

COMPLEXITY, DIVERSITY AND COMPETENCE:
TOWARDS SUSTAINABLE LIVELIHOODS FROM FARMING SYSTEMS IN THE 21ST
CENTURY

Paper submitted to the 1990 Asian Farming Systems Research and
Extension Symposium to be held in Bangkok

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November 1990

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ABSTRACT

In most Asian countries, it seems likely that agriculture will have to provide livelihoods for much larger populations in the 21st century. To be sustainable and effective, this will require more intensive and complex farming systems, with more farm enterprises and more internal linkages. For these farming systems, the balance of advantage shifts from scientists to farmers in managing complexity, exploiting diversity, in experimenting and in innovation. Recent findings from participatory rural appraisal in India and Nepal indicate that given good rapport, rural people can manifest greater analytical capabilities than outsider professionals have supposed. New roles for outsider professionals are implied, to be convenors, catalysts and consultants, searchers and suppliers, and tour operators. The technology now most needed and most lacking is methodological - to change personal attitudes, demeanour and methods of interacting, and institutional, to enable scientists and extensionists to play their new roles.

The Rural Future in Asia

Projections for future populations for a number of countries in Asia (notably Bangladesh, India, Iran and Pakistan) have risen in recent years. Future fertility in these countries is now estimated to be higher than was earlier anticipated. According to the 1990 World Development Report (1990:228-9) regional projections are as follows:

	1988	2025	Percentage increase
South Asia	1,107	1,987	79
East Asia	1,538	2,293	49

For the 16 most populous countries recorded in the Report (no figures are given for Afghanistan) the projections are as in Table 1:

Table 1: Population Projections to 2025 for 16 most popular countries in Asia

	1988	2025	Percentage increase
China	1,088	1,566	44
India	816	1,350	65
Indonesia	175	282	61
Japan	123	131	7
Bangladesh	109	219	101
Pakistan	106	285	169
Vietnam	64	117	83
Philippines	60	103	72
Thailand	54	83	54
Iran	49	129	163
Korea, Rep. of	42	54	29
Myanmar	40	69	73
Iraq	18	49	172
Nepal	18	37	106
Malaysia	17	30	76
Sri Lanka	17	24	41

Without any increase in population, the challenge of enabling the many millions of already desperately poor rural people to gain a better life would be intimidating. But rural populations in most countries will rise. This will happen least in those countries with the highest indicators of wellbeing - Japan, the Republic of Korea, Sri Lanka, even China, and most in those countries which are poorest or which have regions of intense rural deprivation. In these poorer countries, whatever optimistic assumptions are made concerning urban and industrial development, many tens of millions more can be expected to have to find their livelihoods in rural areas.

This means that the ratio of population to physical (non-biological) resources will rise. If there is general economic growth, non-farm and off-farm rural incomes will also rise and generate opportunities for additional livelihoods.

But even so, it seems inescapable, short of an AIDS or other holocaust, that direct agricultural activities in most Asian countries, especially the poorer, will have to sustain vastly more people over the next 35 years, and that if it does not do so at a

decent level, the cost in human suffering in both rural and urban areas will be appalling. Unexploited opportunities for irrigation are diminishing, and yields in irrigated agriculture are levelling off. More and more, taking the long view, attention shifts, as in this paper, to rainfed areas, and how in their more complex, diverse and risk-prone conditions a much larger number of livelihoods can be generated and sustained.

The sustainability of agricultural livelihoods is basic. Most obviously this has an environmental dimension, in maintaining or enhancing productivity of physical resources over the long term. In consequence, and in accord with current fashion, much attention is paid to the erosion or maintenance of the resource base. But a sustainable agricultural livelihood entails much more than that. It includes diversification and competence. Poor families often seek to multiply their enterprises to raise their income and to reduce risk. Their competence in diversifying and continuously adapting to and exploiting changing conditions is a key component in the sustainability of their livelihoods. To support the much larger agricultural populations of the future, then, will require not just that farming systems are physically sustainable, but that people's adaptive abilities are enhanced and continuously expressed.

Future Farming Systems: Complex, Diverse and Dynamic

It is now a commonplace to recognise that small-scale rainfed farming systems are often internally complex, with many linkages between their parts, and often diverse over short distances. Their dynamism in adapting to and exploiting unpredictable conditions is also more widely appreciated. But it is perhaps less well recognised that to achieve sustainable higher production and to do this at lower risk many farming systems require to move in the opposite direction to that of industrial and irrigated green revolution agriculture in the past. Instead of becoming simpler and more uniform, they have to become more complex and diverse. Intensification also takes a different form. Instead of intensification of external inputs, the intensification is more internal, adding enterprises and additional internal linkages (see e.g. Haverkort and Reijntjes 1990). It also requires a nimble dynamism and adaptability, with quick responses to changing external physical and economic conditions.

Such changes follow from, and fit, rising ratios of farming persons to basic agricultural resources such as land and water. They are consonant with Ester Boserup's (1965) thesis of a strong link between population density and technology. As farming population to resource ratios rise, farming can become, and often does become, more management-intensive. The sequence from shifting cultivation to continuous cultivation without trees, and then to agroforestry, is one classic example; another is from free ranging livestock to cut-and-carry stall-feeding.

More enterprises can be, and often are, introduced and intensified - agroforestry, aquaculture, diverse home gardens, micro-irrigation, mixed cropping, multiple canopy combinations, more species of small livestock, and the like. Internal linkages can be, and often are, exploited more, through synergistic complementarities such as nutrient recycling. Microenvironments are often created and exploited (Chambers 1990a; Scoones 1990). A larger population

engaged directly in farming activities provides both the need and the means for this internal diversification, intensification and complication of farming systems.

Complexity, Diversity and Comparative Competence: scientists and farmers

To contrast scientists' and farmers' comparative competences in technology development can give a distorted view through unreal polarisation where there are complementarities. Nevertheless, to do so can sharpen some key points.

Scientists' comparative competence vis-a-vis farmers usually includes:

- * processes where reductionism and precise measurement work well
- * breeding (but not always) and biotechnology
- * minute and microscopic phenomena
- * developing package technology for uniform, widespread and controlled conditions
- * access to knowledge and genetic material from other environments

Farmers' comparative competence vis-a-vis scientists usually includes:

- * the experience and discipline of having to live in and survive through an actual farming system and its physical, social and economic environment
- * the creation and exploitation of microenvironments such as those which concentrate soil, water and nutrients
- * continuous observation of processes
- * freedom to make progressive changes, managing and adapting sequences, unrestricted by rigid experimental design
- * the development and adaptation of technology for diverse local conditions
- * the understanding, development and management of technology with many elements and linkages
- * a long time horizon (unless insecure or desperate)

This last point deserves explanation. There is a common belief that poor people "live hand-to-mouth" and are incapable of taking a long view. This is true of many of the desperate and indigent poor. But it does not appear to be generally true of small farmers who have secure tenure and who can pass on their land and assets to their families. In many parts of the world, where they have secure rights, small and poor farmers make long-term investments in planting trees and in sequences of land shaping which enhance long-term productivity and stability of production. It is commercial enterprises concerned to make early profits, economists who discount the future, and government officials who need to meet their targets within the financial year, who have the short time horizons, not the poor farmers.

Some of the other points have been put with authority by Sumberg and Okali (1989:112):

"We contend that the farmers' role in technology development becomes more critical and increasingly cost effective as the proposed

technology becomes more multi-faceted and complex. In these circumstances, classical methods for designing, refining and evaluating technical innovations become less useful. A good example would be the conceptual and experimental pitfalls inherent in research on even relatively simple intercropping systems. As we look to even more complex technologies such as agroforestry systems, which can potentially produce crops, wood, fruit and fodder, it is obvious that a traditional experimental approach seeking to identify management treatments which maximize an output becomes unwieldy and unrealistic. It is the farmers themselves who hold the keys for developing, evaluating and validating these systems."

An illustration of some of these points can be given from findings in Limbu watershed, near Kamalapur, Gulbarga District, Karnataka, India. There, farmers have for some decades been making silt trap fields in nallas (seasonal watercourses). They gradually, year by year, build up barriers of big stones, and then grow paddy on the new fields formed. This technology has been ignored by modern science, but provides farm families with a source of food that is more reliable than their rainfed crops. In the Limbu watershed, a Government programme has constructed gully checks. Typically, these are larger and higher than the silt trap barriers and have to be completed in one financial year. They have a sloping apron on the lower side to prevent erosion. Farmers do not favour this (literally high) technology since it holds up water instead of meeting their priority of building up silt fields. However, in the lower parts of nallas, where streamflows are larger and where their own technology would be unstable, farmers have recently adapted the Government design, and built walls with a similar sloping apron, but with two differences. First, the walls are low, in order to trap silt and build up silt fields gradually. Second, they have bedded long stones in the apron, sticking up like teeth. When I saw this, I thought this was to break the stream flow. A farmer gave a different reason. The purpose was to provide support for the next layer of stones to be placed on the apron. The intention was to build up the wall gradually over the years as good silt was deposited, progressively forming a field.

In this example, we see complementarities:

- * farmers' original technology effective but over a limited range of conditions
- * Government technology inappropriate because standardised and because of short time horizons (work to be completed in one financial year)
- * farmers observing Government technology and modifying it to exploit new difficult areas
- * farmers having a long time horizon, undertaking sequential investment

The assertion above that farmers have a comparative competence advantage with the understanding, development and management of complex technology receives further support from recent experience in India with participatory rural appraisal (PRA). This suggests that rural people (whether literate or illiterate) have a capacity for the presentation, analysis and management of complex and detailed information that has been underestimated. Their mental maps have proved to be detailed, and when the rapport, methods and materials are right, they have shown a remarkable ability to present these on

the ground and on paper. Their ability to understand and use diagrams - histograms, Venn diagrams, flow diagrams, systems diagrams, pie diagrams - was earlier explored (e.g. Conway 1989; Lightfoot et al 1989) and has subsequently been confirmed and extended (e.g. Lightfoot 1990b), with numerous unrecorded examples from Indian PRA. Quantification, ranking and scoring have also produced surprises, with repeated evidence that when rapport and other conditions are right, rural people have a greater capacity for estimating, quantifying, identifying trends, and ranking and scoring than had been generally supposed (Chambers 1990), except perhaps by a handful of social anthropologists. Use of ranking methods has revealed that many different criteria are applied in making assessments. Wealth and wellbeing ranking, in which participants rank the households in their communities, usually reveal that at least four criteria of wealth and poverty, or of wellbeing and illbeing, are being weighed simultaneously in judgements. In direct matrix ranking (RRA Notes 1) and scoring, many different criteria are used in assessing items in a class, such as fodder grasses, trees, or varieties of a crop. The record to date is held by a farmer in Limbu watershed, Gulbarga District, who scored 27 trees according to 13 criteria. It is outsider professionals who simplify, with their single criteria and single-dimensional scales such as yields, poverty lines, benefit-cost ratios, and internal rates of return. Dealing with a complex and unstable reality, farm families cannot afford such simplifications. They have to live with, manage, and exploit complexity; and they have to develop and maintain the capacity to do so.

Scientists, however, now have new tools such as remote sensing, Geographic Information Systems, and computer simulation models, and are trying to bring these to apply, as illustrated by papers to this conference (e.g. Thung 1990; Zweig 1990). These raise questions of whose knowledge and whose reality count, in practical terms. The essence of wisdom is to be able to distinguish cases where these tools help and those where they hinder. The danger is that the tools have their own momentum of funding, prestige and professional excitement which take off towards outer space rather than towards real farming systems. GIS and remote sensing will be done and may perhaps be able to contribute to, for example, identifying zones vulnerable to certain pests and diseases, but not to micro-level intensification and diversification. "Old" technology in the form of 1:5000 black and white aerial photographs can empower farmers and assist their own analysis, whereas even the French SPOT satellite imagery, with its 10 metre pixels, appears of little use to them. Similarly, simulation models for complex systems will have to face the "so what?" test, of whether they generate insights, technology or advice which is actually and beneficially used. The danger for the 21st century is that the new tools which appear to enable scientists to handle and analyse complexity will seduce them into an inbred world of fantasy, while farmers have to get on with the job unassisted and in other ways.

The lesson is the old one that it is not a question of either-or. Scientists and farmers need one another. But questions of comparative competence and cost-effectiveness do raise strategic issues. To what extent should scientists pursue complexity and diversity through "high" technology, and to what extent should they concentrate on the "low" technology of interaction with farmers?

Many answers could be given. The hypothesis of this paper is that in the past, for complex, diverse and risk-prone agriculture, the roles and relationships have been wrong. Scientists and extensionists, powerful with their superior status education and knowledge, have not enabled farmers to play the full part that their knowledge and competence deserve and demand. What has been missing is not the competence of rural people, but its perception, encouragement and support by outsiders. One reason for this has been that scientists and extensionists have lacked the approach, methods, respect for farmers, and rapport to enable that competence to be expressed and enhanced.

New Roles

For complex and diverse agriculture, four roles for outsider professionals are implied. To varying degrees, they are already fulfilled, especially in the NGO sector, but they appear new in the sense of being not yet generally and widely accepted and adopted.

i. convenor

Initiating and supporting farmers' groups is a time-honoured activity in extension. But is there a relative neglect of convening specially sought out and selected groups of farmers, and bringing them together? Literature on innovator workshops (Ashby et al 1989; Abedin and Haque 1989; FARMIIS 1989), suggests that where innovators have been sought out and brought together to discuss their experiments, and to visit each others' farms, the payoffs have been high. The gains may be greatest with complex systems and sequential innovations where there is most to be learnt from the field experience of other farmers, and from farmers' own analysis.

ii. catalyst and consultant

The role here is to stimulate, support and advise farmers in and for their own analysis and investigations. In Gujarat in India, with the Aga Khan Rural Support Programme, this has taken the form of encouraging farmers to interview other farmers, to do their own mapping and their own transects. Farmers can also be advised and assisted to improve their own analysis and experiments (see e.g. Bunch 1985).

iii. searcher and supplier

In management literature, "search" is a strangely neglected subject; yet many management activities come under this rubric. In agriculture, top-down transfer-of-technology extension, and senior officers who do not welcome extra work resulting from demand from below have impeded search. Yet if convening groups catalysing analysis are effective, one result will be requests - for new varieties, for cultural techniques, for technologies in the broadest sense - to try out to meet needs and exploit opportunities. To complicate farming systems will often require looking for and bringing back something new for testing. The searcher fills the

basket and supplies the client with choices. Does this imply a reorientation of extension services?

iv. travel agent and tour operator.

This role enables exchanges of experience, ideas and genetic material between farmers in different areas. Farmers can sometimes be found who do not know what others are doing even in their own village, and internal village farm walks can help (pers. comm. Parmesh Shah). Trips to ecologically and economically similar farming areas can also be useful, and are becoming more common. MYRADA, an NGO in South India, conducted a participatory rural appraisal in October 1989 in which farmers specified a variety of sorghum highly valued for its fodder, but which they lost in the drought of 1974. When ICRISAT could not trace it, MYRADA arranged a bus for a farmers' expedition to the neighbouring State of Maharashtra, where the variety was believed to have originated. They found it, and brought it back (pers comm. James Mascarenhas). A more expensive and daring example is the project of the International Institute of Rural Reconstruction for a "farmer cross visit" to give Philippine farmers a chance to see and learn about cover cropping in Honduras, and Honduran farmers a chance to see and learn about agroforestry in the Philippines (IIRC 1990). Similarly, it has been suggested to the International Centre for Integrated Mountain Development in Kathmandu that farmers, livestock and technology might be exchanged between the Andes and the Himalaya/Hindu Kush (with Frankfurt Zoo as a livestock transit lounge).

Technology for Change: Personal and Institutional

The rapport needed for these roles requires personal attitudes and behaviour and institutional support different from those often found.

The experience with PRA in India and Nepal in the past year has been that personal attitudes and behaviour are often at first a major obstacle to rapport. Tendencies of outsider professionals to ignore women, to talk down to farmers, to lecture, "to hold the stick", to manifest overweening confidence in the superiority of their knowledge, are still strong. Moreover, they appear to be stronger among men than women, and among older men than younger. The ERR (egocentric reminiscence ratio) provides a set of testable hypotheses. The ERR is the proportion of a person's speech devoted to personal reminiscence (e.g. "When I was in X District..") The working hypotheses are that the ERR is higher among men than women, that it rises with age, and that it jumps to a new high on retirement. This is probably a universal, not just a South Asian, phenomenon. In Africa, for example, the Batswana have identified a tribe of foreigners, the Wa-Wenwe - those who come to Botswana and say "When we were in Kenya..When we were in Tanzania..". The point is serious. Talking too much, reminiscing too much, lecturing too much, smother the knowledge and creativity of those talked and lectured to.

The need then is for software, for self-awareness and reorientation, for methods to nurture and support attitudes, demeanour and behaviour which generate respect and rapport. The PRAs in India stress camping and living in villages, being taught to perform village tasks,

sharing food with villagers, and above all learning from, with and by them. It has been through participation by the outsider that the competence, capabilities and creativity of villagers have been revealed and expressed.

The need for personal change raises questions about the technology and approaches of education and training. Are these too concerned with content, with science and scientific knowledge, and too little with what one might call personal software? How much attention, how effectively, is given to personal attitudes, demeanour and behaviour in the training of scientists and extensionists? Are those who teach and train scientists and extensionists some of the worst offenders, lecturing, holding the stick, presenting a top-down role model, and neglecting the uncontrollable complexities of people and risk-prone farming systems for the controllable simplicities of science?

The obstacles to change also have many institutional dimensions, including professional values and rewards, effects of bureaucratic hierarchy, the syndrome of top-down centre-outwards extension, and others. To take only education and training, the size, convenience and isolation of the physical infrastructure of institutions can act as a magnet to trap trainers and trainees and insulate them from "the field", from farming systems and from people, and to protect the staff from exposure (in both senses of that word). The teacher and trainer is secure, confident and dominant in the controllable classroom, but insecure, uneasy and less in command in the unpredictable realities of the field, farming systems, and the people outside the campus. Counteracting the magnetic force of institutional infrastructure, some agricultural universities have placements for students in rural areas, but much depends on where they live, what they do and how they behave. How effective are such programmes? Are there alternatives?

Concluding Questions

Are the assertions and implications of this paper correct? Is it true that to better serve more complex and diverse farming systems in the future requires major transformations of training, of institutions, of roles, and of personal attitudes, demeanour and behaviour? If this is so, then how can such transformations best be achieved? Are education and training institutions a major obstacle, and also key, to change?

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9 November 1990

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