1.1. LIVESTOCK AND CROP RESIDUES, MANAGEMENT AND TECHNOLOGICAL CHANGE

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INTRODUCTION

Both in society and farming, some strange tensions exist between the need to change and the wish to keep doing what has been practised and learned over ages. Indeed while at the same time one can look back at the good old days, it is tempting to look forward to a better future. While there are so-called non-progressive farmers who do not apply management and techniques as suggested by scientists and extension workers, there are other developments in society that go faster than even policy makers and scientists can grasp with. In fact, some farmers are often ahead of the academic community. Technological change is often expected to result in positive changes, but it also causes less desirable side effects like urbanization, deforestation, labour displacement and salinization. What is then the need for change, which are the trade-offs between technical progress and social equality, why do farmers not follow the advice of specialists and how do these issues apply in livestock development based on use of crop residues? This first section of this handbook intends to throw some light on these questions, and this chapter discusses technical change in general terms.

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LIVESTOCK AND CROP RESIDUES

Though much of today's livestock in India survives on crop residues, this has not always been so. In his *History of Agriculture*, Randhawa (1980) writes that the early Aryans would cultivate crops in the forested Gangetic plains and herd their animals on grassy areas or in the forest. Nowadays little forest is left in those Gangetic plains. Herdsmen from Rajasthan come increasingly to Haryana, letting their animals graze on crop residues, whereas in the long past there would be enough fodder in Rajasthan itself.

Changing resource/demand patterns force society to look for other ways to produce. These shifts in resource use (e.g. between grazing-based and straw-based feeding systems) reflect shifts in the relative scarcity of resources used in production, particularly the relation between land, labour and capital. The changes are also reflected in the generation and use of technologies and in private and public sector investments in research and development in response to these change in relative scarcity. This is called the "theory of induced innovations" (Hayami and Ruttan, 1985) where innovations in the production process are "induced" by changes in scarcities that are reflected in market prices. The returns to be had by increasing the efficiency of a scarce factor (e.g. irrigated land in India) are greater than for a change in the life efficiency of an input which is in abundant supply (such as unskilled agricultural labour in the densely populated areas of India). This is clearly seen now where rapid increases in agricultural productivity and output in Punjab and Haryana has led to labour shortages and increased wage rates, leading to innovations in labour-saving mechanical technologies (such as tractor ploughing and combine harvesting) and chemical technologies (use of herbicides to reduce weeding labour). The same parallels can be applied to the livestock sector where increasing scarcities of common grazing lands led to increased reliance on feeding of crop residues and by-products and increased investment in research and development efforts to improve utilization and productivity of these feedstuffs. The research for induced innovations is apparent in the recent emphasis on work with unconventional feeds, the effort to use tree leaves for feed or the need to import inputs from elsewhere, e.g concentrates feeds, fertilizer or tractors rather than bullocks that used to feed free on plenty cropland. In present days it has become difficult to let the animals graze on common grounds, village land and forests. There is even a feeling that a cow that used to provide wealth and power, now costs money and feed to maintain. From being a "kamdhenu", i.e, the cow that provides all the needs, livestock are slowly but surely becoming a burden. Feed needs now to be purchased and straw has to be stored and kept for feeding, whereas in the past the straw was often left in the field or burned.

From these examples it becomes clear that ways and purposes of keeping animals are changing, due to the changing resource/demand patterns, whether one likes it or not. Fibrous crop residues (straws) are becoming the basal feedstock for the survival of many village animals. Also in cities the straws become expensive as source of fibre for high producing animals. The more valuable crop residues like brans and oilcakes are increasingly being taken to urban centres where they serve as feed for high milk producers or for pigs and poultry. Also, they are exported to other countries, depriving the place of origin from valuable minerals and a possibility to add value.

THE POTENTIAL OF STRAWS

Large quantities of straw are available from cropping, and one hectare yield of rice straw can essentially support the energy needs of one small 350 kg animal (Box 1) for something like a year, though yields and qualities of straw vary. Whereas the nutritive value of wheat and rice straw is not good enough to provide maintenance requirements, the use of coarse straws e.g. from maize, millets and sorghum may allow animals to survive and maintain body weight. In absence of better feeds, the proper use of crop residues can therefore help to maintain more animals, and to retain more nutrients and income in the village. Fortunately, the yield of straw from fertilized and irrigated area may be higher than the yield of fodder from the natural vegetation (#4.5.). Also, and contrary to common belief, the straw yield of new varieties may be relatively less but it can be more in absolute terms . There is no evidence that straw from newer varieties is always inferior to straw of old varieties : shorter stiffer straws can have a higher leaf to stem ratio, resulting in generally better straw! (#4.5.).

Unfortunately however, the nutritional value of straws is likely to be less than that green leaves from forest or grazing. As a result, the quality of the feed resources tends to decline. Many ways to overcome these problems are sought and presented in this book, but before that it is relevant to discuss technical change in general terms.

Box 1. Some facts and figures about straw

- Burning of a hectare of straw from a average rice crop of let us say 3000 kg paddy results in the loss of 4000 kg x 0.6 % N = 24 kg of Nitrogen in the smoke: the equivalent of almost 50 kg of urea!
- Export of the bran results in the loss of 300 kg bran of 10% protein, i.e. 5 kg of Nitrogen, leave alone the other nutrients like P and K.
- If a cow of 300 Kg body weight can eat approx. 5 kg dry matter of straw per day, the same quantity of 4000 kg straw provides for 800(!) days animal feed.
- The quality of particularly slender straws like from rice and wheat is not good enough to keep the animal alive over a long period, but the quantity is large and the value of the straw yield can represent between 10-15% or higher of the total crop value (#4.5.).

CLASSIFICATIONS OF TECHNICAL CHANGE

Different types of technology can be distinguished, but we will discuss it in terms of:

- adjustment of the output to resources (the low input system approach)
- adjusting the resources to the output (the high input system approach)

A combination of these two is possible, and technological change can be categorized differently also, e.g. in terms of either the use of inputs, knowledge, or their combination. Input based technologies are applied for example when fertilizer is used to increase fodder or grain yield. Information based technologies focus on the proper timing of fertilization, e.g. to maximise the output per unit input.

The low input approach is well known from societies or communities that have learned to survive by adjusting to the circumstances. In conditions of low access to inputs, it may even be useful for farmers to deny inputs to animals and to use them on a priority base for the crops. In that sense the animal subsystem has to adjust more to the lack of inputs than the crop subsystem. The high input approach it its extreme form, solves a local lack of resources by obtaining them from elsewhere, e.g. through technologies such as described in #4.3. Urban dairy farmers have purchasing power to extract straws and grain or oilseed milling byproducts from rural areas, turning the surrounding systems effectively into low input systems as far as feed is concerned. Typical high input solutions to feed shortage are the use of fertilizer and irrigation for cultivated fodder.

A strict distinction of technology on the basis of use of input or knowledge can not be made, but the principle can be illustrated by saying that a farmer can prevent the need for inputs by proper management:

- proper milking avoids the need for medicine inputs to cure mastitis;
- the choice of a suitable grain with useful straw reduces the need to grow fodder;
- timely harvest of a fodder reduces the need for purchase of concentrates.

The use of knowledge as a management tool can thus reduce the need for inputs and also the side effects of high input use in terms of waste disposal.

ADOPTION OF TECHNOLOGY

Much of the extension work in India focuses on the provision of services (e.g. inputs like seed, fertilizer, A.I) and provision of knowledge appears to receive insufficient attention. The choice between a proper combination of inputs and knowledge depends on the local conditions. Unlike vaccination campaigns that use the same vaccine and the same syringe on animals for large and small, poor or rich, northern or southern farmers, the application of feeding technology is highly system dependent. The fact that farmers do not adopt a technology from a scientist or an extension worker does not mean that they do not adopt new methods. In fact, the study of traditional or indigenous knowledge systems reveals that much knowledge travels between farmers themselves, completely outside the extension officers sphere of influence. It may also be that farmers perception of needs differs from those of the researcher, or that the need of one farmer is not like that of his neighbour or wife (#2.1.). Last but not least, it may be that a farming community lack the skill or understanding to comprehend the full effect of old practices in new conditions. The emphasis on input supply in may extension programmes is therefore regrettable. Research has shown that investments in exchange of knowledge, rather than one way transfer, is much more effective than programmes aimed at input supply alone.

RECENT DEVELOPMENTS ON INTRODUCTION OF TECHNOLOGY

Much work is recently done to improve the understanding between the researchers, extension workers and the farmers communities. Methodologies are developed to distinguish between farming systems (#1.3.1.), to understand farmer's real needs (#1.3.2.), or to select technologies or management approaches that might be useful for particular conditions (#1.3.3.).

The use of farming systems research methodology for the application of straw feeding techniques implies a stress on the fact that:

- cows and other animals are part of a system;
- large differences exist between systems.

A focus on the production of an individual animal, plant or farmers community, without understanding the overall system, can results in non-acceptance of technology or in undesirable side effects on other sub-systems.

For example: *Crossbreeding and stall feeding may mean extra work by women in collection of the grass. The labour or leisure that they used to spend on other subsystems can now no longer be applied to other activities.*

Neglect of differences between systems results in blanket recommendations that can be effective in one place, but ineffective and wasteful of resources in other conditions.

CONCLUSION

Technological change is sometimes seen as a guarantee for progress, and sometimes it is resented for its undesirable side effects, a remarkable tension indeed. Innovations can be based on use of inputs, on knowledge or on their combination. Transferable technologies in general, and feeding methods more specifically need to take into account that animals are part of a system and that large differences between systems preclude the use of simple blanket recommendations. Change of systems due to shifting resource basis forces farmers and scientists to look for innovations, but not after understanding the overall system, in order to avoid ineffective or undesirable results.

SUGGESTED READING

Alexandratos, N., 1988. (ed.). World Agriculture toward 2000. An FAO study. FAO, Rome, Italy; Belhaven Press, London, UK. 338 pp.

Chambers, R., Pacey, A., and Thrupp, L.A., 1989. Farmers first: farmer innovation and agricultural research. London: Intermediate Technology Publications. 218 pp.

Conway, G.R. and E.B. Barbier, 1990. After the Green Revolution, Sustainable agriculture for Development, Earthscan Publications Ltd. London, 205 pp.

De Boer, F. and Bickel, H., 1988. Livestock feed resources and feed evaluation in Europe;present situation and future prospects. EAAP publ. No.37, Elsevier, Amsterdam, 408 pp.

Ellul, J., 1990. The technological bluff. Translated by G.W. Bromley. William B. Eerdmans Publishing Cy., Grand Rapids Michigan. 418 pp.

Hayami, Y. and Ruttan, V.W., 1985. Agricultural Development, An International Perspective. The Johns Hopkins University Press, Baltimore and London.

Joshi, A.L., Doyle, P.T. and Oosting, S.J., 1994. Variation in the quantity and quality of fibrous crop residues. Proceedings of a national seminar held at the Baif Development Research Foundation, Pune (Maharashtra-India), February 8-9, 1994, Pune, India. 174 pp.

Kiran Singh and Schiere, J.B., 1993 (Eds.), Feeding of ruminants on fibrous crop residues. Aspects of treatment, feeding, nutrient evaluation, research and extension. Proc. of a workshop, 4-8 february 1991, NDRI-Karnal, ICAR, New Delhi, India. 486 pp.

Randhawa, M.S., 1980, A History of Agriculture in India, Vol.I, Beginning to the 12th century, Indian Council of Agricultural Research, New Delhi, India, 541 pp.

Simmonds, N.W., 1986. A short review of farming systems research in the tropics. Exp. Agric. 1986, vol.22, p.1-13.

Simmons, I.G., 1989. Changing the Face of the earth; culture, environment, history. Basil Blackwell, New York/Oxford. 487 pp.

WCED, World Commission on Environment and Development (WCED), 1987. Our common future. Oxford University Press, Oxford, U.K. 400 pp.