



LEGS

Livestock Emergency Guidelines and Standards

Livestock and Nutrition

A Discussion Paper for the Livestock Emergency Guidelines and Standards (LEGS)

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ABBREVIATIONS

ASF	Animal Source Food
AVSF	Agronomes et Vétérinaires Sans Frontières
EED	Environmental Enteric Disorder
ENN	Emergency Nutrition Network
FAO	Food and Agriculture Organisation
ILRI	International Livestock Research Institute
MIYCN	Maternal, Infant and Young Child Nutrition
MUAC	Mid-Upper-Arm-Circumference
SDG	Sustainable Development Goal
VSF	Vétérinaires Sans Frontières
WASH	Water, Sanitation and Hygiene
WELI	Women's Empowerment in Livestock Index
WHO	World Health Organisation

Introduction

Malnutrition represents the single most important threat for children worldwide and brings about substantial impacts both on humans (health and cognitive) and economic potential (Bhutta et al 2013). Globally, almost 200 million children under 5 suffer from stunting, wasting, or both and at least 340 million from vitamin and mineral deficiencies (see Box 1). In recent years, the reduction of malnutrition has become a top policy priority in low- and middle-income countries and whilst some declines are encouraging, most parts of the world are currently not on course to meet targets for the Sustainable Development Goal (SDG) era (UNICEF 2019).

This discussion paper was commissioned by LEGS to review the key issues relating to nutrition in the context of livestock-based emergency interventions, with particular attention to the following key topics:

- The contribution of livestock to nutrition at household level
- The impact of emergencies on this contribution
- The nutritional benefits of appropriate livestock-based emergency interventions

The aim of this report is to provide detailed recommendations for the LEGS Advisory Committee on how nutrition can be better represented in the revised edition of the LEGS Handbook and the wider LEGS programme. The paper presents the outcome of a literature review that summarises key issues for livestock and nutrition. It also presents three short case studies illustrating impacts of livestock emergency responses on nutrition.

Box 1: Types of malnutrition (undernutrition)

The main types of malnutrition include:

Wasting (or ‘acute malnutrition’) is a form of undernutrition that usually indicates recent and severe weight loss, which is often associated with acute starvation and/or disease. Children under five years of age are the most exposed to risks of acute malnutrition, in particular when transitioning from exclusive breastfeeding to complementary feeding. A child is described as ‘wasted’ when its weight in relation to its height is much lower than it should be. It is assessed using anthropometric measures such as weight-for-height or mid-upper-arm circumference (MUAC). The occurrence of wasting often varies seasonally or increases in emergencies such as droughts or floods.

Stunting (or ‘chronic malnutrition’) is a form of growth failure that causes both physical and cognitive delays in growth and development as well as an elevated risk of death. It occurs particularly in the first 1000 days from conception until the age of two due to inadequate maternal and/or young child nutrition. This can be the result of lack of access to adequate foods and/or disease. A child is described as ‘stunted’ when its height in relation to its age is much less than it should be. It is assessed using the anthropometric measure height-for-age. It often coexists with wasting.

Micronutrient deficiency (or ‘hidden hunger’) refers to lack of vitamins, minerals and/or trace elements that are essential for the proper functioning, growth and metabolism of a living organism. Usually caused by poor diets, it is often referred to as ‘hidden hunger’ because its physical symptoms are not obvious, while its consequences can be devastating. It often coexists with wasting and stunting.

Source: Adapted from FAO’s Technical guidance to harness the potential of livestock for improved nutrition of vulnerable populations in programme planning (FAO 2020)

Methodology

A review of key literature built on an initial search and relevant publications were identified through:

- Key informants
- On-line libraries of PubMed and Google Scholar (using search terms 'nutrition' or 'malnutrition' and 'livestock')
- Websites of agencies with an interest in livestock-nutrition linkages such as the Emergency Nutrition Network (ENN), Food and Agriculture Organisation (FAO) and the International Livestock Research Institute (ILRI). On websites with search functions a combination of search terms including 'nutrition', 'malnutrition', 'stunting', 'milk', 'pastoralist', 'livestock' was used
- Further references were identified through snowballing techniques and tacit knowledge of grey literature sources

Case study material was identified from the literature and from discussion with key stakeholders.

Human nutrition and livestock: impact pathways

Livestock are ubiquitous in poor communities across the developing world. An estimated 68 per cent of resource-poor rural households keep some type of livestock (Pica-Ciamarra et al. 2011). Livestock are a source of income and food, support crop production and provide insurance and social status for these households, yet the design of livestock interventions has rarely considered the critical livelihood outcomes of human health and nutrition. Instead these interventions have traditionally involved livestock support for the primary purposes of income generation and poverty reduction (Ruel et al. 2018). However, there has been more focus recently on the potential for nutrition sensitive agriculture¹ and livestock interventions to improve nutrition outcomes, based on increasing evidence that supports the benefits of animal source foods (ASFs) to nutritional status.

Linking livestock and human nutrition

Livestock-related activities can influence the nutritional status of individuals and communities through multiple impact pathways. Not all of these pathways are relevant in all contexts – particularly relevant for emergency affected populations are those that examine the consumption of ASFs, disease transmission and factors that influence these pathways such as income generation, women's empowerment, nutrition knowledge/taboo and care practices. Understanding how these pathways work and how they may coexist or compete can help inform the design of livestock programmes and highlight opportunities to enhance positive nutrition impacts while minimizing potential negative impacts (FAO 2020). These connections have encouraged global efforts within the development and research community to refine current practices in nutrition-sensitive intervention to better target consumption of ASFs and to realise the potential of livestock for nutrition (McNamara and McKune 2018).

The contribution of ASFs to nutrition and dietary diversity at household and/or individual level.

ASFs are micronutrient and protein-rich, with the proteins they contain being good quality and highly digestible and the micronutrients including iron, zinc and vitamins A and B12 that are often lacking in the diets of the nutritionally vulnerable. The bioavailability (i.e. how much of a nutrient can be absorbed and used by the body) of these nutrients is also higher in ASF than in many plant-derived foods (Alonso et al. 2019). For all these reasons, consumption of even small amounts of milk, meat, blood and eggs can contribute substantially to ensuring adequate nutrition. This all marks ASFs as being potentially efficient for improving the quality of diets for the nutritionally vulnerable, especially during periods of high nutritional demand such as pregnancy, lactation, early infancy and childhood, and adolescence.

¹ Nutrition-sensitive interventions are designed to address the underlying causes of malnutrition. As nutrition is affected by access, availability, and quality of food, a nutrition-sensitive intervention may focus on increasing agricultural productivity for own-consumption or sale. Such interventions may serve as an effective platform for nutrition-specific interventions, which directly address the immediate causes of malnutrition – disease and poor dietary intake.

There are some groups, particularly those that rely directly or indirectly on their livestock for food and income (namely pastoralists), for whom ASFs (particularly milk) have traditionally made up a large part of their diet. 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 have been seen to consume between 50 and 90 per cent of their dietary energy in the form of milk and milk products (Sadler et al. 2010). Whilst milk is a valuable source of nutrition for these groups, studies have also noted the importance of diet diversity (see Box 2) to ensure that adequate levels of all nutrients are met (Sadler et al. 2009). For a large proportion of the rural poor ASFs are rarely eaten because they are relatively more expensive than foods from other food groups, they are considered as a 'luxury' and livestock are used primarily for income generation (Alonso et al. 2019). For pastoralists too, access to milk and meat is changing in many communities, impacted by climate change, droughts, seasonality and livelihoods transitioning to sedentarization. Whilst the World Health Organisation (WHO) recommends that ASFs such as meat, poultry, fish, and eggs are critical in the diets of young children, the complementary foods² chosen in most low-income countries do not meet nutrient requirements, specifically micronutrient requirements, which leads to poor growth and malnutrition during the first two years of life (McKune 2020).

There have been many studies in the past 10 years that have found positive associations between livestock ownership, dietary diversity (at household, child and/or women level) and, when measured, with increased intake of essential micronutrients (see Box 2). A recent study in Afghanistan documented an association between sheep ownership, mutton consumption, and decreased anaemia among women of reproductive age, with the authors noting that the results were driven by own-consumption in a situation with imperfect market access (Flores-Martinez et al. 2016). A study of pastoralist households in Kenya (Iannotti and Lesorogol 2014) found cattle and chicken ownership to be a positive determinant of dietary diversity, and livestock ownership in general a predictor of adequate intakes of key vitamins and minerals including vitamin A, vitamin B12, and zinc. A recent agronomy and livestock programme implemented by Agronomes et Vétérinaires Sans Frontières (AVSF) in Mali improved both child and maternal dietary diversity scores during a lean season (Bonde 2016). Several other studies

Box 2: Measuring the impacts of livestock ownership and ASFs on nutrition

Nutrition can be measured directly or indirectly with proxy indicators. Direct measures of nutrition usually involve the assessment of nutritional status using **anthropometry (body measurements)** including weight-for-height and mid-upper arm circumference (MUAC) to assess for wasting and height-for-age to assess for stunting in individuals or populations (see Box 1).

Proxy indicators for indirect assessment of nutrition include:

Dietary/food intake is assessed over a given reference period to obtain quantitative information on the amounts of energy and nutrients consumed and available for the body.

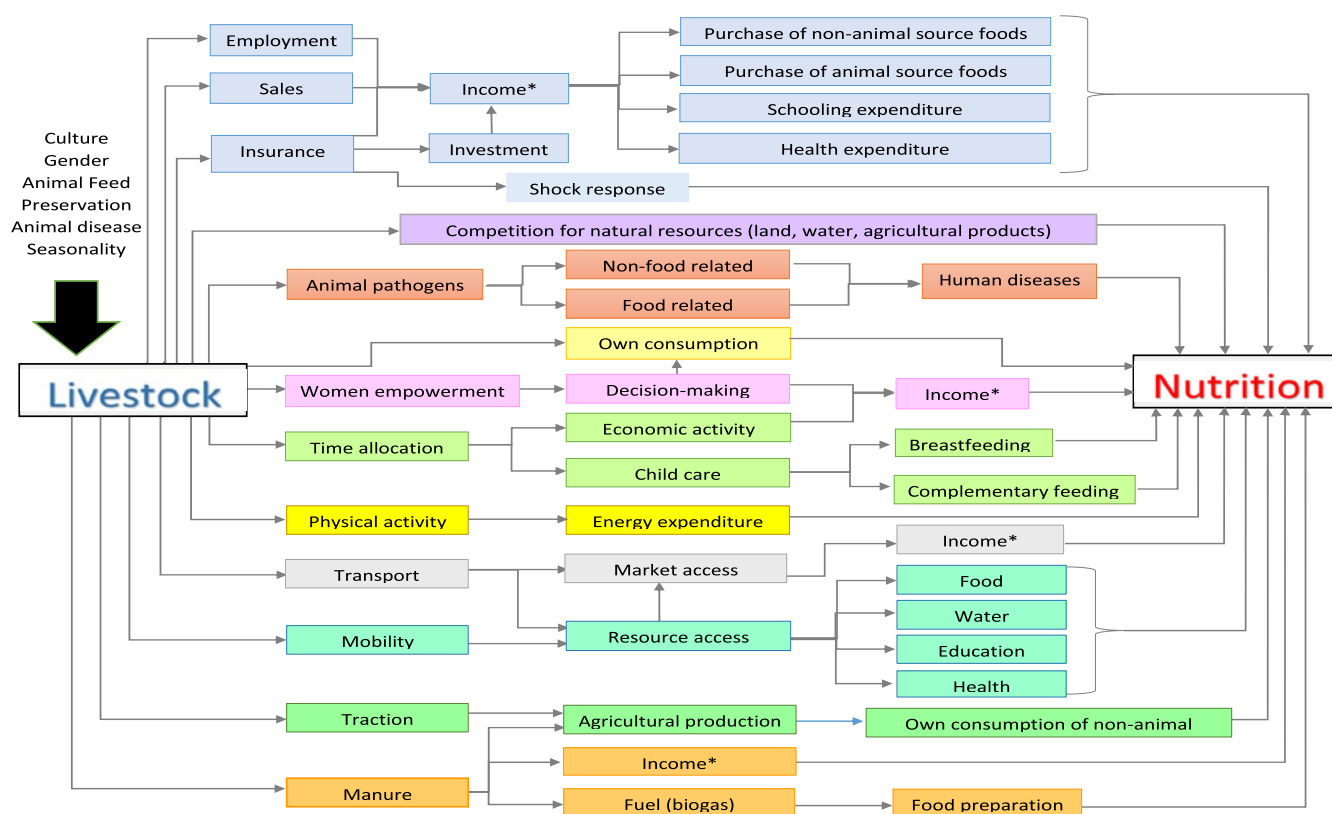
Individual diet diversity, defined as 'the number of different foods or food groups consumed over a given reference period', is strongly associated with the adequacy of nutrient intakes during that period, and it is often used as an indicator of diet quality and nutrition security. There are now well developed indicators for assessing diet diversity in children and women. In pastoralist communities the strong seasonal influence on access to milk and other animal and plant source foods that improve dietary quality needs to be considered in interpretation.

Household diet diversity measures the consumption of different food groups by any member of a given household over a reference period; it is often used as an indicator of food security and household diet quality but does not extend to approximate individual household members' nutritional intake and/or status.

Food security (the state of having reliable access to a sufficient quantity of affordable, nutritious food) is measured at household or community level and is often poorly correlated with the nutritional status of individuals and populations. This is because the process of becoming malnourished lags behind any reduction in food availability/access and because malnutrition has many other causes linked to the health environment and care practices. In pastoralist communities the strong seasonal influence on access to milk and other animal source foods makes this association even weaker.

² Complementary foods refer to those given to young children between 6 months and 2 years in addition to continued breastfeeding.

Figure 1: Impact Pathways from Livestock to Nutrition



Source: Livestock and Human Nutrition Linkages in W.Africa (Domínguez-Salas et al. 2019)

Pathways were identified during the workshop 'Livestock, livelihoods and human nutrition' Senegal, Nov 2014 and build on those identified earlier by Randolph (Randolph et al. 2007).

* Income: supports access to food or non-food (e.g. health care) influences on nutrition

from Bolivia, Ethiopia, Nepal and Tanzania suggest that livestock ownership can significantly increase consumption of nutrient dense animal-source foods by nutritionally vulnerable groups and thereby improve dietary diversity and quality (Broaddus-Shea et al. 2020; Bruyn J. et al. 2018; Hetherington et al. 2017; Jones 2015; Hoddinott et al. 2015)

Evidence of associations between livestock ownership, intake of ASF and nutritional status outcomes (see Box 2) is more limited and much of the evidence comes from observational cross-sectional studies, which do not allow causal inferences (Grace et al. 2018). In addition most studies examine height for age (stunting) only as an outcome, which is usually less relevant than weight for height (wasting) for emergency interventions. One study in Uganda that used panel household survey data to examine associations between livestock ownership and linear growth or child stunting found a positive effect of livestock ownership on child nutrition, with different effects according to child age and animal species. In this study, the role of livestock ownership in sustaining linear growth was more important when there was

limited access to purchased foods and livestock was the only source of certain nutrients (Tiberti et al. 2018). The strongest evidence is seen for the association between milk intake and improved linear growth (height) in children (Dror and Allen 2011). In Ruel et al's recent review of nutrition-sensitive agriculture, four of the studies reviewed confirmed dairy production's association with increased milk consumption and lower prevalence of childhood stunting (or improved height for age) in Ethiopia, Uganda, Nepal and Tanzania (where milk consumption was also associated with reduced levels of wasting) (Ruel et al. 2018). In some of these contexts the magnitude of these associations were greater for households that had limited access to markets and/or were poorer or affected by conflict – all factors particularly relevant for emergencies. In addition early introduction of eggs to the diets of young children is emerging as an important contribution to improved child growth with one randomized control trial in Ecuador showing reduced levels of stunting and being underweight among young children eating one egg a day for 6 months (Iannotti et al. 2017; Iannotti et al. 2014).

The impact of emergencies on the contribution of ASFs

Factors that cause a decline in livestock ownership and reduced access to ASFs including milk have been shown to have a direct negative impact on the nutrition of communities' dependent on livestock. These factors include those common to emergency contexts including armed conflict, drought or flooding that result in animal loss through sales, raids, death and disease (Domínguez-Salas et al. 2019; Abenet et al. 2016; Catley et al. 2018; Chengula et al. 2013; Bauer and Mburu 2017). All of these disrupt many of the impact pathways between livestock and nutrition including those that support food availability and access to a diverse diet through consumption of ASFs, income generation and crop production (see Figure 1). In the context of emergencies there is a particular need to understand the livelihood strategies of affected communities with many examples of livestock keepers prioritising livestock well-being over the nutritional and well-being needs of their households in order to preserve long-term livelihoods (Domínguez-Salas et al. 2019; Young and Marshak 2018). Emergencies can also have a detrimental effect on the health environment, increasing risks to humans for water and food borne disease caused by proximity to animals (see next section).

A common characteristic of emergency affected populations is reduced and low levels of access to functioning markets. Market access, typically measured as distance to the nearest market, comes up in many studies as a key factor that modifies the relationship between production and dietary diversity/quality (Ruel et al. 2018). A pooled analysis of data from Ethiopia, Malawi, Kenya, and Indonesia for example, showed that market access had stronger effects on dietary diversity than did production diversity (Sibhatu et al. 2015). The study documented that reducing distance to market by 10 km had the same effect as increasing farm productivity by one additional crop or livestock species. Overall, market participation in the four countries studied had a greater effect than production diversity, and it reduced the role of production diversity on dietary diversity.

Impact of exposure to animals/animal faeces on child health outcomes

There is on-going debate around the theory that child nutrition and health outcomes in developing countries may be adversely affected by exposure to animals and their faeces. The thinking behind this risk stems from several factors: from the widespread ownership of livestock and pets in developing countries, from the lack of housing and enclosure structures for livestock that separate animals from household members (e.g., scavenging poultry systems), from poor hygiene knowledge and practices, from the common practice of leaving children to sit or play on homestead floors with little monitoring (especially in warmer climates), and, of course, from the very high concentration of potentially harmful bacteria in animal faeces (Headey et al. 2017; Ruel et al. 2018). There is a well-recognized bidirectional relationship between undernutrition and diarrheal illnesses, and some research results suggest subclinical environmental enteric disorder (EED)³ - rather than clinical diarrhoea—is the primary causal pathway from poor sanitation and hygiene to stunting (Mbuya and Humphrey 2016). Some of this research also hypothesizes that while the more pathogenic bacteria in human excreta may be the more important cause of diarrheal illnesses in young children, animal excreta may be an important reservoir of the bacteria that are capable of causing the chronic subclinical damage to the gut, which is characterized as EED. Consistent with an infection/EED pathway, several studies have found that the presence of animal faeces in household compounds is negatively associated with child nutrition outcomes such as height for age and weight for height (Headey et al. 2017; Gelli et al. 2019; Caron et al. 2018). This association is likely to be stronger in emergency contexts where health environments are compromised and care practices such as handwashing with soap is challenging. Other work in Chad has shown that hygiene practices and cattle numbers are correlated with acute malnutrition, with a clear and positive association between livestock concentration at the village level, and levels of malnutrition (wasting).

³ EED is characterized by chronic damage to the small intestine, which inhibits the absorption of nutrients, but also triggers a low-level immune system stimulation (inflammation) that diverts resources away from physical and cognitive development, and leaves children more exposed to infections.

However, evidence that demonstrates an association between poor water, sanitation and hygiene (WASH) practices more generally and malnutrition is somewhat limited and inconclusive.

A series of studies called the SHINE trials⁴ have examined the impacts of nutrition and WASH programmes on child nutrition and diarrhoea, and concluded that: 'WASH programmes provide many benefits including security, time savings, dignity, and gender equity. However, findings from our trials indicate that even rigorously implemented WASH programmes cannot be assumed to achieve the child physical health benefits they are usually designed to address: child health benefits can only be claimed if they are measured. We recommend that evaluations of WASH programmes do not rely solely on process, behaviour change, or exposure indicators, but also incorporate direct measurement of enteropathogenic infection' (Pickering et al. 2019). These findings have re-ignited the debate amongst nutrition and WASH researchers regarding the linkages between poor sanitation and nutrition⁵. However, there is agreement that, while more evidence is building and given the association between diarrhoeal infection and nutrition, improving access to sound WASH practice should remain an important consideration for programmes that aim to address malnutrition (WHO 2015).

The role of factors such as gender, care practices, income and knowledge on impact pathways between livestock and nutrition

Income

Livestock has long been used as a source of income and in many communities and contexts this is prioritized over use as a direct source of food (Domínguez-Salas et al. 2019). Livestock activities generate income for livestock keepers in various ways including sale of live animals, ASFs, non-food products such as skins and wool and through provision of various paid services such as draught power. It is often assumed that increased income will lead to better nutrition, but this is not always the case. Income can be used for various purposes that may have positive (e.g. buying services for improved health and welfare) or negative (e.g. buying other less nutritious food items that reduce diet quality) impacts on nutrition (FAO 2020). Factors such as women's empowerment, nutrition knowledge and features of emergencies such as drought can heavily influence decisions around income generating activities and its use (Ruel et al. 2018).

Gender and women's empowerment

The empowerment of women has been understood to be a strategy to enhance household food security and nutrition for some time (Bhutta et al. 2013). The Women's Empowerment in Livestock Index (WELI) (Gaile et al. 2018), a standardized measure to capture the empowerment of women involved in the livestock sector, examines the domains of 'access to and control over land and livestock'; 'control and use of income'; 'workload and control over own time' and is based on evidence from the literature that women's bargaining power, control over income, control over time and workload affect the health and nutritional status of children under five years old (Gaile et al. 2019). A study in pastoral communities in Tanzania found that women's control over livestock assets and income was positively associated with individual dietary diversity by increasing women's ability to produce or purchase more diverse, nutritious foods and suggests that opportunities to enhance gender equity can be particularly important in communities undergoing dramatic livelihood changes (e.g. sedentarization) and facing new environmental challenges, such as increasing droughts (Gaile et al. 2019; Price et al. 2018). Other studies have looked specifically at the links between livestock rearing, workload and burden on women's time allocation. They highlight that livestock programmes and interventions can put constraints on women's time, which in turn may have negative consequences on nutrition and health by reducing time for childcare, healthcare seeking, food preparation, and leisure (FAO 2020).

Nutrition knowledge and taboos

Knowledge can shape attitudes and behaviour towards improved family and child feeding habits. However, that knowledge can only translate into improved nutrition if those acquiring the knowledge have some control over resources (see women's empowerment above). Increasing knowledge of those making consumption choices and empowering them to have more control over their resources are key to realising the potential of livestock production on nutrition (Grace et al. 2018). Whilst there are many livestock dependent communities that have a good understanding of the value of ASFs for their family's health and wellbeing (Sadler et al. 2012; Catley et al. 2018), some work has noted a general lack of knowledge about the nutritional

4 <https://clinicaltrials.gov/ct2/show/NCT01824940>

5 <https://www.fsnnetwork.org/sites/default/files/WHO%20UNICEF%20Position%20paper%20on%20recent%20WASH%20and%20nutrition%20trials%20-FINALV2%20%281%29.pdf>

value, properties, safety and appropriate use of ASFs (Domínguez-Salas et al. 2019). In northern Ethiopia for example, consumption of animal source foods among 6-23 months old children is very low and home-reared livestock and their products are mainly used for market purposes. Lack of nutrition knowledge, along with high cost of animal source foods, mothers' workload to herd livestock, low household income, low milk production, the poor linkage between health and agriculture sectors, and social norms and beliefs, were identified as common barriers to ASF consumption (Haileselassie et al. 2020).

Linked to knowledge is a whole set of issues around taboos and cultural practice. Numerous cultural and religious beliefs and taboos influence consumption of ASF, including restrictions on which ASF can be eaten by whom. Women and children in particular, are often subject to such restrictions. Meat is more likely to be subject to food taboos than any other food (FAO 2020). For example, a recent study in Sudan found that women do not consume meat during pregnancy because of the risk of excessive in utero growth of the baby, leading to difficult delivery (Tahir et al. 2018). This is a common practice in many regions of the world (Kohler et al. 2019). Religion can also impact the type of foods eaten. Fasting practices of Orthodox Christians for example, the largest religious group in Ethiopia, affect milk intake decisions and channels through which consumed milk is sourced (D'Haene et al. 2019).

Care practices

In low and middle income countries the availability of animal milk may sometimes support sub-optimal child-feeding practices. Exclusive breastfeeding is recommended for the first six months of life as the best feeding practice in early life, particularly in emergency contexts where the risks to infant health of any replacement feeding are large (IFE Core Group 2017). Animal milk is not advised before infants reach 9–12 months of age, however, cow and other milk is often given to younger infants. Data from different ILRI studies (Wyatt et al. 2015) showed that cattle-keeping and other households with easy access to dairy cattle gave cow milk to children at a younger age (three months) compared to households with more limited access. A study among urban poor in Kenya found that knowledge of breastfeeding was generally high but due to many constraints, including the prohibitive cost of baby formula, working women felt that their only viable option was using breast milk substitutes, especially cow

milk and porridge (Kimani-Murage et al. 2015). The Milk Matters study in pastoralist Ethiopia found the introduction of animal milk to infants below 9 months to be common and was in response to a perception by mothers that their breastmilk was not sufficient in quality/quantity because they themselves felt sick and/or fatigued (Sadler and Catley 2009).

Summary

In summary this review has highlighted that whilst the evidence for direct impacts on nutritional status of livestock interventions is limited there is considerable evidence that such projects can improve household access to nutritious foods and the quality of mothers' and young children's diets. Although this has not yet been tested, it is likely that livestock projects could convey similar benefits to other household members, including the nutritionally vulnerable adolescents and elderly. Increasingly evidence suggests that agriculture and livestock interventions may be more impactful when focused on improving access to and consumption of nutritious food and diverse diets than on reducing stunting and wasting (Ruel et al. 2018). It is important to note that most of this evidence comes from the development literature – this review highlights a scarcity of studies/programmes that have examined the relationships between livestock ownership, consumption of ASFs and nutrition in emergencies. Whilst this is certainly a gap that needs filling, the development literature does provide important learning that can be applied to emergency contexts and interventions.

Whilst improving diets for all household members is important for global development, understanding the broader drivers of malnutrition in different contexts is key, particularly for emergency contexts. The literature shows that there are many factors that can influence the pathways between livestock ownership, consumption of ASFs and human nutrition status. These include gender and women's empowerment, income generation and choices around expenditure, nutrition knowledge and care practices. The main implication of this for livestock interventions in emergencies is that they should be designed carefully to ensure that they are as nutrition-sensitive as possible, taking into account the specific context in which they are to be implemented as well as the main constraints that limit household and individual access to healthy diets, women's empowerment and optimal nutrition

Case Studies: the nutritional benefits of livestock-based interventions

Case Study 1: Impact of crop and livestock programmes on dietary diversity of women and children in Mali

Food security is a challenge and acute malnutrition is highly prevalent in Mopti, Mali, a region prone to high seasonal variations in temperature and rainfall. The majority (78%) of the population of Mopti practice agriculture/cereal production with little evidence of any livestock production. Between 2011 and 2015, Agronomes et Vétérinaires Sans Frontières (AVSF) implemented a plant- and animal-production programme that explicitly aimed to improve the diets of children under five and women of childbearing age in 2000 households that were vulnerable to food insecurity. This programme provided the beneficiaries with improved seeds, two goats or ten hens and a rooster. It also provided training on hygiene, horticultural and husbandry practices, and dry cheese production to deal with the surplus of fresh milk in periods of abundance, as well as nutrition education sessions (including awareness-raising on gender and nutrition linkages and cooking demonstrations) and mass screening for malnutrition.

As a result of the programme, the percentage of households with acceptable household dietary diversity increased from 67% to 85% during the lean period. The individual dietary diversity score in the lean season rose from 3.9 to 4.4 out of 9 food groups in children from two to three years of age, and from 2.3 to 3 out of 7 food groups in children from 6 to 24 months of age (according to the World Health Organization Minimum Dietary Diversity for Young Children). Diet diversity also improved among mothers of children under 5 years.

Overall, this intervention had a significant impact on the dietary diversity of mothers and young children through both the consumption pathway (increased consumption of diversity of food groups year-round) and the income-generation pathway (increased income generated through small-scale breeding, which facilitated greater access to certain nutritious foods). *Source: Bonde 2016.*

Case Study 2: Behavioural change for improved nutrition through livestock and nutrition education in Ethiopia

In 2013, Vétérinaires Sans Frontières (VSF) Suisse implemented a livestock-based intervention to help the pastoralist communities in Kebriderhar and Shilabo districts of Somali region, Ethiopia, to improve their food security, nutrition and resilience. The main intervention was providing milking goats to households that had children recurrently affected by malnutrition. The intervention had positive impacts on child nutrition in the target households. The percentage of children with mid-upper arm circumference of less than 11 cm at four months decreased from 33% before the intervention to 0% after. The percentage of children showing signs of acute malnutrition decreased from 56.8% before the intervention to 12.3% after the intervention.

However, it was also reported that some mothers stopped breastfeeding after receiving a milking goat, which could negatively impact child nutrition. To prevent this potential negative effect, the intervention also provided nutrition education through pastoral field schools and village community banks (i.e. groups made up mainly of women who meet regularly and organize collective saving and loans). Nutrition messages focused on maternal, infant and young child nutrition (MIYCN) and hygiene practices (e.g. the first food a new-born should receive, how frequently to feed with breast milk and critical times for hand-washing). Along with these activities, VSF Suisse conducted a study of behavioural change for improved nutrition to assess the ability of pastoral field schools and village community banks to promote positive behavioural change in the community. The study found that mothers in the intervention communities were more aware of what the appropriate practices for MIYCN were. Moreover, participating mothers also passed the messages to other mothers in their communities. *Source: Lense et al. 2017.*

Case Study 3: Gender focus on livestock-related income-generating activities for better food security and nutrition in Bangladesh

Market demand for livestock products is high in Bangladesh. As a result, most rural farm families are involved in some way in livestock-rearing activities. The Asian Development Bank supported a livestock project in the northwest and north-central regions of Bangladesh from 2004 to 2012. The goal of the project was to improve the living standards of the landless and marginal farm households, with a special focus on poor households headed by females. The project provided targeted households with capacity-building on livestock enterprises, microcredit, technical services (vaccination, deworming and artificial insemination) and marketing assistance. A specific component supported the poorest women of the communities with training on building their asset base to start income-generating activities and improve their livelihoods, enabling them to increase their income and contribute towards enhancing their family's food consumption.

The project contributed to increased production of livestock products (milk, meat and eggs). It also developed entrepreneurship among the participants through various measures including enhancing skills and knowledge for value addition and marketing of products, setting up milk collection centres and linking beneficiaries with industrial buyers to ensure fair prices for their products. The project increased household income by 30%, encouraged land purchase and ownership, increased livestock and poultry ownership, helped households build assets and improved amenities. These impacts translated into increased household food consumption, especially children's intake of nutritious food (particularly animal protein), and increased expenditures on children's education and medical care. Ninety eight per cent of beneficiaries were women, who experienced a strengthened role in family decision-making, improved access to inputs, increased control over resources, and improved technical skills. *Source: FAO 2020 and Asian Development Bank 2013.*

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