

Animal Source Foods to Improve Micronutrient Nutrition and Human Function in Developing Countries

Improving Access to and Consumption of Animal Source Foods in Rural Households: The Experiences of a Women-Focused Goat Development Program in the Highlands of Ethiopia¹

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ABSTRACT Ethiopia is one of the poorest countries in Africa and its population experiences low and falling life expectancy rates, high infant, child and maternal mortality and high rates of child malnutrition. This is exacerbated by the fact that Ethiopia is not self-sufficient in animal products and is a net importer of food. For the majority of the population, most food energy (93%) is derived from vegetable products with 7% coming from animal source foods (ASF). FARM-Africa hypothesizes that the inadequate nutritional status of the population, which contributes to the high mortality rates in the country, is related to the population's low consumption of ASF, such as milk and meat. This article presents the findings of the Dairy Goat Project, the objectives of which included the improvement of family welfare through the generation of increased income and milk consumption. The project adopted an integrated approach and increased the productivity of local goats managed by women through a combination of better management techniques, genetic improvements and information exchange. Through pre- and post-intervention analysis of data of those households within the project area, FARM-Africa demonstrated a considerable improvement in the nutritional status and family welfare of project participants. There was increased appearance of milk and meat products in local diets, and the addition of other foods, such as eggs and fresh vegetables, as a result of complementary activities established with funds generated through the principal activities of the Dairy Goat Project. *J. Nutr.* 133: 3981S–3986S, 2003.

KEY WORDS: • goats • Ethiopia • animal source foods • food security • family welfare

The availability and consumption of animal source foods in Ethiopia

Ethiopia is one of the least developed and poorest nations in the world. About 47% of Ethiopia's 65 million people are living in abject poverty (1) and life expectancy at birth has fallen from 50.6 y in 1994 to 43 y in 1998. The infant mortality rate is 118 per 1000 live births, the child mortality rate is 173 per 1000 and maternal mortality is 700 per 100,000. Furthermore, 48% of children <5 y old suffer from malnutrition and, according to the Economist Intelligence Unit (2) in 1998, only 26% had access to safe water. Literacy levels are poor throughout the country: 65% of the population >15 y old is illiterate and

primary school enrollment is low, 48% for males and 27% for females.

Ethiopia is not self-sufficient in animal products and is a net importer of food. The daily energy intake is estimated to be 1610 kcal/person/y (3). In terms of energy sources, vegetable products such as cereals, pulses and root crops account for 93% (1502 kcal) of daily intake with only 7% (109 kcal) coming from animal source foods (ASF). The daily per capita protein and fat consumption is estimated to be 8 and 7 g, respectively (4), which is far below recommended levels, and only 27% of the world average for energy coming from ASF.

The extremely low consumption of ASF may be one of the major contributing factors to the high infant mortality rates and delayed growth experienced by children. The consumption of milk and meat in Ethiopia is very low, even compared with other African countries. The annual per capita milk consumption was 19–20 L in 1993–1994 (4) and has subsequently fallen to 16 L. Meat consumption is estimated to be as low as 11–12 kg/person/y. Sheep and goat meat accounts for between 2.8 and 3.0 kg, and beef, 4.6–4.8 kg, of the annual per capita meat consumption.

Given such low consumption rates of ASF, FARM-Africa's Dairy Goat Development Project in Ethiopia was well placed in its efforts to improve family welfare through generating increased income and milk consumption, and attempting to integrate ASF into the diets of local communities. (7).

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FARM-Africa

Food and Agricultural Research Management (FARM)-Africa is a British-based international nongovernmental organization, which works to reduce poverty by enabling marginal African farmers and herders to make sustainable improvements to their well being, through more effective management of their natural renewable resources.

To achieve this mission, FARM-Africa works in specific ways to be an innovative organization of change, challenging key issues and taking risks. Both a practical and operational organization, it works directly with communities on the ground, but moves beyond mere service provision toward catalyzing a process of development through a focus on capacity building. Its projects tend to work within the contexts and structures of local institutions and people, rather than establishing new parallel structures. FARM-Africa is also an independent organization; a fact that enables it to forward an agenda that truly supports the farmers and rural communities with whom it works. Working as a key link between researchers and farmers, it ensures that its research and projects are relevant to practical problems, issues and challenges faced daily by communities. In addition to direct project work, FARM-Africa emphasizes the regular and timely communication of research results because this is how project results and experiences can be used to advocate for improved policy and practice.

FARM-Africa currently works with rural communities in Ethiopia, Kenya, Tanzania, South Africa and Uganda (5). Its programs include the development of a series of successful dairy goat projects to improve the self-sufficiency and health of poorer, predominantly female-headed households in Ethiopia and Kenya.

The Dairy Goat Development Project in Ethiopia

The Dairy Goat Development Project was originally launched in September 1988, after the importance of goats in the mixed farming systems of the high- and mid-altitude areas of Ethiopia had been identified. In the first instance, a pilot project was initiated in Eastern Hararghe, Oromiya Regional State, which was expanded to the Southern Region of Ethiopia three years later. The original project ran until 1998, at which point it was continued through an expansion phase.

The primary objective of the Dairy Goat Development Project was to improve family welfare through generating increased income and milk consumption. It did this by improving the productivity of local goats managed by women, through a combination of better management techniques and genetic improvements (6). In general terms, the Dairy Goat Development Project aimed to:

1. Increase the consumption of milk by children, thereby improving their intake of vital micronutrients, such as vitamin A and zinc.
2. Increase family incomes and the standard of living of the women and their families.
3. Help in asset creation and diversification to improve the household food security situation.
4. Empower women, through the development of leadership skills and improved technical knowledge, and support them to diversify their economic activities, and have greater control over resulting income generated.

Target beneficiaries

The project worked with the poorest members of the community and especially with women-headed households,

supporting them to become actively involved in goat improvement programs. Because women traditionally keep small livestock such as goats, the project began by encouraging them to grow fodder and provided two local female goats to women that the community had identified as being the poorest. Subsequently, the women organized themselves into groups to manage goat credit disbursement and repayment and established joint saving schemes, which enabled them to gain access to a source of finance. Over time, and with further extension support and animal health training, group members were able to use exotic goats to improve their existing stocks.

The project worked with over 5500 female-headed households in Oromia and the Southern Region of Ethiopia and involved the formation of women's goat groups and local goat credit and savings associations. The savings achieved by the groups were subsequently matched by FARM-Africa, which helped support other initiatives. The project resulted in distinct improvements in family welfare and community nutrition, improved goats' feed resources and feeding systems, support from trained community animal health workers and the provision of essential drugs and equipment. The groups also established and managed community exotic buck stations and the distribution of crossbred goats.

Case study: improving access to and consumption of animal source foods to participating women-headed households

Objective. This case study reviews the impact of FARM-Africa's programs on poor female-headed households in the project areas of Gursum and Gorogutu Districts in Eastern Hararghe, in relation to their increased access to and consumption of ASF.

Methodology. The methodology adopted for each of the project sites is outlined below. In both project sites, pre- and postintervention data was collected to assess the impact of the project.

In Gorogutu District, such data were collected from 100 households belonging to five women's groups, representing ~24% of the women in the district. Data relating to goat health and productivity, kidding, the lactation period, milk yield per lactation, milk availability and consumption patterns were analyzed over a 2-y period. Preproject meat and milk consumption patterns were also assessed. Using the Helen Keller International food frequency method, the availability and consumption of animal source foods by children aged 6 mo to 6 y were monitored and analyzed in November 2000 and November 2001 in the 39 households. The income of 91 households was examined in relation to the purchase and consumption of cereal grains and ASF, particularly milk. The effects of community nutrition activities on the consumption of produce from vegetable gardening and backyard poultry rearing were studied in 75 and 25 households, respectively. Information was compiled on repayment in kind for goat loans and the subsequent formation of more women's groups.

In Gursum District, postproject information from 110 households, representing over 51% of the project beneficiaries in that area, was compiled over three consecutive years (1998/1999–2000/2001). Goat kidding, milk yield and goat disposals by sale, slaughter or gift were analyzed, and from this data, estimates of annual milk availability per household were prepared. The average price paid per goat and income per household was recorded with reference to goat sales. The number of households slaughtering goats, and their reasons for doing so, were also observed. Goat milk availability and consumption by individual household members, particularly

children, was closely studied in 25 households. Households' milk purchasing practices and consumption were examined and the amount of available milk was estimated for those households with their own cows.

The direct effect of the project

Gorogutu study. The preintervention period study indicated that 21% of the households had no access to milk during the previous year and that 67% made only occasional purchases of milk estimated to average 20 L at a cost of \$5.73³ (U.S. dollars) per household/y (4 L/person/y). The remaining 12% had one lactating cow each and had been consuming milk for most of the year. This group sold an average 42% (151 L) of the cows' milk produced for cash to help cover household expenses, thus using only 58% of the milk themselves, reducing the annual per capita milk consumption to 20.9 L. In this preintervention period, children in 21% of the households received no milk at all and in 67% they only had milk for about one-quarter of the year.

The study also revealed that 42% of the households surveyed ate an annual average of 1.3 kg of meat per person, whereas the remaining 58% had no meat at all.

Those households that had no access or limited access to milk often gave children aged 6–24 mo water mixed with sugar and fenugreek juice as a substitute, in addition to breast feeding. Seventy-four percent of the households, who either produced no milk in the homestead or could not afford to buy it, adopted this practice. Consequently, in >50% of the households, there were signs of ill health in children, for example, chronic diarrhea, itching and skin infections.

The diet of these poorer households was low in fat, protein and all ASF, the latter contributing 0–4% of energy (58/1358 kcal). This situation held true in ~1 in 10 households (Table 1). Apart from the lack of animal products, these households were unable to meet more than two-thirds of their minimum daily average energy requirements (2100 kcal) from any source. Their energy intake was frighteningly low at 1200–1358 kcal per person, which is 16–19% below the national average.

In the postintervention period, each of the participating households was milking their lactating goats 2 times/d and was able to get an average of 75 L/y of goat milk per household, with average per capita milk consumption at 15 L/person/y. This resulted in a 100% and 275% increment in milk availability to 21 and 67 households, respectively, with a similar rise in available protein and fat (Table 2). Consequently, 31% of households in total have access to goat milk; that is, 18% of the 67 households who used to buy milk (Table 1, Groups 2 & 3) and >90% of the 21 households who previously had no access to milk at all (Table 1, Group 1). This has also helped each household to save an estimated 50–100 kg of cereal grain that used to be sold to buy milk, but that can now be used for home consumption or to improve food security. It was also noted that 96% of the households with children <3 y of age gave a greater proportion of their milk to this group, thus further improving child nutritional status.

Using the Helen Keller International food frequency method, data collected in November 2000 and November 2001 from 39 households with children between 6 mo and 6 y, showed a spectacular improvement in the amount of milk available to children (Table 3). In November 2000, milk was available to and consumed by children in 46% of these households. In 14 households, children received milk from 4 to 7 d/wk and in four households, milk was consumed from 1 to 3

d/wk. However, by the following year (November 2001 survey) milk was available to children in 91% of these households for 4–7 d/wk. Significantly, in 21 households (61%), the milk was being provided from goats (Table 4). Despite improved access to milk, it was disturbing that neither survey revealed any household that gave children meat.

Gursum study. A similar study was undertaken in Gursum District for three consecutive years (1998/1999–2000/2001) involving over 50% of the households participating in the program. A total of 525 goats kidded during the 3-y period. The majority of the female goats were local breeds and accounted for 90% of the kids (472) and the remaining 10% (53) were from crossbred goats (50% and 75% Anglo Nubian and local Somali crosses, respectively). This represents an average of 175 kiddings/y (1.6 kiddings/household/y). Total milk production was estimated to be 40,920 L over 3 y in 110 households, 77% of which came from local animals and 23% from the crossbreds. The average milk available to each household was 124 L/y. Thus, the per capita milk consumption was 21 L/y or ~57 mL/d. Most importantly, in this area >85% of the households frequently use goat milk for home consumption and small children are the most favored recipients. Another important observation was the more frequent use of goat milk with porridge, especially for small children. Because these households mostly rely on a cereal, root and tuber-based diet, the addition of a small amount of goat milk to their routine food results in an improvement in their intake of protein, minerals and vitamins. Based on the current findings, the daily per capita increase in nutrients was 3.1 g of protein, 4.4 g of fat, 43 kcal and 65 mg calcium (Table 4).

Household nutrition study. Twenty-five households were studied in greater detail to obtain a better picture of goat milk use at the household level. All of these households had access to milk throughout the 3-y period, ranging from 60 to 227 L/household/y and averaging 131 L/household/y. In almost all cases, goat milk was being consumed in the home, with ~55% of the milk given to children in drinks or mixed with porridge. The other 45% was consumed by adults in tea and, to a lesser extent, in porridge.

Compared with the Ethiopian average per capita animal product consumption described above, the increased availability of ASF in this study is encouraging. The per capita availability of milk increased by 109% (from 19 to 39 L/d), energy from animal sources by 39% (from 109 to 151 kcal/d), protein by 39% (from 8 to 11.1 g/d), and fat by 63% (from 7 to 11.4 g/d). The proportion of animal protein reached 20%.

The study concluded that developing the capacity of poor rural households to own and manage small livestock, such as dairy goats, has a direct impact on a family's ability to challenge the vicious cycle of poverty and can significantly improve their access to and consumption of ASF, which is particularly important to small children. In summary, the project saw tangible improvement in the level of food security at the household level.

Goat slaughter and availability of meat. During the 3-y period of the study, 67 households (63%) slaughtered 77 goats. In 37% of cases, the slaughter of animals was for consumption during holidays and festivals, and in 63%, to mark important family events such as a birth or funeral. The amount of meat consumed in this way averaged 3.45 kg/household/y or 575 g/person/y. This is equivalent to 949 kcal, 107 g protein, 54 g fat, 53 mg calcium, 12.6 g thiamin and 1.8 mg of riboflavin. Despite the valuable contribution to household nutrition represented by these animals, it still left a depressing statistic of 37% of the families without any access to meat throughout the period of the study.

³ Based on December 1998 exchange rates.

TABLE 1

The availability of milk and meat in the preintervention period (1997–1998) in Gorogutu District, Eastern Hararghe

Group	Household category	N	% HH	Total (kcal)	Total protein (g)	Milk available (L/person)	Milk (kcal)	Milk protein (g)	Milk fat (g)	Meat (kg/capita)	Meat (kcal)	Meat protein (g)	Meat fat (g)
1	No access to milk	21	21	1300	36	0	0	0	0	0	0	0	0
2	Purchased milk	37	37	1308	0.4	4	8	0.4	0.7	0	0	0	0
3	Purchased milk and meat	30	30	1323	1.2	4	8	0.4	0.7	1.3	15	0.8	1.3
4	Milk cows/access to meat	12	12	1358	2.9	20.8	43	2.1	3.4	1.3	15	0.8	1.3

Community beliefs and practices. The Gursum community believes that goat milk is particularly nutritious and that it has medicinal properties, so its consumption by very young children is prioritized. For example, children aged 4–32 mo are often given goat milk as a supplement to breast milk. Such beliefs and practices should make it easier to encourage the development of goat breeding and reinforce the overall nutritive values of goat milk.

Background poultry scheme. In an effort to improve the availability and consumption of micronutrients such as vitamin A, supplementary small-scale activities were set up to complement the increased consumption of ASF through the dairy goat project. For example, a small-scale backyard poultry program was initiated as part of family welfare and community nutrition action. Two distinct approaches were devised based on the availability of select or exotic stock. One approach focused on supplying five exotic pullets and one exotic cock per household, whereas the other provided one exotic cock and two local pullets per household. Both approaches were tested in Gorogutu District, with 15 households benefiting from the first approach (Group 1) and 10 from the second (Group 2). Provisional results from each were presented after 5 mo for Group 1 and 8 mo for Group 2.

In Group 1, total production over the 5-mo period reached 673 eggs. Of the 11 households (73%) of this group with children, 176 eggs were consumed (40% of the total of the 441 eggs they produced). The remaining four households with no children produced 232 eggs and sold all of them in the local market. Average egg consumption in the 11 households in this group was ~16/household/mo. In Group 2, 840 eggs were produced in an 8-mo period. Despite this quite reasonable level of production, six of the households (with children) consumed only 181 (36%) of the 504 eggs laid, an average consumption of 30 eggs/household. The remaining four households (older and without children) sold all of the 336 eggs they produced during this period. In both of the trials, the outcome of improving the access and consumption of ASF was encouraging, even though it was far from adequate in terms of fulfilling the nutritional

requirement of the children in each household. It is clear that greater effort is needed to change attitudes and awareness of the nutritional potential of poultry products.

The indirect effect of the program

The high level of community participation in the design and implementation of the project means that the main target groups were well represented in all project activities and that the impact of dairy goat provision to improve access to ASF was high. In addition, targeting women (and women's groups) enabled them to assume direct control over their resources and to increase their capacity for participation in community life, as well as strengthening their influence in household decision-making and events. The method of repaying goat loans in kind proved to be workable and effective in broadening the impact and appeal of the project. It is not uncommon to see 100% of such repayments made within 2 y. In this way, the benefits of goat ownership that accrued to the original participants are spread quickly throughout the community—while continuing a focus on the more vulnerable female-headed households. As of now, in Gorogutu District alone, of 100 women who received 200 goats from the repayment in kind, over 70% have their goats kidded and are getting milk to their families. In addition, ~50% are ready to pass their goats on to yet more women's groups.

The integrated scheme initiative and its implications

In addition to the many positive improvements regarding access to and consumption of ASF from the dairy goat project, contributions from a range of other activities are equally significant. Such activities include, for example, improvements in animal forage development and feeding systems, training of community animal health workers, provision of crossbred goats, development of community-based buck stations and setting up private breeders' establishments. Building on the success of women's goat groups, direct extension training to the women in

TABLE 2

Energy, protein and fat availability from animal products in four categories of households in Gorogutu District, compared with the Ethiopian and world average

HH Category (N)	Compared to Ethiopian average			Compared to world average		
	Energy (%)	Protein (%)	Fat	Energy (%)	Protein (%)	Fat
No access milk/meat (21)	—	—	—	—	—	—
Access to milk/purchased, no meat (37)	8	5	9	2	2	2
Access to milk and meat/purchased (30)	21	15	28	6	5	6
Own cows and access to meat (12)	53	36	67	14	12	15

TABLE 3

Milk consumption pattern among children using the Helen Keller International food frequency method in November 2000 and November 2001, in 39 households in Gorogutu District

Year	HH (n)	Milk HH (n)	Milk available (L/HH)	Cow milk (L/HH)	Goat milk (L/HH)	Purchased milk (L/HH)	Goat + cow milk	Milk consumed by children (d/wk)						
								7	6	5	4	3	2	1
Nov. 2000	39	21	18	2	13	3	—	9	2	2	1	2	1	1
Nov. 2001	39	4	35	5	21	8	1	28	5	1	1	—	—	—

literacy and numeracy, leadership, business management, family welfare and community nutrition have all had a beneficial effect in steering the household to improved use of ASF. Such an integrated approach ensures greater success, not only in increased use of ASF, but in terms of long-term sustainability for the communities' livelihoods.

Matched funding

Other community-oriented and demand-driven initiatives can often complement the improved living standards resulting from keeping small livestock. In Gorogutu, members of five women's groups benefited from matching funding provided by local savings and loan associations to kickstart small business ventures, such as petty trading (salt, soap and coffee), baking, and "chat" trading, all of which had positive impacts on their families.

Ninety-one women were engaged in small businesses between November 2000 and October 2001, making an average annual net profit of \$33 per person (U.S. dollars). Forty-nine percent of these women used 56% of their profit to buy milk for their households, providing them with 79 L each. An annual average of 15.8 L was available to each person in the household, providing a daily intake of 325 kcal, 1.6 g protein and 2.6 g fat. Forty-six households purchased an average of 175 kg of cereal grain costing 56% of the profits and providing 35 kg of grain/person/y, and supplying an average 340/k/d. This represents a 26% increase over the previous year's energy food consumption.

Furthermore, it is generally agreed that what cannot be provided by small stocks can be complemented by other community-oriented and demand-driven initiatives such as poultry. However, future discussions on how to obtain matching funds for such initiatives should refer to the experience of Gorogutu District's five women groups ($N = 91$ women), where the availability of matching funds helped at least half of the households to spend more cash on ASF and milk to nourish their families.

Improvements in family welfare and nutrition

Complemented by training, information sharing and educational activities regarding the food system, the project's impacts

on family welfare and nutrition were enhanced further. For example, one component of the project that addressed family and reproductive health, supported local trainers to share and provide information targeted to women of childbearing age and mothers with small children. Trainers promoted the use of locally available foods rich in vitamin A (such as local cabbage, pumpkin and sweet potato). They distributed a variety of vegetable seeds, selected planting materials (potato and sweet potato), poultry stock, fruit seedlings (papaya and peach) and followed up progress through the women's groups. The trainers also worked closely with local schools to organize annual nutrition days. As a result of these activities, in 1999–2000, 75% of the women in local women's groups established vegetable gardens and used over 90% of the produce in their home cooking, producing enough food for >50 d/y. In 2000–2001, over 90% of households were cultivating a variety of vegetables.

Large changes in attitudes to food and feeding behavior were observed as a result of such community initiatives. These included increased purchase of vegetables from the market, increased use of fresh vegetables in meals (particularly locally produced vitamin A-rich foods), passing skills and knowledge to other women in the neighborhood and buying and planting vegetables. Local schools were helped to establish nutrition clubs and supplied with seeds and tools, which in turn led to greater cooperation between students and their parents. Furthermore, the program worked closely with tree nursery centers and district health education officers.

The implications of consistent income from goat sales

Once households had completed their goat repayments, the sale of excess goat stock became a regular event. In a study conducted in Gursum District for three consecutive years (1998–2001), it was observed that an average of 62% of the households sold 1–3 goats/y, receiving a cash income of \$17–20 (U.S. dollars).

Generally, each of the households has managed to generate a steady annual income from goat sales. Through this, they have since acquired diversified assets such as cows, oxen and donkeys, have been able to start up small businesses of their own, or have invested in improved agricultural technologies, such as inorganic fertilizers, improved poultry stocks and select

TABLE 4

Animal source food (ASF) and nutrient intakes in Ethiopia, and the increase in Gursum District

Ethiopia					Increase due to goat milk from goat project						
Kcal	Total protein(g)	Animal protein (g)	Fat (g)	ASF kcal	Kcal	Protein (g)	Fat (g)	Kcal %	Protein %	Fat %	Lysine %
1610	52	8	7	109	43	3.1	4.4	39	39	63	5

grain seed. Such initiatives have raised crop and animal production and enabled the households to send their children to schools as well as improve their welfare. Up to 20% of the households have moved into ownership of cattle, generally cows.

The study reveals that currently 27 out of 110 households are getting milk from their own cows, estimated to be 126 L/y or 21 L/person/y. Similarly ~22 households were buying as much as 0.5 L/d over a 7-mo period (118 L/household/y or 19 L/person/y). The indirect benefits experienced from goat keeping by these households are clear and we conclude that the steady income from goat sales has had a tremendous impact on the availability of ASF to the rural poor and their households.

Giving goats as gifts

The Gursum community has a long tradition of passing on goats as gifts to friends and relatives. Between 1998/1999 and 2000/2001, 64 households gave away 80 goats. More than 70% of the goats were females that were given to newly married couples and households who did not have any livestock. The 80 goats provided to others represented up to 10% of the 820 local nanny goats distributed by FARM-Africa in Eastern Hararghe between 1999 and 2001. In monetary terms, the goats cost ~\$1064 (U.S. dollars).

Recommendations

Our experience from this project led us to offer a series of recommendations for consideration with regards to future practice.

- Community participation in both project design and implementation is key.
- Although the goat intervention has seen increased milk consumption, particularly in young children, local diets still demonstrate a shortfall in certain proteins and minerals

(such as vitamin A); therefore, alternative activities to fill the gaps, such as poultry schemes, should be encouraged. The availability of extra cash, often as a direct result of alternative activities, enables women to purchase additional vegetables and animal source foods, particularly milk, to improve the diet of their families.

- Community management of microfinance initiatives can have large impacts on the generation of both small enterprises and cash.
- The biggest impact of the project was in asset creation that can subsequently be used in times of need, such as periods of drought, and an increase in the sustainability of household food security.
- The importance of capacity-building in such projects cannot be underestimated and should be integrated to ensure increased success and impact of any intervention. As a direct result of this project, women participants received adult literacy and numeracy training that enabled them to better manage their microfinance and credit schemes successfully, sustaining the food security of their households.

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