African Journal of Agricultural Research Vol. 7(2), pp. 153-163, 12 January, 2012
Available online at http://www.academicjournals.org/AJAR
DOI: 10.5897/AJAR09.028
ISSN 1991-637X ©2012 Academic Journals

Full Length Research Paper

Socio-economic, food and nutrient intake and nutritional status indicators associated with successful livestock development programmes in Western Kenya.

Mary Khakoni Walingo

Maseno University, Box 333, Maseno, Kenya. E-mail: marywalingo@yahoo.com or marywalingo@gmail.com.

Accepted 5 January, 2010

Dairy production and marketing dominates the livestock contribution to household economies and is one of the highest deliverer of the per capita milk availability in sub-Saharan Africa. Livestock activities are integrated within household consumption and production decisions, increasing drudgery among women. In Kenya the livestock projects were established to improve household food security and the nutritional status of household members by increasing the consumption of dairy products. A comparison was made between beneficiary and non-beneficiary households to identify factors that were associated with the success of diary programmes. Beneficiary households increased time and income expended in the dairy enterprise, on veterinary services, and had more knowledge on dairy management. There was increased consumption of milk and milk products and green leafy vegetables, and also in the intake of protein, vitamin A and energy in the beneficiary than in the non-beneficiary households. The selection criteria of differentiating beneficiary and non-beneficiary indicate that beneficiary farmers had already had capacity of significant investment in dairy activities. Though it may be ambiguous to tell whether dairy programmes themselves significantly affected the outcomes given in this position, the identification of household factors that are improved by dairy projects has promising returns for sustainable dairying and, improved food and nutrient intake in households and nutritional status of women and their preschool children. Inclusion of livestock as a policy issue in national goals and objectives could result in improved nutritional status and improved living standards.

Key words: Livestock, dairy project, food and nutrient intake, women, preschool children, Western Kenya.

INTRODUCTION

Livestock Development Projects were established to improve household food security and the nutritional status of household members through increased availability and intake of dairy products. The livestock projects components included support to women groups to participate in the cow-from-cow rotation scheme; upgrading of the cattle herd from the low potential zebu bred to cross-bred using exotic bulls; enhancing of milk marketing through the provision of milk collection and marketing facilities. The general goals of the livestock development projects [LDP] were to generate income and meet growing demand for animal-source-food (Hoffman, 2003). Farming in rural Kenya is mixed crop-livestock systems with productivity per animal of land unit well below those of industrialized countries (Randolph et al., 2007). Agriculture contributes over 25% to the Kenyan Gross Domestic Product, of which livestock contributes over half. Most of Kenya's dairy cattle are kept by smallholder farmers in crop-livestock systems in areas of high and medium cropping potential with low-external-input subsistence production (Hoddinott, 2006; Staal, 1997). Smallholder dairying contributes directly and indirectly to food security and poverty alleviation of the smallholders in Kenya. Livestock play diverse economic and social roles in the national economies of Sub-Saharan Africa, often contributing to multiple livelihood objectives and offering pathways out of poverty (Randolph et al., 2007). Keeping livestock is considered an alternative form of insurance, providing the family with assets that can be sold in times of crisis (Moll, 2005).

Considerable value is placed on livestock as an indicator of social importance within the rural community to strengthen social bonds, including the use of livestock to pay dowry (Wilson et al., 2005). Higher social status may translate into access to or authority over a broader base of resources in the community (Randolph, 2007). Livestock waste is an important input for maintaining soil fertility and so contributes to greater crop production for food and income (Kitalyi et al., 2005). Dung is used as fuel, building material (Randolph, 2007), and as organic fertilizer. Further, livestock is used as an alternative for storing savings or accumulated capital as a 'living savings account' that, although not without risk, provides a reasonable robust hedge against inflation (Powell et al., 1998).

Livestock provide meat and milk for households and cash income that is often invested in households' demands and crop production technologies (Powell et al., 2004). Intensification of dairy production has been shown to potentially raise milk production and income, especially where demand and infrastructure is favorable (Thorpe et al., 2000). Dairying is a very significant source of income and food for over 625 000 smallholder producer households and for those involved in the marketing of milk, in total some 25% of all households (Muriuki et al., 2001).

Dairy production and marketing dominates the livestock contribution to household economies in Kenya and is one of the highest deliverer of the per capita milk availability in sub-Saharan Africa (Muriuki and Thorpe, 2001. A majority of smallholder dairy producers rely on informal milk markets providing a source of employment for small-scale market agents (Staal, 2001). Milk can help mitigate the effects of often large seasonal fluctuations in grain availability (Wilson et al., 2005). The household may own livestock for the express purpose of producing for the market and for sales to meet urgent need for cash (Wilson et al., 2005). Livestock owned also provides traction and nutrient cycling services that increase food crop production possibly increasing crop sales, household income, and household food crop consumption (Randolph, 2007). Owning animals increases the amount of ASF available, which can increase ASF consumption, dietary intake and nutritional status (Randolph, 2007), animal production, animal and livestock product sales and household incomes. Livestock can be sold and transformed into cash needed and so also provide an instrument of liquidity and consumption smoothing (Randolph, 2007). Income from sale of livestock can be used to purchase food and non-food items in households. Livestock can produce a regular supply of nutrient-rich Animal source foods (ASF) that provide a critical supplement and diversity to staple plant-based diets (Murphy and Allen, 2003).

Dairying has potential to improve nutrient adequacy (Azadbakht et al., 2005), reduce blood pressure and risk of stroke (Massey, 2001; Steffen et al., 2005), regulate weight gain (Rosell et al., 2006), and improve body mass index (Hollis and Mattes, 2007). Further, a lower prevalence of stunting and improved nutritional status, increased milk consumption and better food security situation has been reported in households keeping dairy cattle (Mbagaya et al., 2004). Livestock can worsen human nutrition and health when allocation of household resources such as land and labor to livestock reduces production, consumption and sales of other foods. Smallholder management systems are low-or-no-input, letting animals forage for themselves, feeding on plants or waste that otherwise would not be used (Randolph et al., 2007). The relative prices for livestock products and feeds discourage farmers from using purchased inputs to develop intensive production systems (Rueda et al., 2003). Resource constraints hinder productivity among the poor, whose livestock serve multiple roles and is a great contributor to the households' livelihoods base, strengthening the asset base. Livestock activities are integrated within household consumption and production decisions (Randolph et al., 2007), increasing drudgery among women. The labor allocated to livestock can increase total household labor demands, particularly for females, and reduce time and quality of care and feeding of young children, and thus affect their nutritional status. The introduction of livestock activities in households and the need to increase productivity of existing livestock does not necessarily translate into increased animal source foods. Smallholder dairy farms are not typically market-oriented management systems that are more intensive and dependent on purchased inputs, and the production is not consumed on-farm but sold to meet household demands (Hoffman, 2003). Income-mediated effect on nutritional security may become diluted because only a portion of the income gain goes to food expenditures. Diets may not improve as income and food expenditures increase (von Braun and Kennedy, 1994).

Malnutrition remains a large persistent problem in this community, with diets based mainly on cereals, and low in several micronutrients (Neumann et al., 2003). Cereal diets are important sources of phytic acid and dietary fiber, which inhibit absorption and (or) retention of nutrients such as iron and zinc (Gibson, 1994). Malnutrition lowers human capital development and productivity constraining macroeconomic performance and potential for economic growth (Waithaka et al., 2006). However several agricultural projects failed todemonstrate any improvement in the nutritional status of vulnerable groups and also improve the household food security situation [von Braun and Kennedy, 1996; Kennedy, 1988; Rubin, 1988; Kennedy and Oniang'o, 1990; Rubin, 1990). Livestock development projects seek to increase productivity of livestock products and improve household food security by introducing the exotic dairy bred that not only have higher milk-yield potential but also replace the low genetic potential zebu cattle that dominate the area. These projects may contribute to the

general social and economic improvement in households, which may not necessarily have been part of the project objectives. The purpose of the present study was to identify socio-economic, food and nutrient intake factors and nutritional status indicators associated with successful Livestock Development Programmes in Western Kenya.

MATERIALS AND METHODS

Study site

The study was carried out in Vihiga District, Western Kenya. Vihiga is a rather highly populated area with high agricultural potentials, in comparison to arid-/semi-arid pastoral areas in most parts of Kenya. Therefore, the livestock activities here require more or less intensive management than in more marginal pastoral zones. The district occupies an area of 523 km^2, out of which 409 km^2 is arable land supporting 53928 farm families. Poverty level in Vihiga District stands at 60% with an average total income of Kenya Shillings 56 (€ 0.70) per day (Thornton et al., 2007). Livestock interventions have been initiated in this area in view of the manifestation of negative developmental characteristics, including high levels of poverty.The district is divided into two main agro-ecological zones: 1) the Upper Midland (UMI) and 2) the Lower Midland (LMI) zone. The Upper Midland zone has fertile well-drained, dark red soils, which support the growing of tea, coffee, finger millet, maize, beans, fruits and cassava. The Lower Midland zone has red loamy soils derived from sediments and basement rocks, supporting the growing of sugarcane, maize, coffee, beans, finger millet and sorghum.

Participation in the livestock project

The project targeted women farmers who were members of active women groups in the project area and must have had an established a Nappier grass plot (*Pennisetum purpureum*), constructed a zero-grazing unit and must have acquired basic facilities for disease control. Thus, the project had set criteria for participation, women farmers who had capability of significant investment in dairy farm activities (that is exotic dairy cattle and goats). Women beneficiaries of the LDP were trained in basic dairy management skills and were provided with chuff-cutters, rain water catchments roof tanks, relevant on a cost-sharing basis to reduce drudgery. The programme had to create motivating conditions for more productive participation by women in the ownership and dairy management through training and provision of workload easing facilities.

The cow-from-cow rotation scheme

The dairy programme supported women groups, by enabling them to participate in the cow-from-cow rotation scheme. In-calf heifers were 'loaned' to selected women groups fitting the specified criteria. The heifers were then passed onto an individual woman member sequentially till all of them received a heifer. The decision to pass on a heifer to a member was based on a selection criteria agreed upon by the group members through a lottery. The decision was to have the heifers pass on to individual women based on impracticality of keeping a women's group herd which could be subjected to neglect. Officials and targeted women of the selected group were their trained in dairy farming before receiving the in-calf dairy cow. This training was basically on dairy cow management.

Study design and sampling

The study was carried out using a cross-sectional design with a case-control model. A list of women beneficiaries of the LDP was obtained from the Divisional Livestock Extension Office. This list was used to randomly select women beneficiaries of the LDP for participation in the study. Three Divisions in the district were randomly selected for the purpose of the study. In each Division, a total of 50 households were randomly selected from a list of beneficiaries of a livestock programme, and were matched with 50 non-beneficiaries of a livestock project. Overall, 300 households were selected to form the sample households: 150 participant and 150 non-participant households. Though women non-beneficiaries were not members of the Livestock projects they kept livestock in this mixed livestock-cropping environment.

Data collection and statistics

Pre-tested interview schedules were used to collect data on socio-demographic and agro-economic characteristics of index households. Women heads of households were the respondents who provided information on selected variables of the study. Anthropometric measurements of women and preschool children were taken using standardized techniques. Anthropometric measurements of preschool children were expressed as Z-scores of weight-for-age, height-for-age and weight-for-height. Preschool children falling below –2SD were considered to be malnourished. Body mass index (BMI) was used as an indicator of nutritional status of women. Women falling below 18.5 were considered malnourished, while those below 16 were classified as severely malnourished.

Recruitment strategies

Qualification for inclusion in the study was based on a woman's participation in the dairy program for at least three consecutive years. Women non-beneficiaries of the LDP were purposely selected and matched with the beneficiaries of the LDP for locality, age group range, socio-economic status and time duration as mixed crop-livestock farmers. The measure of the program participation for the beneficiary women was membership in a women group for at least five years. The participant women had developed a Napier grass plot, which had a zero-grazing unit and had been trained in basic disease control. Definition of non-beneficiary comparison was based on non-beneficiaries in the dairy program who lived in the same geographical area, of similar age and near-comparison socio-economic status as the beneficiaries.

Permissions

Permission to conduct the research was granted by the office of the President. To access women beneficiaries of the program a list of members of the program was provided by the Ministry of cooperative Development Divisional Offices. A list of women non-beneficiaries in the program was derived from the divisional administrative office. Clearance to conduct the study was finally granted by the District Officer, Administration, as is the procedure in Kenya for research where individuals are interviewed. The District Officer introduced the research team to all his constituents in a general meeting and the purpose of the study was also explained. Permission was sought from the individual respondents, for participation in the study. The purpose of the study was explained to all for them to make an informed decision on participation in the study.

Measurement instruments and data collection procedure

All data was collected during the long rains season (March to August 2008). Interview technique using interview schedule was used to collect data on selected variables of the study. Data on food and nutrient intake and anthropometry were collected using standardized equipment. The 24-h diet recall survey, repeated for three consecutive non-feast days, was used to collect dietary intake information. The recall method involved exhibiting the different size of standardized vessels to women respondents (who are assumed to cook and serve the food to the family), collecting information regarding the foods consumed the previous day and estimating the quantities using a set of standardized diet survey cups. Food left over the previous day and consumed on the day of the survey was recorded. The individual food intake of preschool children and women were recorded for three consecutive days excluding special days. The nutrient intake of the individual per day was calculated from a standard food composition table for Kenyan foods (Sehmi, 1993). The mean intake of raw equivalents from intake of cooked amounts was calculated using the formula given by Sehmi (1993) and Gopalan et al. (1991) as follows:

$$\text{Individual intake in terms of raw amounts} = \frac{\text{Total amount of each Ingredient used in the preparation} \times \text{Individual intake (Cooked amount)}}{\text{Total cooked amount of each preparation (g/ml)}}$$

Food and nutrient intake in households, by women and preschool children was compared with the FAO (1987) RDI for East Africa. The Seca alpha electronic digital scale was used to record the weights of subjects accurately to the nearest 0.1 kg. The electronic digital tray was used to weigh children under two years in a sitting position. Height was measured using a height board of infantometer calibrated in centimeters. The subjects were measured barefooted and were made to stand erect with their feet parallel on a flat surface. Height in children under two years was taken in a recumbent position. Height was recorded to the nearest 0.1 kg. The NCHS reference standard was used for the assessment of the nutritional status of preschool children. The Gomez classification was used. Preschool children were classified into groups of 'normal', 'mild', 'moderate', and 'severe malnutrition'. The Z-scores were used for weight-for-age, height-for-age and weight-for-height. Body mass index (BMI) was used as an indicator of nutritional status for women and grouped to reflect different degrees of Chronic Energy Deficiency [CED] and obesity as given by James et al. (1988).

Data analysis

Selected variables of the study were scored by allotting a tentative score according to the number and type of responses. The total attainable score was attained by summing up tentative scores for each question in the subsection (demographic, economic, dairy cooperative, nutritional awareness and food and nutrient intake). The total attainable score was equated with 100 and the conversion factor 100/s was used in awarding scores to each question:

Therefore equating with 100, conversion factor = $100 \times \Sigma x/a$.

Where x = tentative score for each response; a, is total attainable score for each subsection.

The mean and standard deviation of scores were calculated and Z-test was used to assess the significant differences between the two groups. Correlation coefficient between the sets of scores was found out to identify the degree of association. The socio-demographic and agro-economic data were analyzed using chi-square, Z-test and ANOVA. Correlation of these variables with indices of nutritional status was carried out to find the associated variables. The Stepwise Discriminant function analysis was undertaken to trace the order and best sets variables which have the highest power of discrimination between beneficiary and non-beneficiaries. This method was one of selecting a linear function, which would best discriminate between beneficiaries and non-beneficiaries of a livestock development projects on the basis of certain selected variables.

The Discriminant function classifies and estimates differences between two or more groups. Discriminant functions were fitted for socio-demographic patterns of food intake in households by women and preschool children, and patterns of nutrient intake in households, and by women and preschool children. The significance of each Discriminant function fitted was assessed by the *Mahalanobis* D^2 and *Fishers 'F'* test of significance. The relative importance of all the discrimination functions was assessed by comparison of the absolute values of 'F' ratio showing the significance of each linear discriminating function and by testing the significance in relation to each other.

RESULTS AND DISCUSSION

There was no baseline data before the inception of the project to compare to the results discussed here. Though the project selection criteria for beneficiary women could have discriminated well-endowed farmers who were able to build a zero-grazing unit and plant Nappier grass, and have the ability to belong to a women group, effort was made to match the beneficiary and non-beneficiary to mitigate the impact of social disparity.

Population composition by age and sex, and the dependency ratio

The total population under 15 years was 38 and 39% males in households with beneficiary and non-beneficiary women respectively. There were less females (36.6%) in households with beneficiary women than in those with non-beneficiary women (43%). The mean age of women was 24 years among beneficiary and non-beneficiary groups respectively. Females from beneficiary households tended to be older than those from non-beneficiary households. About 14.7% of households of women beneficiary and 18.5% of households of women non-beneficiary had small families (less than 5 members). While 27.3% of households of women beneficiary had medium family (5 to 6 members), about 35.8% of households of women non-beneficiary had medium families. Large families (over 6 members) were observed

in 58% of households of women beneficiary and 45.7% of households of women non-beneficiary.

The mean family size was 7.04 in beneficiary and 6.54 in non-beneficiary groups respectively. Dependency ratio was 1.1.68 in households with beneficiary women and 1:1.37 in those with non-beneficiary women. Dependency ratio is worked out as a ratio of population between 15 to 65 years old over those below 15 years and those above 65 years, the population that is not economically active.

Education level and occupation in households

Among the female heads of households, 57.4 and 76.8% of women beneficiary and non-beneficiary of the Livestock Project respectively, had low education. The education level of male and female heads of households was higher among women beneficiary of the Livestock Project (LDP) than in women non-beneficiary of the LDP, though the level of illiteracy was high in both groups. However, there was no significant difference in the education level among the male and female heads of households from both groups. More beneficiary women (57.3%) were employed compared to only 38.4% non-beneficiary women. Statistically significant differences were observed between the two groups regarding employment ($P<0.01$) and occupation structure. More beneficiary women were employed in the teaching profession than the non-beneficiary women.

Education was vital in the provision of livestock veterinary services, interpretation of extension material and maintenance of farm records, and for both understanding and interpretation of project objectives. There was a direct link between education and employment, evidenced through higher employment rate in the beneficiary over the non-beneficiary households. Both factors had a resultant and determining effect on the occupation and income earned in a household, and on their ability to purchase staple.

Income levels in households

The monthly household income ($P<0.05$) and mean household income ($P<0.001$) was significantly higher in households of women beneficiaries of the LDP. While 30.7% women beneficiaries earned over 5000 Kenya shillings (KShs.), 51.4% non-beneficiaries earned less than KShs. 5000 a month. Only 25.6% beneficiaries had per capita income of KShs 600.00 compared to 35% non-beneficiaries. Though mean per capita income was higher among the beneficiaries than the non-beneficiaries, the difference was not significant. Household income had no effect on the nutritional status of preschool children. Kennedy and Oniang'o (1990) also found no association between nutritional status of preschool children and income. The extra income earned is hardly spent on food but goes for non-food purposes.

Though dairy projects could be seen as important sources of income in households, it was not easy to pinpoint this decreasing trend to the effects of the dairy projects singly given that many rural development programmes that had been initiated in this area.

Composition of the livestock herd and income expenditure in the dairy enterprise

There was a significant change in the size and composition of the livestock herd between the two groups. Significantly less women beneficiaries (14.5%) kept local bred and cross bred cattle compared to 96.8% women non-beneficiaries. Beneficiaries spent more income on dairy inputs ($p<0.001$) including the purchase of Napier grass (*P. purpureum*) from other farms and the purchase of dairy supplements. There was no difference in the use of cow dung between the two groups, as they all tended to use it as farm manure and for building purposes. The use of cow dung as farm manure could increase food crop production possibly increasing crop sales, household income, and household food crop consumption.

Labour provision in the dairy enterprise

Women beneficiaries provided 71.3% of the total labor requirements in the dairy enterprise, the non-beneficiaries provided 69.5%. Women were responsible for cleaning the cattle shed, watering the animals, fetching green fodder, stall feeding and milking the cows. Women beneficiaries spend on average 7.07±3.67 h in the dairy enterprise compared to only 2.5±3.0 h by the non-beneficiaries ($P<0.00001$). Changes in time-use across and within agricultural households could create important shifts in production and consumption outside nutrition that may have favorable effects on the welfare of some project population. However, the labor allocated to livestock can increase the total household labor demands, particularly for females, and reduce time and quality of care and feeding of young children, and adversely affect their nutritional status.

Profit utilization in the dairy enterprise

Beneficiaries received more income from the disposal of calves than the non-beneficiaries and spend more on hired labor ($P<0.001$). Though there was no significant difference between the two groups concerning expenditure on veterinary services, mean expenditure among the beneficiaries was more than that of the non-beneficiaries. The relative prices for livestock products and feeds discourage farmers from using purchased inputs to develop intensive production systems. More beneficiaries used the profit from the dairy enterprise to repay loans, for agricultural improvement, and for non-food purposes. Profit derived from the dairy enterprise

Table 1. Scores of Socio-demographic, agro-economic, food and nutrient intake and nutritional status (mean ± SD) of beneficiary and non-beneficiaries of Livestock Development Programmes.

Variable	Ideal Score	Beneficiary Household	Non-beneficiary Household	Z-value	Significant level
Demographic factors	20	3.49 ± 0.98	2.78 ± 1.45	4.97	<0.001
Economic factors	75	4.19 ± 3.81	3.04 ± 3.01	2.90	<0.01
Dairy cooperative factors	45	0.74 ± 0.67	0.40 ± 0.40	5.24	>0.001
Production, consumption and marketed surplus milk	75	6.23 ± 1.37	2.10 ± 1.45	25.35	<0.00001
Nutritional awareness of women	90	5.04 ± 7.78	4.97 ± 7.71	0.77	NS
Food and nutrient intake	270	33.54±10.20	28.45 ± 9.43	4.50	<0.001
Nutritional status of women and preschool children	25	4.28 ± 0.51	4.20 ± 0.44	1.60	NS

Ns – Not significant.

was spent on non-food items. Livestock and livestock products offer diverse range of value to farmers. Livestock products are sold in the market, the livestock transformed into cash for to meet pressing demands and thus providing an instrument of liquidity and consumption smoothing in households. However, most of the profit is not used to improve the dairy enterprise but to meet other pressing household demands.

Land ownership and food security

While only 8% beneficiaries owned less than 0.5 ha of land, 29% non-beneficiaries owned 0.5 ha of land. Landholding size was significantly higher (P<0.001) among the beneficiaries. More beneficiaries (24.7%) sold crops harvested than the non-beneficiaries (18.5%). On the other hand 80.4 and 88.2% beneficiaries and non-beneficiaries respectively, were purchasing staple to meet nutritional requirements of their family members. A significant difference was found regarding the ability of households to purchase staple (P<0.001), with more households suffering food insecurity due to increased inability to purchase staple foods.

Milk production, consumption and marketed surplus

Mean milk production was 268.14 L/day in households of beneficiary women and 89.7 L in households of non-beneficiary women (P<0.0001). Variables that showed correlations with milk production included milk price, milk marketing structure, milk consumption, and knowledge of dairy management, use of supplements and green fodder, and time input in dairy enterprise. Milk consumption in households was 240.9 g/day those of beneficiary women and 79 g/day those of non-beneficiary women (P<0.001), and 170 g/day for preschool children from households of beneficiary women and 30 g/day for preschool children from households of non-beneficiary women.

The mean marketed surplus milk was 7.4 and 2.5 L per day for the beneficiaries and non-beneficiaries, respectively. Mean income from marketed surplus of milk was KShs. 181.40 per day in households of beneficiary and KShs. 56.19 per day households of non-beneficiary women. Factors associated with marketed surplus milk were milk price, milk yield, expenditure on green fodder and supplements, knowledge of dairy management, expenditure on veterinary services and use of hired labor.

The discriminant function model for socio-economic factors

The mean scores of all the socio-economic factors included the demographic factors, economic factors, dairy cooperative factor, production, consumption and marketed surplus of milk presented in Table 1, were significantly higher among the beneficiaries than the non-beneficiaries.

There was a significant increase in the production, consumption and marketed surplus milk (P<0.00001), food and nutrient intake (P<0.001) among the beneficiaries. There was no significant difference in the nutritional status of women and preschool children, and, awareness of nutrition value of milk between the two groups.

The socio-economic variables that penetrated into a discriminant function model are presented in Table 2. The important variables with the power to differentiate between beneficiaries and non-beneficiaries were: milk price, time expenditure in dairy enterprise, income calves than the non-beneficiaries and spend more on hired labor (P<0.001). Though there was no significant difference between the two groups concerning expenditure on veterinary services, mean expenditure among the beneficiaries was more than that of the non-beneficiaries. The relative prices for livestock products.

Nutritional status of preschool children of women beneficiary and non-beneficiary of the livestock project

Nutritional status was measured by underweight, stunting and wasting. Level of underweight was 1.25 and 2.9% amongst preschool from beneficiary and non-beneficiary

Table 2. Order and best set of socio-demographic and agro-economic variables that are different among participant and non-participant groups.

Order and best set of variables miscalculation	D^2	D.F.	F-Ratio	Percent
1) Order of variables				
Milk price				
Time expenditure in dairy:				
Enterprise				
Income expenditure on animal supplements				
Change in dairy size				
Mean age of household members				
Income expenditure on government				
Veterinary Service				
Ability to purchase staple				
Knowledge of diary management	7.81	18.28	30.59	9.7
Occupation of women heads of households				
Employment of household members				
Milk yield				
Income expenditure on green fodder				
Person managing dairy enterprise				
Milk consumption by preschool children				
Income expenditure on staple				
Income from subsidiary sources				
Income expenditure on veterinary medicines				
Knowledge of diary cooperatives.				
2) Best set of variables				
Milk Price				
Time expenditure in dairy enterprise				
Income expenditure on animal supplements				
Change in dairy size				
Mean age of household members				
Income expenditure on government		7.28	12, 28	43.69
Veterinary service				
Knowledge of dairy management				
Occupation of women heads of households				
Employment of household members				
Milk Yield				
Income expenditure on green fodder				

groups respectively. Level of stunting as measured by height-for-age was 1.25% in beneficiary and 1% non-beneficiary group. However, the prevalence of stunting, on the whole, was significantly higher ($P<0.05$) in the non-beneficiary group. Wasting was not a problem in this community. Factors which showed correlation with nutritional status of preschool children were body mass in a household, time input by women in the dairy enterprise, and amount of milk consumed by preschool children.

Preschool children from households where mothers were well nourished tended to be well nourished. Though there seemed to be a direct link between the preschool child nutritional status and the mothers' body mass index, there were some special cases where a mother's body mass index was normal and yet the child's nutritional status was low and vice versa. Such cases were common in households where children had experienced prolonged illnesses, or children were left under the care of housemaids.

Nutritional status of preschool children from households of beneficiary women tended to be poorer than that of preschool children from households of non-beneficiary women. On the contrary, Mbagaya et al. (2004) found a lower prevalence of stunting and improved nutritional status, increased milk consumption and better food security situation in households keeping dairy cattle.

Further, other studies that compared participants and non-participants of Kenya Sugarcane Outgrowers programme found no significant difference in the nutritional status of preschool children from the two

Table 3. Order and best set of foods that are different among participant and non-participant groups (household, women and preschool children).

Order and best set of variables	D^2	D.f.	F-Ratio	Miscalculation
Household				
All variables				
Milk and milk products Green leafy vegetables Roots and tubes Other vegetables Sugar Fats and oils.	4.53	6.53	10.36	15.0
Best set of variables				
Milk and milk products	3.10	1.58	46.45	
Women				
All variables				
Milk and Milk products Green leafy vegetables Other vegetables Fats and oils Sugar	4.92	6.53	11.25	11.7
Best set of variables Milk and milk products Green leafy vegetables	3.71	2.57	27.36	
Preschool children				
All variables				
Green leafy vegetables Other vegetables Roots and tubes Pulses	5.57	7.30	6.23	10.5
Best of variables				
Milk and milk products Green leafy vegetables	3.17	2.35	14.46	

groups (von Braun and Kennedy, 1996; Kennedy, 1988; Rubin, 1988; Kennedy and Oniang'o, 1990; Rubin, 1990).

Nutritional status of women beneficiary and non-beneficiary of the livestock project

The mean body mass index (BMI) was 23.4 for the beneficiaries and 22.9 for the non-beneficiaries respectively and was higher than the national average of 21 for Kenya. The mean height of 1.61 m in both groups was higher than the national average of 1.59 m while the mean weight was 60.9 kg for the beneficiaries and 59.2 kg for the non-beneficiaries, respectively that are higher than the national average weight of 56 kg for Kenyan women (KDHS, 1992). While 6.7 and 7.3% beneficiaries and non-beneficiaries had BMI less than 18.5 cut-off point, 0.7% beneficiaries and 1.3% non-beneficiaries fell below 16 cut-off points for severe malnutrition.

Prevalence of obesity was higher (6%) among beneficiaries than among women from non-beneficiaries (4.5%). BMI was associated with the sale of crops harvested, the ability of households to purchase staple, and the person managing the dairy enterprise. The sell of surplus crops harvested by households added extra income to the households to meet immediate pressing demands (e.g. payment of school fees to offset bills etc.).

Patterns of food intake

The foods fitted into the discriminant model which included animal foods, cereals, pulses, green leafy vegetables, roots and tubes, milk and milk products, fats and oils, and sugar as presented in Table 3.

Table 4. Order and best set of nutrients that are different between the participant and non-participant groups (households, women and preschool children).

Order and best set of variables Miscalculation	D^2	D.f.	F-Ratio	Percent
Household				
All variables				
Protein				
Vitamin A	3.19	4.55	11.35	21.7
Energy				
Calcium				
Best set of variables				
Protein				
Vitamin A	2.99	3.56	14.43	
Energy				
Women				
All variables				
Protein				
Vitamin A	3.95	4.55	14.05	13.3
Energy				
Calcium				
Best of variables				
Protein				
Vitamin A	3.75	3.56	18.09	
Energy				
Preschool children				
All variables				
Protein				
Energy	3.14	4.33	6.77	26.3
Calcium				
Vitamin A				
Best set of variables				
Protein				
Energy	2.6	4.35	12.06	

The best sets of foods that differentiated between households of beneficiaries and non-beneficiaries were consumption of milk and milk products. Intake of milk and milk products, and green leafy vegetables formed the best set of foods with discriminatory power between women beneficiaries and non-beneficiaries.

Mean intake of these foods was higher in the participant group.

The best sets of foods that had the power to discriminate between preschool children of beneficiaries and non-beneficiaries were the consumption of milk and milk products and green leafy vegetables.

Patterns of nutrient intake

The nutrients fitted into the discriminant model included energy, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and ascorbic acid and is presented in Table 4. The best set of nutrients that differentiated between households of beneficiaries and non-beneficiaries were protein, vitamin A and energy. Intake of protein, vitamin A and energy in that order formed the best sets of nutrients that differentiated between women beneficiaries and non-beneficiaries, while protein and energy in that order were the best set of nutrients with

discriminatory power between preschool children of beneficiaries and non-beneficiaries women.

Owning livestock increased the intake of protein, vitamin A and energy, the consumption of animal source foods (ASF) and the nutritional status of the beneficiaries. The improvements in nutritional status and nutrient intakes among the beneficiaries over the non-beneficiaries were not significant. Increase in income and food expenditures did not translate into improved diets since only a small portion of the income gain was spend food. However, dairying has potential to improve nutrient adequacy and improve body mass index.

Implications for research and practice

This study demonstrates the interaction of livestock projects, poverty and household factors, and nutritional status of women and preschool children. To improve the household factors and reduce poverty funding from external sources it is essential if the very poor are to be targeted. Efforts should be directed toward reducing poverty among the poorest of the poorest of the society. Inclusion of livestock as a policy issue in national goals and objectives could result in improved nutritional status and improved living standards. Though it is probable that the dairy project may have discriminated farmers initially endowed with better livelihood assets, the identification of household factors that are improved by dairy projects has promising returns for sustainable dairying, improved food and nutrient intake in households, and nutritional status of women and their preschool children. The project selection criteria for beneficiary women do not allow argument for pure independent effects of the programmes on welfare of beneficiaries in relative to the precedent significant investments made by the dairy management.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the Maseno University and Government of Kenya (GoK) for granting the research permission and for also providing an enabling environment for the conduct of this research work. Thanks to all the participants in Vihiga District without whom this work would not have been presented.

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