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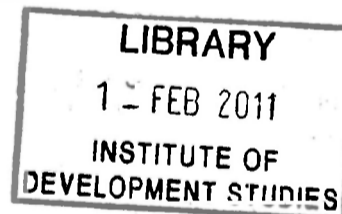
THE ECONOMICS OF BEEF/DAIRY SUPPLY IN THE  
TRADITIONAL FARM SECTOR. POLICY AND  
METHODOLOGICAL INVESTIGATIONS

by

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ABSTRACT

This study aims (a) to investigate policy alternatives for the beef and dairy industries through the construction of a multi-period linear programming model and (b) to evaluate a quantified model of this kind.

The paper outlines and discusses the methodology of the study. Nandi District was chosen for its suitability of agricultural mix. The sample design is described and the type of data collected is detailed - this covers dairying, beef and maize principally. Since the data is still being collected no results can be presented yet. The policy implications are indicated briefly.

The Economics of Beef/Dairy Supply in the  
Traditional Farm Sector. Policy and  
Methodological Investigations

The objects of this study are (1) To investigate policy alternatives for the beef and dairy industries in Kenya; this objective will be pursued through the construction of a multi-period, linear programming model which can generate a normative supply function for livestock on smallscale mixed farms in the Traditional Farm Sector. The necessary data for this model is being collected in Nandi District during the period March 1974 - May 1975.

(2) The evaluation of a quantified model of this kind in terms of timeliness of results, /<sup>cost</sup> and the accuracy of the data required to build the model and its usefulness in the preparation of regional development plans.

Kenya is a developing economy with a rapidly increasing domestic demand for meat and dairy products and a promising export potential for beef. It is anticipated that export market will be primarily furnished by the largescale Ranching Sector. Since exports compete with domestic demand, the Traditional Farm Sector will in future play an increasingly important part in the production of beef for the local market and in supplying immatures to the Ranching Sector for finishing.

The Kenya Government is anxious to protect the domestic consumers from rapid inflation in the price of basic foodstuffs such as meat, milk and maize and has kept the price of these domestically produced commodities below the international level. The farming community is faced with input costs for fertilisers, feed concentrates, machinery etc which have risen at a much higher rate than output prices. This has presented considerable difficulties for the small commercial farmer.

In the Traditional Farm Sector, whilst there is a certain degree of complementarity, dairy and beef production compete at the margin for the resources available. The author is particularly interested in investigating the repercussions of inflation on the levels of the beef/dairy/maize activities on the farms she is observing.

Policy formation for livestock (dairy) <sup>expansion</sup> and the assessment of the economic viability of large-scale market facilities require detailed knowledge of (i) the responsiveness of farmers to the direct beef and milk prices and input costs (ii) the operative constraints on production (iii) the interaction between livestock and dairy production and the other agricultural activities open to farmers. In Nandi District these are primarily maize and tea cultivation. As noted in the Development Plan 1970-1974, 'Marketing and pricing problems are perhaps the most <sup>stubborn</sup> problems hindering rapid agricultural development and no easy solutions are in sight for some of them.'<sup>1</sup> In the Development Plan 1974-1978 it states that, 'The principal development goal of the livestock sector are to increase marketed production and to increase the share of total production and market output accruing to small holders and pastoralists. Beef production in range areas will be stressed and smallholder dairy production will be supported.'<sup>2</sup>

#### Criteria for Choice of District

Nandi District was chosen for investigation because it fulfilled the following conditions, (i) land settlement and consolidation was far advanced. The registration and adjudication records provide the sample frame. Possession of title deed is necessary if farmers are to obtain loans for development and provides the security of tenure essential for commercial farming entailing long term livestock activities.

(ii) Established mixed, low density farms whose average size is in the 40 - 50 acre range. Considerable attention has been given to large scale methods of livestock production and crop growing on the small holdings. Little information is available of production on medium - sized commercial farms in the Traditional Farm Sector, outside the Settlement Schemes.

(iii) Proposed development in beef and dairy production as outlined in the National Development Plan. Nandi District falls entirely within the high potential zone (i.e. minimum of 35 inches of rainfall) which is suitable for dairy production. The traditional pastoral interests of the Nandi people ensures a high livestock population in the District and involvement in livestock development on the part of the farmers.

1. Republic of Kenya, Development Plan 1970-74.

2. Republic of Kenya, Development Plan 1974-78.

### The Choice of Farms - Sample Design

Nandi District comprises two distinct ecological zones which can be identified by the areas in which tea can be grown and the areas where it is too dry for tea in North Nandi. Beef/dairying and maize cultivation are the main farm activities in the small scale farming sector in both zones. There is little cultivation of other crops such as beans, cabbages, millet etc. Of the 44 sublocations in the District where small scale farms are situated, 22 sublocations fall in North Nandi and 22 in the central and southern area.

10 sublocations from each zone were selected at random. From each sub-location land register, and for those sub-locations where registration is not finalised, the land adjudication documents, 13 farms were selected on a random start basis, taking every  $n^{\text{th}}$  farm, where  $n = \frac{\text{total number of plots}}{13}$ . Where the plot selected was less than 7 hectares the next plot on the register of suitable size was chosen.

A pilot survey (see the Appendix for copy of questionnaire used) of 10 farms from the 13 selected for each sublocation was undertaken. The extra 3 farms allowed for the non-availability of some farmers selected due to changes in land ownership, death etc which were not documented in the land documents.

The pilot survey entailed the collection of information on total land holdings, level of education of farm owner, offfarm employment, crops grown and sold, cultivation methods, livestock numbers, animal husbandry practices, cattle and milk sales, family and hired labour, financial assistance and perception of farming problems.

From this information 50 farms were selected which represented the different farm activities undertaken in the District and the different stock holdings in terms of grade, upgrade and local cattle. The author wishes to construct representative farm linear programming models therefore care must be exercised in selecting the 50 farms for intensive study, to minimise aggregation bias when the models are solved and the resultant activity levels aggregated to the District level.

The farms comprising any individual group must be as homogeneous as possible. R.H. Day<sup>1</sup> has established the following set of sufficient conditions for homogeneity of multi-product/multi-resource farms: (i) All farms in the short run must be technologically homogeneous; the same type of resources and constraints, the same levels of technology and the same level of managerial ability.

(ii) Individual farmers in a group must hold expectations about unit activity returns which are proportional to average expectations.

(iii) The constraint vector of the programming model of each individual farm should be proportional to the aggregate constraint vector.

Using the representative farm approach therefore implies, if the above conditions are fully met, that the representative farm is in fact the arithmetic mean farm. But one of the main reasons for representative farm programming is to avoid the need for full data on the technological matrices of individual farms.

Buckwell and Hazell<sup>2</sup> have suggested that one possible solution to this problem is to delineate grouping of farms based on conditions (ii) and (iii) and then disaggregate the resultant groups where there is evidence of differences in technology.

Once the farms in the pilot survey have been sub-divided into distinct categories a representative or model farm can be defined for each category. A multi-period, linear programming matrix will be constructed for each of the representative farms. This requires the collection of very detailed data from a limited sample of farms within each group, approximating to the representative farm, over a period of 15 months.

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1. Day, R.H. "On Aggregating Linear Programming Models of Production", Journal of Farm Economics, 45, 1963. Also further discussion in Agricultural Economics Research.

2. Buckwell, A.E. and Hazell, P.B.R. "Implications of Aggregation Bias for the construction of Static and Dynamic Linear Programming Supply Models". Journal of Agricultural Economics, 23, 1972.

Individual Farm Data Requirements

Detailed information has been collected by the author and three assistants since the end of March 1974 on the beef/dairy/maize activities engaged in by each of the 50 farms selected. This entailed the establishment of simple farm records (see the Appendix for Dairy, Maize and Livestock recording sheets) and the visiting of each farm once every two weeks.

For dairying, the daily milk yields from grade, upgrade and local cows are noted by either the farmer or a literate member of his family and entered on the record sheet. The yield is subdivided into milk sold, milk consumed by the family, and when it occurs, milk bucket fed to calves. The number of grade, upgrade and local cows being milked each day is also noted. Daily milk records for individual cows has not been investigated. The herd composition is checked every two weeks.

The daily feed rations for the milking cows, calves, heifers and male cattle is also noted. Since there is little daily variation in these quantities, this information is collected on a seasonal basis. The acreage of improved and unimproved pastures and fodder crops is checked periodically.

In addition to these dairy and livestock records, details of the types of cattle bought and sold and the prices involved, calves born, cattle gifts, and mortalities are collected on a two week basis. The farm routine concerning the distance cattle have to be taken to water, milking times and dipping frequencies have also been documented.

The maize cultivation is being documented as follows. Seed and fertiliser quantities purchased and their prices and the acreage planted was determined at the beginning of the survey period. In Nandi District there is one maize crop grown each year, with planting taking place at the end of March to coincide with the start of the long rains. Labour inputs in terms of family labour and hired labour for each stage of cultivation has been collected throughout the year. This has covered the clearing of land, <sup>ploughing,</sup> planting, weeding, cutting, stacking, harvesting, storing and shelling. The information entails the



number of persons, the average number of hours per day and the number of days worked by each labour group, the cost of hired labour and tractors/oxen used.

Harvesting occurred in December 1974 and January 1975 and the maize shambas on each farm were surveyed after harvesting, using the triangulation method, to ascertain the exact acreage. The quantity of maize harvested was determined by measuring the volume of maize stored on the farm and adding the number of bags of maize sold, maize given to friends, relatives and employees, maize consumed by the family, both on the cob and shelled, maize fed to cattle and also used for making beer since harvesting. The prices realised by the selling of maize was also noted.

The farm records are still being collected and this will continue until early May 1975. The author is presently involved in the collection of additional information concerning time series of input and output prices for farm products, weather conditions, incidence of disease and research station data on livestock and maize production to augment the farm data collected. Milk quantities sold by Nandi farmers to KCC, livestock sales, and artificial insemination and Agricultural Finance Corporation records for the District are also being investigated.

Soon after the intensive survey began it became evident that whilst the farmers had given fairly accurate information during the pilot survey concerning their total herd size the breakdown into grade, upgrade and local animals was inaccurate. The author wished to obtain simple information on the development of the farms so the 200 farmers interviewed during the pilot survey, were revisited to ascertain herd composition by actually counting the cattle on each farm and the farmers were asked when they first planted hybrid maize and subsequent acreages, expected acreages in 1975, first use of fertilisers, tractors, feed concentrates, fodder crops, purchase of upgrade and grade cattle and the planting of tea (See Appendix for Innovations questionnaire).

Analytical Techniques

Once the resources and other restrictions of the region are specified, the inter-relationships of the various activities identified and the costs of inputs and outputs given, on the assumption of gross farm margin maximization, the representative farm linear programming models can be solved and the resultant activity levels aggregated to the District level.

If sufficient data on commodity prices and input costs over the past few years are available it will be possible to include an expectational hypothesis of farmers' reactions to prices which is much more realistic than the assumption of perfect knowledge and immediate adjustment to a normative supply position. As livestock production entails decisions over a 3 to 4 year period, multi-period, i.e dynamic linear, programming is required.

Parametric programming indicates how important a precise value of a variable is to the model, by showing its effect on the optimal plan. By altering the prices of inputs and final products and re-solving the representative farm models a series of output levels corresponding to different prices can be determined for the District and alternative pricing and credit policies assessed.

Once the initial technological matrices have been constructed it will also be possible to consider the repercussions of introducing new methods of production and improved marketing facilities which have been implemented in other areas.

Possible Implications for Policy

Knowledge of farmers' supply response enables the construction of more detailed: (i) District plans especially when the national Development Plan emphasises beef and dairy production in the particular District.

(ii) Policies concerning beef and dairy products including not only the pricing of final products but also the design of programmes incorporating inputs, extension, research, credit, etc., in similar production areas.

As the methodology suggested is essentially normative, the results obtained could be incorporated in future farm management advice.

The author will be analysing the data collected at the School of Development Studies, University of East Anglia, England during the remainder of 1975. While it is impossible to predict what the final results of the computations will be, the author intuitively feels that the present high input prices will dictate lower output levels and that without input subsidisation the small scale mixed farming sector will experience a contraction in marketed production.

Appendix

PILOT SURVEY OF THE SMALL SCALE MIXED FARMS OF NANDI DISTRICT

CODE NUMBER \_\_\_\_\_ NAME OF INTERVIEWER \_\_\_\_\_  
 DATE \_\_\_\_\_ PLOT NUMBER \_\_\_\_\_  
 LOCATION \_\_\_\_\_ SUBLOCATION \_\_\_\_\_  
 NAME OF FARMER \_\_\_\_\_

- (1) What is the acreage of this farm? \_\_\_\_\_ acres
- (2) When did you acquire it? \_\_\_\_\_ How was it acquired? \_\_\_\_\_
- (3) Has the farm been registered? yes \_\_\_\_\_ no \_\_\_\_\_
- (4) Do you own other land in Nandi District? yes \_\_\_\_\_ no \_\_\_\_\_

If yes, ask: What is the area and location of each plot? When was it acquired?

	plot acreage	location	date acquired
(a)	_____	_____	_____
(b)	_____	_____	_____
(c)	_____	_____	_____
(d)	_____	_____	_____
(e)	_____	_____	_____

- (5) Do you own any land outside Nandi District? yes \_\_\_\_\_ no \_\_\_\_\_  
 If yes, ask: What is the total area? \_\_\_\_\_

- (6) Do you rent land? yes \_\_\_\_\_ no \_\_\_\_\_  
 If yes, ask: What is the total area rented (a) in Nandi \_\_\_\_\_  
 (b) elsewhere \_\_\_\_\_

- (7) Have you had any formal education? yes \_\_\_\_\_ no \_\_\_\_\_  
 If yes, ask: Up to what standard? \_\_\_\_\_

- (8) Have you had any other training? yes \_\_\_\_\_ no \_\_\_\_\_  
 If yes, specify \_\_\_\_\_

(9) Do you have any off-farm employment (either permanent or temporary)?  
yes \_\_\_\_\_ no \_\_\_\_\_ If yes, specify \_\_\_\_\_

Wife (wives) employment \_\_\_\_\_

(10) What crops do you grow? (Distinguish between local and hybrid maize and if tea is grown, give the number of stems. Include fodder crops.)

	crop	area	crop	area
(a)	_____	_____	(b)	_____
(c)	_____	_____	(d)	_____
(e)	_____	_____	(f)	_____
(g)	_____	_____	(h)	_____

(11) What crops do you sell? \_\_\_\_\_  
\_\_\_\_\_

(12) How do you do the following?

	by hand	ox plough	tractor	other (specify)
(a) clearing land	_____	_____	_____	_____
(b) ploughing	_____	_____	_____	_____
(c) sowing	_____	_____	_____	_____
(d) weeding	_____	_____	_____	_____
(e) harvesting	_____	_____	_____	_____

(13) If a tractor is used, ask: Do you (a) own a tractor \_\_\_\_\_

(b) hire a tractor \_\_\_\_\_

(14) Has there been shrub clearance on your land? yes \_\_\_\_\_ no \_\_\_\_\_

If yes, ask: What area has been cleared? \_\_\_\_\_ acres

(15) Do you use fertiliser: (a) at time of planting? yes \_\_\_\_\_ no \_\_\_\_\_

(b) force feeding? yes \_\_\_\_\_ no \_\_\_\_\_ (c) top dressing? yes \_\_\_\_\_ no \_\_\_\_\_

- (16) How many grade cattle do you own?  
(a) mature cows \_\_\_\_\_ (b) heifers \_\_\_\_\_ (c) bulls and castrated  
males \_\_\_\_\_ (d) female calves, under one year \_\_\_\_\_  
(e) male calves, under one year \_\_\_\_\_
- (17) How many local cattle do you own?  
(a) mature cows \_\_\_\_\_ (b) heifers \_\_\_\_\_ (c) bulls and castrated  
males \_\_\_\_\_ (d) female calves, under one year \_\_\_\_\_  
(e) male calves, under one year \_\_\_\_\_
- (18) How many of the following do you own?  
(a) sheep \_\_\_\_\_ (b) goats \_\_\_\_\_ (c) pigs \_\_\_\_\_ (d) poultry \_\_\_\_\_
- (19) How do you feed your grade cattle? \_\_\_\_\_
- (20) Do you do any of the following  
(a) make silage (b) bucket feed calves \_\_\_\_\_ (c) use A.I. \_\_\_\_\_  
(d) use animal feed concentrates \_\_\_\_\_ (e) dip cattle \_\_\_\_\_ (how  
often?) \_\_\_\_\_ (f) grind maize in mobile feed or water mill \_\_\_\_\_  
(g) grow fodder crops \_\_\_\_\_
- (21) Do you sell milk? yes \_\_\_\_\_ no \_\_\_\_\_ If yes, how often? \_\_\_\_\_  
What is the average quantity sold at one time? \_\_\_\_\_  
Is the evening milk sold? yes \_\_\_\_\_ no \_\_\_\_\_  
If no, what is it used for? \_\_\_\_\_
- (22) Do you belong to a co-operative society? yes \_\_\_\_\_ no \_\_\_\_\_  
If yes, which one? \_\_\_\_\_
- (23) Have you less milk during the dry season? yes \_\_\_\_\_ no \_\_\_\_\_

- (24) Do you sell cattle for beef? yes \_\_\_\_\_ no \_\_\_\_\_ If yes, how often? \_\_\_\_\_
- (25) Have you made any of the following improvements to your farm?  
(a) fencing \_\_\_\_\_ (b) water installation \_\_\_\_\_ (c) housing \_\_\_\_\_  
(d) other, specify \_\_\_\_\_
- (26) How many members of the family work on the farm?  
(a) all year round: adults \_\_\_\_\_ children \_\_\_\_\_  
(b) part of the year: adults \_\_\_\_\_ children \_\_\_\_\_  
If (b), ask: At what time of the year and for what purpose? \_\_\_\_\_  
\_\_\_\_\_
- (27) Do you hire any labour?  
(a) all year round: adults \_\_\_\_\_ children \_\_\_\_\_  
(b) part of the year: adults \_\_\_\_\_ children \_\_\_\_\_  
If (b), ask: At what time of the year and for what purpose?  
\_\_\_\_\_
- (28) Do you have any other help on the farm apart from family and hired labour? yes \_\_\_\_\_ no \_\_\_\_\_ If yes, ask: How many?  
Adults \_\_\_\_\_ children \_\_\_\_\_  
What work do they do? \_\_\_\_\_  
At what time of the year do they work on the farm? \_\_\_\_\_
- (29) Do you have any of the following?  
(a) current bank acc. \_\_\_\_\_ (b) savings acc. \_\_\_\_\_ (c) P.O. savings acc. \_\_\_\_\_  
(d) shares in a co-operative society in Nandi District \_\_\_\_\_ (e) shares in any other agricultural activity:

(i) in Nandi District \_\_\_\_\_ (ii) outside Nandi District \_\_\_\_\_

(30) Have you received any loans for the improvement of your farm?

yes \_\_\_\_\_ no \_\_\_\_\_

If yes: amount \_\_\_\_\_ purpose of loan \_\_\_\_\_

(a) \_\_\_\_\_

(b) \_\_\_\_\_

(c) \_\_\_\_\_

(31) What do you think are the main problems facing the Nandi farmers at present? (e.g. shortage of water, capital, labour, veterinary services, marketing etc.)

(a) \_\_\_\_\_

(b) \_\_\_\_\_

(c) \_\_\_\_\_

(d) \_\_\_\_\_

(e) \_\_\_\_\_









INNOVATIONS SURVEY OF SMALL SCALE MIXED FARMS OF NANDI DISTRICT

CODE NUMBER \_\_\_\_\_ NAME OF INTERVIEWER \_\_\_\_\_  
 DATE \_\_\_\_\_ SUB LOCATION \_\_\_\_\_  
 FARMER'S NAME \_\_\_\_\_

	MATURE COWS	HEIFERS	CALVES	BULLS	CASTRATED MALES
GRADE					
LOCAL					
UPGRADED					

What year did you first plant hybrid maize? \_\_\_\_\_

How many acres have you grown each year since then?

1960 \_\_\_\_\_ 1961 \_\_\_\_\_ 1962 \_\_\_\_\_ 1963 \_\_\_\_\_ 1964 \_\_\_\_\_  
 1965 \_\_\_\_\_ 1966 \_\_\_\_\_ 1967 \_\_\_\_\_ 1968 \_\_\_\_\_ 1969 \_\_\_\_\_  
 1970 \_\_\_\_\_ 1971 \_\_\_\_\_ 1972 \_\_\_\_\_ 1973 \_\_\_\_\_ 1974 \_\_\_\_\_

How many acres of hybrid maize do you intend to grow next year? \_\_\_\_\_

If less than this year's acreage, ask why? \_\_\_\_\_

Why did you first plant hybrid maize? (advice from FTC, etc.,) \_\_\_\_\_

When did you first use fertiliser? \_\_\_\_\_

If a tractor is used, ask: When did you first use a tractor? \_\_\_\_\_

What year did you first obtain an upgraded animal? \_\_\_\_\_

What year did you first obtain a grade animal? \_\_\_\_\_

Who told you about upgraded and grade cattle? (FTC, vet scouts, other farmers, etc.) \_\_\_\_\_

Did you obtain a loan for your first upgraded/grade cattle? yes \_\_\_ no \_\_\_\_\_

If feed concentrates are used, ask: When did you start feeding concentrates?

\_\_\_\_\_ If fodder crops are grown, ask:

When did you first plant fodder crops? \_\_\_\_\_

How many acres have you grown since then each year? 19 \_\_\_\_\_

19 \_\_\_\_\_ 19 \_\_\_\_\_ 19 \_\_\_\_\_ 19 \_\_\_\_\_ 19 \_\_\_\_\_

If tea is grown, ask: When did you first plant tea? \_\_\_\_\_

What was the tea acreage? \_\_\_\_\_ How many stems? \_\_\_\_\_

Did you obtain a loan to plant the tea? yes \_\_\_\_\_ no \_\_\_\_\_