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A VIEW ON LIVESTOCK IN RESOURCE-POOR MIXED FARMING SYSTEMS

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Abstract

Current views underlying livestock research, development and education have to be reconsidered to understand the possibilities for amore sustainable animal production in resource-poor farming systems. Animal production systems are complex and dynamic and they provide more than just food trough their versatile role in supporting human welfare. The intangible products are important in areas lacking formal insurance and developed financial markets. The different roles of livestock are the basis for decision making the farming households. The objective of research, development and education should be set in relation to this broad perspective on livestock keeping. Changes in economic condition are the major driving force for change in animal production systems. A systems approach is needed to assess disciplinary research focused on production level of individual animals and sustainability prospects of new technologies within the context of farming systems. This can help us to plan for the future.

Introduction

In the tropic we can fine a wide range of agricultural production systems. However, the majority of the farmers can be found in resource-poor and low external input production environment. The traditional grazing systems are being or have been replaced by mixed farming systems. In urban areas the strategy is to replace mixed farming be specialised industrial systems. The family base smallholder mixed farming systems, however, will continue to be the dominant production systems (Davendra, 2002). Farming systems have to intensify due to population growth and economic development. In smallholders systems livestock technologies have had little impact on production and productivity at farm level. One important reason is that interaction of livestock with socio-economic environment have not been properly understood or appreciated. The role of livestock in many agricultural production environment also under discussion, because of this environment impact: land degradation, soil mining and over grazing in semi-arid areas, deforestation in rainforest frontiers, involution of mixed farming systems in densely populated areas and nutrient surpluses in industrial livestock systems (de

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Haan et al., 1997)

We argue that current underlying livestock research, development and education have to be reconsidered in order to understand possibilities for a more sustainable animal production in resource-poor living systems.

Functions of Livestock

The view of research has always very much focused on biological production. More than have rural population in developing countries depends at least in part of livestock for its living. The majority of these farmers can be found in resource-poor and low-external-input production environments. At macroeconomic level, livestock contributes around one-quarter of the gross value of agricultural production. At farm level, however, livestock has more impact, because intermediate product, such as manure and draught power are important benefits of livestock. The capital asset function of livestock is important in areas lacking formal insurance and financial markets. Keeping livestock is an insurance policy against unforeseen events. When there are no possibilities of credit for cash needs selling livestock can be the only solution.

Studies on resource-poor livestock systems in Bangladesh, Nigeria and Indonesia (Udo et al., 1992; Bosman et al., 1997; Ifar, 1996) have shown that solely physical production of livestock cannot explain why farmers keep animals. For West African Dwarf Goat systems in Nigeria a concept was developed to estimate the insurance value of keeping goats and the financing value of animal sold (Bosman et al., 1997). The cash return form goats were far below the return form cocoa or even cassava. But goats enable farm households to meet unexpected expenditures. The capital invested in the flock is in fact a guarantee that future requirements will be met; for this sort of benefit, an insurance premium must be paid in situations where an insurance market exists. There benefits can be assessed by considering alternative insurance options. Disposal of animals as and when required means that financing through formal or informal agents can be avoided, which in turn means a saving on transaction costs. These transaction costs can be considerable. The insurance and finance function were four times as important as the meat production function. Thus, the benefits form goats per unit of labour were comparable to the benefit form crops per unit of labour. For mixed farming systems in East Java, Indonesia, Ifar (1996) came to similar conclusion, only if the insurance and financial values were included, returns form livestock were comparable to labour wages. There are often conflicts between the different of livestock. Selling an animal for urgent cash needs (e.g. a new roof for house, a household member hospitalised, a wedding) may not coincide with the moment form a meat production or breeding perspective. The farmer has to balance the sometimes conflicting goals with respect to the socio-economic and ecological context of the farming systems.

The intermediate (manure, draught power) and intangible (finance and insurance) benefits are very much neglected in research and development, even though all these benefits support human welfare and form the basis for decision

making by the farming households. The objectives of research and development, and consequently also in education, should be set in relation to this broad perspective on livestock keeping.

Driving Forces

The view of research has always very much focused on biological production. This has been a reason that livestock technologies have had little impact on production and productivity at farm level. We have produced interventions that farmers find unprofitable, too risky, too labour-intensive, or impossible to implement. De Jong (1996) studied dairy development under a wide range of production conditions. He concluded that producer-friendly policies (price and investment support, credit schemes) are more important than technology development (e.g. zero-grazing technologies). In the Sahel region, Breman (1995) concluded that efforts to create more favourable socio-economic conditions would be more useful than those directed towards the direct adoption of technical options by farmers. Slingerland (2000) concluded that, for the Sahel region, farming to mixed farming. For crop farmers wealth is the drive towards mixed farming, whereas for pastoralists it is poverty.

The studies on resource-poor livestock systems in Bangladesh, Nigeria and Indonesia (Udo et al., 1992; Bosman et al., 1997; Ifar, 1996) indicate that farmers are doing the best they can, given their limited resources. This does not mean that there are no differences among farmers. The coefficients of variation in household resources and income parameters are usually extremely large (Udo et al., 1992; Ifar, 1996). Livestock systems are not static either. Changes in availability of resources influences the feed resource base, whereas changes in the non-agricultural sector influence the demands and therefore the functions of livestock, and the availability of labour and cash resources (Udo et al., 1992). Research and development have to be reoriented towards supporting rather than transforming existing systems. Our first priority should not be to change production systems; we should first try to understand them. Changes in resources and economic conditions may trigger changes in livestock systems. Consequently we should be able to identify constraint, and to develop and apply more appropriate technologies for sustained animal production.

Sustainability

The continued intensification of livestock systems, the awareness of environmental impacts of livestock, and growing concerns about health and welfare of animal place livestock on the sustainability agenda. The sustainability concept has economic, societal, and ecological dimensions. An important step in making the sustainability concept operational is the formulation of proper criteria or indicators. These indicators should describe the performance of agricultural production systems in their specific context, and thereby cover the three earlier mentioned dimensions. Some of these indicators will be easily measurable; others might be quantifiable

only by way of value judgments. To assess and communicate the process of sustainable development the sustainability indicators have to be aggregated in a scientifically sound and clearly structured way.

The testing of the relevance of livestock interventions for mixed farming systems in marginal upland areas in East Java is an example of assessment of sustainable development options (Udo et al., 1996). The results of a multiple criteria analysis, on basis computer simulation of production, labour productivity, capital productivity, and environmental indicators, showed that the use of concentrates or making optimal use of the better quality local feeds can increase cattle production, as can the introduction of dairy cattle. However, for each intervention, either labour or capital productivity was reduced, showing the conflicts between different goals. Most interventions yielded a small increase in the quantity and quality of the manure, but this increase was by far not enough to compensate for nutrients in the harvested crop products. Actually the results indicate why farmers in resource-poor farming systems are hesitant about changing their cattle production systems.

Nutrient imbalances have a substantial impact on sustainability of agro-ecosystems worldwide. N, P, and K balances can be used as sustainability indicator. Results from Kenya show that soil mining contributes 60 – 80 % to farm income (de Jager et al., 2001). Soil improvements, improved land tenure regulations, increased rentability of the applications of chemical fertilisers, and integration of arable farming with livestock are prospective policy measures to stimulate farm households in introducing sustainable agricultural productions techniques (Savadogo, 2000). Livestock can make a positive contribution to the nutrient depletion problems; however we should not overestimate this positive contribution. In the above-mentioned farming system in East Java the livestock density is about two heads of cattle per ha of crop land. For maize land 5 animals are needed and for sugarcane and cassava even 16 to compensate for nutrients in harvested crops (Efdé, 1996).

Sustainability is a scale dependent concept. Livestock has to be studied at different aggregation level to develop sustainable production systems. This requires a shift from animal level studies towards the study of animal production systems at the spatial scale of a farm and a region. The multi-dimensional aspect of the sustainability concept implies that what is, or is not sustainable, depends on the local ecosystem and the agricultural systems that have evolved in that specific situation. In other words, multi-dimensionality suggests that a development towards sustainability means following a different strategy in different circumstances. This observation has important consequences for the transfers of existing technology develop in other situations, as well as for the choice of indicators to give a sustainability prospect.

Systems Approach

The traditional animal science research and education approaches, which are subdivided into specific discipline categories, are not equipped to tackle the sustainability issues that we face. The interactions of livestock with socio-economic

and physical environments call for a system approach. A systems approach from a livestock research perspective includes three steps: 1) a definition of the problems of an animal production system in relation to its economic, social, and ecological context. 2) in-depth disciplinary study of specific system components and their mutual relationships. 3) interpretation of the results in relation to the context of the agricultural production system. The systems approach is neither a new science nor a new discipline. It is a distinctive way of looking at the problems we encounter in agriculture nowadays. As a result, conventional disciplinary boundaries are, at least partly, fading away. This is especially true for applied disciplinary areas, such as the animal science disciplines. Still, a disciplinary and a systems approach are not mutually excluding. They are mutually supporting.

Both hard and soft systems methodologies are important systems approach research tools. Simulation and optimisation models can be used to explore future impacts of specific interventions on production and the environment (environmental loading and soil mining) in a manner that is not possible with empirical observation and experimentation. Participatory research methodologies have to be used to investigate farmers and other stakeholders perceptions on constraints and opportunities of present production systems and the relevance of suggested technologies and future developments.

A systems approach implies that research focused on production levels of individual animals has to be integrated with an understanding at system level. Such an evaluation should include resources availability and production performances, along with labour requirements (role of women), contribution to household income, the effect on the other function of livestock, and income distribution. I will discuss a few examples.

Ruminant feeding strategies

It is generally concluded that the availability of high quality feed remains the major constraint to increasing ruminant production in resource-poor farming systems. In many regions the grazing areas are disappearing, or have already disappeared. The planting of productive grasses, such as elephant grass, is contributing to the soil mining problem in many tropical areas. Thus, ruminants have to rely more on crop residues and forage from roadsides and other marginal lands. Poor quality feeds cannot contribute to higher meat and milk production. Meat and milk production can only be increased when we make less use of the poor quality feeds and increase the supply of higher quality feeds (concentrates, leguminous tree leaves). When the intermediate products (manure, draught power) and the intangible benefits are important objectives of livestock keeping, then more of the poorer feeds can be used and more animals can be kept (Zemmelink et al., 2002).

In-depth studies on supplementation of low quality feeds (concentrates, treatments, legumes) have shown that these supplements can contribute to higher production levels. However, practical use of these supplements depends very much on the specific production system. Supplements often are too costly, too labour-

intensive, and not readily available. Research on ruminant feeding strategies in resource-poor farming systems has to be based on an analysis of the total feed resource base, farmers' access to feed sources, the objectives of the production system, and the ecological impact of a specific strategy (Ifar, 1996).

Crossbreeding strategies

Crossbreeding for dairy production is probably the most used animal production intervention. It is generally evaluated at individual animal level. However, crossbreeding implies that the production system has to be intensified and that farmers have to become more market-oriented. It can also give extra workload to the women of a household. Moreover, Introduction of crossbreds for dairying can drain away resources (e.g. the better quality feeds) from other farmers keeping livestock. Crossbreeding is often done haphazardly and it contributes to the genetic erosion of well-adapted local breeds (de Haan et al., 1997; Thomas et al., 2002). Thus, the consequences of crossbreeding have to be evaluated at system level. Crossbreeding for dairy production has definitely brought (short-term) economic gains. Studies in India and Bhutan (Patil and Udo, 1997; Samdup, 1997) have shown that smallholder farms with crossbreds had higher farms without crossbreds. However, the long-term sustainability of crossbreeding needs to be addressed. In Bhutan, crossbreeding can contribute to ecological problems as crossbreds cannot take part in the nomadic migration of stock. The adaptability of crossbreds in terms of reproduction and calf mortality is generally poor. In smallholder dairy development projects, replacement stock (purebred or crossbred) is generally in short supply, because of low reproductive rates. Local genetic resources are the big looser of crossbreeding. The introduction of crossbreeding requires that resources, including replacement stock, and a marketing and support services infrastructure are available. Adaptability is an important prerequisite for implementing a crossbreeding programme, as resource-poor farmer's need to minimise risks cannot be over emphasised. Research efforts have to be directed from assessing individual animal performances only to more complex forms of observation and analysis to understand the long-term consequences of crossbreeding for the specific mixed farming systems concerned.

Animal health

Animal health programmes have generally been geared to disease control for individual animals, without due consideration of the overall farming system. Reducing mortality and improving the health status of animals are generally seen as important tools in increasing animal production, but if the number of animals kept alive is too high, it may exceed the capacity of the (feed) resources. Farmers with more resources may profit earlier from veterinary interventions, but with more their animals surviving, may contribute to a greater depletion of natural resources than small farmers.

Improved control of animal diseases using vaccines, diagnostic tools and enhanced genetic resistance to disease, can reduce that cost of animal production and

increase the supply of animal products. More cost-efficient production and more livestock products on the market are expected to increase food security for the urban and peri-urban populations, as well as for some smallholder livestock producers. There is another possible scenario that could result in a negative impact from the use of the research efforts. This scenario includes an oversupply of livestock products leading to reduced farm prices and decreased smallholder incomes, and an increase in animal numbers, which in turn may lead to overgrazing and soil mining.

We studied the impact of vaccinations and deworming on goat mortality and offtake in the semi-arid area of Mali (Ba et al., 1996). In Goats older than 6 months these treatments significantly reduced mortality, but had no effect on either weight gain or offtake. So, animal production, in terms of selling animals, was not increased by improved healthcare. The net result was an increase in numbers, and ultimately it will be the socio-economic and ecological context that will determine whether this increase has a positive or negative effect. Offtake is related less to the numbers of animals available, and much more to immediate cash needs of the farming households. This example shows that the technical indicators, such as mortality and off take, are not proper indicators for measuring the impact of interventions at production system level.

Cost-benefit analyses are often used to study the impact of disease control programmes at production system level. However, if farmers have to pay the costs involved in disease risk management, their production systems have to be intensified and they have to become more market-oriented. This requires a proper macro-economic environment. Added to this, it could lead to increased competition with other village farmers and with large-scale operators. This could result in a reduction of the number of small farmers with livestock. This discussion on animal health strategies illustrates the relevance of the interpretation of findings in relation to the context of the agricultural production systems concerned.

Concluding Remarks

Research of livestock keeping in resource-poor farming systems has shown that these animal production systems are complex and dynamic. They provide more than just food through their versatile roles in supporting human welfare. It is expected that future research emphasis will be on the understanding of interactions of livestock with the economic, social and ecological environments and on the development of methodologies to explain, explore and predict the functioning of livestock farming systems. This will require considerable research efforts directed to more complex forms of observation, analysis and operation at field level.

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