บรรยายพิเศษเรื่อง
Challenge of Sustainable Agriculture [1/]

INTRODUCTION

Sustainable agriculture has become a phrase much used by aid officials, by agricultural research and development workers and among the academic community. Inevitably, given this widespread interest, it is open to many interpretations. I do not propose, here, to provide a comprehensive review. The interested reader is referred to the paper by Conway and Barbier (1988), from which many of the following arguments are drawn, and to other recent publications (see for example Davies and Schirmer, 1987, WCED, 1987a, b; CGIAR, 1988).

IDEAS OF DEVELOPMENT

Our concept of development has undergone a number of important changes since the second World War (Barbier, 1987). In the 1950s and early 1960s economic development was equated with economic growth, as defined by a sustained increase in real per capita gross national income. It was argued that such growth would eliminate poverty in the less developed countries by a process of 'trickle down'. Growth did occur, but it was accompanied by more poverty rather than less. This realisation led, in the late 1960s and early 1970s, to a shift toward the concept of 'growth with redistribution'. Growth was still seen as the main objective but agricultural development became a priority, with the aim of helping the poorest income groups through the elimination of hunger and the creation of jobs in the rural sector. However, in the mid-1970s this strategy, too, was seen as insufficient. It was realised that absolute proverty is not likely to be reduced unless such essential needs of the poor as nutrition, health, water, shelter, sanitation and education are met, together with the fulfilment of certain non-material, but also essential, needs of self-reliance and determination, security and cultural identity. Furthermore, it was recognised that these 'basic needs' have to be met even, perhaps, at some sacrifice of overall growth and, in large measure, through direct government action.

The most recent shift in development thinking has been the addition of a concern for 'sustainability'. In common with the basic needs strategy, the emphasis is on improving the livelihoods of the poor. But this approach additionally argues that 'real' improvement cannot occur in the developing countries unless the strategies of growth are environmentally and socially sustainable over the long term. Growth has to be ecologically sound and consistent with social values and institutions. It is further argued that to accomplish this requires not only local knowledge but also the full participation of the beneficiaries themselves in the development process.

The Policies implicit in sustainable development have been best articulated by the report of the World Commission on Environment and Development - the Brundtland report (WCED, 1987a) - and are now very much part of the thinking of the leading development agencies such as the World Bank, USAID, CIDA and the European aid organisations.

AFTER THE GREEN REVOLUTION

Complementary to the early emphasis of development policies on economic growth was a concern with the problem of feeding a rapidly multiplying world population. Strategies to increase per capita gross national income were matched by strategies to increase per capita food production. Embodied in the so-called 'Green Revolution', these strategies focussed on :

1. breeding for staple cereals that produced early maturing, daylength insensitive and high yielding varieties (HYV);
2. the organisation and distribution of packages of high pay-off inputs, such as fertilisers, pesticides and water regulation;

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3. implementation of these technical innovations in the best favoured agro-climatic regions and for those classes of farmers with the best expectations of relising the potential yields.

The impact of the Green Revolution has been phenomenal. Per capita food production in the developing countries has increased by some 7% over the past twenty years and for Latin America and Asia the increases have been 9% and 27% respectively (Figure 1). Only in Africa has food production per capita declined - at 1% per annum.

Thailand's achievement has been particularly impressive, increasing at a rate higher than the Asian average and comparable with that of the industrialised countries (Figure 2). Agricultural output in Thailand has risen by some 4-5% per annum or twice the population growth rate. Indeed it is the only country in Asia which has consistently had a net surplus of food over that period. However, it should be remembered that only part of this has been the result of Green Revolution technologies. Most of the increase has come from the opening up of new lands and the extension of dry season cultivation through new irrigation.

These successes in boosting food and, in particular, staple cereal production in the developing countries have not been without their problems and we are today left with a number of significant issues that need to be tackled (Conway, 1987a).

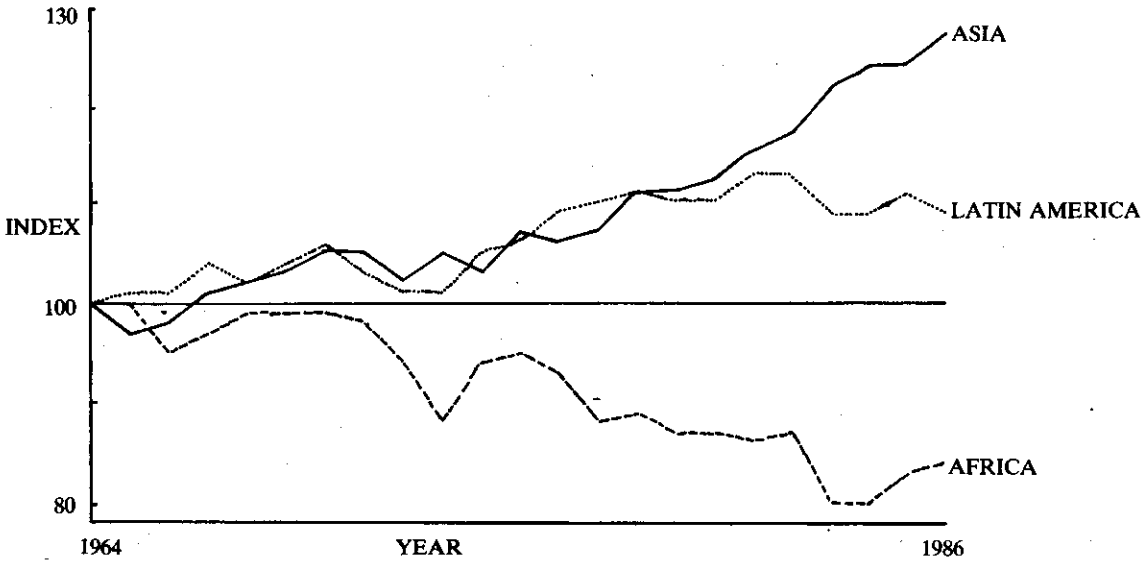


FIGURE 1 Food production per capita for Asia (including China), Latin America and Africa, 1964-1986 (from FAO, 1973, 1976, 1984, 1986)

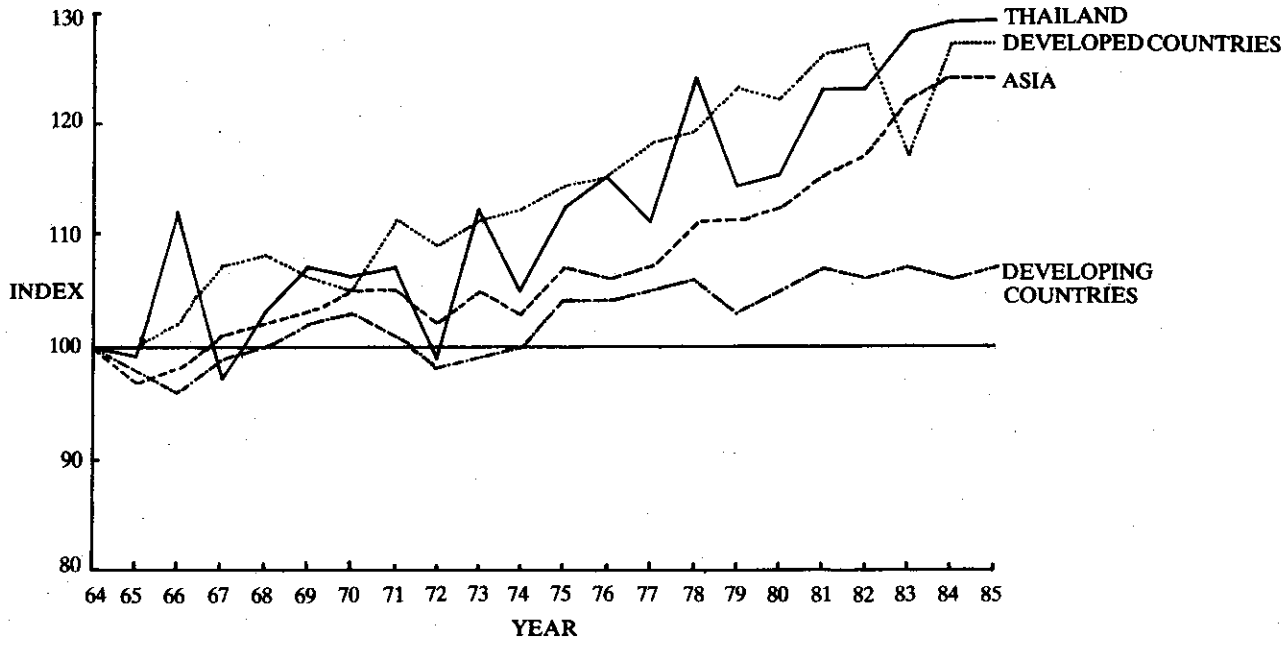


FIGURE 2 Increasing food production per capita for Asia (including China), Thailand, Developed and Developing Countries, 1964-1985. (Developed and developing do not include centrally planned economies). (from FAO, 1973, 1976, 1984, 1985)

THE GAP PROBLEM

The first of these issues concerns the persistent gap between agricultural performance on the research station and in farmers' fields. This gap has two dimensions. The first is the disparity between environmental conditions on the research station and the farms. For a variety of good reasons stations tend to be located on fertile soils with excellent, well regulated water supplies. Research scientists are accustomed to having good control over their experiments and, not surprisingly, their experimental yields can be impressive. By contrast, farmers work in less ideal conditions. They have to deal with difficult topographies and with soils that frequently suffer from toxicities or deficiencies. While some farmers are served by efficiently run irrigation systems, many are located on the fringe of such systems, are subject to variable water supplies, and have little ability to influence important irrigation decisions.

Second, there is a crucial socio-economic dimension to the gap. Research scientists do not normally have to worry about inputs; they do not have to raise credit to purchase seed or agrochemicals, nor do they have to deal with the vagaries of input supplies. They also have an assured team of technicians and field workers who can implement their carefully designed field operations. Farmers typically have poor access to inputs. They also have to rely on family labour or on complex exchange labour arrangements and need to take into account the opportunity costs of labour diverted to a new technology. In cosequence research station technologies, even when demonstrably superior in productivity, are not as readily adopted as might be expected. The further a farmer's field is from the research station, in physical distance or in socio-economic circumstance, the less likely is a new technology to be adopted.

THE ISSUE OF SUSTAINABILITY

The second issue is that of sustainability. There are many definitions of sustainability in the current literature (see Douglass, 1984 for a good discussion of the different strands of thinking that contribute to sustainable agriculture). The common day use of the word suggests an ability to maintain some activity in the face of stress - for example to sustain physical exercise, such as jogging or doing press ups - and this seems to me the most technically acceptable

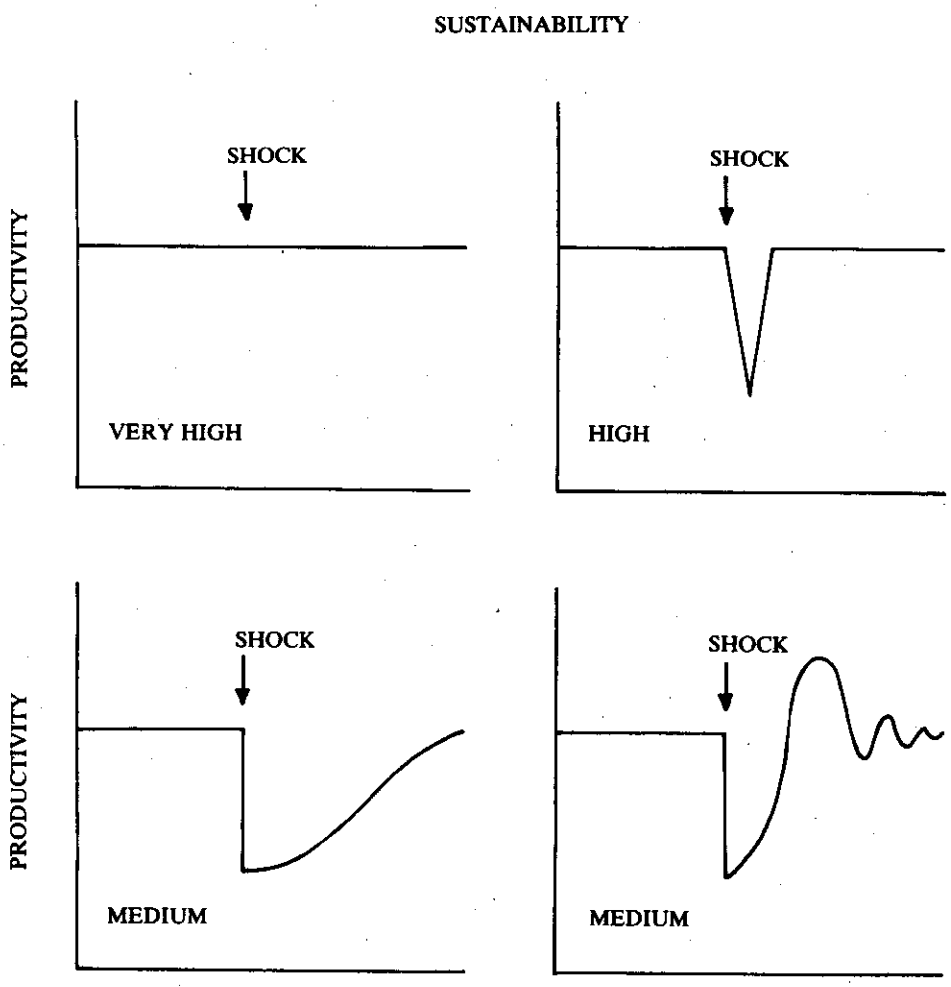
meaning. I thus define agricultural sustainability as :

'the ability of an agroecosystem to maintain productivity when subject to a major disturbing force such as a stress or shock' (Conway, 1987b)

A stress can be defined as a regular, sometimes continuous, relatively small and predictable force, having a cumulative effect. Examples of stresses include biological, chemical or physical factors such as continuing pest attack or growing acidity or salinity or erosion; alternatively stresses may be socio-economic in nature such as increasing debt or declining commodity prices. Shocks, on the other hand, are defined as irregular, infrequent, relatively large and unpredictable forces such as a rare drought, or a new pest or disease, or the sudden closure of a market, or a rapid rise in oil price.

When subject to such stresses and shocks, productivity may be little affected, or may decline but rebound, or may collapse altogether (Figure 3).

Reduced sustainability is an almost inevitable consequence of agricultural intensification whether this occurs on the best favoured or 'Green Revolution' lands or on the more marginal lands (Table 1).



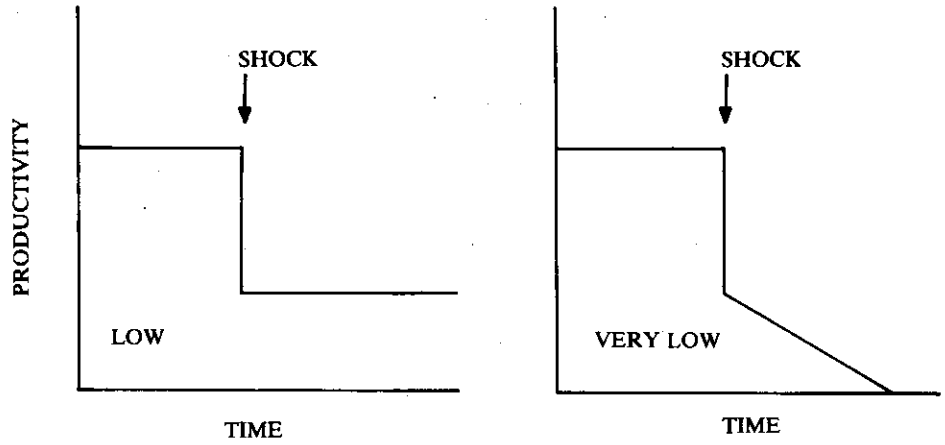


FIGURE 3 Agroecosystem sustainability

TABLE 1 The Consequences of Poor Sustainability

Green Revolution Lands
Pest and disease outbreaks
Declining soil quality
Genetic erosion
Pollution from pesticides and nitrates
Indebtedness and bankruptcy
Landlessness
Migration to urban areas and marginal lands
Loss of security and self-reliance
Marginal Lands
Deforestation
Erosion
Desertification
Salinisation
Acidification and growing toxicity
Malnutrition and starvation
Migration to urban areas

As yet, Thailand has not suffered as badly from sustainability problems on the Green Revolution lands as have neighbouring countries. This is largely because the dominance of the HYVs has not been as great. There is still, for example, a wide range of indigenous rice varieties being grown in Thailand. In the Chiang Mai valley over 50 different rice varieties have been identified and many are in common use. Genetic erosion has yet to become a serious problem.

Similarly the relatively low rates of agrochemical inputs have resulted in little adverse affect. Rice pests, for example, have not yet become a major problem, unlike in Indonesia where pesticide use coupled with widespread asynchronous monocropping of rice has resulted in very severe outbreaks of brown planthopper and major losses of rice production (Loevinsohn, 1984). The lower use of pesticides in Thailand has also meant little adverse health impact so far, but gain experience from the Philippines indicates the kind of hazards that may arise should pesticide use increase (Loevinson, 1987; Conway and McCracken, 1987). Health and eutrophication problems from nitrates may also become a problem in the future if fertiliser applications begin to exceed rates of 100 kg of nitrogen per hectare (Conway and Pretty, 1988).

However, Thailand is already facing severe sustainability problems on its marginal lands (Arbhabhirama et al., 1987). In the highlands erosion is as high as 50-300 tonnes/ha of soil washed away each year and it is estimated that some 30% of the country is affected by erosion levels greater than 30 tonnes/ha. The annual damaged area of non-irrigated paddy due to salinity, flooding, drought and other factors rose from 10% of the planted area in 1960 to 20% or 1 million rai in 1970. Over the past two decades Thailand's forest cover has been lost at a rate of some 2% per year and now accounts for less than 30% of the country's land area. These statistics are very crude, but give some idea of the magnitude of the sustainability problem on Thailand's marginal lands. More precise figures for all of the country's marginal land types are urgently needes.

THE EQUITY ISSUE

The final post-Green Revolution issue is that of equity. The world today is still divided into haves and have-nots. Major conflicts exist between the industrialised and the developing countries and within nations between the urban populations, the rural populations, who live on the best favoured lands, and those who live on the marginal lands. In villages and households there are continuing inequities between landlords and tenants and the landless, between men and women, and between young adults, children and the elderly.

Thailand is no exception : its population, too, divided between haves and have-nots. Despite tenfold increases in GNP per capita over the past three decades, actual and real incomes have been falling in the North-east. The subsistence crop there frequently fails to reach the self-sufficiency level; severe droughts, as occurred in 1987, result in massive crop loss, severe hardship and increased outmigration. Large numbers of people in the North-east, North and South live in poverty and suffer from malnutrition, as do the inhabitants of Bangkok's urban slums who are largely migrants from these areas. Overall it is estimated that some 20% of the population (10 million people) continue to live in 'absolute poverty'.

A NEW PHASE OF AGRICULTURE

To address these issues requires a 'new phase' in agricultural development that places greater emphasis on achieving high levels of sustainability and equity along with increased productivity. This new phase has a number of novel characteristics, of which the following are among the most important :

BUILDING IN SUSTAINABILITY

First, a major research and development effort has to be devoted to building sustainability into the structure and functioning of agroecosystem - so-called conservation or regenerative agriculture. The principles involved can be illustrated by reference to two fundamental agricultural processes - fertility and pest control. The process of harvesting inevitably depletes nutrients and will, if not compensated for, result in declining yields and eventual collapse of the agroecosystem (Figure 4a). One approach to improving sustainability is to apply chemical fertilizer, but this has to be regularly repeated, costs money and, if high rates are used, may eventually result in pollution. An alternative strategy is to build the sustainability into the system by planting perennial legumes, for example in alley cropping using leguminous trees. This provides a continuous supply of nitrogen nutrients. Rotations with legumes or encouraging the activities of blue-green algae or nitrogen fixing bacteria will have a similar effect.

In the case of pest control the repeated attacks of pests may eventually cause declining yields and collapse (Figure 4b). Pesticides enhance short-term sustainability but again at some economic and environmental cost. The alternative strategy is to build in control by release of a biological control agent such as a parasite or predator of the pest.

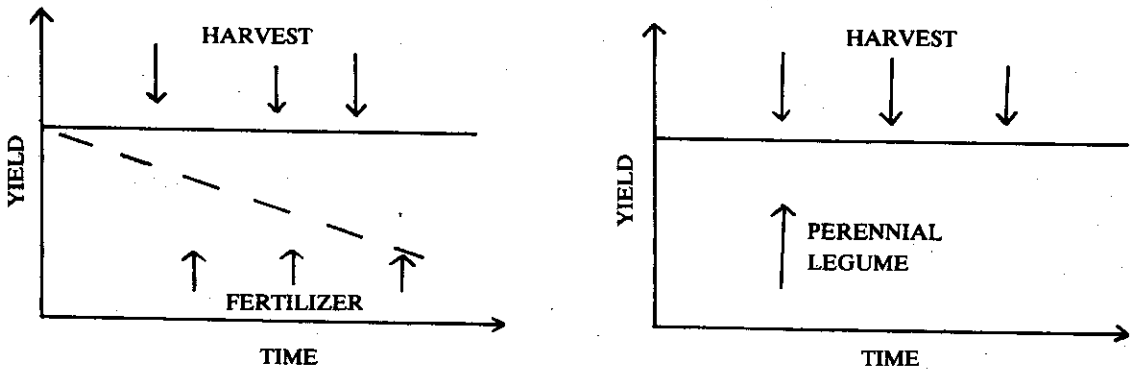


FIGURE 4a Building sustainability fertility into an agroecosytem

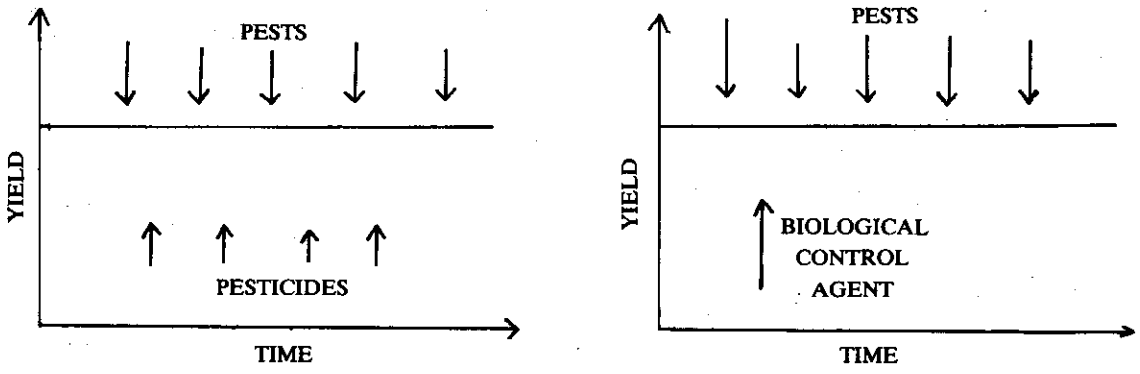


FIGURE 4b Building sustainability pest control into an agroceosytem

FINE-TUNED AND FLEXIBLE

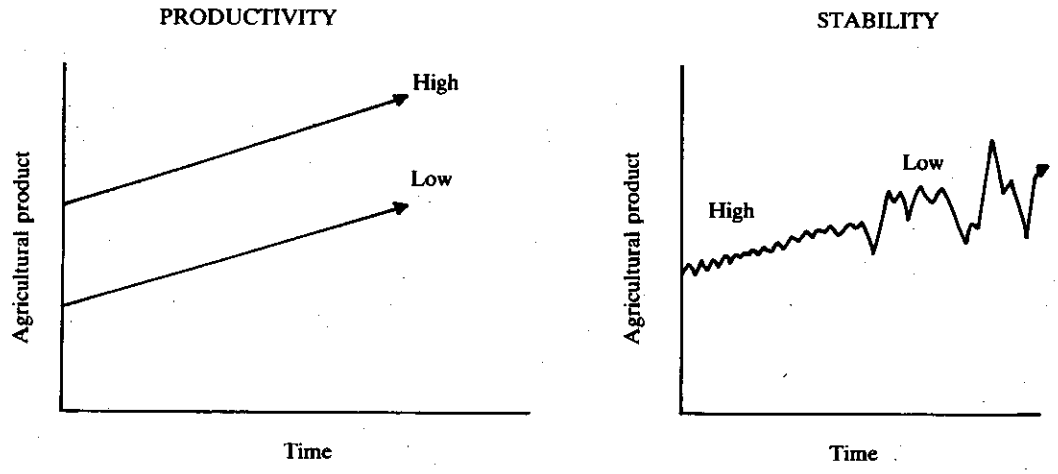
Second, the new phase research has to be both fine-tuned and flexible. Attention needs to be given to breeding and disseminating crop varieties and animal breeds that are specifically adapted to individual niches, in particular to environments that are in some respect marginal, and to the development of innovative technical packages that are specially tailored to individual regions, farms and even fields. The aim here is to create a fine-grained agriculture based on a wide range of varieties and technologies fitted to a mosaic of environments. On the other hand, this should not become a rigid, blueprint approach. Varieties and technologies that are ideal at one time may become inappropriate in the future and may well destroy rather than promote sustainability. Farmers need to keep their options open and hence need, at hand, a range of alternative farming strategies and components.

LOCAL KNOWLEDGE AND PARTICIPATION

To achieve environmental and social sustainability also requires, of necessity, a great deal of local environmental and social knowledge. This implies a significant reorientation of existing research and extension philosophies and practices, away from a top-down, technology driven approach to one that is more sensitive and responsive to local conditions and to farmers' goals and needs. Extension workers, in particular, will need to take on new roles : first as communicators of local needs and practical realities to their research colleagues; second, and perhaps more importhant, as partners directly with farmers in experimentation and development. There is increasing evidence that farmers can be effective expe'rimenters and innovators on a large scale and this potential, rather than being ignored, needs to be fully exploited.

EXPLICIT TRADE-OFFS

The third characteristic of the new phase is that it must be explicit, at all levels of intervention, in terms of the very real trade-offs that inevitably occur in development (Conway, 1987b). Besides sustainability there are other key indicators of agricultural performance - most importantly productivity, stability and equitability (Figure 5).



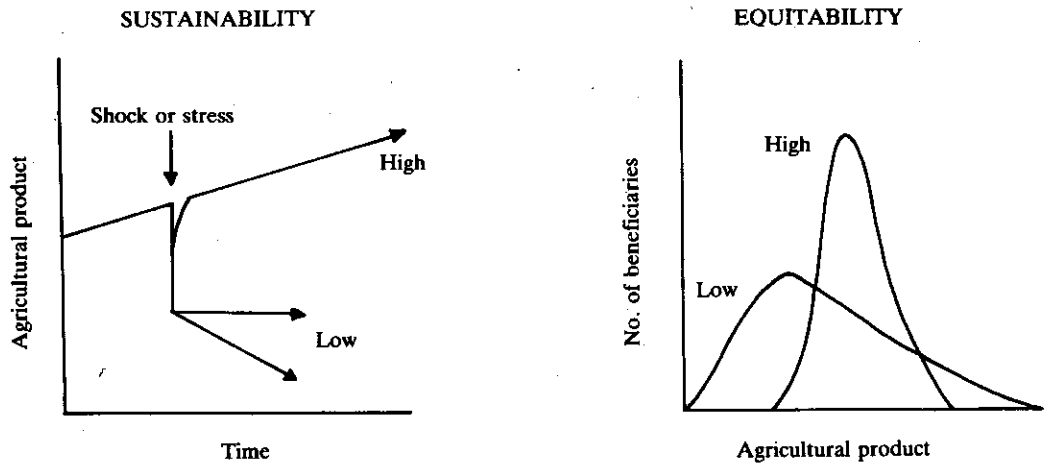


FIGURE 5 Agroecosystem properties

Of these productivity, measured as output of valued product per unit of resource input, is understandably the most widely recognised. Expressed, for example, as tonnage of grain per hectare or kg. of food per man-hour or net income per farm it can provide a good indication of food sufficiency or cash crop earnings.

Stability is a measure of the constancy of such productivity, from season to season or year to year, in the face of climatic variation or the fluctuation in markets. It can be expressed as a coefficient of variation about the productivity trend line.

Finally, equitability describes the distribution of agricultural products or income among the beneficiaries. It can be measure by indices such as the Gini coefficient or the Lorenz Curve.

Defined in this way, the four key indicators are fairly readily understandable by all concerned in development, whether they be policy makers, project designers and implementers, or the farmers themselves. They are powerful, practical indicators of the success of agricultural development. However, experience suggests that there are, almost inevitably, significant tradeoffs between these indicators. Increased productivity, for example, may be at the expense of sustainability; or high equitability may reduce productivity. Choices have to be made, both by farmers in their day to day activities and by governments determining agricultural strategies and policies. But, because these are inherently difficult choices, they tend to be frequently ignored. This usually has the implicit effect of elevating productivity at the expense of sustainability and equitability, with the consequences I have already described.

HIERARCHIES

The final essential component of the new phase is the recognition that agroecosystems exist in a hierarchy and that sustainable development cannot be achieved by intervention at only one level (Figure 6). It is not enough to focus on genetic engineering, or on macro-economic policy or, even, on farming systems. Each of these areas of research and development have to be conducted simultaneously and in concert with one another.

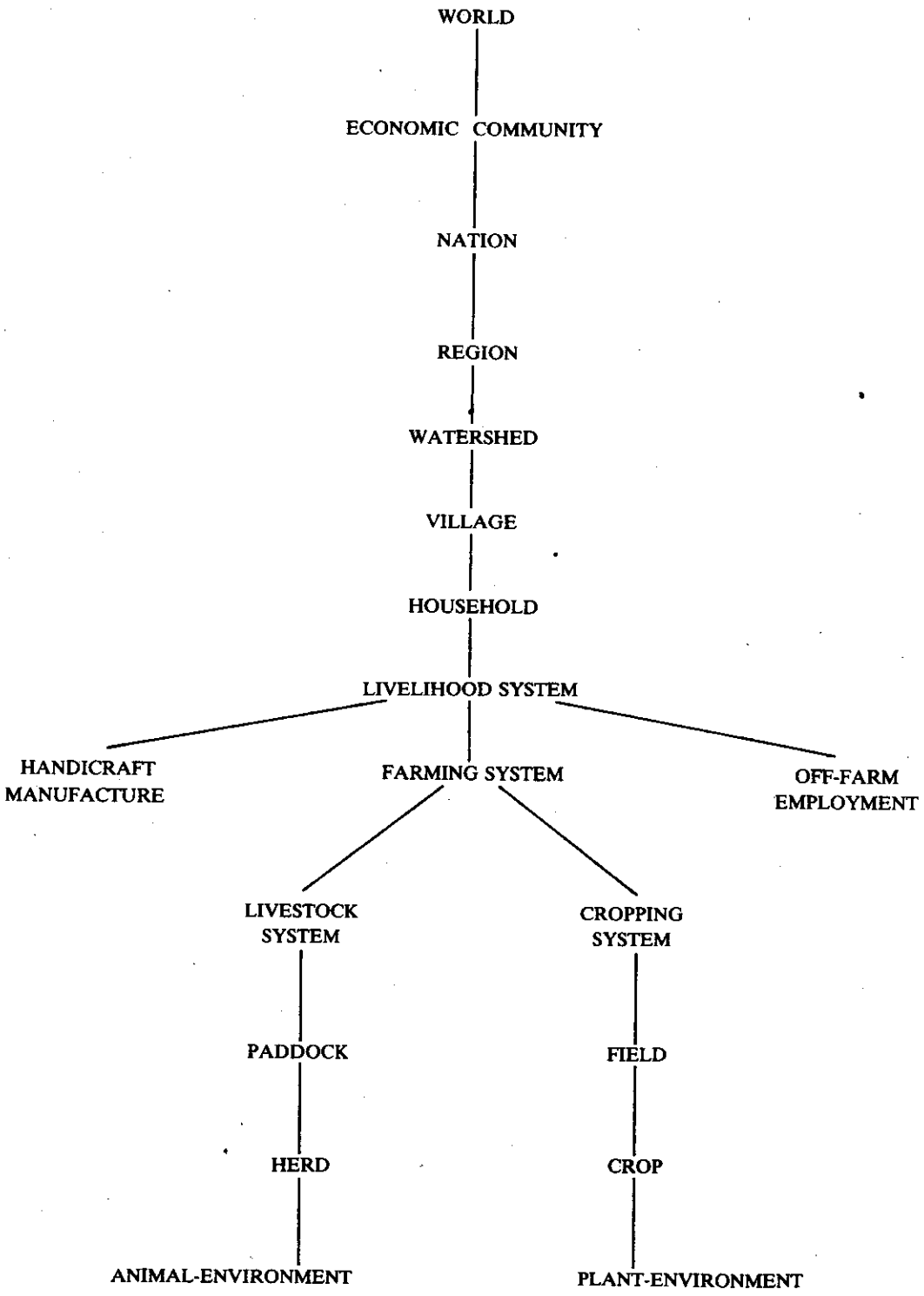


FIGURE 6 The Agroecosystem Hierarchy

THE INTERNATIONAL CONTEXT FOR SUSTAINABLE AGRICULTURE

Agricultural development in countries like Thailand is highly vulnerable to a range of stresses and shocks, that originate outside Thailand (Figure 7).

Most important of these is the real long term decline in the world prices of agricultural commodities. These have fallen to record lows over the period 1984 - 1986 (Figure 8). There are a number of factors behind this decline (Conway and Barbier, 1988). First, the demand in the industrialized countries has been weak. Second, the high prices of many agricultural commodities in the 1970s led to significant over-production and encouraged substitution in consumption, changes in tastes and the development of production processes that use raw materials less intensively. Finally, the high levels of domestic support for agriculture in the industrialised countries have caused the production of large surpluses and their subsequent appearance on world markets at highly subsidised prices with, at the same time, protectionist policies have reduced the markets for developing country exports.

For Thailand these trends have particularly hurt the country's export trade in rice (Siamwalla, 1987; American Embassy, 1987). Thailand is now facing strong competition from the USA which because of its farm income support programmes has been producing large quantities of rice, surplus to its requirements. In order to dispose of these it is subsidising its rice exports, cutting the price in half over 1985 - 1986. Thailand now has to compete with the United States in the high quality rice markets of the European Community and the Middle East, as well as with more traditional rivals, Pakistan and Burma, in the low quality rice markets. In 1986 the price of rice fell from $215.85 to $173.46 per ton and American exports to the European Community rose by 33,000 tons while those of Thailand fell by 44,000 tons.

Overall, Thailand's earnings from rice exports fell by $112 million in that year. Although world rice prices have subsequently risen to over $200 a ton they will probably stay at near this level for the rest of the century. The US still has 2 million tons of rice stocks and another 2 million tons of excess production capacity in the form of land presently diverted from production.

Stresses and shocks are also generated by the world economy as a whole. Although the world economy began to recover in 1982 this was short lived. Since 1984 both global economic growth and trade have slowed significantly, reducing the demand for developing country products, both agricultural and non-agricultural. A particularly acute problem for the developing countries has been the growing debt burden which has meant, among other things, a pressure on the developing countries to emphasise the production of foreign exchange earnign export crops, sometimes at the expense of much needed food crops. Thailand's debt is not as high as that of some countries, but at 25% of the annual national budget is still a significant burden. Thailand is also affected by the debt burden of other developing countries in that they are increasingly not in a position to purchase Thailand's rapidly growing exports of industrial and consumer goods. On top of these problems Thailand, like other developing countries, is vulnerable to the recurring instability in the world financial markets and in international exchange rates.

NATIONAL POLICIES

There is an actual or potential sustainability component to virtually every aspect of national agricultural policies (Table 2). There is not the space to discuss these in full here, and I will select only a few examples.

A crucial policy issue for Thailand is the relative weight of investment to be directed toward the best favoured lands as opposed to marginal lands. As I have already indicated, a great deal of Thailand's agricultural production in recent years has come from the opening up of new lands. This must soon come to halt simply because there is virtually no such land left that is even marginally suitable for agriculture and there is an urgent need to preserve Thailand's remaining forests for both production and conservation. Future increases in agricultural production will have to come largely from intensification on the best favoured lands, involving the introduction of new high yielding varieties and increased inputs of fertilizers and pesticides. Nevertheless marginal lands will remain extremely important, if only because a high proportion of the rural population, that also contains the poorest segments, is dependent upon them. There is further the possibility that such marginal lands are more productive, at least in terms of returns to investment, than many of the best favoured lands. What is required is a better and more comprehensive understanding of Thailand's marginal lands, their current uses and future potential.

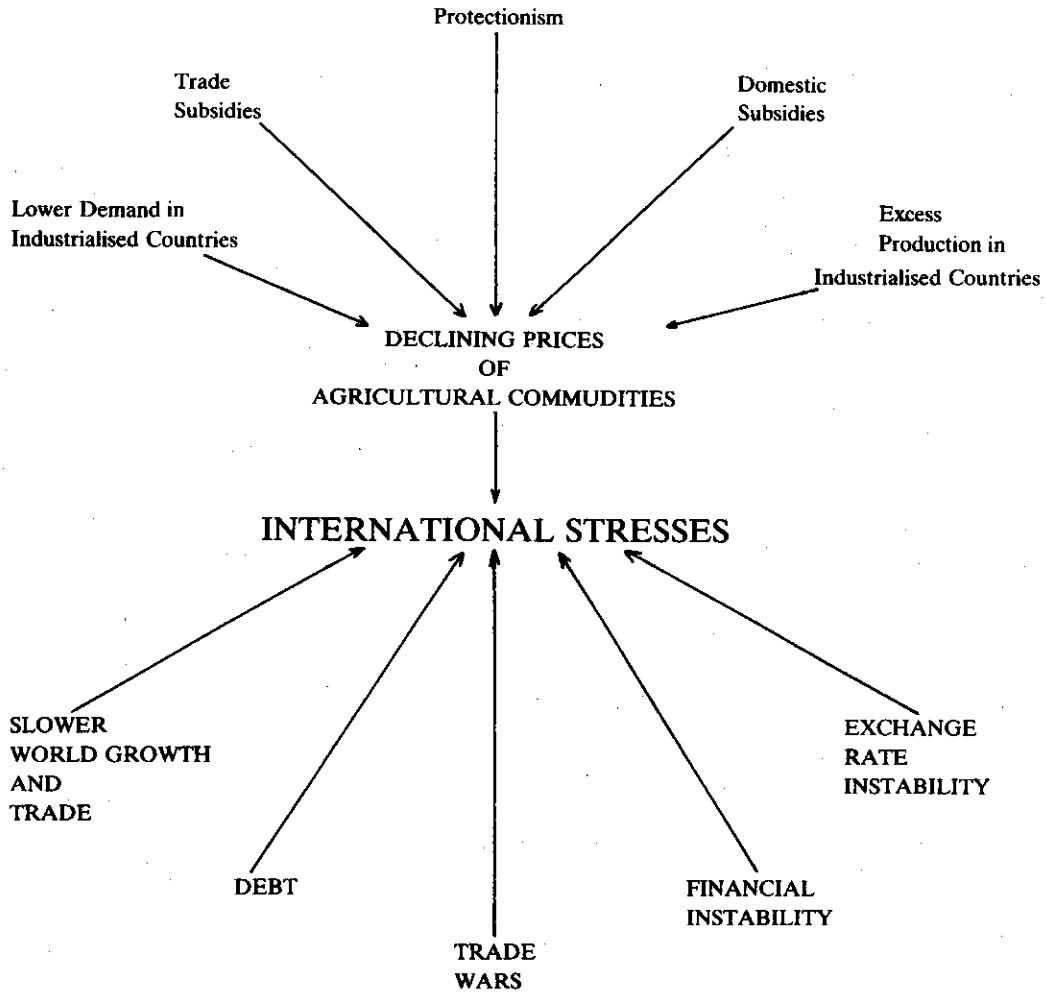
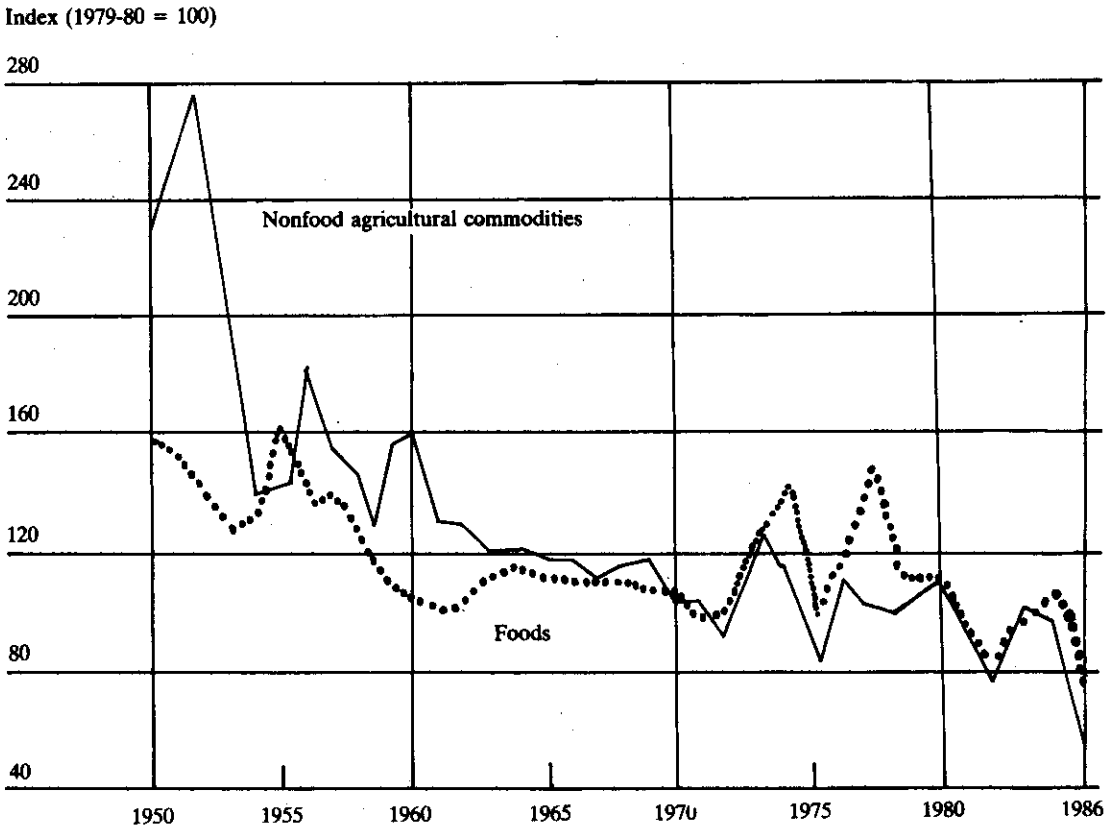


FIGURE 7 International Stresses on Agricultural Production



Source : World Bank, **World Development Report 1987,** Washington, DC, 1987, Figure 2.3.

FIGURE 8 Real Agricultural Commodity Prices, 1950-1986 (World Bank, 1987).

A particularly important policy for current consideration in Thailand is the pricing of agricultural inputs. At present both fertilisers and pesticides are not subsidised. In the case of fertilizers a combination of import restrictions. and other measures have led to the creation of an oligopolistic fertilizer industry which has resulted in prices being well above those prevailing in the world market. This has been a primary reason why average fertilizer applications to arable land have been well below those of other countries in South-east Asia (A national average of 17 tons for Thailand compared with 34 tons for the Philippines, 54 tons for Indonesia and over 100 tons for Malaysia; 1979-81 figures quoted in Panayotou, 1985). Intensification of the best favoured lands will be greatly accelerated if fertilizer prices fall. Equally though if fertilizer prices fall to very low levels they may reduce reliance on indigenous and intrinsically more sustainable fertility promoting practices, such as the use of legume rotations and the reliance in paddy fields on blue green algae and nitrogen fixing bacteria. Similarly for pesticides the question is : if prices are lowered will this result in not only greater use but increasing pest problems due to resurgences and resistance together with environmental pollution resulting in damage to the health of humans and wildlife?

TABLE 2 Aspects of National Agricultural Policy with sustainability dimensions (Conway and Barbier, 1988)

Strategy Debates
Emphasis on food crops or export crops?
Investment in large scale versus small scale agriculture?
Investment in best favoured lands versus marginal lands?
The extent of reliance on external assistance?
Emphasis on the private rather than the public agricultural sector?
Pricing and Macroeconomic Policies
Trade, exchange rate, fiscal and monetary policies
Input and output pricing policies
Stabilisation policies
Infrastructure and Institutions
The development of an integrated infrastructure
Establishment of comprehensive system of rights and tenure
Investment in appropriate research
New forms of extension training

The final issue concerns the development of an integrated infrastructures for agriculture. Sustainability is not only a function of techniques and economic policies but also is critically dependent on having an appropriate infrastructure. Thailand has a good record of creating stable physical and institutional environments for agricultural development. In the Chiang Mai valley, for example, government irrigation schemes blended with traditional systems, a good road and marketing network, high quality educational and health facilities have enabled entrepreneurial farmers to create a highly poductive and sustainable agriculture. The lessons learnt here need examining, particularly in the light of the need to create similar infrastructure environments for the considerably more challenging upland and highland agricultures of the North and for the rainfed agriculture of the North-east.

LIVELIHOODS

Actions at the international and national levels are extremely important in attaining sustainable agriculture but, of course, it is the individual actions of millions of farmers and farm households that, in the end, makes the difference. The World Commission on Environment and Development (WCED, 1987b) and the writings of Robert Chambers (1987) have pointed out the value of focusing attention on the concept of the livelihood.

The dictionary defines livelihood as the means of making a living. For the members of a rural family in Thailand it comprises the totality of resources that are available to them, the activities they undertake and the products that they make. Together these give them, either directly or indirectly, food, clothing, shelter and the other basic requisites of life.

The concept of livelihood has a number of important consequences for sustainable agriculture. The first of these is that for most rural Thai families farming is only a part of the livelihood, albeit usually a dominant component. In addition to farming, members of the family may undertake off-farm labour, or may engage in non-farm activities such as weaving silk or making other handicrafts, or may make direct use of nearby natural resources, for example in

gathering firewood or making charcoal. Even if they wanted to engage in agriculture full time their experience, particularly in more marginal environments, is that agriculture alone is neither sufficiently stable from month to month or year to year, nor is reliably sustainable in the face of numerous stress and shocks to provide a secure livelihood. Instead they have learnt to optimally mix agriculture with other activities so as to secure a living in accordance with their needs and the environment in which they live. The implications are obvious - innovations and interventions, however welcome they may seem by sustainability criteria, will only improve livelihood sustainability if they can be integrated into the existing livelihood mix.

The second important consequence is that livelihood thinking focuses attention not only on the farmer but on the farm family. Families consist of men and women, the elderly, children, those at home and those away. In many cases, they are also part of larger extended family networks and exchange labour groups. Family livelihoods are a combination of their joint activities and again the mix of these, their allotment to different individuals and the decision making process that underlies them have been evolved out of long and often bitter experience. Agricultural research and extension, to be effective, has to understand and take account of this.

AGROECOSYSTEM ANALYSIS, RAPID RURAL APPRAISAL AND FARMING SYSTEMS ANALYSIS

My final topic concerns the methods we have at our disposal to analyse the complexities of livelihoods and sustainable agriculture and to translate theory, quickly and efficiently, into practice. Over the past ten years Thailand has become a world leader in developing innovative methods of field based analysis under the headings of Agroecosystem Analysis (AEA), Rapid Rural Appraisal (RRA) and Farming Systems Research (FSR). These three approaches are strongly overlapping and the differences are less important than their common features (Figure 9). FSR makes use of AEA and RRA methods, but also engages in more traditional and sometimes longer term research and experimentation. AEA like RRA focuses on rapid methods of field analysis but is more structured than most conventional RRA and it differs from FSR in looking beyond the farm to the village, the watershed, the province and the region. RRA, of course, is not confined to agriculture, being applicable to a wide variety of rural development activities including health, irrigation management and natural resource management. But what these three approaches have in common is a powerful array of methods and techniques for multidisciplinary research and extension.

The original AEA workshop held at Chiang Mai University in 1978 has now been replicated in many parts of Thailand and in other countries in Asia and Africa (Table 3). Perhaps its most exciting recent application has been in Ethiopia where it has been used to rapidly determine ways of making rural communities sustainable in the face of extremely harsh and unreliable environments.

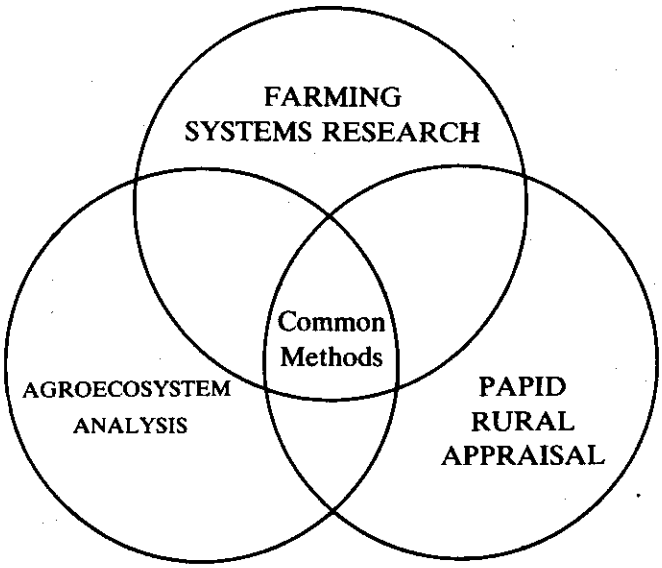


FIGURE 9 Methods for achieving sustainable agricultural development

TABLE 3 Agroecosystem Analysis Workshops held to date with sponsor and foucs of analysis

Thailand	
University of Chiang Mai (Ford Foundation)	Research
University of Khon Kaen (Ford Foundation)	Reserach
North-east Rainfed Agricultural Development Project (USAID)	Research and Development
Indonesia	
Southern Kalimantan (KEPAS, Ford)	Research
Upland East Java (KEPAS, Ford)	Research
West Timor (KEPAS, Ford)	Research
Upland Java (USAID, World Bank)	Research and Extension
Philippines	
Lake Buhi (USAID)	Conflict resolution
Pakistan	
Northern Areas (Aga Khan)	Development
Ethiopia	
Wollo (SIDA, Swedish and Ethiopian Red Cross)	Development

The present challenge, however, is to see these methods more widely adopted by development workers, especially government extension agents, and used on a day to day basis in the design and execution of development projects. In Thailand the new MSc in Agricultural Systems at Chiang Mai University, the Diploma in Farming Systems at Khon Kaen University and the numerous short courses designed by these universities and the NERAD project in collaboration with the Department of Agricultural Extension and the Farming Systems Research Institute are making good progress. The new USAID project on Sustainable Resource Management plans to help this process, funding pilot projects, short course training and the development of new methods of practical utility.

CONCLUSION

In meeting the challenge of sustainable agriculture we are faced with several paradoxes to resolve. First it takes a long time before we can be sure we have sustainable development, yet we cannot wait for the results of long term research. We have to act quickly and on the best information that is available. Second, action is also required not only at international and national levels but in the day to day practices of extension workers and farmers. Finally sustainability is not the only goal of agricultural development - in all our activities whether at policy levels or in development projects, the trade offs between sustainability, productivity, stability and equitability have to be assessed and acted upon.

The resolution of these paradoxes depends on partnership between the natural and social sciences, between the universities and government agencies, between research and extension workers and above all, between development workers and the farmers themselves. In these respects Thailand is well placed. It has the requisite skills and experience

together with a genuine desire to see these translated into action. I believe there are good grounds for optimism that the challenge of sustainable agriculture for Thailand can be successfully met.

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