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MILK MATTERS

A Literature Review of Pastoralist Nutrition and Programming Responses

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Cover page graphics
Child drinking from gourd reproduced from training materials developed by VSF Belgium in South Sudan; mud cow in South Sudan adapted from line drawing by Evans-Pritchard, 1940.

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Acronyms

ARI	Acute Respiratory Infection
ASF	Animal Source Foods
CAHW	Community Animal Health Worker
CHW	Community Health Worker
EAR	Estimated Average Requirement
ENN	Emergency Nutrition Network
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
FIC	Feinstein International Center, Tufts University
FMD	Foot and mouth disease
FSAU	Food Security Analysis Unit, Somalia
IDP	Internally Displaced Person
ILRI	International Livestock Research Institute
MUAC	Mid-Upper Arm Circumference
NGO	Non-Governmental Organization
ODI	Overseas Development Institute
PHNI	Pastoralist Health and Nutrition Initiative
RNI	Recommended Nutrient Intake
SCUK	Save the Children UK
SCUS	Save the Children USA
SD	Standard deviation
SSR	Standing height to sitting height ratio
WFH	Weight for Height
WHO	World Health Organization

1. INTRODUCTION

Background to Save the Children's Africa Region Pastoral Initiative

Created by Save the Children USA in mid-2007, the African Region Pastoral Initiative aims *to develop the evidence base for programming in pastoralist settings; to use this experience to advocate for better practices, programs and policies; to support effective implementation; and to work with the SC Alliance, communities, government and other stakeholders to take the work to scale*.[1]

One component of the Regional Initiative is the Pastoral Health and Nutrition Initiative (PHNI), created in April 2008 to help understand and prioritize interventions that improve the health and nutritional status of children in pastoral settings. Within the PHNI, Save the Children USA and UK (SCUS/SCUK) and the Feinstein International Center (FIC) at Tufts University have joined efforts on a venture called *Milk Matters* to explore interventions related to one of the most important component of children's diets: human and animal milk.

Aim of *Milk Matters* and the literature review

In the first phase *Milk Matters* is primarily an Ethiopian initiative, with the agencies involved all based in Addis Ababa. Therefore, the activities under the following aims are first and foremost focused on the Ethiopian pastoralist population, but will, we hope, create learning to be applied to the broader context of pastoralists in the African region.

- To identify interventions that lead to an enhanced supply of animal and breast milk for children in pastoral communities across seasons and wealth groups, thereby leading to improved nutritional status;
- To support implementation of effective interventions at a large-scale;
- To advocate for policies that promote healthy and well-nourished children in pastoral communities and influence the implementation of the Government's national Nutrition Strategy accordingly;
- To communicate the results to a broad audience of pastoral communities, government institutions, researchers and practitioners.

A great deal is already known about the nutrition, health and food security of children in pastoralist populations. The aim of this literature review was to draw together this knowledge, particularly that around the role of milk in the livelihoods of pastoralist people; and to help us understand those aspects of pastoral child nutrition that are well established and those issues that remain debated or poorly covered by the literature.

Broad themes to be investigated were:

- The epidemiology and causes of malnutrition in children in pastoralist communities; including debate on how we measure malnutrition in these communities;
- The role of human milk (i.e. breastfeeding) and of animal milks in the diet of children in pastoralist communities;
- Key interventions that have aimed to improve breastfeeding and complementary feeding practice in pastoralist regions and their impact on nutritional status of children (if this is measured), and;
- Key interventions that have aimed to enhance milk supply from animals in pastoralist regions and their impact on nutritional status of children (if this is measured).

2. METHODS

Literature search

Major reference databases were systematically searched using a set of agreed search terms and 'key words'. These included ISI Knowledge, Expanded Academic ASAP (Gale), Medline (OVID), CAB Abstracts, and PubMed. Google Scholar and the online publications databases for the ENN Field Exchange and the ODI Humanitarian Practice Network and Pastoral Development Network

[1] From Terms of Reference for Literature Review July 2008.

were also searched. Articles and bibliographies received from FIC and SCUK were reviewed for relevance to the literature review topics. These sources were found to include many NGO draft materials, evaluation documents and field reports related to the objectives.

References were organized by theme and sub-theme linked to one or more of the above objectives and labeled accordingly under the *keyword* heading in the reference database for ready sorting. Articles available electronically (the vast majority) were downloaded and categorized into folders labeled by theme. A few hard or scanned copies were obtained where electronic versions were not available, either from the library stacks or from neighboring university libraries, using interlibrary loan services. Citations and abstracts for each reference were uploaded or typed into reference management software (Endnote 2006).

Themes originally developed by the literature review team and included in the first draft of reports were subsequently consolidated into the themes presented in this report.

Focus of the literature review

Pastoralism is defined in many ways. In 1994 Fratkin and Smith defined it as:

> *… a strategy in which people raise herd animals, often in arid or marginally agricultural regions, in order to provide a regular supply of food in the form of milk, meat, blood and trade for grains. For the most part, this production is subsistence based, aimed at producing foods (primarily milk) for household members. Exchange is secondary* (Fratkin and Smith 1994).

Although this definition conforms to the 'classically held' view of pastoralism, many would agree that it is now rather outdated, and that exchange plays a key role in many pastoralist livelihood strategies (see sections 5 and 6). A more current definition has been put forward by Nori and Davis:

> *Pastoralism is the finely-honed symbiotic relationship between local ecology, domesticated livestock and people in resource-scarce, climatically marginal and highly variable conditions. It represents a complex form of natural resource management, involving a continuous ecological balance between pastures, livestock and people* (Nori and Davies 2007).

The primary focus of this review is pastoralist ethnic groups whose livelihoods fall under the definition above. However, in many cases there are rapid socioeconomic changes happening within these groups that are changing livelihood strategies and reducing reliance on animals for food. Consequently, some of the literature refers to communities that might now be better described as agro-pastoralist i.e. with livelihoods that depend on a mix of agriculture and raising animals. However, there are common elements within both pastoralist and agro-pastoralist groups; including an element of mobility, a livelihood strategy that maximizes milk and meat production and a diet that includes relatively large amounts of animal products; that are likely to impact the nutritional status of children. Most of the findings of this review therefore, could be applied equally to both livelihood groups.

Pastoralist communities can be found all over the world, from the mountains of the Hindu Kush to the deserts of Sudan. On the topic of milk, the Maasai of Kenya and Tanzania are by far the most well-researched pastoralist peoples globally; a total of 10 publicly-available series of studies exist. Kenya is also a common research location, with 20 (nearly one third) out of 67 country-specific studies. Yet by the end of the 20th century, milk was beginning to play a smaller role in the diets of some of these ethnic groups, such as the Maasai of Kenya. Several other East African pastoral groups have also been extensively researched regarding milk and nutrition; for example, the Turkana of northern Kenya, stemming from the STEP long-term research programme initiated by Jim Ellis, and secondly the Boran of southern Ethiopia with numerous studies by staff from ILCA, now

ILRI (the International Livestock Research Institute). In the rest of the world, there have been very few studies of milk from the herds and flocks belonging to the millions of pastoralists still extant in Asia, the Middle East and South America. This literature search located only 10 studies with any information on livestock milk in pastoralist societies outside Africa.

The report presented here focuses primarily on pastoralist ethnic groups in eastern Africa, as it is this literature that is most useful for the broader objectives of the PHNI. However, the literature from other regions of the world may in some instances provide useful comparisons and contrasts to the role of livestock milk in East African pastoralist systems. Therefore, it may be advantageous to revisit this literature at some point during the project.

Lastly, it is important to note that there exists huge variation in how different pastoralist groups manage their animals, secure food and feed their children. This review attempts to draw together the most important works that go some way in explaining these aspects of pastoral livelihoods, but it will be important for the PHNI to do further work to increase understanding of particular issues within those ethnic groups targeted by the initiative. The primary data collection planned as a follow up to this literature review should help to do this.

3. EPIDEMIOLOGY OF MALNUTRITION IN PASTORALIST SETTINGS

Nutrition studies and surveys over the past two decades have shown that children in pastoralist populations present with higher levels of wasting (measured by weight for height [WFH]) and lower levels of stunting (measured by height for age) than agrarian populations in the same countries and regions (Wagenaar-Brouwer 1985; Little, Gray et al. 1993; Sellen 1999; Roth, Fratkin et al. 2003; Fratkin, Roth et al. 2004; Gray, Wiebusch et al. 2004; Fratkin, Nathan et al. 2006; Myatt 2007). Pastoral child populations in the Greater Horn countries of Eritrea, Ethiopia, Kenya, Somalia, South Sudan, and Uganda demonstrate wasting prevalence of 17% on average, seven percentage points higher than agriculturalists or populations with mixed livelihoods in the same regions. (Mason, Chotard et al. 2008).

A note on child growth

Recent work has suggested that some of this difference in levels of wasting in children aged between 2-5 years may be due to differences in growth or body shape rather than differences in actual nutritional status (Myatt 2007). Children in pastoralist communities had, on average, a significantly lower Cormic Index (or sitting height to standing height ratio [SSR])[2] than children in agrarian populations. This had the effect of overestimating the prevalence of wasting measured by weight for height in pastoralist children in this age group. This effect is a well established problem with using the body mass index to assess the nutritional status of adults (Collins, Duffield et al. 2000). However, this finding for children under five years conflicts with that of the World Health Organization, which, in developing its new growth reference population and standards, maintains that all children under the age of five demonstrate similar growth (weight to height ratio) (de Onis, Garza et al. 2003). Myatt's work showed that levels of wasting measured by mid-upper arm circumference (MUAC) on the other hand were not associated with SSR (Myatt 2007).

The possible reasons behind a different pattern of growth among children under five years are debated. The most common school of thought relates it to diet, with several authors discussing the relationship of growth pattern to a diet high in protein (particularly milk) and other nutrients that support growth in stature (see section 4), but low in energy (particularly during 'leaner' times) that does not support deposition of soft tissue (or fat). This results in pastoralists demonstrating greater fluctuations in wasting (particularly in lean years), as well as higher baseline levels (Mason, Chotard et al. 2008). Other studies suggest that linear morphology has a

[2] SSR - Sitting Height/Standing Height. Smaller values of SSR indicate longer limbs and/or shorter trunks. Larger values of SSR indicate longer trunks and/or shorter limbs.

strong genetic component arising out of selection pressures related to diet. Metabolic adaptations to the pastoralist diet are thought to occur during the growth period and in particular during the weaning transition, when butterfat given as a complement to breast milk is replaced by protein as the principal source of energy. Selection for metabolic plasticity is intense at this time, and the assumption is that there is a characteristic pattern of growth in surviving children, in which growth in height and weight become increasingly discordant. This could mark the attainment of metabolic competence among these individuals (Gray 1996; Gray 1998; Gray, Wiebusch et al. 2004).

Authors differ in their suggestions on how to deal with this. Myatt (2007) recommends moving to a different indicator to measure nutritional status in pastoralist populations. He refers to previous work that has demonstrated the relationship between MUAC thresholds and short-term mortality risk - a relationship that is found not to vary significantly between populations. For this reason the author concludes:

> *In the populations represented in this study, MUAC is likely to be the most robust (i.e. to body-shape) indicator of acute under-nutrition. If WFH is used then, as with adults, it should be corrected for body-shape before applying case-definitions. The correction for body-shape would, however, require the collection of sitting height which would complicate surveys whereas the use of MUAC would considerably simplify surveys.*

Other work (Grobler-Tanner 2006; Mason, Chotard et al. 2008) has suggested that, because of the higher prevalence of wasting as measured by WFH in pastoralist populations, we continue to use WFH but raise levels of wasting that:

a. Define the baseline (or the 'norm') from 5-10% in agrarian/mixed populations to 15-17% in pastoralist populations;
b. Trigger emergency food interventions from 15% in agrarian/mixed populations to 20-25% in pastoralist populations.

Neither of these recommendations however appears to be based on any functional measure of outcome related to nutritional status i.e. how does a change in the way we define baseline levels of malnutrition relate to outcomes such as mortality and morbidity.

Seasonal fluctuations

Seasonality is a crucial factor in the study of pastoralism with livelihood strategies revolving around seasonal patterns of water and plant availability and corresponding geographic mobility. There is without doubt a seasonal increase in vulnerability to malnutrition when livestock pasture becomes scarce, in turn limiting both drinking water and milk availability for human consumption (Fujita, Roth et al. 2004). However, seasonal fluctuations in nutritional status are noted to vary considerably by pastoralist ethnic group. Studies among the Turkana and Datoga document only a moderate decline in anthropometric status in the dry season, despite significant seasonal variation in rainfall and food availability (Shell-Duncan 1995; Sellen 2000). The Rendille and Ariaal studies by Fratkin, Nathan and Roth describe less variability during the dry season among pastoralists compared with their settled counterparts, and suggest that in these communities, seasonally determined food availability is not a significant determinant of nutritional status (Fratkin, Roth et al. 1999; Fujita, Roth et al. 2004). A more significant decline in nutritional status by season has been noted among the Fulani and Tamasheq in Niger (Loutan and Lamotte 1984; Wagenaar-Brouwer 1985), the South Turkana ethnic groups (Galvin 1985; Little 1989) and the Somali pastoralists in Ethiopia (SCUK 2007).

In Eastern Africa this decline is not usually linked to the cereal 'hunger gap', but occurs in the early half of the year linked to the dry season, the end of which is considered to be the most dangerous period for human health in pastoralist societies (Fratkin, Roth et al. 1999) due to decreased pasture, reduction in

Table 1: Nutritional status in Somali Region, 2006 (adapted from SC UK, 2007)

Date	Season	Pastoral area	Prevalence of global acute malnutrition (95% confidence interval)	Prevalence of severe acute malnutrition (95% confidence interval)
January, 2006	Dry	Dollo-ado, Dollo-bay, Barrey	18.8% (15.8%, 21.6%)	1.4% (0.3%, 2.5%)
August to September, 2006	End wet/ early dry	Dollo-ado, Dollo-bay, Barrey	14.5% (11.8%, 17.2%)	0.7% (0.1%, 1.3%)
January, 2006	Dry	Moyale, Hudet	19.7% (16.0%, 23.4%)	1.8% (0.8%, 2.7%)
August to September, 2006	End wet/ early dry	Moyale, Hudet	7.6% (5.3%, 9.8%)	0.1% (0.0%, 0.3%)

milk production and increased work loads. However, the size of the seasonal effects, of about five percentage points in normal years, are not such as to obscure the considerably larger shifts seen in years of deteriorating food security i.e. in this region also the nutritional state of pastoralist groups seem to be relatively protected from seasonal changes in food availability (Mason, Chotard et al. 2008). This should not obscure the fact that other responses to seasonal reductions in food availability, the slaughter or sale of livestock for example, may be increasing vulnerability in other ways.

Summary - epidemiology of malnutrition in pastoralist settings

- Pastoralists demonstrate higher levels of wasting measured by WFH at baseline than agrarian communities. Recent work suggests that this, at least in part, is due to different growth patterns of pastoralist and agrarian ethnic groups and that MUAC should be used in preference to WFH to assess nutritional status of pastoralists. Further study is required that links levels of malnutrition (measured by weight for height and by

Figure 1: Seasonal fluctuations in wasting measured by WFH in Somali Region, Ethiopia (adapted from Mason, Chotard et al. 2008)

MUAC) with functional outcomes such as morbidity and mortality in pastoral populations. This will help define appropriate 'trigger' levels for humanitarian intervention.

- The 'hungry' or 'lean' season in pastoralist populations is often different from that of agrarian communities and appears to be linked to the dry season and a reduction in availability of pasture and subsequently milk, rather than a cereal gap.
- In some ethnic groups, the nutritional status of pastoralist populations appears to be relatively protected from seasonal changes in food availability in 'normal' years, but appears to fluctuate more dramatically in years of drought and crisis. This has implications for the timing of nutrition and health intervention and the type of intervention in 'normal' and 'crisis' years.

4. Milk as a Food for Children

The importance of milk for infant and child health is well established. In Europe, the nutritional value of milk was repeatedly demonstrated by intervention studies between the two world wars and, in the face of considerable wartime undernutrition, the first Nutrition Policy for Britain (1939-1945) relied heavily on milk to provide the extra nutrients to those with special physiological requirements; mainly young children and pregnant and lactating women (Darke 1979). The general consensus was that this nutritional policy was highly successful and contributed to a considerable improvement in the health of the nation despite the adversities of war (Magee 1946).

Breast milk is an unequalled way of providing ideal food for the healthy growth and development of infants; it provides all the essential nutrients needed for optimal growth of an infant up to 6 months of age and continues to be an important component of the diet of young children between the ages of 6 months and 2 years (WHO 2003). Animal milk also contains the nutrients needed for the growth and development of their young and is therefore considered to be a valuable food, contributing high quality protein, fat, vitamins and minerals, in the diets of young children, particularly for those that are no longer breastfed (Dewey 2005).

Milk is an especially good source of Type II nutrients i.e. those that are needed in a full complement for growth and development (Golden 1991). These include all eight of the essential amino acids (that make up a high quality protein), zinc, potassium, sulphur and phosphorous. The high protein quality of milk is particularly important across the developing world where the traditionally cereal based diet of agriculturalists is often deficient in some of the essential amino acids. Lysine, for example, is commonly limiting in maize-based diets. The addition of milk to such a diet allows cereal protein to be more fully utilized for growth, by providing the missing essential amino acids. It should be noted however, that the protein in milk will only be fully utilized for growth where the energy requirement of an individual is met. Otherwise, some of the protein will be oxidized to provide energy (Hoppe, Andersen et al. 2008). The strongest evidence for the association between milk and growth comes from observation (Allen, Backstrand et al. 1992; Allen 1994; Dewey, Peerson et al. 1995) and intervention studies (Orr 1928; Du, Zhu et al. 2004) that have shown associations between the consumption of cow's milk and increased linear growth in children.

Milk is also a good source of important Type I nutrients i.e. those that prevent specific clinical deficiency diseases and that are important for protection against illness (Golden 1991). These include vitamin C (camel milk particularly), B vitamins such as riboflavin and B6 and calcium. Deficiency of vitamin A and iodine are two of the three micronutrient deficiency diseases (MDD) that are of greatest public health significance worldwide. Milk is also a good source of these nutrients.

Fat is important in the diets of infants and young children because it provides essential fatty acids, facilitates absorption of fat soluble

vitamins and enhances dietary energy density and sensory qualities (Dewey 2005). Whole milk is a good source of fat and, when consumed regularly by a young child under the age of two years, only a small amount of additional fat (up to 5g/day), is needed to meet requirements for essential fatty acids. Meeting energy requirements however, is more difficult with milk alone, and requires the addition of carbohydrate-based foods or fats and oils.

Table 2 shows that two cups of milk per day can meet at least 50% of the recommended intake of many of the essential nutrients listed. For young children particularly, nutrient needs per unit body weight are very high and many reviews have shown that animal source foods such as milk are essential if nutrient needs are to be met.

Given the relatively small amounts of foods that are consumed at 6-24 months, the nutrient density (amount of each nutrient per 100 kcal of food) of the diet needs to be very high. To evaluate the potential for various diets to meet nutrient needs at this age, linear programming techniques were applied to data available from five developing countries, Peru, Honduras, Guatemala, Ghana, and Bangladesh. The results indicated that a diet based predominantly on unfortified plant-based foods cannot meet the needs for certain nutrients at this age, particularly protein, iron, zinc, calcium and vitamin B12. Therefore, it is advisable to include milk products, as well as meat, poultry, fish or eggs, as often as possible (Dewey, Cohen et al. 2004).

Table 2: Nutritional composition and contribution to recommended nutrient intakes of animal milk

	In 250ml* cow milk	In 250ml* goat milk	In 250ml* camel milk	RNI**			2 cups milk provide 50% RNI or more
				6-11 mths	12-23 mths	24-59 mths	
Energy (Kcal)	165	173	163	700	900	1500	No
Protein (g)ß	8	8.9	7.9	13	14	16	Yes
Thiamine (mg)	0.1	0.1	0.1	0.3	0.5	0.6	Yes (younger children)
Riboflavin (mg)	0.4	0.4	0.2	0.4	0.5	0.6	Yes
Niacin (mg)	0.2	0.7	1.1	4	6	8	No
Vitamin B6 (mg)	0.1	0.1	0.1	0.3	0.5	0.6	Yes (younger children)
Vitamin B12 (µg)	0.9	0.15	0.5	0.7	0.9	1.2	Yes (not goat)
Folate (µg)	12.5	2.5	1	80	150	200	No
Vitamin C(mg)	3	3	9	30	30	30	Yes (camel only)
Vitamin A (µg)	95	139	125	190α	200α	200α	Yes
Calcium (mg)	288	335	317	400	500	600	Yes
Phosphorous (mg)	300	302	214	275	460	500	Yes
Magnesium (mg)	30	40	30	54	60	76	Yes
Potassium (mg)	380	453	354	700	2000	2100	Yes (younger children)
Iodine (mg)	0.05	0.06	no data	0.09	0.09	0.09	Yes
Iron (mg)	0.2	0.1	0.5	7.7	4.8	5.3	No
Zinc (mg)	1.3	1.4	1.1	0.7	1.7	2	Yes

*250ml is equivalent to 1 cup milk. Levels of nutrients in milk taken jointly from Park and Haenlein (2006) and WFP 'NutVal' 2006 v1.4 (Seal 2006)

** RNI = Recommended Nutrient Intake - all taken from WHO FAO Vitamin and Mineral Requirements in Human Nutrition, 2004. RNI = the Estimated Average Requirements + 2SDs, and is therefore sufficient for 95% of the population

α The RNI for vitamin A gives the EAR only - i.e. estimated average requirement. This is due to the potential toxicity of this vitamin when consumed in amounts in excess of individual daily requirements.

ß based on high quality protein

Iron, niacin and folic acid are not well supplied by milk. To meet the needs for these nutrients other animal-source foods are needed unless multiple micronutrient supplements or adequate amounts of fortified products are provided. The amounts included by Dewey et al in a linear programming analysis were 50 g egg (1 egg/day) and 14-75 g/day of meat, poultry, fish or liver (Dewey, Cohen et al. 2004). Children living in pastoralist populations may have better access to some of these foods than those living in agrarian communities, where, in most cases, some sort of nutrient supplement or fortified food will be necessary.

As well as providing many of the Type II nutrients essential for growth, milk consumption also increases blood concentrations of insulin-like growth factor I, which is a major determinant of growth during childhood (Hoppe, Molgaard et al. 2006; Olsen, Halldorsson et al. 2007). It has been suggested that the effect of milk on linear growth may be superior to that of other animal source foods (Hoppe, Andersen et al. 2008). The "milk hypothesis," put forward by Bogin, proposes that a greater consumption of milk during infancy and childhood will result in taller adult stature (Bogin 1998). However, the evidence for this hypothesis is still debated.

In pastoralist populations, the transformation of milk into dairy products can help deal with 'gluts' of milk during the wet season and supply valuable nutrients during the dry. Products such as butter or ghee, yogurt and cheese not only prolong the shelf life of milk but also change its nutrient profile. For example, butter and ghee are a concentrated source of energy containing approximately 800 kcals per 100g, whilst the protein component of milk has been completely removed in these products (Platt 1962). Such 'milk fats' are a valuable mechanism for increasing the energy density of young children's diets. Whilst the density of the fat soluble vitamins such as vitamin A and E is considerably increased in butter and ghee (there is approximately 2500 I.U. of vitamin A in 100g butter and ghee compared to approximately 150 I.U. in 100g of whole cow's milk), the water soluble vitamin content such as vitamin C and the B vitamins, and the minerals such as calcium and phosphorous are reduced to very low levels (Platt 1962; U.S. Department of Agriculture and Agricultural Research Service 2008).

Processing milk into hard cheese also increases the energy and fat soluble vitamin density of the product by, roughly, a factor of between 5 and 9 (U.S. Department of Agriculture and Agricultural Research Service 2008). Unlike the transformation into milk-fat, transforming milk into hard cheese also increases the density of protein and minerals such as calcium (U.S. Department of Agriculture and Agricultural Research Service 2008). Both soft cheese (of the type often produced from milk in the developing world) and yogurt maintain a very similar nutrient profile to milk (Platt 1962; U.S. Department of Agriculture and Agricultural Research Service 2008).

Nomadic woman making charl (soured camel milk), Turkmenistan

Many of the components contained in milk have been shown to demonstrate anti-infective properties. Lactoferrin, one of the proteins in milk, exhibits both bacteriostatic and

bacteriocidal activity against a range of disease causing microorganisms, and could improve immunity against infection in children.

Fermented milk products such as yogurt have been consumed for centuries around the world and a number of health benefits have been associated with them (Heyman 2000). Probiotic (or beneficial) bacteria, either present in milk or added at the time of fermentation, multiply during the fermentation process. Their growth is supported by milk's complex carbohydrates, oligosaccharides (an example of a prebiotic). These carbohydrates will also promote the growth of probiotic bacteria in the gut. Such bacteria have been shown to improve intestinal microbial balance and may decrease the incidence and reduce the severity of illness such as diarrheas, caused by pathogenic bacteria (Shah 2000).

Summary - milk as a food for children

- A high intake of animal milk is linked to growth in stature and may contribute to the patterns of child growth seen in pastoralist ethnic groups. It is a very good source of high quality protein and other micronutrients needed for synthesis of lean body tissue, and increases blood concentrations of insulin-like growth factor.
- High quality milk protein allows cereal protein to be more fully utilized for growth and development by providing missing essential amino acids.
- For young children, two glasses (500ml) of milk per day can provide 100% of the RNI of protein, riboflavin, vitamin B12 and iodine, and 50% of the RNI of several other micronutrients including vitamin A. Vitamin A and iodine are two out of three nutrients that cause the greatest burden of micronutrient deficiency disease in the world.
- The transformation of milk into dairy products can help deal with 'gluts' of milk during the wet season and supply valuable nutrients during the dry. Milk products (butter, ghee and hard cheese) are a particularly good source of energy and the fat soluble vitamins contained in milk. Cheese and yogurt are also a good source of protein and other micronutrients such as calcium and phosphorous.
- Iron, niacin and folic acid are not well supplied by milk and must be provided by other animal source foods, legumes, fortified foods or supplements.
- Fermented milk products with probiotic properties may help to control childhood illness such as diarrhea.

5. Pastoralist Reliance on Livestock Milk for Nutrition and Livelihoods.

The importance of livestock milk to pastoral survival was first documented by social anthropologists in their research among African pastoralists in the 1950s and 1960s (Stenning 1959; Dupire 1963). The extent of pastoralists' dependence on milk and other livestock products, and the reasons behind this, are now well-reported in the literature on pastoralism in Africa. There is by contrast, very little information on this topic among pastoralists elsewhere.

Why pastoralists rely on milk

The answer to why, and the extent to which, pastoralists depend on milk versus other animal products has been attributed to an efficiency of energy production, as well as to the availability of grazing. Milk is available daily during certain seasons, meat only sporadically; and it allows a system which provides subsistence for far more people per unit area than any other arid zone production method (Suttie 2001). In parts of eastern Africa, pastoralists can survive more exclusively on milk because the double rainfall allows year-round milking. This explains why the Sahelio-Sudanic pastoralists rely more than East African herders on agriculture, hunting and fishing (Western and Finch 1986).

An efficient herder can obtain over 2.5 times the energy from milk and meat than from meat offtake alone (Western 1982).

Livestock herding strategy

Herding multiple species is an adaptive strategy by pastoralists which reduces risk and extends the milk supplied by livestock. Different livestock species feed on different types of vegetation, thereby maximizing natural resources. To some extent, losses due to diseases are also limited by mixed herds because some diseases are species-specific. In dryland Africa, camels are often the most valuable livestock species as they possess remarkable abilities to exploit very limited resources, especially water, and have the longest lactation period of any livestock species (El-Agamy 2006). Sheep and goats are the most widespread livestock raised by pastoralists world-wide. These small ruminants are particularly important for milk production during dry seasons and droughts.

Goats are particularly drought-resistant and can continue to supply some milk for human consumption throughout a dry season. They multiply faster than large livestock and produce more milk through a longer lactation period than that of sheep (Degen 2007). Cattle

Sheep in South Sudan

Afar cattle, Ethiopia

produce relatively high volumes of milk but also need more water and therefore dry up relatively quickly during the dry season.

In pastoral and agro-pastoral areas of Africa there is considerable variation in pastoral herd composition by species. In part this depends on rainfall and vegetation. As a general rule, drier areas support more camel and goat production. These patterns are clearly evident in countries like Somalia, with camels and goats found to dominate pastoralism in the dry central rangelands and cattle pastoralism found in the lower Juba areas in the south (Baumann, Janzen et al. 1993). Market forces also affect herd composition, and pastoralists adapt to changing market demands for different species (Al-Najim 1991). Another general rule is that African pastoralists often associate wealth with ownership of larger species such as camels and cattle, and poorer households tend to convert some sheep or goats into cattle and camels when the opportunity arises.

In other parts of the world such as Afghanistan and Tibet, there are comparable pastoralist herding strategies designed to minimize risk and maximize milk supply. In high altitude areas, the selection of livestock species includes their ability to withstand severe cold rather than drought, while also

Milking Maasai goats, Tanzania

producing milk. The use of yaks in Tibet is an example of this strategy, but here again, mixed herds are used comprising yaks and sheep (Nori 2004). In Afghanistan, Kuchi pastoralists rear mixed herds of cattle, sheep and goats, with some also keeping camels and donkeys for transport (Fitzherbert 2007).

In Mongolia, pastoralists:

> *... herd sheep, horses, cattle, goats, camels, and yaks. Although horses are the most valued animal, Mongols actually depend on sheep for their basic livelihood as sheep provide milk, which is processed into butter, cheeses, and other dairy products; mutton, wool, and hide for clothes and tents; and dung for cooking and heating. Sheep can be herded on foot, with one person and a few dogs responsible for a flock* (Worden and Savada 1989).

The contribution of milk and milk products to energy and nutrient requirements

Whilst there are few pastoralist groups in existence today that exist solely on milk and meat for their nutritional intake, in the past many studies have noted the important contribution that livestock milk has made to energy and nutrient requirements. This has varied considerably by ethnic group and by season, with ethnic groups such as the Masaai, Rendille and Turkana of Kenya and Tanzania, the Borana of southern Ethiopia and the pastoralists of Koch county in south Sudan seen to consume more than 50% of their dietary energy in the form of milk and milk products (Galvin 1992; Lindtjørn, Alemu et al. 1993; Galvin, Coppock et al. 1994; Homewood 1995; Barasa, Catley et al. 2008). For groups such as the Turkana, studies have noted more than 90% of dietary energy coming from milk during the rainy season (Galvin, Coppock et al. 1994).

Agro-pastoralists such as the Awlad Hamid in northern Darfur in the Sudan, have a diverse diet …Camel milk and milk products only constitute about 20-25% of the food energy of the diet (Holter, 1988b).

Malian Tuareg (Kel Tamasheq) pastoralist diets include millet and rice, milk and meat, with milk and cereals consumption varying by season (Wagenaar-Brouwer, 1985).

At the other extreme are the Maasai and Turkana in Tanzania and Kenya pastoralists*, whose diets of milk and other animal products from livestock may contribute nearly their entire caloric intake at certain times of the year* (Galvin, 1988; Nestel, 1985).

Milking a yak on the Tibet-Qinghai plateau

For the Borana in Southern Ethiopia *...the diet was based mainly on milk and milk products. Children under 5 years of age had, on average, milk for 2.3 meals per day. However, the true amount of milk consumption was probably higher as young children were often observed drinking milk between meals* (Lindtjørn, Alemu et al. 1993).

Whilst many of the studies cited above are now more than 10 years old, there is some more recent literature that suggests that milk and animal products in the diets of pastoralist communities remain relatively important. In cattle-keeping communities in South Sudan, milk accounted for up to 30% of total energy intake (Muchomba and Sharp 2006) and among Nuer agro-pastoralists milk accounted for 50% of the total energy intake of children aged less than 5 years (Fielding, Gullick et al. 2000).

The 'Rendille Sedentarization project' discussed below (see section 6) demonstrates the importance of milk in the diets of pastoralist children in northern Kenya relative to their settled counterparts (Fratkin, Nathan et al. 2006). At the pastoral household level, milk is a particularly important food for pastoralist children and children have been noted to receive preferential treatment in terms of milk consumption (Barasa, Catley et al. 2008).

> *In Shinelle, Somali Region Ethiopia, milk is a very important part of the pastoralist and agro-pastoralist diet, and from a young age children are given milk. The proportion of children over 6 months that had consumed milk during the previous day was between 68% and 94%. This consumption pattern is related to livestock condition and migration of animals causing poor food security at that time* (SCUK 2007).

However, a number of factors, including population growth and a shift from subsistence production to commodity production, appear to be reducing dependence on milk and increasing dependence on cereals as the main staple in some areas.

> *The Borana* (in southern Ethiopia) *today are in a state of considerable change that has been induced primarily by a long-term decline in the per capita supply of cow's milk, the traditional dietary staple. This imbalance has resulted from steady growth in the human population in combination with density dependent fluctuations in cattle population* (Coppock 1993).

Over the past 20 years there have been a number of studies of pastoral production systems that have clearly shown that, whilst animal products remain important, it would be difficult for pastoralists to subsist without grains and sugar and that these commodities were purchased in increasing amounts during the last decades. This shift is attributed to a decrease in livestock productivity and a shift from a subsistence milk-surplus system to a sale or commercial live animal system (Abdullahi 1993; Fratkin 2001).

Hard choices: milk for calves, milk to eat, milk to sell or milk for social exchange

Milk from livestock can be used in several ways to support a pastoral family and this often means hard choices, especially for poorer families.

> *Traditional subsistence pastoralists in East Africa tend to keep large herds, milk cattle in preference to eating them, and subject them to long foraging treks.*
>
> *Milk must be available in sufficient quantities to sustain calves to weaning age. The surplus is available for human consumption. Offtake that deprives calves, though benefiting the pastoralist in the short-term, will impair herd replacement and growth rate in the long-term. The herder must therefore balance his immediate and long-term needs when milking. Moreover, because milk yields decline through the dry season for both the calf and human dependent, the herder must rely increasingly on alternative livestock products, or other food sources* (Western and Finch 1986).

The importance of 'preserving the herd' in pastoralist communities for future food and livelihood security and social status and ties was noted by de Waal in his eminent text on 'Famine that Kills' in Darfur, Sudan.

> *Pastoralists may even, under conditions of stress, endure serious hunger to sustain the household herd* (de Waal 1989).

This phenomenon has been noted widely within the literature on the coping mechanisms that communities employ in response to food insecurity (Corbett 1988; Maxwell 1996).

The exchange of milk and milk products for income and more energy dense grains or other starchy food is an important pastoral strategy to fulfill caloric needs, and is practiced widely. In Borana, southern Ethiopia for example, grain purchased with the sale of livestock products met over 30% of dietary energy requirement (Cossins and Upton 1987) and in Somali Region, Ethiopia milk production was noted as the most important source of revenue (66% of total income) (Barrs 2000). Sales peak in the wet season and both wealthier households and households closer to the market have been noted to sell or exchange considerably more (in quantity) than others (Holden and Coppock 1992). However, poorer households have been observed to take proportionally higher milk off-take per animal in order to purchase grains for human consumption (Holden, Coppock et al. 1991). This has been observed by livestock scientists to lead to a cycle of poverty: ill-fed young animals mature more slowly to reproductive age (so the herd or flock does not expand as fast) and are weaker and more susceptible to drought, cold and disease. Their human owners, however, are able to provide a little milk to their families, including children.

Pastoralists have other choices too. One of these is whether to convert some of the raw milk into some form of preserved dairy product such as yogurt, cheese, butter or ghee (separated butter fat). Pastoralists must decide whether to exchange some of these products for other goods, or retain the preserved form of protein and fat as a food source for the family in lean periods. In Somali Region, Ethiopia a high proportion of cattle milk is converted to ghee (SCUK 2007) for consumption or sale, with wealthier households converting substantially more than poorer households.

The social value of milk and dairy products also plays an important role in decision making. Rather than sell or consume surplus milk products, pastoralists often use lactating animals or their milk products to maintain social ties. In some pastoral societies, there are cultural prohibitions on selling milk products, which must be kept for hospitality and sharing between group members. These practices are well-documented for many pastoral African societies (Oba 1994; Bush 1995) and also occur in Afghanistan (Fitzherbert 2007). When decisions must be made on how to allocate milk from animals, the future social insurance gained by sharing milk between group members may outweigh an immediate financial gain from its sale. Likewise, children of pastoralists often have informal access to livestock milk off-take from other families in their social group, making measurement of children's milk consumption somewhat problematic.

Impact of commercialization on the use of milk

The pan-African economic review published by Sikana, Kerven et al. (1993) is probably the most significant commentary to date on the impact of commercial change in pastoral Africa. It focuses on the shift in the value of milk, which is influenced by a number of discrete and identifiable variables. Importantly, it documents the diminished role of milk in pastoral diets under commercialization, especially among poorer households. Better-off households with a calorically sufficient diet can afford to view milk as a source of protein, while calorically insufficient households view milk as a source of calories and, as a result, practice higher rates of milk offtake for sale to purchase cereals for consumption. Other studies note that the closer (poorer) households are to markets, the more milk offtake is taken for sale. Because of this greater dependence on milk income, the management strategies and milking practices of poorer pastoralists differ from those of richer households. They often live nearer to watering points, despite range

being of poorer quality there, and water animals more frequently as a strategy to maximize milk output.

> *The greater dependence of poorer households on dairying income may also reduce their herd mobility, which , in turn has been linked to milk output [through reduced access to quality grazing* (Sikana, Kerven et al. 1993).
>
> *These findings together with calf morbidity and mortality data lend some support to a causal relation among factors of proximity to market, dairy sales and risk to calf health for poorer households. Dairy marketing seems to be an appropriate survival strategy for poorer households, however it's associated short and long term risks (cuts in milk production and calf mortality and problems in human nutrition) should be reduced by appropriate interventions that create alternative income opportunities and improve calf feeding management* (Holden, Coppock et al. 1991).

The role of milk in the diets of infants and young children in pastoralist settings

Several studies (in eastern Africa) that examine the dietary intake of infants and young children in pastoralist areas identify some common themes with regard to the use of animal source foods. These include very early introduction (often within the first few days of life) of animal milk (sometimes mixed with water) and/or an animal fat (such as ghee) to supplement breast milk. Intake of these complementary foods continues, along with breastfeeding, throughout the first six months of life and beyond, when milk is often mixed with cereals to make porridge. The two most substantial bodies of research recently generated on the role of milk in infant and young child feeding in pastoral communities concern the Datoga of Tanzania (Sellen 1998; Sellen 2001; Sellen 2002) and the Turkana of northern Kenya (Gray 1994; Gray 1995; Gray 1996; Gray 1996; Gray 1998).

Daniel Sellen's longitudinal studies on the Datoga found that supplementary foods fed to infants and young children included fresh and soured goat or cow's milk, maize-meal gruel and the principal adult staple, stiff maize-meal porridge; that the median ages of introduction of non-human milks, introduction of grain-based solids, and cessation of breast-feeding were 2, 11 and 20 months respectively; and that feeding practices show a lack of concordance with international standards.

Baggara Arab nomad with milk containers, Darfur

Sandra Gray's important study on butterfat feeding in early infancy (Gray 1998) builds on earlier research among Turkana pastoralists (Gray 1994; Gray 1996) and found similar patterns of breastfeeding and complementary feeding as among the Datoga (including early supplementation of breast milk with animal milk and with butterfat).

Save the Children UK, in their report on the causes of malnutrition in Somali Region Ethiopia, reported that only 6.6% of infants were exclusively breastfed, mostly due to the common practice of giving animal milk early.

> [In Somali Region] *From a young age children are given milk. …In addition to breast milk children less than 6 months consumed animal milk. Up to 12 months the children still consumed predominantly animal milk with approximately 20 % consuming cereal and 14% oil. The most common milk is goat's followed by cow's. Cow's milk is*

more common in agro-pastoral compared to pastoral.

Lindtjorn, in his work with the Boran in southern Ethiopia also reported the practice of supplementing breast milk with cow's milk from the first few days of life. Understanding these practices and their consequences for nutritional status is further discussed under section 6 below.

Summary - pastoralist reliance on livestock milk for nutrition and livelihoods

- Herding multiple species is an adaptive strategy by pastoralists which reduces risk and extends the milk supplied by livestock. Whilst camels are the most valuable of all livestock species, goats and sheep are more common and can continue to supply a little milk for human consumption through the dry season when cows cease lactating.
- During the 80s and 90s many pastoralist ethnic groups in eastern Africa were found to consume between 50% – 90% of their dietary energy as milk and milk products. Although this proportion may now be changing, the relative importance of milk and animal products in the diets of these groups seems likely to remain.
- Exchange of milk and animal products for grain is an important strategy to fulfill caloric needs for all pastoralists.
- The balance between milk offtake for human consumption and/or exchange and maintaining calf health is a difficult one, especially for poorer families for whom total milk yields are rarely sufficient to cover consumption requirements. Choices may mean putting human health at risk to preserve animal health.
- Commercialization (producing animal products for market) is reducing dependence on milk and increasing dependence on cereals as the main staple in some areas. This is especially true for poorer households nearer to markets, who convert a higher proportion of milk to higher calorie grains and, to maximize milk yields, may use herd management strategies that puts calf health at risk.
- Sharing of milk within a social group is a strong cultural practice for most pastoral communities. It improves access to milk for children within the same group as well as acting as an important social insurance strategy in leaner times.
- Contradictory to international recommendations milk and/or an animal fat (such as ghee) are often introduced into the diets of infants from a very early age in pastoralist communities. They continue to be the most common complementary foods given to infants and young children throughout the first six months of life and beyond, with milk often being mixed with cereals to make a porridge.

6. How Pastoralist Diets and Livelihoods Affect Nutritional Status

Diets and nutrient intakes

This literature review highlights the considerable inter-ethnic group variability in dietary intake and intra-ethnic group variability by season. However, there are a number of common themes that stand out in the literature as being important determinants of the nutritional status of pastoralist people, particularly of women and children.

Reliance on milk: a protective or harmful factor?

In contrast to the diets of most populations across Sub Saharan Africa, pastoralists generally have good access to high quality protein and other Type II nutrients in the form of milk and, seasonally, blood and meat. Several studies, starting with those led by Galvin in the 1980s, noted that these pastoral diets were adequate in terms of protein (providing between 200-400% of daily protein recommended intake in many cases) but were low in energy. This became known as the *'protein-rich calorie-poor'* phenomenon (Galvin

1985; Galvin 1992; Homewood 1995; Fratkin, Roth et al. 1999; Fratkin 2001).

As discussed under section 3, researchers have suggested that it is the high level of good quality protein intake and other Type II nutrients that, in part, results in the significantly lower levels of stunting found among pastoralist people, compared to their agrarian neighbors. High levels of Insulin-like Growth Factors (IGF) found in milk are also likely to play a role in this. However, this link is still debated.

Fratkin and others have noted that the main nutritional challenge for pastoralists is obtaining sufficient calories, and that most pastoralists supplement their livestock-based diets with grains and sugar to provide carbohydrate calories and to maintain food supply during the dry season and drought when milk yields fall. Several studies have quantified inadequate levels of energy provided by pastoralist diets reliant on milk and animal source foods and have linked this to high levels of wasting (measured by weight for height). Homewood, in her studies of the Kenyan and Tanzanian Maasai identified high levels of wasting and noted populations surviving on 70% of international recommended energy intakes (Homewood 1995). Several authors have found energy intakes of pastoralists in northern Kenya ranging from 1000-1400 kcal per person per day, only about 50% of the average daily adult requirement, and have linked this to the low body mass indices identified (Little 1989; Galvin 1992; Galvin, Coppock et al. 1994). However, none of these studies accounted for the different body shapes of pastoralist people when using nutritional indices like body mass index and weight for height. This may have biased their assessment of nutritional status.

- **Increasing milk intake is protective against wasting**

It is important to note that milk (particularly where intake is high) is an important contributor to total nutrient intake in many pastoralist populations. Therefore, it follows that increasing intake of milk (which provides energy as well as protein) is protective against wasting, as well as stunting, in young children. This is shown with multiple regression analyses in a number of reports and studies (see discussion on sedentarization below) (Nathan, Fratkin et al. 1996; Fratkin, Roth et al. 2004; Grobler-Tanner 2006; SCUK 2007).

- **Vitamin and mineral deficiencies are rare apart from iron deficiency anaemia which is common**

The role of animal source foods (ASF), that include milk, meat, eggs and blood, in improving micronutrient status is well known, in particular for vitamin A, vitamin B12, riboflavin, vitamin C (camel milk only), calcium, iron and zinc levels (Bwibo and Neumann 2003; Murphy and Allen 2003; Neumann, Bwibo et al. 2003).

Milk alone is a good source of many of these micronutrients and, as a result, some authors have noted micronutrient deficiencies as being rare among pastoralist populations that consume large amounts of milk along with other foods (Fratkin, Roth et al. 1999). However, iron, folic acid and niacin are provided in very small amounts in milk, and therefore pastoralist populations may be at risk of deficiency of these micronutrients. Deficiencies in iron and folic acid cause anaemia, and this has been commonly noted in studies of pastoralist populations. About 25% of Maasai women and children studied by Nestel et al were anaemic (Nestel and Geissler 1986) whilst among the Rendille pastoralists of northern Kenya, Fratkin et al also noted the prevalence of iron deficiency anaemia as being high (although not as high as their settled counterparts) (Fratkin, Roth et al. 1999). However, there are also important non-nutritional risk factors associated with anaemia; malaria and hookworm are the most important of these, and both are common in many pastoralist settings (Schelling, Daoud et al. 2005; SCUK 2007).

Low levels of fruit and vegetable intake have also been noted in some pastoralist populations which may put them at risk of vitamin A and vitamin C deficiencies where milk (particularly camel milk) is not consumed in sufficient quantities to meet

requirements (Zinsstag, Schelling et al. 2002). This is discussed further below.

SCUK, in their recent analysis of the pastoralist diet in Somali region, Ethiopia suggested that the main risks for micronutrient deficiencies were from iron and folic acid, making anaemia a particular risk. Zinc and vitamin C were consumed at marginal levels, although the analysis did not account for any wild food consumption, thought to make some contribution to intake of these nutrients (SCUK 2007).

- **Supplementing milk with a range of other foods is important**

Although studies do support the use of animal milk as an important source of many nutrients some have also noted the importance of diet diversity to ensure that adequate levels of all nutrients are met.

This review has already noted the importance of supplementing animal foods with carbohydrate-based foods if pastoralists are to meet their energy requirements. It is worth noting here the particular importance of sugar. Several studies and analyses have noted the high consumption of sugar among pastoralist populations; it is considered a crucial addition to cereal-based mixes for children and to tea for the whole family by many pastoralist groups (Abdullahi 1993; FSAU and FAO 2004). The Household Food Economy Group's livelihood zone analyses and SCUK's analysis of Somali caring practices found it to be a prioritized expense across all livelihood zones with consumption rising when availability of milk fell (2008). It is likely that sugar plays an important role in filling the energy gap (FSAU and FAO 2004).

Human serum retinol and livestock milk retinol levels were assessed as part of a study on the health status of Chadian nomadic pastoralists and their livestock. Of the examined women (n = 99), 43% were moderately retinol-deficient and 17% severely retinol-deficient. None of the interviewed women (n = 87) reported the consumption of fruit, and only two reported consuming fresh vegetables in the past 24 hours. Milk is the almost exclusive source of vitamin A for these populations and vitamin A intake was closely correlated to retinol levels in milk. Zinsstag concluded that although milk was an important source of retinol, intakes from milk need to be complemented by green leafy vegetables, fruits, and supplements (Zinsstag, Schelling et al. 2002).
This conclusion is also highlighted by the Food Security Analysis Unit (FSAU) in their study on Infant and Young Child Feeding and Health Seeking Practices in Somalia. They conclude that diet diversity is associated with changes in levels of wasting across populations. This underlines that higher consumption of all foods, and ideally a variety of foods, supports good nutritional status (FSAU 2007). This association has been widely noted in populations across the developing world (Ruel 2002).

The effect of season on nutrient intake and nutritional status

The considerable variation in milk supply by season for many pastoralist groups is discussed under section 3.

- **Recovery of nutritional status after dry season and drought**

A common conclusion in the literature reviewed is that the nutritional status of pastoralists appears to be relatively well protected against short-term declines in food availability i.e. during seasonal changes in milk and food availability, and recovers more quickly after a dry season than their agrarian neighbors. In southern Ethiopia, Lindtjorn observed a more rapid improvement in nutritional status of pastoralist Boran children after the start of rains compared to children living in a Boran agricultural community. He found that outside of drought years, the pastoral livelihood is more resilient to seasonal variations as milk yields increase much more quickly than food production from cereals once rains arrive (Lindtjørn, Alemu et al. 1993). Studies among the Ariaal, Rendille, Dagota and Turkana find that despite significant seasonal variation in rainfall and food availability, child nutritional status shows only moderate, if any, decline in the dry season (Shell-Duncan 1995; Sellen 2000). Other studies describing patterns of wasting

in Somalia and northern Kenya note that the peak in levels of wasting (in normal years) does not necessarily occur in the traditional 'cereal-based' hungry season suggesting that pastoralists might be relatively protected from the usual cereal gap (Chotard, Mason et al. 2006).
Some reports suggest that those groups that keep higher numbers of camels and have maintained strong social networks that emphasize food sharing (for example the Ariaal and Rendille in northern Kenya) are more protected in drought than those groups that rely more on cows and small livestock and that do not have such a strong culture of 'social protection' (e.g. those in south Turkana and some Somali ethnic groups) (Roth, Fratkin et al. 2003).

Whilst pastoralists may show relative resilience against normal seasonal changes in food availability, some reports have observed that nutritional status decline is considerably more marked as a result of longer term food insecurity such as successive droughts over a number of years. Chotard et al noted that for the pastoralist populations of Somalia and northern Kenya nutritional data analyzed by season indicated that fluctuations in levels of wasting were about five percentage points in normal years with considerably larger shifts seen in years of subsequent drought (Chotard, Mason et al. 2006).

This seeming 'resistance to drought' but 'vulnerability to destitution' has long been discussed in the literature:

> *If they are able fully to employ their range of coping strategies, of which mobility is central, pastoralists are resilient to drought [Ellis, 1985]. Turkana herders, for example, can survive a failed rainy season or two without external assistance. Nonetheless, not all pastoralists are resilient. Their degree of vulnerability depends on several factors: access to dry season ranges; peace with neighboring pastoral communities; the ratio of female to male stock; and the availability of, and access to, commercial cereals [Swift, 1989]. Herd sizes also determine vulnerability. The greater the buffer stock of animals, the greater the likelihood that households can weather a drought on their own. The real Achilles heel of pastoralism is the slow pace of recovery after a devastating drought. Just as the slide into destitution is a slow spiral downwards with total collapse occurring very rapidly at the end, so recovery is a long, uncertain journey back up. It takes several seasons for herds to rebuild to a point of reasonable food security. Until this threshold is reached, milk will be scarce, and the sale of stock to obtain maize, while necessary, will be limited* (Bush 1995).

The effect of animal disease on milk availability and nutritional status

Some livestock diseases cause the death of animals and so directly and permanently stop the supply of milk from affected adult females, and indirectly prevent purchases of milk because fewer animals are available for sale. Other livestock diseases affect productivity and therefore reduce the volume of milk which is available for direct consumption, processing or sale. Given the high importance of milk in the diet of pastoralists (see section 5) it has been assumed that livestock disease has a direct and major impact on household food security. There has been little mention in the literature however, of the direct link between reduced milk yields due to animal disease and the impact that this might have on the nutritional status of pastoralist children. No studies were identified that have examined the causal relationship between the two.

- **Conventional studies and research**

The assumption that livestock disease has a major impact on pastoral household food security seems reasonable given that standard veterinary textbooks note that various diseases cause reduced milk production, reduced fertility or other losses which affect milk supply. As an example, chronic trypanosomosis affects cattle and camels in many pastoral areas of east Africa and is well described in texts (Stephen 1986; Brown,

Hunter et al. 1990; Radostits, Blood et al. 1994).

Although there is a reasonable body of research which quantifies milk production in different livestock species in pastoral areas of Africa (Wilson and Clarke 1976; Mefit-Babtie 1983; Simpkin 1985; Oxfam and Ireland 1990; Nauheimer 1993; Kaufmann 1998; Zeleke and Bekele 2001) the losses due to animal disease are rarely quantified in the veterinary literature.

Trypanosomosis causing emaciation and reduced milk production in cattle, Somali region of Ethiopia

The limited quantitative data on milk losses due to specific diseases might be explained, at least in part, by the approaches and methods of conventional livestock research. For example, the measurement of milk production requires summation of the milk which is consumed by offspring plus milk which is obtained during milking for human use. The former is difficult to measure and requires accurate weighing of calves, lambs or kids immediately before and after feeding; the volume of milk consumed is then calculated from the difference between these two weight measurements. This methodology is cumbersome, especially when large scales are needed to weigh calves, and when pastoral herds are moving. A further complication of milk measurements in pastoral herds is *ad hoc* milking by herders, especially children, while animals are grazing. This off-take away from the homestead is very difficult to measure. In addition, factors including the availability and quality of vegetation, water supply and distances traveled to grazing areas or water sources all influence milk production. Therefore, studies on disease impacts need to understand the relative importance of the disease in question compared with these other factors.

- **Pastoralist views**

Alternative perspectives on the impact of livestock diseases on milk supply are provided by pastoralists themselves, and include both qualitative and quantitative estimates. For example, the use of participatory methods has enabled pastoralists to define their own indicators of disease impact and compare different diseases. In Somaliland the indicator 'Disease reduces milk yield' was one of 26 indicators identified by herders when comparing livestock diseases (Mohammed 1993), and pastoralists in South Sudan (Catley, Okoth et al. 2001; Barasa, Catley et al. 2008), Tanzania (Catley, Chibunda et al. 2004) and Ethiopia (Rufael, Catley et al. 2008) have all included a milk loss indicator in their descriptions of important livestock diseases.

Using participatory methods in South Sudan, Nuer herders estimated milk losses in cattle due to acute foot-and-mouth disease at 1.6 liters per day (95% CI 1.20, 1.95 liters per day) for an average of 14 days; this represented a 62% fall in production in affected cows during the period of clinical disease (Barasa, Catley et al. 2008).
By combining this information with estimates of disease incidence by age group, the reduced volume of milk available for human consumption due to foot-and-mouth disease (FMD) was estimated at 839 liters per household. Assuming intake of no other foods,

Research in South Sudan on the livelihoods and nutritional impact of foot-and-mouth disease

this volume of milk could feed one adult for 240 days or a family of two adults and five children (between two and 12 years of age) for 47 days. The study also explored these impacts in terms of seasonality in human diets, with high dependence on milk at certain times of year. Outbreaks of FMD occurred shortly before the 'hunger gap' period in South Sudan, when milk was a particularly important component of the diet.

These participatory impact assessments show that pastoralists associate specific livestock diseases with reduced milk production, and can rank or score diseases according to the impact on milk supply. Similarly, pastoralists can assess the value of disease control against indicators such as milk production, and can estimate absolute reductions in milk off-take per milking by disease. Pastoralists are well aware of the multi-factorial nature of milk production, and can describe the relative importance of factors such as rainfall, pasture and conflict for milk supply compared with livestock diseases.

Understanding infant and young child feeding practice and its consequences

> *In FGDs women were asked what foods they gave to an infant in the first 40 days. Water with sugar was almost universally provided and animal milk and 'badhi' (fatty tissue from sheep). When asked why they thought that breast milk is not sufficient for a new baby most replied that more vitamins were available from the other foods* (SCUK 2007).

The important role that milk and animal foods play in the diet of children from a very young age is discussed above under section 5. The timing of the introduction of complementary foods has been widely noted in the literature as not complying with international standards in pastoralist populations. Animal milk is commonly introduced from a few days old and it is suggested that this may reduce the frequency of breastfeeding. This has commonly been cited as a risk factor for malnutrition among pastoralist infants under the age of six months (Sellen 1998; Sellen 2001; SCUK 2004; Nyaruhucha, Msuya et al. 2006; SCUK 2007) although none of these studies directly measured wasting in this group.

There are other risks associated with this practice. Not only is the iron content low and poorly absorbed in animal milk but its early introduction to infants less than nine months has been shown to provoke microscopic intestinal bleeding. This could increase the risk of poor iron status and anaemia in infants, although a causal link between intestinal blood loss and iron status has not been demonstrated (Ziegler, Jiang et al. 1999; Agostoni, Decsi et al. 2008). In addition the renal solute load of animal milk is high due to the relatively large amount of protein and several minerals (sodium, chloride, potassium and phosphorus). This could lead to hypernatremic dehydration and is a particular risk for infants under six months of age that receive all of their nutrients from a single source (breast milk or formula) and do not consume water (Dewey 2005).

The introduction of complementary foods other than milk to young children in pastoralist societies is often late (at nine months or older) and of poor diversity. This has also been noted as a risk factor for malnutrition in young children particularly because, on average, rates of wasting in pastoralist populations tends to be lower, in comparison to settled populations and national averages, below six months of age, but rises quickly after six months (Little, Gray et al. 1993; Gray 1996; Sellen 1998; Sellen 2001; Sellen 2002; FSAU 2007).

> *In FGD, when asked why they do not start* (weaning) *earlier, the pastoral and agro-pastoral women gave the following reasons: there is food shortage so they give just milk; the child cannot eat sorghum which is the main food available; the child lacks teeth for chewing; complementary foods are not needed; because the child will develop diarrhoea; breast milk is sufficient. To enable earlier introduction of weaning foods, these constraints will need to be addressed,*

i.e. both knowledge and practical constraints of food availability (SCUK 2007).

However, it is widely agreed that milk and animal food consumption that complements breast milk for children over the age of six months is protective against malnutrition (SCUK 2007; Dewey and Adu-Afarwuah 2008). The literature that examines the effect of settling on the nutritional status of pastoralist children demonstrates this well. This is discussed below.

The reasons behind early introduction of animal foods in the diets of infants and reduction in frequency of breastfeeding have been widely debated in the literature. Gray, in her studies of the Turkana in the 90s, explains these practices as adaptive responses to a highly stressful reproductive environment characterized by high maternal and infant morbidity and mortality and chronic undernutrition (Gray 1994; Gray 1996; Gray 1998). The structure of the pastoralist system requires high human fertility to maintain the family herds at adequate levels. Their childbearing role requires that Turkana women balance the needs of the child currently breastfeeding with the demand for large families. The implications of this are suggested by the finding that the real reason for early introduction of complementary foods is to shorten birth intervals, a result echoed by Sellen (Sellen 2001).

Others have found that Datoga and Turkana birth spacing strategies have a strongly seasonal component, with mothers preferring to terminate breastfeeding at the end of the long rains before food supply becomes scarce and their own nutritional status deteriorates (Leslie and Fry 1989; Sellen 2001). Labor demands on the lactating mother have also been linked to a reduction in breastfeeding frequency. The high workloads of the pastoral system, and work that requires considerable travel, exert significant pressure on the time available for feeding (Gray 1994; SCUK 2007).

Finally, some have suggested that the early introduction of animal milk into the diets of young infants is due to low breast milk volume (Ettyang, van Marken Lichtenbelt et al. 2005) and that the energetic benefits accrued to nurslings by increased intake of foods such as butterfat may be of greater significance than any reduction in exposure to infection (Gray 1998). Several studies have shown that, at least in the first six months, breast milk production can be maintained at levels sufficient to satisfy infant needs and is typically maintained even when mothers are moderately undernourished (Cohen, Brown et al. 1994; Prentice and Goldberg 2000). Due to this work it is generally thought that the infant is reasonably well protected against any deterioration in nutritional status of the mother. However, this work does not take into account women's own perception of how able they are to provide sufficient nutrition for their infants. This is an important factor to consider when examining factors associated with the frequency and duration of breastfeeding (Gray 1996).

The links between maternal and child nutritional status

It is well established that maternal nutritional status is an important predictor of the nutritional status of her young children. The first article in the recent 'Lancet Nutrition Series' discusses the strong associations between maternal short stature and cephalopelvic disproportion (i.e. the baby's head being proportionately too large for safe delivery) and between low maternal body-mass index and intrauterine growth restriction (Black, Allen et al. 2008). Severe anaemia has also been linked to the risk of premature delivery and low birth weight (Huma, Salim Ur et al. 2007).
There is only one study in pastoralist populations that has linked maternal nutritional status to birth weight. Pike found that infant birth weight was correlated to the seasonal pattern of maternal exposure to illness and fluctuation in nutritional status among the Turkana in northern Kenya (Pike 2000). The Rendille Sedentarization Project found that maternal dietary intake and nutritional status was highly seasonal in pastoral communities (although better than their settled counterparts) (Fujita, Roth et al. 2004; Shell-Duncan and Yung 2004) and

anaemia, whether through dietary or infection pathways, has been noted as prevalent in some pastoralist populations (see section 6). However, none of these studies examined the link with infant birth weight nor were they able to comment on the prevalence of low birth weight in the populations under study. Maternal nutritional status (measured by mid upper arm circumference) was found to be one of the factors independently associated with child wasting and stunting in the Somali region of Ethiopia (SCUK 2007). This relationship may be working through a number of pathways including direct maternal nutrition-infant nutrition links, maternal workload and caring practice.

Black et al. (2008) reaffirm that maternal under-nutrition has little effect on the volume or composition of breast milk unless malnutrition is severe. There is evidence however that demonstrates the importance of maternal nutritional status for the concentration of some micronutrients (particularly vitamin A, iodine, thiamin, riboflavin, pyridoxine, and cobalamin) in breast milk. The risk for infant deficiency of these micronutrients is increased by maternal deficiency. Although these micronutrient deficiencies have not been commonly noted in pastoral populations, low human serum retinol has been demonstrated in nomadic populations in Chad (see section 6) (Zinsstag, Schelling et al. 2002). However, this study did not examine vitamin A levels in breast milk nor risks to infant nutritional status. There does seem to be a link between mother's own feeling of well being and the frequency and duration of breastfeeding (see section 6) although a direct association with poor nutritional status among infants has not been demonstrated.

Sedentarization and commercialization

There is a global trend for mobile or nomadic pastoralists to cease moving, either partially or completely settling with their animals. This trend is sometimes linked to increased pastoralist participation in markets, and sometimes results from impoverishment, loss of grazing land, climatic disasters and other causes, all of which are now quite well-documented.

As a result of settlement, some work has documented an improvement in nutritional status among children and adults due to an increase in commercial opportunities, improvements in child care practices and better access to health care. Ensminger's study of the economic transformation of the Orma of Kenya for example found increased residence in market centers and agricultural commercialization associated with improved nutritional markers (weight for height) for adults and male children but not for female children (Ensminger 1991).

However, whereas settlement may hold some opportunities, these can be at the expense of herd productivity, and in particular, milk yields. A comparative study of milk yields carried out among the Ngok Dinka of Sudan indicates that milk production in migratory herds is about 50% higher than in sedentary herds during both the wet season and the dry season (Niamir 1982).

By far the largest work that has examined the consequences for child nutrition of sedentarization is that of the 'Rendille Sedentarization Project' in northern Kenya, which ran for several years in the mid-90s. By comparing the diet, nutritional status, fertility and morbidity of women and children in nomadic and sedentary communities they were able to show, quite conclusively, that child nutrition and growth patterns were worse in the sedentary communities in comparison with the nomadic control group (Fratkin, Roth et al. 1999). What clearly differentiated the nomadic from the sedentary communities was the consumption of milk. Based on 24-hour dietary recall the project was able to show that children in Lewogoso (the nomadic community) consumed on average over ten times as much milk (3.2 vs. 0.3 cups) as children in Songa (the settled community). It was particularly during the dry season that the sedentary communities had significantly more malnutrition and significantly higher levels of anemia and infection such as diarrhea. This study suggests that the pastoral nomadic diet, particularly one dependent on camels' milk,

offers children better resistance to the pressures of drought and supports findings that the subsistence base of mixed-species pastoralism is superior to sedentary alternatives with respect to child health (Nathan, Fratkin et al. 1996).

Other studies have noted similar findings. Children of settled Bedouins had a poorer nutritional status than both the true nomads living under the same environmental conditions and the semi-settled agro-pastoral populations (Baba, Shaar et al. 1994). In 2006 Grobler-Tanner found that pure pastoralists with animals in Turkana were comparatively better off than those who had settled and were dependent on food aid, trade and begging in urban and peri-urban areas (Grobler-Tanner 2006).

Wealth

The influence of economic status on dietary intake and nutritional status of pastoralist people is debated in the literature. Studies on Borana, Turkana, Rendille and Datoga pastoralists in southern Ethiopia, Kenya and Tanzania examine the interactions of market access and household wealth on nutrition status. Several of these studies find wealth to be a poor determinant of nutritional status in these populations. They highlight the positive role that intra-household dynamics and the sharing of resources amongst social groups have on nutritional status during periods of decreased food availability (Galvin 1992; Galvin, Coppock et al. 1994; Homewood 1995; Fratkin, Roth et al. 1999; Shell-Duncan and Obungu Obiero 2000; Sellen 2003). Between 2000-2006, the nutritional status of children in Somali Region, Ethiopia did not change with wealth (Mason, Chotard et al. 2008).

> *This study finds no significant differences in diet and nutritional status between Maasai communities, and other studies have failed to find theoretically expected nutritional differences within these communities. Grandin (1988) found no significant difference between rich and poor Maasai households' milk consumption in the Kenyan sample. Nestel (1985) showed energy intakes consistently 65-75 per cent of recommended dietary intake for body weight irrespective of wealth stratum for Kajiado Maasai, and few significant differences between wealth strata in stunting and wasting. A Tanzanian sample showed few significant differences in nutritional status between rich and poor households (McCabe et al., 1989). This can be attributed to a number of reasons. Maasai women have to partition milk between their human dependants and their calves. There is powerful motivation to invest in calves any milk apart from the bare minimum needed for people. The careful husbandry of milk supplies and the low importance attached to hunger probably account to some extent for the striking similarities of consumption and nutritional status within and between the two communities (Homewood, 1992). The ethos of sharing milk also acts as a leveling influence between households, and household composition (which includes poor dependants as well as lineal descendants of the household head) and may mean that the variation in energy intake, expenditure and resultant nutritional status is greater between individuals within a household than between households (Homewood 1995).*

However, other studies of the Borana that have investigated wealth and nutrition status find wealth to play a significant role in decisions around milk off-take (Holden, Coppock et al. 1991; Lindtjørn, Alemu et al. 1993). Holden examined the interaction of wealth, household milk allocation and the nutritional value of pastoral diets. She found that poorer families have higher rates of milk offtake, with the milk increment being sold to purchase cereals for human consumption; and that improved access to a dairy market reduced the proportion of milk allocated to calves in these households. The authors conclude that their results support a causal relation between factors of proximity to market, dairy sales and risk to calf health for

poorer households. The pan-African economic review on commercialization and pastoral dairying discussed under section 5 supports Holden's conclusion and documents a diminished role for milk in pastoral diets under commercialization, especially among poorer households (Sikana, Kerven et al. 1993). None of these studies however have documented direct evidence of the impact of reduced milk intake on either young humans or animals.

A study of maternal depletion syndrome among the Rendille of northern Kenya found that consumption of milk is highly influenced by economic status, with poor women having 2.3 times higher risk of low intake as compared to economically sufficient women. Moreover, both low milk intake and poverty had a strong negative influence on energy balance (Shell-Duncan and Yung 2004). SCUK have also observed an increasing prevalence of wasting with decreasing wealth. Factors associated with greater wealth were increased milk consumption, improved dietary diversity and health (SCUK 2007).

Morbidity and health care coverage

Studies among Turkana in northern Kenya and Borana in southern Ethiopia find that food availability is not likely to be the sole determinant of nutritional status and that infections such as diarrheal disease, malaria and acute respiratory infection (ARI) may be important contributors to the high levels of nutritional stress, compounded by low vaccination and vitamin A supplementation coverage (Lindtjørn, Alemu et al. 1993; Shell-Duncan 1995; SCUK 2006). The cyclical relationship between malnutrition and infection is well established elsewhere (Tomkins 2000; Caulfield, de Onis et al. 2004).

Many reports and surveys have shown that pastoralist communities across Sub Saharan Africa are some of the most poorly covered by health services in the world (CSA, EDRI et al. 2006; UNICEF 2007). In the Somali pastoral areas of Ethiopia for example, only 12% of the population reported a health clinic in their community, with the nearest average distance of the clinic being 36 km away, and only 24.4% of children were fully vaccinated compared to 49.4% of children in urban areas (Devereux 2006). A recent evaluation of health interventions in the Somali Region of Ethiopia found measles vaccination coverage to be between 40-60% among children over nine months old (personal communication: Catley, A. et al. 2008. Impact assessment of the Save the Children USA LEAP Health Program).

The low level of measles vaccination in many pastoral communities is particularly relevant to malnutrition. Although the relationship between measles and wasting is complex, children with measles are generally more susceptible to wasting, and children who are wasted are more likely to develop complications of measles and have higher case-fatality rates. During recent drought emergencies in Somali region, Ethiopia 22% of the mortality among children under five years was the result of this relationship (Salama, Assefa et al. 2001). However, this is likely to be related to the gathering of large numbers of people around food assistance sites. The more usual wide dispersion of pastoralist populations would generally support lower levels of measles transmission and reduced severity of the infection.

In Somali region, SCUK found an association (odds ratio 1.6-1.7) between children presenting with fever and/or diarrhea and wasting. However, as for measles above, this relationship is complex, and it was not clear in which direction causality lay (SCUK 2007).

Agents transmissible between livestock and humans (zoonotic agents) may have an important impact on the health status of pastoralists because they live in close contact with their animals. Schelling found that the impact of brucellosis and Q-fever on the health status of three nomadic Fulani and Arab communities in Chad, appeared marginal in comparison to other diseases such as diarrhea and malaria (Schelling, Daoud et al. 2005). Randolph discusses the likely increased exposure of pastoralist populations to zoonoses and food-borne disease including anthrax, trachoma, brucellosis, tuberculosis and salmonella (Randolph, Schelling et al. 2007). However, he states that the levels and

impact on human health and nutritional status of these infections are poorly described. Whilst vaccination coverage and access to health services may be poor in pastoral populations, studies among settled and nomadic Rendille pastoralists reveal significantly lower rates of respiratory and diarrheal morbidity among women and children in nomadic communities relative to their settled counterparts (Fratkin, Nathan et al. 2006). In Somali Region SCUK also found lower rates of infection among pastoralist compared to agro-pastoralist children (SCUK 2007). As settlement has been associated with poorer nutritional status, this may reflect the synergy of illness with malnutrition i.e. that poorer nutritional status preempts illness. An increase in 'crowding' i.e. communities living closer together for longer is also likely to strengthen this relationship.

Although HIV is likely present in pastoralist communities, in particular in settled urban and peri-urban communities, the virtual lack of research on HIV and AIDS and pastoralism means the link is currently impossible to establish (Morton 2003; Mason, Bailes et al. 2005).

Summary - how pastoralist diets and livelihoods affect nutritional status

- Generally, nutritional intake is protein rich and calorie poor. This has been linked to the low levels of stunting and high levels of wasting found in pastoralist populations.
- Higher milk intakes, as well as increasing the number of different foods consumed, is protective against wasting.
- Iron deficiency anaemia is the most common micronutrient deficiency disease described in the pastoralist literature. Whether this is due to the low levels of iron in milk or to infection is not clear. Risks for vitamin C and vitamin A deficiency are also identified where fruit and vegetable intake is low. Dietary diversity is an important factor linked to the presence or absence of dietary deficiency disease.
- Outside of drought years, the pastoral livelihood is more resilient to seasonal variations, as milk yields increase much more quickly than food production from cereals once rains arrive. Social ties that emphasize the sharing of resources also strengthen this resilience.
- Where seasonal levels of wasting do occur, they happen at a different time from the normal 'hungry' season or 'cereal gap' seen in agrarian populations.
- Pastoralists are more vulnerable to long-term food insecurity such as drought over several years, because of the time it takes to rebuild herds. Large annual fluctuations in nutritional status are seen in response to successive drought years.
- Participatory assessments and research shows that pastoralists themselves are able to make rapid and logical associations between livestock health and production, milk supply and human health and nutrition.
- Early introduction of animal milks to the diets of infants under six months is a risk factor for malnutrition and morbidity. The reasons behind this practice are debated and include a belief that additional foods to breast milk provide important nutrients and/or can supplement low breast milk volumes; to shorten birth intervals and increase fertility; and to preserve maternal nutritional status.
- Whilst late introduction of appropriate complementary foods is likely to be a risk factor for malnutrition in children more than six months, it is in the older children (24-59 months) that the highest prevalence of malnutrition is demonstrated. This may be linked to a number of factors including body shape.
- Whilst maternal nutritional status has been noted to be highly seasonal in some pastoral populations, the link with low birth weight and infant nutritional status is not well studied.
- The increasing trend of settlement and commercialization in pastoralist

communities can offer opportunities for market exchange and better access to health care. However, it also equals significantly less access to milk and, often, higher levels of infection.

- Whether wealth is an important determinant of nutritional status in pastoralist communities is debated. Some studies have found that the sharing of resources between social groups reduces the effect that wealth might have on dietary intake and nutritional status. Other studies, particularly in the context of commercialization and sedentarization, have found that wealth is a determinant of the amount of milk consumed (rather than sold) and that this milk-cereals tradeoff may put young children at risk of malnutrition.
- Poor access to health care, particularly prevention and treatment services for measles, diarrhea, malaria and acute respiratory infection, has important implications for nutritional status in these communities. The impact of zoonoses on the health status of pastoralist populations is poorly described.
- Although the presence of infection and low vaccination coverage is associated with poor nutritional status in pastoralist communities it is not clear in which direction causality lies. Pastoralist children have been shown to present with lower rates of infection than those in settled (previously pastoralist) communities.

7. Program strategies used to enhance milk supply and consumption

There is a dearth of evaluation and impact assessment of programs that have specifically aimed to improve the nutritional status of pastoralist children. Where they do exist they have rarely documented impact on the final outcome indicator i.e. nutritional status, well. Livestock interventions however, are reasonably well covered in the literature. Although many of these interventions have primarily focused on impacting livestock and livelihood outcomes (such as animal health, milk yields and financial security), they often make reference to the potential impact of these interventions on food security and human nutritional status.

Breast milk and animal milk: Improving feeding practice for young pastoralist children

Three articles detailing interventions that have aimed to enhance maternal nutrition, breastfeeding and complementary feeding practice in pastoral communities (Somali, Borana, Pokot and Iranian) were found. The first documents the launch of a two year community-based health intervention pilot program in a Pokot pastoral community in western Kenya but without providing any measure of impact (Ettyang 1999). No follow-up report could be located.

The second more recent report presents the 2008 assessment results of the human health component of an SCUS integrated development project in Somali and Oromiya Regions of southern Ethiopia known as LEAP or Livelihoods Enhancement for Agropastoralists and Pastoralists (Catley, Bekele et al. 2008). Results of impacts on vaccination coverage, breastfeeding practices, maternal health, adoption of positive nutritional practices, and knowledge of HIV transmission are presented against SC global indicators where relevant. Measures of child nutritional status are not included.

The Iranian project used a community-based education strategy to change practice around feeding and care of children in nomadic pastoralist groups. The findings suggest that in this community, educational interventions involving parents and/or other family members who might play a role in caring for young children could improve child growth even under conditions of poverty (Salehi, Kimiagar et al. 2004).

Livestock development and humanitarian interventions

Pastoral development projects in Africa have often been framed around food security

objectives, with a wide range of projects being evaluated in terms of their technical and social approach, geographical focus, and duration and level of funding. The relatively large-scale programs, supported by donors such as the World Bank and African Development Bank, have tended to be multi-sectoral and covered natural resource management, livestock production and health, livestock marketing and related capacity-building support. These often worked through government partners or 'pastoral associations'. From the 1970s to the mid 1990s, the success of these projects in terms of development objectives seemed to be very limited. For example, Scoones noted how livestock development in dryland areas of Africa during the preceding 30 years was considered by many to have been a disaster (Scoones 1994), and according to Chambers, *A history of pastoral 'development' in the drier areas of sub-Saharan Africa would read like the afflictions of Job. Few domains can claim such consistent failure* (Chambers 1997). Another general experience is that very few projects have attempted to measure impacts on human food security, and assumed that improved grazing, livestock production or markets would automatically lead to benefits for people. Looking specifically at milk production and consumption, similar assumptions were made about livestock development programming and its direct links to household milk supply. Despite past performance and limited evidence of impact on livelihoods or nutrition, in early 2009 large-scale pastoral development programs are still being designed and implemented that follow very similar models and approaches to the earlier projects.

More localized and smaller in scale are a diverse group of NGO pastoral development projects, using various multi-sectoral and sector-specific approaches. These projects include a range of emergency and rehabilitation interventions, often related to drought. In part, in international NGOs these approaches reflect their global organizational aims and strategies, and sectoral experience or expertise. However, in common with larger bilateral or multilateral programs, the explicit linkages between interventions and human nutrition impacts are poorly documented and rarely measured. For those agencies with a child focus, such as Save the Children, the need to examine the impact of pastoral livestock programs on child nutrition was raised in the late 1990s (Catley 1999) and over time some of their program evaluations have asked questions about milk production and use (see below).

Improving animal health to increase milk supply to children

Veterinary interventions have been one of the most commonly-used approaches to improve food security in pastoral areas, both in development and relief projects. The underlying assumptions for this are discussed under section 6 above.

- **Conventional studies and research**

The methodological and study design issues discussed under section 6 help to explain why so few veterinary project evaluations attempt to quantify impact on milk supply. Various evaluations of veterinary projects make either very general qualitative statements about milk production, or state that the assessment of disease impact on milk production was not attempted (Groot 1997). In addition, there are often basic weaknesses in the monitoring and evaluation of veterinary projects which hinder detailed analysis of the possible impacts of disease control. For example, many projects report veterinary activities using indicators such as the absolute numbers of livestock treated for a given disease within a project area, without reference to the population at risk from the disease in question. Therefore, it is often difficult to determine the proportion of affected animals which were treated in a project area (Catley, Abebe et al. 2009).

In the literature search for this review, only one formal study was found on the impact of veterinary interventions on milk production. Conducted in northern Kenya, the study compared production variables in two camel herds with and without a veterinary program (Simpkin 1985). The mean milk yield over an entire lactation period was 1,146 liters in treated camels (n=26) compared with 687 liters in non-treated camels (n=16). The mean

length of lactation was 13.1 months in treated camels and 9.4 months in non-treated camels. This finding is relevant to *Milk Matters* because it indicates that a comprehensive veterinary program can improve milk production both in terms of the volume of milk supply and the duration of lactation. Although valuable as a rare example of herd monitoring, the small sample size reflects the practical difficulties of this kind of research.

- **Pastoralist views**

In northern Kenya, an evaluation of a community-based animal health worker (CAHW) project in Wajir compared households with and without access to CAHWs (Odhiambo, Holden et al. 1998). The CAHWs reduced annual mortality in camels, cattle and sheep and goats by 31%, 32% and 25% respectively compared with annual mortality of 20%, 17% and 18% in areas without CAHWs. The reduced loss of livestock was valued at approximately USD 350 for each household in the project area and this sum was sufficient to buy grain to feed two adults and two children for 250 days. The evaluation did not describe impacts on milk supply or consumption.

In South Sudan, participatory evaluation including a cost-benefit analysis of rinderpest control was conducted as part of an evaluation

Box 1: The cost-benefit of rinderpest control in southern Sudan (Blakeway, 1995)

Short-term benefits through reduced rinderpest mortality

- Rinderpest mortality is highest in younger cattle, less than 3 years of age. Around 60% of this age group will die during an outbreak, and outbreaks occur every 2 to 4 years (average 3 years).
- Using proportional piling to assess herd age structures, around 38% of cattle were less than three years of age.
- Assuming a cattle population in the south of 4 million (1995 estimates), 304,000 cattle would die from rinderpest each year. Market value of young cattle was $25/head.

Based on these assumptions and a control program which protected up to 50% of the total cattle population, the immediate saving was $3.8 million per year.

Long-term benefits through increased production and related to food aid

In the absence of rinderpest, the cattle population would grow at around 7% per year. Proportional piling indicated an average herd composition of 40% adult cows. A cow calves every 2 years and produces about 1.3 liters of milk per day for human consumption for most of the year.

Based on these assumptions, rinderpest control would produce 72,800 liters of milk per day.

- 3 liters of milk provides the daily calorific needs of an adult person. Other livestock-derived foods (direct and indirect) contribute another 75% of food needs relative to milk. Rinderpest is controlled in only 50% of the cattle.

Based on these assumptions, cattle-derived foods after rinderpest control would feed 21,000 people.

- WFP provides 400g of cereal per person per day. Food aid provision in southern Sudan costs $1,000 per metric tone.

Based on these assumptions, 21,000 people would require 3001 metric tones of cereal costing around $3 million (the total food aid delivered to southern Sudan in 1994 was 21,844 metric tones). The combined short- and long-term benefits of rinderpest control amount to $6.8 million.

Cost-benefit ratio of rinderpest control compared with food aid

- The total cost of the UNICEF-OLS Livestock Programme in 1994 was $500,000, of which $200,000 was for hard inputs i.e. vaccine and vaccination equipment; assume benefits to 21,000 people as described above. The hard inputs of food aid to provide the same food benefits to 21,000 people costs $3 million.

The cost-benefit ratio of rinderpest control is 0.5/6.8 = 1:13.

Ignoring staff and logistical costs, the input cost ratio for rinderpest control versus food aid to achieve the same level of benefit is 0.2/(3.0 +3.8) = 1:34.

Community-based animal health workers in South Sudan

During the last 10 years or so, various NGOs have assessed the impact of CAHW projects in pastoralist areas using participatory impact assessment approaches and methods. The reports provide qualitative insights into impact, and to varying degrees, describe and attribute project activities to changing livestock disease impacts and milk supply or consumption (Nalitolela and Allport 2002; Dejenu 2004; Admassu, Nega et al. 2005; Abebe, Cullis et al. 2008). An example is provided in Table 3.

Due to the potential impacts of protecting livestock assets and reducing production losses, veterinary interventions are important in pastoralist areas and often prioritized by pastoralists themselves. However, as with any type of programming, badly designed and delivered interventions have limited impact. For example, in Ethiopia livestock vaccination was regarded as a normal and useful response

Table 3: Impact of a community-based animal health project in northern Tanzania (Nalitolela and Allport 2002)

Rank	Location Ngage	Loiborsoit	Ruvu Remit
1st	Increased milk availability	Increased milk availability	Increased milk availability
2nd	Milk available for sale as previously this was not possible	Improved human health due to ability to foot health bills	Increased income from the sale of cattle has allowed an increase in cultivation
3rd	Ghee available for children	Increased income	Increased ability to provide schooling for children
4th	Increase in livestock population	Improved ability to educate children	Increased ability to build good houses
5th	Increase in livestock trade and income	Improved quality and cleanliness of clothing	Improved human health
6th	Increased ability to pay school fees and contribute in community development projects	Increased area under crop cultivation	
7th	Good meat available for traditional meat eating camps, locally known as Orpul	Increased ability to build better housing	
8th	Improved human health	Availability of good quality meat improved	
9th		A sense of well-being resulting from having a larger herd	

in pastoralist areas during drought by technical agencies such as the Food and Agriculture Organization. However, a combination of weak design of vaccination programs and poor delivery led to limited impact (Catley, Abebe et al. 2009).

Increasing livestock ownership to provide milk to pastoral children

Various livestock interventions aim indirectly to improve food security by assisting pastoralists to increase livestock holdings. The veterinary interventions outlined in section 7 often aim to reduce livestock mortality and therefore, assume that more cows will survive and calves and milk will follow. Similarly, livestock feed projects reduce mortality and may safeguard milk production, at least in part (see section 7). A more direct and immediate approach to increasing livestock holdings is the provision of animals to pastoralists, and this has occurred most commonly (or at least is well documented) through 'restocking' projects. In pastoralist areas, these projects have been implemented as part of a post-natural disaster rehabilitation strategy (Hogg 1985; Aklilu and Wekesa 2002; Burns and Suji 2008) or as a means to assist the re-integration of returnees back into pastoralist communities (Catley and Blakeway 1997; Wekesa 2005; SCUK 2007).

Over time, various best-practice guides to restocking have been published (Oxby 1994; Kelly 1997; Heffernen, Nielsen et al. 2004; LEGS 2009 in print) and some of the common issues that emerge include:

- The need to carefully target recipient households and select people with previous herding expertise who wish to return to a pastoral way of life. These criteria tend to omit former pastoralists residing around urban centers who do not wish to return to pastoralism. As these people can be among the poorest people in a pastoral area, restocking does not necessarily target the poorest or most vulnerable.
- The need to understand and where possible, complement indigenous restocking systems. Pastoralists often have their own traditional ways of providing animals to poorer households, and therefore there is local knowledge on how to target recipients and the types and numbers of animals which should be provided.
- Although the introduction of 'improved breeds' seems to be an appealing approach for many external agencies, restocking should be based on local indigenous types of livestock which are well-adapted to the environmental conditions and disease challenges in pastoral areas.

- **Restocking and humanitarian assistance**

Restocking as a disaster response strategy has been used in pastoral areas since at least the early 1980s (Hogg 1985), and when designed and implemented well fits the livelihoods aspirations of pastoralists. However, the repeated use of restocking in the Horn of Africa reflects the failure of pastoral development and emergency programming to address depletion of core assets due to drought. In very different pastoral areas, such as Tibet, restocking has been proposed as a means to assist poor pastoralists to become more viable (Nori 2004). It is far more cost efficient to enable sale of some livestock while also protecting core assets (such as a specified number of adult breeding female livestock) during a disaster, than replacing these assets afterwards (Abebe, Cullis et al. 2008; Catley, Leyland et al. 2008).

Some evaluations and studies indicate that when restocking is carefully designed, the impacts include nutritional benefits. For example, Lotira (2004) interviewed restocked pastoral households in northeast Kenya 18 months after the receipt of livestock and recorded sources of food before and after restocking (Figure 2). It was also noted that,

> *During the wet season an average of 12 sheep and goats were lactating per beneficiary family, each one producing a daily average of 1 liter of milk, and 7 liters of milk available for daily home consumption. Whereas in the dry season an average of 8 shoats were lactating*

> *each producing an average of 0.5 liters of milk daily, and 2 liters of milk was available for daily home consumption* (Lotira 2004).

In common with many evaluations, the assumption was that some of this milk from livestock was fed to children, although the amount consumed by children was not measured.

Although not in a pastoral location, one small scale project that has attempted to examine the nutritional impact of providing goats to rural families in highland Ethiopia is the 'Dairy Goat Project' (FARM Africa). Post intervention evaluation found a significant increment in milk availability to participating households and, in a small subsample, almost all households were consuming the extra milk at home, with 55% of the milk given to children in drinks or mixed with porridge (Ayele and Peacock 2003). No direct assessment of child nutritional status was made however.

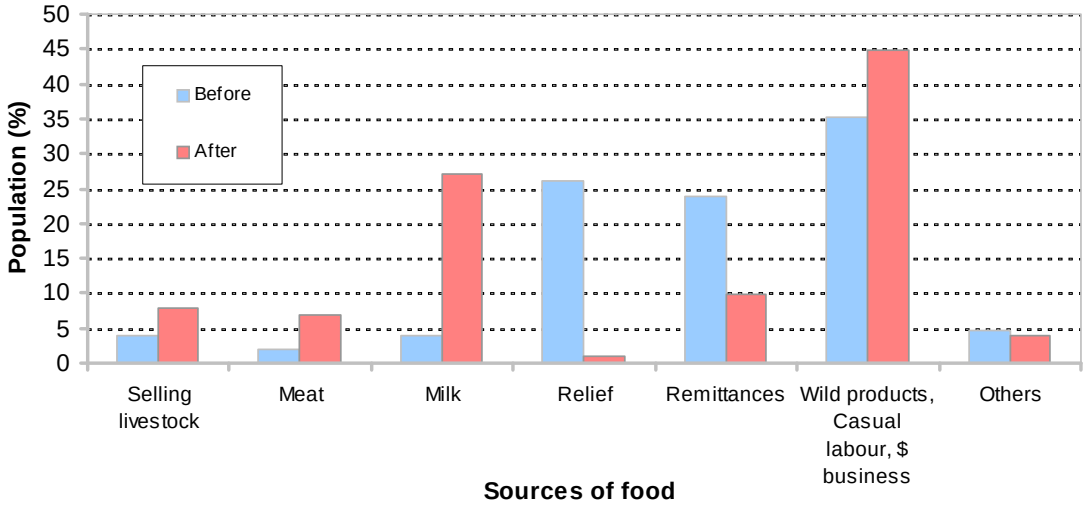
- **Provision of livestock to returnees and IDPs**

The provision of livestock has been used as a means to assist the re-integration of returnees and internally-displaced people (IDPs) in pastoral areas. Although not exclusive to pastoralists, the large-scale Programme for Refugee Reintegration and Rehabilitation of Resettlement Areas in Eritrea included provision of livestock to former pastoralists (Catley and Blakeway, 1997). Monitoring data indicated that milk was the third most important benefit derived from livestock among returnees, but the data was not specific to pastoralists and information on consumption or uses of milk was not recorded. Working in Somali agro-pastoral areas in Ethiopia in the mid 1990s, SCUK provided sheep and goats to 616 female-headed returnee households. A preliminary evaluation noted that,

> *Those respondents whose sheep and goats have delivered told the team that on average, sheep produce about 500ml of milk whereas goats produced 800ml. About one third of milk is given to children in the breastfeeding stage* (goat milk only) *and the rest is used for home consumption. After the breastfeeding stops, almost all the milk is left for children* (SCUK, 1997b).

More recently, SCUK used restocking to assist the return of 500 IDP households to pastoralism in Fik zone in the Somali region of Ethiopia, with 75% of restocked IDP households resuming a pastoral lifestyle 18 months after the end of the project (Wekesa, 2005). The evaluation also stated that,

Figure 2: Sources of food for restocked pastoral households in north east Kenya, before and after restocking (from Lotira, 2004)



> *… evidence shows that nutritional and dietary status of households, especially among children has improved. All the 51 households interviewed in 6 different sites claimed that the restocking had had a positive impact on the health of their children due to increased availability and accessibility to milk, meat and income to purchase cereals and medicine. Milk was provided to children at least 3 times a day; in the morning; at lunchtime and in the evening. The milk was served along with other foodstuffs, mainly maize or sorghum meal.*

Water, feed, pasture and range management

For more than 50 years pastoral development programs have attempted to improve pastoral livestock production through introducing pasture improvement and range management techniques. In Africa, often framed within a technology transfer mode of development, these approaches viewed pastoralism as inherently inefficient and in need of improvement and control. Experiences were summarized by a multidisciplinary NGO team in central Somalia:

> *The second approach* (to pastoral development) *which has been tried over and over again since the early colonial times everywhere in Eastern Africa, was the attempt to conserve and/or rehabilitate the open range by controlling livestock numbers and regulating livestock movements through government interventions. This has not only been a story of total and dismal failure, but has been counterproductive in all those instances where and when it was done in conjunction with forced sedentarization* (Janzen, Schwartz et al. 1992).

However, in the early 1990s conventional range science theories were challenged by research which showed that traditional pastoral livestock production based on mobility could actually outperform more modern ranching systems (Behnke and Scoones 1992). The new thinking argued that pastoral systems were already productive and could remain so if mobility and opportunistic use of rangelands could be supported. Over time, more localized, participatory and community-based natural resource management approaches have been used in pastoral areas, with growing recognition of the strong indigenous knowledge and traditional institutions of pastoralists (Homann and Rischkowsky 2005; Ridgewell, Mamo et al. 2005). However, there seems to be limited information available on the livelihoods impact of these projects, or production and consumption benefits. Simultaneously, in some areas there has been a decline in rangeland quality associated with increasing water points (especially boreholes) and sedentarization. Research in pastoral areas such as Wajir in northeast Kenya and the Somali region of Ethiopia (Sugule and Walker 1998), and Borana areas of Ethiopia (Homann, Rischkowsky et al. 2008) are examples of environmental change and reduced livestock productivity associated with inappropriate development interventions. In some areas these trends are compounded by encroachment of land by woody plants which reduce grazing quality and availability (Dalle, Maas et al. 2006). Among the few positive evaluations of water development are participatory evaluations in Somaliland, where pastoralists scored water sources against 46 indicators, including *good for milking animals* (ActionAid 1999). Well rehabilitation and better water supply was also associated with healthier and more productive livestock in Niger (Burns and Suji 2008).

The use of cultivated fodder, crop residues or other feeds to feed pastoral livestock is a normal part of some pastoral systems. In West Africa, Sahelian transhumance can involve reciprocal agreements between pastoralists and sedentary farmers in which fodder is purchased by herders, or livestock graze harvested fields and provide manure. In Afghanistan, Kuchi pastoralists routinely buy livestock feed from farmers during the winter, or graze their animals on fallow fields whilst paying rent (Fitzherbert 2007). In terms of development interventions, supplementary

feeding of livestock using high quality concentrate or cultivated fodder is a well-known strategy for improving livestock production, including milk production. Various approaches are described in standard tropical animal husbandry and management textbooks (Payne and Wilson 1999), and are taught in animal science and production courses in colleges and universities. Perhaps for this reason, a wide array of 'improved fodder' and fodder production projects have been attempted in pastoral areas, but with very limited evidence of success.

Although often assumed to have inherently weak production characteristics, indigenous pastoral breeds can respond well to supplementary feeding (Melaku and Betsha 2008) and indeed, livestock sourced from pastoral areas are often fattened in other areas before sale to domestic or international markets (Aklilu 2002). In terms of the use of supplementary feeds, the challenges seem to relate more to the economics, availability and delivery of these feeds to pastoral areas rather than the inability of pastoral livestock to respond in production terms. For poorer households, there may also be affordability issues.

For drought preparedness and response interventions, feed banks and feed supplements have also been used. In Niger, livestock feed banks were established under community management as a means to make livestock feed available and affordable during drought (Burns and Suji 2008). Concentrate feed, wheat bran, cotton seed and salt were used, and during an impact assessment informants associated use of the feed banks with healthier and more productive livestock, and specifically mentioned milk production as a benefit. Between 40-50% of this milk was consumed and the rest was sold or given away as a gift. Milk consumption by children was not recorded.

In northern Kenya, livestock feed supplementation was used in drought response projects in pastoral areas (Aklilu and Wekesa 2002), and has been used in Afar, Borana and Somali areas of Ethiopia during drought (Demeke 2007). During drought in 2008 SCUS implemented a supplementary feeding project in Borana based on 10 feeding centers with 6,750 cattle (Bekele and Tsehay, 2008).

Supplementary feeding of cattle during drought in Borana areas, southern Ethiopia

Two of the feeding centers were assessed in detail and 48.6% (191/393) of cows either returned to milk production, or began milk production following the birth of calves while in the feeding centers. These results were compared to the performance of cows outside the feeding centers, where lactation ceased. In one center the mean daily milk yield was 0.7 l/day (95% CI 0.44, 0.97; n=46) and the estimated total milk production was 2,276 liters while cows were fed in the feeding center. In the other feeding center the mean daily milk yield was 0.9 l/day (95% CI 0.64, 1.22; n=63) and the estimated total milk production was 3,364 liters while cows were fed in the feeding center. Informants stated that this milk was fed to children. Based on mortality, body condition, milk production and calf survival estimates, the cost-benefit of the project was estimated at between 1.6:1 and 1.9:1.

Traditional milk preservation

Most pastoral societies in the Middle East and Asia have a culture of using surplus animal milk to make into cheese and other preserved forms of milk. This is rarer in pastoral sub-Saharan Africa, though is practiced by Fulani and Arab pastoralists in the Sahel and Sudan. Warda et al. give detailed descriptions and chemical analyses of the many different types of preserved dairy products made by pastoralists in Sudan (Warda, Abdelgadira et al. 1998). Somali pastoralists use short-term milk preservation methods such as souring camel milk in smoked containers, or boiling milk (Mohammed 1993). As this holds good potential for both improving access to milk products during the dry season and for income generation, several development interventions and commercial ventures have sought to improve the technology of milk preservation, as well as create a market for a pastoral dairy product. However, this review could not find any published article that discussed the impact of these interventions specifically.

Milk and markets

Several authors comment on the potential for dairy marketing (i.e. the sale or exchange of milk) as an appropriate survival strategy particularly for poorer households. Promotion of income-earning dairying opportunities for pastoral women should be based on ensured, proven market demand and should be carefully targeted at those women who have the need, ability and interest to be involved in dairy marketing (Sikana, Kerven et al. 1993).

In Somalia, a well-organized camel milk trade to supply the capital Mogadishu started in the early 1970s and was described by Herren (1990):

> *This* (milk) *chain is entirely local and in the hands of women milk traders, called abakaar. It manages to handle between 1.5 and 5 tons of camel milk, daily, reliably, and at an affordable price, from highly mobile nomadic camel herds 100-150 km from Mogadishu. It does so without any external input (expatriate or other), whether technical know-how or capital. The pastoral producers have geared their production and movements to the milk chain, so that in most camel-owning households, milk sales dominate in their total cash income. This is however not to say that pastoralists in the study area are 'commercial dairy producers'. Their basic outlook has remained subsistence oriented* (Herren 1990).

Transport of milk from southern Ethiopia for sale to Mandera

The same research described the impact of milk sales and noted that income from camel milk sales *clearly dominated other income sources*. In southern Ethiopia there is a dynamic milk trade over the border to Mandera town, again organized by women.

According to workers in Ethiopia in the early 1990s, the associated short and long term risks (reduced milk production, calf mortality and effects on human nutritional status) of significant milk sales should be reduced by appropriate interventions such as alternative income opportunities, improved calf feeding management and nutritional education (Holden, Coppock et al. 1991). However it is unclear if these additional interventions were ever attempted and if so, what impact was achieved.

The potential to develop processing and markets for camel milk as a source of income for pastoralists is endorsed by FAO (Food and Agriculture Organization of the United

Nations) and has been commercially successful in several countries that have large numbers of pastoralists that keep camels. FAO see the potential for camel milk marketing as massive, but as yet investment in this sector has been small. One successful project is the Laitière de Mauritania, which buys camel's milk from thousands of nomads in Mauritania, processes and sells it in the cities as well as for export (Smith and Duebel 1997).

In northern Kenya, an OFDA-funded project implemented by Tufts University and AU/IBAR supported women's groups to set up small dairies for processing and sale of milk. The intervention was assessed in terms of the viability of the dairies as small businesses and recent development includes the commercial sale of camel milk for packaging and supply to local supermarkets and for export (Odhiambo 2006).

The Loglogo women's dairy in northern Kenya

Other strategies

Commercial destocking as a response to drought

As a response to drought, commercial destocking is intended to enable pastoralists to sell some of their animals before they become worthless and die. The approach is a form of cash transfer, and pastoralists can then buy the goods and services which they prioritize. In a commercial destocking project in southern Ethiopia households received an average of US$186 from cattle sales and spent around 28% of this income on food for the family (Cullis, Mekonnen et al. 2007; Abebe, Cullis et al. 2008). Of 114 households interviewed during an impact assessment, all of them stated that they used the income to buy supplementary food for children, although the specific types of food were not detailed.

Cash distributions during drought

Cash distributions have been used as a response to drought in pastoral areas, and households spend a considerable proportion of this income on food (Ali, Toure et al. 2005). Specific information on food purchases by food type and impact on the nutritional status of children was not available.

In Turkana, northern Kenya, recipients of cash-for-work invested in goats (Kimetrica 2007). As an important reason for keeping goats in this area is milk, a nutritional impact on children might be assumed. However, these kinds of impacts need further study.

Food aid distributions

In pastoralist communities food aid is the dominant humanitarian response in areas such as the Horn of Africa. However, there is very limited information on the impact of food aid distributed to livestock-rearing communities. In fact many authors have commented on the continual high rates of child malnutrition across pastoral areas despite this assistance (see section 3). According to some authors food aid has been a valuable source of fodder for livestock in some pastoralist areas (Abebe, Cullis et al. 2008; Buchanan-Smith and Fadul 2008). Therefore, there may have been some indirect benefits in terms of livestock survival or even milk supply.

In Kenya, milk powder has been included in food distributions to pastoral areas since at least 2003 (Anon 2003), and was still being used in early 2009. This strategy poses risks for infant and young child feeding, and international policy and guidelines state that any distribution of milk products should be governed by strict criteria (WHO 1981; UNHCR 2006; IFE 2007).

Safety nets

Safety net programs are a relatively recent development in pastoral areas, and limited information is available on nutritional impact.

Summary - program strategies used to enhance milk supply and consumption

- In terms of breastfeeding practices, only one impact assessment of breastfeeding interventions with pastoralist women was found for this review. The assessment showed very limited changes in behavior and practice against Save the Children global indicators.
- A number of strategies to increase animal milk supply for pastoralist populations are discussed. These include increasing the number of milking animals, improving animal health, improving livestock feed and water, milk preservation and market-based interventions. However, while many of these interventions have been designed and implemented with explicit food security objectives, very few demonstrate clear linkages between changes in livestock health and production, or household incomes, with food supply and consumption at household level. Even fewer impact assessments or evaluations examine nutritional impacts on children.
- As so few research projects or evaluations have directly measured impact on human nutritional status, it is difficult to draw firm conclusions about 'best bet' interventions for enhancing milk supply to children. However, there is some evidence that veterinary care improves pastoral food security when delivered during 'normal' periods while approaches such as commercial destocking, livestock feed supplementation and feed banks have benefit as drought response measures. Restocking, when well designed and implemented, could also support human nutritional status but as a post-disaster measure to rebuild assets, has so far failed to prevent asset loss during drought.
- Interventions that support commercial dairying (or sale of milk) hold promise for improving the livelihood security of pastoralist households. However, such strategies need to be aware of potential negative outcomes for poorer households such as reduced milk production and higher calf mortality, due to increased levels of milk offtake and reduced mobility.

8. CONCLUSIONS

This review highlights the ongoing problem of child malnutrition in pastoral areas of sub-Saharan Africa, particularly during drought years when access to milk is significantly reduced. It discusses the importance of milk and milk products in the diets of pastoralists and the critical contribution it makes to improving dietary quality for women and young children. There are many challenges however to ensuring a sufficient and constant supply of milk in pastoral communities. These include the impact that more frequent drought and animal disease has on milk supply and the increasing trend of settlement and commercialization in some areas.

There are several important gaps in our understanding of factors that might influence the pastoralist child's access to animal and breast milk and ultimately their nutritional status. Firstly, despite the mass of research and programming there is very little work that has specifically aimed to improve milk supply to pastoral children. Where programs have aimed to directly or indirectly improve milk supply there is no evidence of the impact of these programs on the nutritional status of children. With these findings in mind, there is a need to continue to support the range of livestock interventions that are currently used in pastoral areas, but also to invest in better monitoring and impact assessment to enable a deeper understanding of the possible benefits of these projects on child nutrition. More information on the prevalence of micronutrient deficiencies and of zoonotic disease in these populations is needed, as is a better understanding of the relationship between wealth, social ties and dietary

quality. Before we invest more in educating mothers on recommended breastfeeding practice, there is a need to further explore the logic underlying practices like the very early use of animal milks for infant feeding in pastoral communities and the impact of this on the nutritional status of infants. This would help to improve the design of interventions aiming to change infant and young child feeding practice.

The literature indicates that nutritionists and pastoralist or livestock experts have often worked in isolation, and assessed strategies using their own sectoral interests and methodologies. Participatory assessments and research shows that pastoralists themselves make rapid and logical associations between livestock health and production, milk supply and human health and nutrition. The need to improve intervention in pastoral areas, both to strengthen pastoral livelihood systems and to alleviate the impact of drought, has been highlighted before (Aklilu and Wekesa 2002). There are now opportunities to use a combination of quantitative and systematic participatory approaches and methods to link human nutrition and livestock information which, for external actors at least, tend to exist as two separate bodies of knowledge. This would go some way to providing a better understanding of the most appropriate and effective responses in pastoral areas to protect the nutritional status of children.

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