Sustainable increase in livestock productivity in developing countries through efficient utilisation of feed resources

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During last several decades world production of animal products has increased rapidly. Due to increasing incomes and economic growth, urbanization and population growth, the livestock will continue to be the most dynamic sub-sector of agriculture in the coming decades. The world would require 60-70% more meat and milk than the current consumption levels. Besides energy, availability of feed would be critical to meeting the projected demand of animal products. This is amidst growing concerns over scarcity of land, soil and water, food-feed-fuel competition and on-going global warming. In developing countries, the inability of farmers to feed animals adequately remains the major constraint in most livestock production systems. A concerted effort is required to sustainably meet the future rising demands of feed ingredients and feeds. The strategies that could address this challenge are: i) assess available feed resources and make the best use of them, ii) enhance fodder availability and its use in place of concentrate component in the diet, which is expensive and contains components competing with human food, iii) enlarge the feed resource base by tapping into new and unconventional resources that do not compete with human food, including the plants that are adapted to the region and iv) enhance nutrient absorption from feeds by strategically using anthelmintics and mineral and vitamin mixtures in diets. In order to enhance livestock productivity, these efforts should go hand-in-hand with the use of proper animal genetic resources that match the environment, and the adoption of good management practices including provision of clean drinking water, and good animal comfort and health. An enhanced emphasis is required to increase nutrient use efficiency in ruminant production systems because ruminants have special place in the animal food value chain since they do not compete with human food and can produce human-edible animal protein from human-inedible sources such as grasses, crop residues and agro-industrial by-products.

Introduction

The livestock sector accounts for 40% of the value of world agricultural production and it contributes to the livelihoods and food security of almost a billion people. It is a source of high quality food, income, biogas, animal traction and transport, fertilizer, wool and insurance and it also provides social status and has cultural and affective value. Livestock production generates income and provides employment opportunities not only for farmers but also for various operators throughout the production and distribution chain of food of animal origin. Hundreds of millions of people living in rural areas keep livestock in traditional production systems, to ensure their livelihood, as a safety net and to contribute to meet the food needs of the household.

The success of animal reproduction and health programmes rests on proper nutrition. Improper feeding leads to productivity losses and increase in emission of pollutants in the form of methane (up to 12% of feed energy is lost in the form of methane) and nitrogen and phosphorus release (60 to 70% of the nitrogen and phosphorus fed in intensive production systems is lost to the environment) in soil and water channels, which if not managed properly could cause pollution, decrease biodiversity and affect adversely human health. In addition, animal feeding impacts land use and land use change, water pollution and greenhouse gas emission. Also feed is financially the single most important element of animal production, forming up to 70% of the cost of production; thus affecting economic viability of the production and household security. Proper animal nutrition therefore plays an important role in addressing ongoing and emerging challenges imposed by increasing human population, global warming, land degradation, water shortage and pollution, biodiversity erosion and increasing energy prices.

In parallel, population growth, urbanization, and income growth are driving enormous increases in demand for foods of animal origin. The consumption of animal products is likely to be 70% higher in 2050 than what it was in 2005 (FAO 2009). A high demand for feed will ensue by 2050 with an increase in the food-feed-fuel competition and expected food price increases. It is a challenge especially when we are faced with: a) increase in population, b) decrease in arable land for crop production, c) water shortage, d) food-feed-fuel competition, e) limited supply of phosphorus, f) frequent climate extremes, g) increasing animal and human health risks, and h) economic instability.

Possible solutions

Some of the possible solutions are to: a) make the best use of available resources including reduction in losses in feeds, b) enlarge feed resource base by identifying new feed resources especially those that are lesser-known, adapted to the region and do not compete with human food, c) enhance fodder

availability, and d) increase nutrient absorption from the consumed feed.

A pre-requisite for making the best use of available resources is to accurately assess availability of feed resources and their nutritive value at the national level. Feed resources must be assessed and monitored. Information provided by livestock feed inventories would be of immense utility for policy makers, government agencies, non-government organizations, intergovernmental agencies, and development agencies in formulating and implementing sustainable livestock development activities and for preparing and coping with natural or man-made calamities. In addition, information on availability of feed ingredients at a country level will: enhance efficiency and profitability of the animal feed industry and assist researchers to formulate sustainable feeding strategies; improve the accuracy of estimates of the livestock environmental impacts, not only through land use transformations, but also in the estimation of greenhouse gas emissions associated with livestock production; and help determining potential for carbon sequestration. A manual containing methodologies, tools and guidelines for establishing and maintaining national feed inventories is available (FAO 2012a). Its use would assist countries to generate the required feed related information.

The next major step that needs fulfilling to make the best use of feed resources is their evaluation for chemical composition and nutritional value, so that guidelines could be developed for their safe, sustained and productive use. Equally important are the accurate determination of these parameters. Unfortunately most feed analysis laboratories in developing countries do not integrate quality control systems in routine analysis of feed ingredients and as a result the quality of data emanating from laboratories is doubtful. So there is a need to integrate the quality control approaches in feed analysis laboratories. To this end as well, FAO manuals (FAO, 2011a, Cowie, 2013 and de Jonge and Jackson, 2013) provide detailed information on setting up of an animal nutrition laboratory and integration of quality control approaches.

There is a chronic deficiency of good quality feeds in developing countries. It is imperative to make the best use of whatever feed resources are available. Precision feeding or in developing countries context – balanced feeding is one of the attractive options. It makes the best use of available resources by enhancing nutrient availability and at the same time decreases wastages. The feeding of a diet balanced in all nutrients and at a level that meets the production objective considering the animal's physiological state is imperative for achieving higher and sustained livestock productivity. This is valid across livestock production systems. Improper feeding leads to productivity losses and increase in emission of pollutants. A number of software programs are available for preparing balanced rations, however implementation of the balance feeding approach at the farmer's shed is challenging. A substantial increase in livestock productivity and decrease in methane emission have been recorded in India on application of balanced feeding at farmers' doorsteps (FAO 2012b). It has also been recorded that correction of mineral imbalances enhance animal productivity (FAO 2011b), which is through optimization of rumen function which increases the nutritional status of the animal as well as through provision of minerals that are important for maintaining reproductive efficiency.

A number of feed resources such as crop residues, discarded fruits and vegetables and their wastes are burnt or discarded causing environmental pollution. The crop residue management could include the use of specially designed balers for collection of straw from the field, followed by the use of processing technologies for the manufacture of balanced complete feed for ruminants. In this respect, the technology for making densified total mixed ration blocks (DTMRBs) or densified total mixed ration pellets (DTMRPs) based on straws and oil seed meals is an innovative approach (FAO 2012c), which provides an opportunity for the feed manufacturers and entrepreneurs to remove regional disparities in feed availability and to supply the balanced feed to dairy and other livestock farmers on a large scale. This technology can also be effective in disaster management and emergency situations. For efficient utilization of fruit and vegetable wastes, silage preparation is an attractive and feasible technique for developing countries (Wadhwa and Bakshi, 2013). Other simple technologies like chopping of forages increases animal productivity and reduces waste of forages. Intake of chopped forage is higher compared with un-chopped forage (FAO, 2011b). Silage making especially using locally available resources is also a useful approach for reducing wastage of forages whose availability is high in rainy seasons. Feeding of total mixed rations (TMRs) has also been shown to have several advantages such as decrease in feed loss, higher nutrient availability, lower enteric methane production and higher animal performance over feeding ingredients separately (FAO 2011b and FAO 2012b). Information on the production and feeding of TMRs should be widely disseminated.

There is a need to enlarge indigenous feed resource base and rely more on locally available feed resources and their efficient use. Developing countries should also consider increasing fodder production, which would decrease reliance on imported feed ingredients and also decrease cost

of feeding. Fodder development in so-called 'wastelands', fallow lands and along the roads needs particular attention. Practicing agroforestry and silvopastoral systems would also enhance forage availability and carbon sequestration. Development of animal industry based on locally available feed resources is expected to decrease their carbon footprint and reliance on the trade. Identification of lesser-known good quality feed resources that are adapted to the harsh conditions of poor soil, high temperatures and drought conditions, and developing a system to produce seeds or planting material in large amounts and their wide propagation must be considered (FAO, 2012d). Equally important is to identify forage plants widely used in other countries with similar climatic conditions as the country in reference and to bring them to the country for wider use. A successful example is Napier grass. Use of winter barley and sorghum could be other examples for overcoming fodder shortages in winter periods. Dense plantation of Mulberry, Moringa and Tithonia plants for use as a fodder (and not as a tree) could also be an attractive option for many tropical countries. Recent impetus on the production of biofuels has generated a number of co-products such as distillers grains, sweet sorghum and cassava wastes, Cramble meal, glycerol, detoxified Castor or Jatropha meals, non-toxic Jatropha curcas meal, among others, which are promising feed resources (FAO 2012e). Azolla also needs to be promoted, and thornless cactus is a good feed for small ruminants in the dry areas (FAO, 2011b).

Internal parasites divert a part of the feed nutrient from the production of animal products to their own development. In addition, the presence of parasites decreases intake and digestibility of feed. Control of intestinal parasites through strategic use of anthelmintics would enhance nutrient availability from intestinal track. Generally, farmers find chemical anthelminthics expensive. Use of validated plant and herbal material should be considered. Feeding of Pineapple, Calliandra, Sericea and Cassava leaves and other tannin containing plants are effective in controlling helmintics.

Conclusions

For commercial pigs and poultry, feeding requirements are strain specific and this information is provided by the companies supplying these animals. Nevertheless, it is important to provide ingredients of good quality and free from deleterious substances such as mycotoxins and heavy metals for achieving the potential of these commercial strains. Feed losses and livestock productivity losses due to the presence of aflatoxin reach billions of dollars. Good infrastructure for proper storage of feed resources is vital for decreasing these losses. For monogastrics in the mixed system, simple methods to determined feed intake through scavenging need to be developed, enabling a proper supply that meets the nutrient requirement of animals.

It could be surmised that the solutions do exist for increasing livestock productivity through efficient utilization of feed resources. These efforts should go hand-in-hand with the use of proper animal genetic resources that match the environment, and the adoption of good management practices including provision of clean drinking water, and good animal comfort and health.

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