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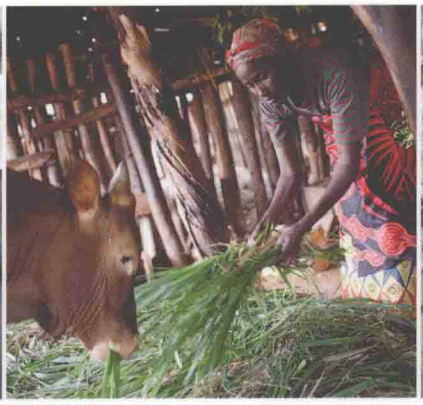
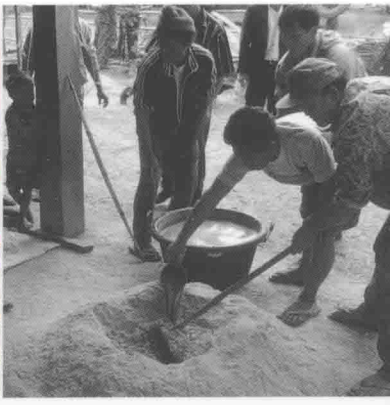

proceedings

SUCCESSES AND FAILURES WITH ANIMAL NUTRITION PRACTICES AND TECHNOLOGIES IN DEVELOPING COUNTRIES

FAO Electronic Conference
1-30 September 2010

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Introduction

Nutrition is the foundation of a livestock production system and proper nutrition is imperative for achieving high and sustained livestock productivity. The success of animal reproduction and health programmes rests on proper nutrition. During the last four decades a number of animal-nutrition-based technologies and practices have been developed and applied both on-station and on-farm in developing countries, with varying degrees of success. Some technologies have produced profound beneficial effects and have been widely used; while others have shown potential on research stations but have not been taken up by farmers. Other nutritional strategies produced benefits to farmers so long as they were supported by a donor-funded project, but their use could not be sustained after the project concluded.

To learn from these experiences, the FAO Animal Production and Health Division organised an E-Conference from 1 to 30 September 2010. This was a stock-taking exercise to describe the current status and analyse the reasons for the success or failure in applying different animal nutrition practices and technologies and to draw conclusions for the future. The conference covered both ruminant and monogastric animals and the focus was on developing countries.

This E-Conference provided an opportunity for researchers and development workers with an interest in livestock development, based in government and non-government organisations and in private sectors, to share their knowledge and experience in the area of animal nutrition.

Before the conference, a background document was prepared that contained an overview on the different animal nutrition technologies and practices for consideration in the E-Conference (can be downloaded from: http://www.fao.org/ag/againfo/home/documents/2010_sept_E-Conference.pdf). The background document also provided guidance to participants, for example the issues to be addressed in the E-Conference and suggestions on the format for providing inputs. Some salient guidelines were:

- For any one (or combination) of the practices and technologies, identify those that have generated significant impact in your region and those that failed to do so considering its application at the field level in one of the different livestock production systems and in any particular developing country;
- For each identified technology/practice provide an overall assessment of the experience of applying them and state whether it was a success or failure, partially or fully;
- Based on this, describe some of the key features that determined its partial or complete success (or failure). For assessing a practice or technology as success or failure, the impact (economic, environmental, social and/or on food security/biodiversity/natural resources) generated through its application should be considered and presented in your contribution (quantitative information on these impacts would be appreciated by readers). Impact of applying a practice or technology on trade, equity, gender and food safety could also be parameters for defining success or failure.
- What lessons can be learnt from the experience, and how do you see the future of the technology?

Most of the lead contributions followed these guidelines. These contributions were posted on the E-Conference platform as discussion papers and the participants were invited to give comments, views and experiences on the technology(ies) discussed in the paper. Each contribution or a message from the participants was given a number, in the sequence it was posted (message from the Moderator was not given a number). The participants were assumed to be speaking in their personal capacity, unless they explicitly stated that their contribution represented the views of their organization. The messages can be downloaded from http://www.fao.org/ag/againfo/home/en/events_archive/Messages_E-conf_0910.pdf

After the conference, the participants who submitted the lead contributions were invited to submit their contributions in extended form. These proceedings present the extended papers, giving the current status of animal nutrition practices and technologies being practised in developing countries (with considerable emphasis on South Asia) and an analysis of the reasons for their success or failure. The proceedings also contain a synthesis paper that summarises the major issues discussed by participants and presents conclusion drawn and lessons learnt for the future.

This document is expected to assist developing countries make informed decisions about the adoption of appropriate animal nutrition practices and technologies. In addition, it should also be useful for the development community, including donor agencies, to better understand, prioritise and support appropriate animal nutrition practices and technologies in developing countries.

Contents

Change in animal nutrition research paradigm needed to benefit resource-poor livestock producers in countries like India

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SUMMARY

A case for change in the animal nutrition research paradigm to extend benefits to the resource-poor livestock producers in countries like India is presented. The characteristics of livestock production which form the basis for the argument and discussion include: a) crop-livestock mixed farming prevails in India, b) resource-poor rural families are major contributors to livestock produce and depend on it for family income, c) low external-input system prevails in livestock production, d) livestock can provide pathway out of poverty provided some constraints are overcome, and e) livestock feeds and feeding is one such constraint and a challenge for the research system. The paper draws attention to the limited benefits of research to resource-poor farmers. The need for change in the research paradigm to meet the challenges is stressed by discussing issues such as, relationship between livestock production and research systems and lack of pro-poor focus; persistence of reductionist approach and low adoption of 'systems and participatory approach' by the research system; reasons for low adoption of animal nutrition research outputs and apathy of the system about it, and need for rethinking of some conventional recommendations on feeding livestock. Approaches are suggested to make research outputs appropriate and beneficial for resource-poor livestock keepers.

Keywords: *animal feeding, participatory approach, pro-poor, research paradigm*

INTRODUCTION

Crop-livestock mixed farming prevails in India and the majority of rural families own livestock. Livestock production in countries like India has characteristic features such as:

- Prevalence of crop-livestock mixed farming system;
- High diversity and multi-functionality;
- Dependence of a large number of rural families on livestock for their livelihood;
- Increasing demand/prices of livestock products provide an opportunity for extra income;
- Ruminants dominate livestock production; and
- Feeding is based on 'Low External-Input System' utilising crop residues and by-products.

Livestock development provides a pathway out of poverty for the underprivileged families, however some constraints have to be overcome (Thomas and Rangnekar, 2004). Feeding of livestock is one such constraint and a challenge for the research system in India since the contribution of research to livestock development and particularly for the resource-poor farmers, is marginal.

Hardly any livestock research project is planned whilst keeping resource-poor farmers in focus (Rangnekar, 2006). The paper is based on a review of literature and observations and experience of more than four decades of livestock development, extension and applied research. The arguments presented highlight the need to change the research paradigm to extend benefits to resource-poor farmers.

RELATIONSHIP BETWEEN LIVESTOCK PRODUCTION SYSTEMS OF RESOURCE-POOR FARMERS AND ANIMAL NUTRITION RESEARCH SYSTEM

Commonly reported observations on feeding of livestock focus mainly on two aspects: the majority of producers follow traditional feeding practices and they resist change/adoption of scientific recommendations and technologies. These observations imply that the fault lies with the livestock producer while the research system has done its job. There is hardly any attempt made to understand the reasons for non-adoption which raises an important question as to why the research system is not sufficiently concerned with the utility of outputs/products of research. This situation indicates that there is probably a mismatch between the prevailing livestock production systems (that are not likely to change in the near future) and research systems (resistant to change). Some characteristics bearing on the relationship between these two systems are discussed below.

Whole-farm approach of the farmers as against sectoral approach of the research system. Livelihood and farming systems of the underprivileged are complex and livestock production is a crucial component. Most farmers are concerned about the output of the whole farm and not of livestock alone while animal nutrition research usually focuses only on the animal. As the sub-systems influence each other, changes in any sub-system tend to impact the whole farm.

Reductionist approach of the research system. Studies on production of greenhouse gases (GHG) by ruminants is a good example of the reductionist approach. It is only the enteric GHG production that is estimated and no attempt is made to get a total picture based on production as well as savings of GHG due to the feeding systems of ruminants applied. Mishra and Dixit (2004) studied the total picture and reported that GHG produced by ruminants are balanced by savings due to the feeding systems adopted in India. Use of crop residues and agricultural by-products saves GHG that would have been emitted in producing grains and making grain-based livestock feeds. These uses also save the GHG that would have been produced by burning of crop residues. Recommending low fibre/high energy rations to reduce methane production is also inappropriate for Indian conditions.

Methane production by different types of animal is compared on the basis of amount of methane per unit of milk produced, which is not appropriate since the majority of cattle and buffalo, in a country like India, are not dairy type. A different approach that also accounts for other useful services, functions and products for farmers is needed for

comparing GHG production. There is a need to consider farmers' perceived value of these services and products, however, as these are not quantifiable by conventional methods, a social-cost accounting approach may have to be used.

Livestock production in India is highly internalised. The system is mainly low external-input oriented and thus tends to optimise the use of available resources (human as well as material). Livestock are mostly grazed and supplemented by farm produce (crop residues, by-products, tree fodders), hence the resistance to adopt new feeding systems or technologies that require purchase of material or hire of labour.

The Indian Council of Agriculture Research (ICAR) led the Indo-Dutch project on Bio-conversion of crop residues which was implemented in the 90s through a network of centres in different regions. This project demonstrated the use of systems and participatory approaches to understand the farming system in general, with in-depth understanding of livestock sub-systems in various agro-ecozones of India. The project showed a way of planning animal nutrition research based on the understanding of systems and the need to define conditions under which each recommendation/technology would work.

While the role of women in feeding of livestock is well known the research system has not given it due consideration. Studies on the involvement of women in livestock production show women to have good knowledge of feeding habits of animals and of local feed resources, and that women take decisions related to feeding of animals (Rangnekar, 1994). However, the research system rarely involves women or considers their knowledge and views in planning studies, conducting trials or assessing the research outputs.

Some of the conventional recommendations for livestock feeding need reconsideration. Rangnekar, Schiere and Rao (1995) have discussed recommendations e.g. feeding milk or milk replacer to calves and kids at the rate of 10 percent of body weight, and feeding of greens equivalent to 33 percent of total roughage dry matter. Feeding of milk is probably recommended for ideal gain in body weight, however, hardly any small farmer can afford to offer that much milk to calves. Green fodder production is taken up only on small plots and its availability will always be limited. Most recommendations suit high external-input systems, are aimed at maximising production (of a particular commodity) and are not appropriate for smallholders. Moreover, there is variation in systems and resources between and within regions of the country, thus making uniform recommendations inappropriate. Critical assessment of reasons for non-adoption of recommendations would provide useful guidance for the future.

FACTORS INFLUENCING DECISIONS BY FAMERS TO ADOPT NEW PRACTICES AND TECHNOLOGIES

The decision to change from traditional feeding systems and to adopt new practices and technologies is a complex process. Contrary to common belief the decisions are not based on economic benefit considerations alone; several more factors come into play. A good understanding of the decision-making processes is useful in the selection of appropriate research outputs for recommendation.

The factors usually considered by farmers while deciding change of practices or adoption of technology were listed and discussed by Rao *et al.* (1995). These factors range from

relative advantage, observable results, divisibility, simplicity/complexity and initial cost to compatibility of the recommendations with the farming and social systems. Another factor crucial in deciding adoption is the 'relevance to constraints/problems' faced by livestock owners. Hence, only outputs of research (feeding recommendations or technologies) that are technically sound, economically beneficial, socially acceptable, suit the prevailing farming system and solve current problems stand a chance of adoption.

In a study of the role of women in urban livestock production, in western India, it was observed that most of the commercial dairy producers in urban areas continue to make feed mixtures and feed animals in the traditional manner (S.D. Rangnekar, personal communication, 1990) contrary to the reports that educated, commercially-oriented and urban livestock producers are early adopters. Multidisciplinary research may provide better understanding of the reasons for continuing traditional practices of feeding livestock by these urban producers.

Roy and Rangnekar (2006) conducted a participatory study to understand the reasons for adoption of urea treatment of cereal straws (rejected in most parts of India) in the operational area of Vaishali cooperative milk union in the state of Bihar, in eastern India. The farmers reported three main benefits of urea treatment, namely prevention of spoilage of straw due to unseasonal rain (common in that area), more straw could be stored in the bins and marginal increase in milk production. Other factors contributing to adoption of the technology were: initiative of dairy cooperative in demonstration of the technology, availability of straw and water, shortage of legumes in summer and high level of milk production of the cows. According to recent reports, more than 4 000 farmers adopted the technology in 2010. It can be concluded that urea treatment of straws fitted well with the straw handling system in Vaishali area, and benefitted the whole farm operation of the farmers (not milk production alone).

SUGGESTED APPROACHES TO MAKE ANIMAL NUTRITION RESEARCH RESOURCE-POOR FRIENDLY

To be effective, development needs research, and without linkage with development, research remains academic. There is a need to promote pro-poor approaches in livestock research, similar to that done by the FAO, for livestock development. Hazel and Haddad (2001) recommend that public sector research in developing countries should give priority to developing a strategy for pro-poor research through strategic planning. Moreover, to develop pro-poor research there should be good understanding of livelihood systems and adoption of a 'participatory approach involving women'. Developing technologies and prioritising research areas on the basis of agro-ecological and socio-economic conditions, at national as well as regional levels, is recommended.

The participatory research should not be 'scientist led' but all the stakeholders including farmers should be involved from planning to the stage of interpreting the results (Conroy, 2005). The study of traditional feeding practices and perceptions of the livestock owners, especially the women, about feeding of livestock is suggested to 'understand why farmers do what they do'. The large network of Krishi Vigyan Kendras (technology transfer centres in India), universities, research institutes and centres of the ICAR in India should enable adoption of such approaches without much difficulty. However, there would be need to

orient animal nutrition research workers to develop close linkage/interaction with extension system and farmers.

To further explain the nature of change proposed in animal nutrition research, the case of studies on GHGs in ruminants is taken as an example and suggestions are given below:

- Estimate total GHG production by local ruminants under traditional feeding regime;
- Undertake balance study of GHG using the approach and social cost accounting method suggested by Mishra and Dixit (2004) to get a holistic picture under different production systems; and
- Screen various feed materials including tree leaves and pods, in different regions, for effect on GHG production in ruminants. Identify low-cost locally-available materials that reduce GHG and can be used by an average livestock owner. Used by a large number of farmers would have impact, even with a marginal decrease in methane production.

There are two new initiatives developing in India that are worth considering. One is in the crop sector known as "System of Rice Intensification or SRI" and based on participatory research and technology development (C.S. Prasad, personal communication, 2010). It is a joint initiative of farmers, NGOs and scientists and is fast emerging as an alternative to conventional high-input system of rice cultivation and is being tried with other crops (for information visit http://hib.ximb.ac.in/Hibiscus/Pub/faccvDet.php?client=ximb&facid=XF 262). The other initiative is "Knowledge Swaraj" taken by scientists and a civil society organisation to renew the relevance of traditional knowledge with the objective of guiding the use of science and technology for development of India (for more information visit www.kicsforum.net).

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Technologies and practices for improving livestock feeding in India

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SUMMARY

Marginal farmers constitute the core of the livestock production sector and own over 80 percent of all livestock in India. Ruminant production is based on grazing and crop residues. Small ruminants subsist entirely on open grazing/browsing. Fodder scientists have developed many superior fodder crops like hybrid Napier varieties CO3 and CO4 yielding over 300–400 tonnes of green fodder per hectare annually and giving net income of Rupees 250 000 per hectare (1 US$ = *ca* Rupees 45). In some villages there are several few 'land surplus' farmers with fully-irrigated land to spare for high-yielding fodder crops. The milk collection centres, dairy and farmer cooperative societies in the village can identify 'land surplus' farmers and enter into mutually-benefiting annual contracts with them for cultivation and daily supply of cut-green fodder. Rotary chaff cutters in farmer households can maximise fodder utilisation. In straw-rich states millions of tonnes of straws are burnt as a means of disposal. This straw could be used for making pellets. Enriched straw pellets from Punjab state could take care of the total needs of ruminant feeds/fodder in the adjoining deficit states. The technology for pulverising, chopping and pelletising straw will have industrial-scale application in all regions.

Keywords: *enriched straw pellets, fodder on contract, land surplus farmers*

INTRODUCTION

Marginal farmers constitute the core of the livestock production sector in India (Table 1). Nearly 80 percent of all large ruminants, including the high-yielding crossbred cows, and over 85 percent of all other livestock are owned by marginal farmers. Ruminant production in India is predominantly based on grazing highly-overgrazed common grazing lands and on crop residues like straws and stovers.

Concentrate feeds are used to supplement the dry fodder diets in the case of producing/working large ruminants while small ruminants subsist entirely on open grazing or browsing. Supplementing the dry fodder diets with some green fodder considerably enhances the efficiency of the production system including reducing the emission of greenhouse gases and reducing the dependence on expensive concentrate feeds and lowering production costs. As far as promotion of green fodder production is concerned, India has been trying to persuade the marginal farmers to grow green fodder, but with very limited success.

TABLE 1
Land and Livestock Holding in India in 2003

Category	RHH (million)	RHH %	AFCB Cattle %	AF Indigenous Cattle %	AF Buffalo %	Sheep/ Goat %	Pig %	Poultry %
Landless (no land)	46.09	31.18	0	0	0	0.21	0.15	1.03
Marginal (0.002–1 ha)	70.89	47.89	78.47	77.40	71.86	85.34	94.79	85.07
Small (1–2 ha)	16.59	11.22	4.80	5.39	5.98	3.46	1.91	4.79
Semi-medium (2–4 ha)	9.21	6.23	7.09	8.04	9.34	4.04	1.63	3.68
Medium (4–10 ha)	4.33	2.93	8.77	7.42	10.69	4.45	1.04	4.79
Large (> 10 ha)	0.81	0.55	0.87	1.75	2.12	2.50	0.48	0.63
Total	147.84	100	100	100	100	100	100	100

RHH, rural households; AF, adult female; CB, crossbred

Source: Livestock Census of India (2003); National Sample Survey (2003)

APPLICATION OF TECHNOLOGY AND PRACTICE BY FARMERS

Fodder on contract by 'land surplus' farmers. Access to fodder in every village with a milk collection centre (MCC), dairy cooperative society (DCS) or farmer cooperative (FC), would greatly enhance animal production. There are over 100 000 villages in India with some type of organised milk marketing infrastructure (MCC/DCS/FC). Without such access to quality fodder, livestock production in India will not be in a position to meet its burgeoning demand for livestock products.

Research efforts of fodder scientists in the country have resulted in the development of high-yielding fodder varieties of grasses and legumes. A number of high-yielding perennial (replanting in 5–6 years) tropical grasses like hybrid Napier varieties CO3 and CO4 yield over 300–400 tonnes of greens per hectare annually. Selling green fodder at Rupee 1 per kg, the fodder-producing farmer would receive daily cash income round the year, totaling up to Rupees 300 000 per hectare annully and net income of Rupees 250 000. One hectare of such fodder crops could sustain the fodder requirements of at least 30 cows or buffalo round the year (@ 20 kg/animal daily) or over 300 small ruminants @ 4 kg per head daily.

There are farmers that have surplus, fully-irrigated land to spare for high-yielding, high-income cash crops, in almost every village. Such farmers are keen to obtain a higher income from their irrigated land than that obtained from the cultivation of conventional crops. The MCC/DCS/FC could identify the 'land surplus' farmers in the village with irrigated land to spare for cash crops and enter into mutually-benefiting annual contracts with them to cultivate and supply cut-green fodder daily to collection centres for sale to milk suppliers or other small ruminant-farmers. Milk collection centres and dairy cooperative societies sell branded, balanced cattle-feed daily to milk producer members. Similarly the MCC/DCS/FC in each village can sell the cut-green fodder daily in the collection centre, making marketing of green fodders easier.