Priorities for socio-economic research in farming systems in South-East Asia

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Abstract

Experiments conducted on-station and on-farm for the alleviation of various constraints to animal production — such as acute shortage of animal fodder — indicated that most of these technologies were technically feasible, but that farmer adoption was relatively low due to socio-economic reasons. Some of the major socio-economic reasons were (a) declining trends in draft animal usage particularly because of mechanisation; (b) higher off-farm wage rates and opportunity costs of family labour; (c) unfavourable government agricultural policies for smallholder livestock development; (d) unavailability of required inputs and support services; (e) risk aversion; (f) inadequate training and extension for knowledge-intensive technology and lack of credit to the poor without collateral. Socio-economic research priorities in crop-animal research are (a) to review the past research conducted by NARS and identify priorities for further research; (b) farmer participatory research on dissemination of proven technologies in similar agro-climatic and socio-economic environments to increase research utilisation; (c) examination of the effects of macro-economic policies in relation to adoption of improved livestock as well as the changing trends from subsistence to commercialisation; (d) study of farmers' practices, knowledge, attitudes, perception and decision-making processes and the incorporation of women's concerns in technology design, testing and evaluation of technologies; (e) more emphasis on *ex-ante* analysis of technologies; (f) systems simulation and modelling of crop-animal systems and, (g) evaluation of the impact of crop-animal integrated technologies.

Introduction

In humid and subhumid Asia, rice is the staple food and principal crop. It accounts for 30–50% of agricultural incomes and provides 50–80% of the calories consumed by the people (Hossain 1994). About 57% and 43% of the total rice area in Asia are under irrigated and rainfed conditions, respectively (IRRI 1993). Rice yield has remained low in the rainfed lowlands (2.3 t/ha) and uplands (1.1 t/ha) compared with the yields in the irrigated ecosystem (5 t/ha). Crops grown in the rainfed lowlands and uplands are highly dependent on the amount and duration of rainfall. In these rainfed areas, agricultural lands in general are acidic and subjected to soil erosion and degradation; they are therefore low in fertility. Hence, the smallholder farming system in Asia is near subsistence, resulting in pervasive poverty in the rural areas.

Due to the low and uncertain level of crop productivity in these environments, animals form an integral and important component of the farming system. Thus, it is in the rainfed lowland and upland systems where there is a particularly strong interaction between crop and animal subsystems. While these areas are environmentally fragile, they have great potential for agricultural and socio-economic development. These areas are not only biologically diverse, but are also characterised by a wide array of socio-cultural structures and beliefs, which directly and indirectly influence animal production.

Thus, this paper will attempt to identify some socio-economic constraints to animal production and suggest socio-economic research priorities/strategies to optimise animal production in the smallholder farming systems of Asia.

The importance of animals in farming systems in Asia

Animal production is an integral part of crop production in Asia. The two are interdependent since Asian agriculture is characterised by mixed farming. The practices in such crop–animal systems are very complex and vary depending on the physical, biological, and socio-economic parameters (Carangal 1995). Large ruminants provide draft power and animal manure for crop production while crop residues and crop by-products are important sources of animal feeds. Large ruminants are also raised as forms of savings and hedge against risks. Sale of livestock and poultry and their products are used to improve and stabilise farm income for the purchase of cash inputs and to offset household expenditures such as school fees, social obligations and health care. Swine, goats and poultry, raised mostly by women, are immediate sources of cash, forms of social security, insurance, personal investments, and sources of funds for school fees, family health care costs, dowry and other household expenses.

In many Asian and South Pacific societies, farmers raise animals for social reasons. Small animals and poultry are used to seal social contracts such as marriage, kinship ties and friendship. Chickens are a popular form of sacrifice for rituals in animistic and some institutionalised religions, in which case the colour of the plumage may be significant. However, in some countries there are cultural and religious practices mitigating against certain aspects of livestock development, and these must be understood and respected. Buddhist strictures against the killing of animals, Moslem and Jewish taboos regarding swine and other scavenging animals, Hindu veneration of the cow, and the vegetarian's attitude to animal foods are reasons for not promoting certain livestock production. Ownership of animals is also a measure of a family's social and economic standing (RAPA 1990a).

Understanding these crop–animal interactions, and the social and economic reasons why farmers raise animals in specific agro-ecosystems, will help scientists design farming technologies which will not only improve animal production but, more importantly, ensure a higher rate of adoption.

Crop–animal systems research under the Asian Rice Farming Systems Network

The importance of livestock in smallholder farming systems, particularly in rainfed environments, was given explicit attention at IRRI when cropping systems research expanded to farming systems research with the inclusion of the animal component of smallholder farms in Asia. Thus, in 1983, the name of the Asian Cropping Systems Network (ACSN) was also changed to Asian Rice Farming Systems Network (ARFSN) with support from the International Development Research Centre (IDRC).

In 1984, ARFSN initiated collaborative research both on-station and on-farm with selected countries in Asia. The aim was to develop appropriate technologies and methodologies for conducting crop-animal systems research in irrigated, rainfed lowland and rainfed upland rice ecosystems. On-farm research was initiated in five key research sites in four countries representing different rice ecosystems (Table 1). The existing team of crop researchers and socio-economists was expanded to include animal scientists, forage agronomists, veterinarians etc to conduct an integrated approach to solve farmers' problems, particularly in rainfed rice environments. Recommended strategies in food–forage production systems are given in Table 2.

A farming systems perspective was adopted in the technology development process. Although there are different modifications in different countries in implementing this systems approach, the basic components are the general methodology for farming systems research and its steps in diagnosis, design, evaluation and transfer of technology have been followed in animal production with modifications (Carangal 1993; Calub et al 1988; Calub et al 1993). The highlights and contributions of the ARFSN to crop–animal systems research have been documented by Carangal and Sevilla (1993).

Socio-economic constraints to animal production

Several studies (IRRI 1986; IRRI 1990; IRRI 1993) identified common problems in animal production in Asia. These include acute shortage of animal fodder, particularly during the dry season, low productivity/performance of animals, low nutritive quality of crop residues, and animal nutrition and health-related problems.

Table 1. *The crop–animal farming system key sites indicating the location of crops, trees and animals involved in the study.*

Location	Rice ecosystem	Crops and trees	Animal
1. Phumdi Bhumdi, Nepal	Rainfed lowland midhills	Maize, wheat rice, mustard oats, millet Napier and fodder trees	Buffalo
2. Changping, Beijing, China	Irrigated	Rice, rye maize, triticale and wheat	Dairy cattle
3. Ban Phai, Khon Kaen, Thailand	Rainfed lowland	Rice, maize cassava, peanut, mungbean grasses and stylo	Beef and dairy cattle and cow/calf
4. Batumarta, South Sumatra, Indonesia	Rainfed upland	Rice, cassava maize, soybean peanut, mungbean coconut, rubber, forage crops and grasses	Cattle, goats and chickens
5. Santa Barbara, Pangasinan, the Philippines	Rainfed the lowland	Rice,mungbean cowpea *Leucaena*, *Sesbania* and forage legumes	Cattle and pigs
6. Magallanes, Cavite, the Philippines	Rainfed the upland	Rice, maize cassava and cowpea	Cattle, chicken and pigs
7. Zhenjiang, Jiangsa, China	Irrigated	Rice, wheat, barley, vegetables and rapeseed	Pigs

To address these constraints on-station and on-farm experiments were conducted in several countries in Asia: China, Indonesia, the Philippines, Thailand, Vietnam, Nepal, India and Myanmar. The technologies involved ways to improve the quantity and quality of animal feeds by improving the cropping systems in different rice ecosystems. Based on the crop–animal systems research experiences, the technologies to improve animal production were found to be technically feasible. However, in spite of numerous demonstrations through research and the potential benefits of mixed crop–animal farming systems, technology adoption had been relatively low. In many instances the low adoption rate was due to socio–economic reasons. Generally these socio-economic reasons are:

1. The declining trend in draft animal usage particularly in irrigated and favourable lowland rainfed areas due to the shift to small-scale mechanisation

Studies on the effect of rice bran supplementation on draft capacity, draft usage, and improvement of the utility of draft animals and how these can contribute to sustained farm productivity were conducted in the favourable, rainfed village of Sta. Barbara, Pangasinan, the Philippines. However, with the increasing use of power tillers for land preparation, draft animals are used only for light work such as hauling or transporting farm products instead for heavy work (ploughing). With growing economic prosperity and rising wage rates in Asia, carabao and cattle will be used more as a source of milk and meat and less as a source of draft power.

2. Higher off-farm wage rates and opportunity costs of family labour

As economic development takes place, there is a general withdrawal of labour from the agricultural sector to the industrial and urban sectors (Pingali 1993). With increasing opportunity costs of family labour, especially male labour, labour intensive activities with low returns have low potential for adoption. For example, to increase the profitability of backyard swine production, on-station and on-farm experiments in Cavite, Laguna, the Philippines, were conducted using home-grown crops such as cowpea, cassava or sweet potato as ingredients in the feeding ration. While on-farm experimental results were encouraging, this technology was not adopted due to the rapid industrialisation of the province which was not anticipated when the project was initiated. Similarly, in Khon Kaen, Thailand, the migration of men affected the adoption of forage grasses as a feeding intervention for cattle fattening. Male family members, who have greater opportunities for non-farm employment, leave the care and management of animals to female family members (Paris 1993).

Table 2. *Recommended strategies in food–forage production systems.*

Ecosystem	Proposed on-farm experiment
Irrigated lowland rice	• Evaluate different cropping patterns involving rice–food + forage legume production system. • Use forage crops adapted to the environment. • With good irrigation during dry season: – evaluate a rice–food crop–food crop where forage legume is intercropped in the first food crop; – grow forage legume until the planting of the next rice crop. • Introduce a fast growing forage species as relay crop in standing transplanted Aman rice or between winter rice–transplanted Aman. • Evaluate growing grasspea/fieldpea/sunhemp as relay crops in transplanted Aman and Dhincia grown before transplanted Aman. • In areas with two rice crops grow a third crop of food–forage between the two rice crops rather than forage crops. • In temperate environments, such as north China and Korea, evaluate forage crops after rice, e.g. triticale, rye, Italian rye grass etc.
Rainfed lowland	• In monocrop transplanted Aman area, evaluate grass pea and blackgram as relay crops after rice and mungbean plus *Sesbania* before rice. • After rice, intercrop berseem with wheat in subtropical countries. • In tropical environments, evaluate food plus forage legume intercropping after rice during the dry season using early maturing food legumes such as mungbean and cowpea and drought tolerant forage legume such as *Siratro*, stylo and *Crotolaria.* • In areas with more than 0.5 m water depth, evaluate rice varieties that can be harvested for forage from 50–80 days after planting and then grow to maturity for the grain crop. • Relay crop of forage on standing deepwater rice, e.g. grasspea/field pea, blackgram.
Upland	• With limited rainfall and one main rice crop: – main cereal crops intercropped with forage legumes such as stylo, *Siratro, Pueraria* and *Clitoria;* – main cereal crops intercropped or relay cropped forage legumes. • With good rainfall and two crops with forage legumes: – main cereal crops during the first crop followed by food legume plus forage legume intercropping; – main cereal crops intercropped with food legumes followed by food legume plus forage legume intercropping combination of the two every other year.
Upland hilly areas	• Alley cropping using cereals (millet, maize, sorghum, upland rice etc) or food legumes (soybean, mungbean, blackgram, peanut etc) and alley crops species (pigeon pea, *Sesbania* spp, *Flemingia, Gliricidia* and *Desmanthus*). In areas with good rainfall, add crop between the alley crop after harvesting the cereal crops. • Use forage grass or legumes as alley crops in the contour, e.g. Napier, hybrid Napier, *Setaria* etc. • Grow food crops (cereals and legumes) between the alley crops. • Use trees (fruit trees, coffee etc) in the contour with forage legume (stylo) or grass (*Setaria*) between the trees in the alley. • Grow food crops (cereals and legumes) between the contour or alley.
Non-cropping land	• Rice bunds: evaluate *Sesbania, Clitoria, Desmanthus,* pigeon pea, and forage grasses such as Napier, *Setaria,* hybrid Napier etc. • Farm boarder: evaluate *Leucaena, Desmanthus* and *Gliricidia.* • Homestead area: planting of multi-purpose fast growing tree species around the homestead, such as *Leucaena,* jackfruit, *Sesbania* spp, *Albizia* etc. • Roadsides, embankments, highways and railways should be covered with appropriate fodder/forage species.

3. Unfavourable government agricultural policies for smallholder livestock development

Macro-economic policies affect the adoption of mixed crop–animal technologies at the farm level. Policies such as overvalued exchange rates which encourage the importation of livestock products discourage local producers from growing local feeds. High interest rates also discourage the long-term investments required in many animal production systems, particularly cow–calf operations and dairying.

Policies which promote the use of modern, internationally tradeable agricultural inputs rather than the non-tradeable traditional inputs (e.g. the crop residue, pasture, manure and draft power advantages in crop-animal farming) encourage the separation of crop and livestock.

4. Unavailability of required inputs and support services

Improved technologies require inputs which are often inaccessible, unavailable at the right time or are unaffordable to poor farmers. Selected introduced forage species identified as being suitable for food/forage integration were evaluated at the IRRI experimental farm and in a few farming systems key sites in the Philippines and in Myanmar (Tengco 1995). On-farm experiments on mungbean and siratro intercropping showed potential for producing food and fodder in limited lands; however, the sustainability of this system depends on the availability of siratro seeds. To sustain farmers' interest in growing siratro, there should be farmers who are willing to grow and sell seeds as well as supply the other farmers. The unavailability of molasses and mineral mixtures for urea–molasses block licks also discourages farmers from adopting this technology. Artificial insemination schemes have been tried but were not adopted due to the difficulties in making use of the service. Raising improved poultry breeds requires stock and vaccination services which are not readily available in some communities.

5. Risk aversion, perceptions

Many of the proposed interventions are not adopted due to farmers' perceptions and the reduced emphasis on the economic benefits from animals. To increase the protein quality of animal feeds, leguminous trees such as *Leucaena* and *Gliricidia* were introduced as feeds for ruminants. However, aside from the problem of psyllid infestation, farmers were reluctant to use these leaves to feed their cattle because of a misconception that these leaves would precipitate abortions in pregnant cows. There was a lack of knowledge regarding the difference between the digestive system of the ruminant and non-ruminants.

One of the reasons for low adoption of forage crops despite the availability of technologies, is farmers' perceptions. For example, farmers in north-east Thailand raise animals for draft and as a form of savings. Farmers are not concerned with technologies such as growing forage grasses, which will increase the weight of their draft animals, as long as the animals can plough and haul and can be sold at any time. Farmers do not see the benefits of providing better quality feed to these animals, and do not think it is worthwhile putting in the extra effort to grow forage crops.

Farmers are hesitant to go into cow–calf operations because of the long pay back period, and because smallholder cattle often show a delay in the first calving and have long calving intervals. However, on-farm experiments in Sta. Barbara, the Philippines, demonstrated the technical feasibility and profitability of improved cow–calf management (protein supplementation, creep feeding and early weaning of calves). Results of such experiments should be further replicated in other similar socio-economic conditions and agro-ecosystems to encourage more farmers to adopt this technology (Sevilla 1995).

6. Inadequate training and extension for knowledge-intensive technology

Despite the nutritional advantages of treating straw with urea, adoption is low mainly because farmers do not have adequate training and knowledge of the proper utilisation of the technology. For example, as a supplement to cattle ration, or for treatment of straw, farmers need to fully understand that if urea is used in the right amount the chance of toxicity is nil.

7. Lack of credit to the poor without collateral

Improved breeds of poultry (e.g. crossbred between native males and Rhode Island Red females in Chiang Mai, Thailand; F_1 offspring of native chicken crossed either with New Hampshire or White Cornish breed in Matalom, Leyte; or Star Cross Brown in Sreepur, Bangladesh) were introduced with improved management such as feeds, confined housing, artificial incubation, tendering and marketing, vaccination and the use of artificial brooders for day-old chicks in key sites in the Philippines, Bangladesh and Thailand (Alcober 1991; Banu et al 1991; Shinawatra et al 1991). Although the interventions contributed to income and family nutrition, these were not sustainable for farmers who lived away from markets, who could not afford to buy supplemental feeds and where traditional technologies were found to be more efficient. Lack of credit, particularly for those who do not have collateral, often constrains improved poultry raising ventures.

In Bangladesh, the Grameen Bank provided women from landless and resource poor families with access to credit for livestock and poultry production without collateral. The proportion of the total loans to female borrowers in livestock (milch cow raising and cattle fattening), poultry and fisheries increased from 42.8 to 54.9% from 1979–83 to 1986. The repayment performance was best for women borrowers — 81% of them had no overdue instalments, compared with 74% from men (Hossain 1988). In Batumarta, Indonesia, successful revolving credit schemes for women's groups encouraged women to improve the management of Peling (native breed). This contributed to the sustained adoption of the intervention (Supriadi et al 1991). Moreover, improved poultry breeds require intensive management, skills and time of women which have to be considered in technology design.

Socio-economic research priorities in crop–animal systems research

With the described socio-economic constraints to adoption of integrated crop and animal technologies, the following are suggested as socio-economic research priorities in crop–animal systems research in South-East Asia.

1. Review of past research conducted by NARS and identify priorities for further research

For the past 10 years, numerous studies on crop–animal production systems have been conducted by NARS and with IRRI's upland research consortium. We should learn from past experience and identify which of these technologies need to be tested under similar environments using a farming systems perspective. On-farm research for incorporating food forage legumes in the rainfed rice-based farming systems should be continued. On-farm experiments using grasses and leguminous plants as animal feeds and organic fertiliser should be conducted in upland rice environments in Laos, Cambodia, Vietnam and Thailand taking into account physical, biological and socio-economic factors. Increased utilisation of homestead lands for the production of forage should be explored further.

2. Farmer participatory research on dissemination of proven technologies in similar agroclimatic and socio-economic environments to increase research utilisation

Community-based service schemes such as revolving credit funds, animal sharing systems, smallholder banks for forage seeds, parent stock for poultry and other stock, and vaccination services should be explored to help smallholder farmers move from subsistence to semi-commercial production. This will require links with development NGOs and extension workers, particularly in the communication of information. Since women play important roles in livestock management, particularly of small animals, appropriate methods of extension to reach women should be given greater attention.

3. Examination of the effects of macro-economic policies in relation to adoption of improved livestock and the changing trends from subsistence to commercialisation as a result of economic prosperity and rising wages

Economists can play an important role in examining the effects of macro-economic policies as influenced by GATT in relation to livestock development.

4. Study of farmers' practices, knowledge, attitudes, beliefs, perceptions and decision making processes and the incorporation of women's concerns in technology design, testing and evaluation of technologies

5. Provision of more emphasis on *ex-ante* analysis of technologies

Due to the risks involved in introducing feeding interventions, it is important for economists to conduct *ex-ante* analyses of interventions recommended by animal scientists. Will the proposed interventions require more labour, land and capital? Livestock scientists are rarely trained to consider the important economic variables influencing the supply/demand for new technology. This often results in generating technology for a specific group of farmers, under a narrowly defined technology scenario.

6. Systems simulation and modelling of crop–animal systems

A lot of resources and effort can be saved if we are able to predict the more likely outcome of a particular technology within a very complex system such as the smallholder farm. Systems analysis should be used to better understand how various resources are allocated within a farming systems

7. Evaluation of the impact of integrated technologies for crop–animal improvement

While much research has been conducted over a period of years, the evaluation of impact in terms of changes in income, work-load of men and women, family nutrition and the effect on the environment is necessary. Technologies should not only be technically feasible and economically viable but socially acceptable and environmentally friendly.

Conclusions

Adoption of technologies for crop–animal integration will depend on the specific agroclimatic and socio-economic conditions under which farmers live. The linkage between crops, draft power and manure will disappear in areas where wages and opportunity costs of labour are increasing (Pingali 1993). The potential for adoption of food–forage production systems will be high in areas where farmers realise the benefits to such enterprises as cattle production, fattening and dairying. While scientists are concerned with increasing food and income for smallholder families through technologies which improve the integration of crop and animal subsystems, economic development which will contribute to the disappearance of these complementarities should be anticipated. International and national research efforts to help smallholder farmers through research should continue. However, unless government policies will provide the farmers with incentive and support services, they will be resistant to any interventions proposed by scientists.

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Discussion following Drs Paris and Sevilla's paper

Carroll: There is a tendency for all of us technicians to concentrate on technical matters, the scientific and technical issues which we have all been trained to follow through in our University days, and we tend to have a fairly narrow view, perhaps, of an approach to development. And this, I believe, gives rise in many cases to a tendency for development efforts to be directed far too much to the technicalities without taking into account what those technicalities are for — the people. So I am pleased we have been able to concentrate on the "people" aspects of technology adoption.

Dr Paris also mentioned the need for closer liaison between the farmer at the grass roots and the research worker, a point I would like to emphasise and I think ILRI should also be considering (if I may be so bold to say so), not just research of technicalities but we need perhaps to do a bit of research into the methodologies for linking the problems at the grassroots with the sort of research that is done. The way in which the information flows take place between the farmer — who is obviously the recipient of the technology — and the people who carry the information from him to the research worker is similarly important. Again, I would emphasise what I call "systems approach" where I believe the farmer should be involved to the extent that is possible for him, given his technical background or lack thereof, for him to be involved in defining the problems and defining what sorts of things he would like to see done so that the research worker does not lose sight of what the purpose of the work is.

Siriwat: I am in livestock extension and I would say that what the speaker has described, we have done through another line. First we gave farmers improved breeds, like Brahman bulls. For the forage, we get the forage seed to them from the government and arrange for its dissemination. Vaccines are given for free by a volunteer in the village. For the rice grower we have demonstrations by the District Officer down to the village level. For the livestock farmer we just had some urea–molasses blocks distributed to the farmers as a demonstration, because we cannot give the blocks to all. We always find that women have a big role in helping us so, as the speaker said, I think this is an area we should concentrate on. Because they provide labour to raise chickens, pigs or even dairy animals, they can do more than males. When we talk about new techniques, we find it is the women we can teach more (I don't know why!).

David Little: The availability of poultry vaccines at the village level appears to be a constraint almost everywhere — despite demonstrations that you can vaccinate numbers of poultry. Are there any successful stories of sustained vaccine use by smallholder poultry producers in Asia?

Carroll: In Bangladesh, we have had a lot of success in the last 10 years with village animal health workers and poultry development where mostly landless women are involved. We have broken the whole poultry production cycle into each component part, so one women will have a hatching system hatching may be 300 eggs at a time. She sells the day-old chicks on to a chick raiser, she will raise the chick to six weeks and will pass it on to a pullet raiser, and then on to a layer farmer, usually women. And involved in that process, and what has really revolutionalised the whole system and enabled it to happen, is the availability of Newcastle disease vaccines in the villages administered by selected village woman who had been given a small vaccine kit and trained to give the vaccines.

Mukherjee: Chairman, unfortunately my colleague Professor Latif is not here, but in Malaysia in collaboration with Australia we have developed a vaccine which is administered through the feed and this feed vaccine actually takes into account modified combinations of strains of Newcastle disease vaccine. It has been demonstrated that the immunity can be long term and this is now being investigated in many trials in Asian and African countries.

Carroll: I am aware of that vaccine, but I think it is still fairly costly for the village level which is maybe why it has not been utilised very much. Also the feed production is very piecemeal and localised, the mixing becomes a problem.

Leng: I wanted to bring up the whole concept of the effects of increasing environmental concern on the future of animal production because it has not been raised.

I have been in Cuba recently. Cuba has a system where plenty of fossil fuel used to be used and there was acceptance of high technology, rations, grain use, concentrate feeding etc which, on the removal of the Russian subsidies on fossil fuel has created a bigger problem than previously. Without all the inputs, agricultural production has fallen to the extent that people are now hungry in a country that previously had standards of living equal to many of the developed countries.

Carroll: This can be demonstrated by the effects on milk yields where high input requirements cause small farmers to go out of business. I think that argument also applies to crop yields if I am not wrong as the high yielding varieties of wheat, maize and rice depend very much on high fertiliser application and high water application. If you remove those the actual yield is less than the local strains or the local varieties that were replaced. I guess we are really caught in the nexus: there are so many people to feed in the world there is no going back. If we cannot provide the necessary inputs to maintain the production levels then we really have a problem that we are likely to face in the near future.