding of lactating cows in the area during the dry months. The significantly higher milk yield at the commencement of the dry season in November suggests that feed availability and/or quality may be better during the rainy season. Lactating Sanga cows may therefore need little or no concentrate feed in the rainy season.

The results suggest that 1.5 kg of concentrate per day (treatment T3) containing 18% CP may be the most economically viable level of supplementation for Sanga cows in the Kumasi district (Tables II and IV). The daily partial milk yield of 2.6 L produced by cows in treatment group T3 was not significantly different from the 2.7 L produced by cows in T4 group, but was significantly higher ($P < 0.05$) than the 1.7 L and 2.1 L produced by those in treatments T1, and T2, respectively. The T3 cows also produced the highest net income from milk sales (Table IV). T1 cows generated about Cedis 40 600/month (US$ 17.7) while T3 cows generated about Cedis 47 000/month (US$ 20.4). Each T3 cow, therefore, generated an additional Cedis 6,400 (US$ 2.8) per month compared to non-supplemented (T1) cows. The T3 cows produced 53% more milk and gained 16% more revenue from milk than their T1 counterparts. The importance of both milking and feed supplementation in the economics of cattle production in the Kumasi district can, therefore, not be over emphasised. One other factor worthy of note is the finding that feeding 2 kg/day of a concentrate containing 18% CP to Sanga cows may not be economical in the Kumasi area even though it may increase the quantity of milk for the market. The study has also shown that the present plane of nutrition is inadequate even for a low milk producing cow like the Sanga to realize its potential in the dry season. It would, therefore, seem unwise to import high yielding dairy cattle from Europe to the area if the feed situation cannot be markedly improved. The high producing, early maturing European breeds require a high plane of nutrition, which is very difficult to provide under tropical conditions, and in any case environmental conditions are likely to interfere with the conversion of feed even if adequate standards can be maintained.

The trend of the present results was expected as higher levels of nutrition allow for higher percentages of nutrients to be available for milk production. This is because maintenance requirements of a cow are roughly proportional to her body weight, but remain fairly constant regardless of the level of milk production. The raw materials from which milk constituents are derived, and the energy for the synthesis of some of these in the mammary glands, are supplied by the feed. The actual requirement for feed therefore depends upon the amount of milk being produced and upon its composition [16]. A cow fed at a higher plane would, therefore, be expected to produce more milk. It could be deduced from the present results that substantial amounts of money could be realized if the partial milking system is encouraged and a market found for the extracted milk.

From the study a Sanga cow supplemented with 1.5 kg/day of a concentrate containing 18% CP could generate about Cedis 320 000 (US$ 139) net income from milk every year, if a 200-day milking period is assumed. The effect of dairying on the local economy could, therefore, be enormous if all cows in the district were properly fed and milked. A greater part of the potential revenue from milk is lost to the economy because many local farmers are not interested in milk production. A campaign to bring to the fore the profitability of peru-urban dairying is therefore advocated. The fact that inadequate feeding could hamper profitable dairying also needs to be stressed. Table III confirms that cows are more persistent in milk production if feeding is improved. It is possible that apart from improving milk yield, the duration of milk production may also be prolonged by proper feeding of lactating cows under the partial milking system [17]. Even though supplemented cows did not show statistically significant reproductive performance ($P > 0.05$) in the present study, some earlier reports have shown that supplemented cows can have superior performance [3, 5, 7, 8].

The large variability in performance observed among individual cows suggests that selection of more productive cows or culling of less productive ones in conjunction with feed supplementation could be used to significantly enhance the productivity of Sanga cows in less endowed environments. It is suggested that to be able to develop the Sanga cow so as to be able to determine with any degree of accuracy its true productive potentiality, the primitive trait connected with the temperamental function of milk let down should be overcome. In this way milking would be less cumbersome in the Sanga cattle and more farmers could easily be convinced to participate in the emerging peri-urban dairying in Ghana.

5. CONCLUSIONS

It is concluded that with proper feeding of lactating cows and education of farmers, peri-urban dairying could be a significant component of the agricultural economy of the Kumasi area. A sustained means of information dissemination is considered vital for the growth of the emerging dairy industry in the area. It is therefore, suggested that farmers should be encouraged to form and sustain their own trade associations which could raise funds to ensure that member farmers receive vital information for their efficient operation. The associations could raise substantial amounts of money for their work by engaging in the supply of inputs like feed supplements, drugs and proven bulls or semen and artificial insemination (AI) services. They could retail the produce of member farmers in the form of a cooperative organization to help pay for the items and services offered to them.

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