

ISSN 1327-8231

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**Working Paper No. 34**

**Coevolution, Agricultural Practices and  
Sustainability: Some Major Social and  
Ecological Issues**

**by**

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**August 1999**



**THE UNIVERSITY OF QUEENSLAND**

ISSN 1327-8231  
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WORKING PAPERS IN THE SERIES, *Economics, Ecology and the Environment* are published by the School of Economics, University of Queensland, 4072, Australia, as follow up to the Australian Centre for International Agricultural Research Project 40 of which Professor Clem Tisdell was the Project Leader. Views expressed in these working papers are those of their authors and not necessarily of any of the organisations associated with the Project. They should not be reproduced in whole or in part without the written permission of the Project Leader. It is planned to publish contributions to this series over the next few years.

Research for ACIAR project 40, *Economic Impact and Rural Adjustments to Nature Conservation (Biodiversity) Programmes: A Case Study of Xishuangbanna Dai Autonomous Prefecture, Yunnan, China* was sponsored by the Australian Centre for International Agricultural Research (ACIAR), GPO Box 1571, Canberra, ACT, 2601, Australia.

The research for ACIAR project 40 has led in part, to the research being carried out in this current series.

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# **COEVOLUTION, AGRICULTURAL PRACTICES AND SUSTAINABILITY: SOME MAJOR SOCIAL AND ECOLOGICAL ISSUES**

## Abstract

Outlines major social and ecological issues involved in the coevolution of social and ecological systems by initially reviewing relevant aspects of the recent literature relating to economic development and their implications for agricultural development. Coevolutionary qualitative-type models are presented. There has been a failure amongst advocates of structural adjustment policies (involving the extension of markets and economic globalisation) to take account of coevolutionary principles and allow for historical differences in the evolution of communities and their varied circumstances. This lack of sensitivity has had unfortunate social and ecological consequences for some communities eg The Russian Federation and subsistence agriculturalists in some less developed countries. The evolution of globalized market systems involving industrial/commercial agriculture (largely dependent on inputs external to the farm) under the 'patronage' of oligopolistic suppliers is seen to increasingly threaten the balance between social and ecological systems and as undermining the sustainability of both. Capitalistic processes of technological change eg advances in biotechnology, play a major role in this evolution.

Keywords: Coevolution, globalisation, industrial/commercial agriculture, property rights, ecological systems, social systems.

## COEVOLUTION, AGRICULTURAL PRACTICES AND SUSTAINABILITY: SOME MAJOR SOCIAL AND ECOLOGICAL ISSUES

### 1. Introduction

The general idea of coevolution is by no means new to social science, that is the view that social structures change and evolve with variations in other components of mankind's environment such as climate, resource availability, and technology. Karl Marx and Friedrich Engels were for example of the view that available technologies to a large extent determine the nature of societies and that societies alter in relatively predictable ways as modes of production change. At the same time, however, Marx's theory of the evolution of societies (in *Das Kapital*) was of a relatively deterministic nature. He seemed to have in mind a social system driven by inexorable internal logic until the revolution, after which presumably positivism would hold sway and be used to engineer economic and social organisations to serve the collective benefit. For Marx, the social system evolves to a final utopian state.

However, many different models exist of how evolution of economic systems occurs; a taxonomy of which has been prepared by Hodgson (1993). Furthermore, one may study evolutionary processes in relation to shorter and longer time-scales and for this purpose, different types of modelling may be appropriate and different types of phenomenon may warrant attention. Hence, the appropriate type of modelling of evolutionary processes often varies with the time-scale.

Despite the fact that a coevolutionary perspective is not new, it has received little weight in social thought and policy in modern times, possibly due to the prevalence of scientific specialisation and to the widespread use of the reductionist approach to obtaining knowledge. This has encouraged a technical and mechanistic approach to social policy formation and

favoured the growth of technocracies reliant on the expertise of specialised experts (Cf. Norgaard, 1994) which in turn has favoured (via feedback mechanisms) the development of educational systems designed to produce experts in ever narrower areas of specialisation; such has happened, in economics. Consequently, we have more specialised knowledge than ever before but are less able to use it well for solving social problems involving multiple dimensions because few individuals grasp the overall pattern and dimensions of social problems. While in economics the analytical importance of institutional and cultural dimensions is starting to be increasingly recognised, this recognition is often superficial. The purpose of this essay is not to produce a grand theory of the coevolution of agricultural, social systems and 'natural' systems. Rather it highlights aspects of coevolution discussed in the recent economic literature and indicates their relevance to agricultural development, points to the failure of structural adjustment policies, (promoted by the Washington consensus), to take account of important coevolutionary factors such as cultural and regional pluralism, and considers possible coevolutionary consequences of rapid and widespread technological change in agriculture engineered and fostered by experts outside local communities; and takes account of the fact that technology is subject to speedier diffusion than ever before due to the forces of economic globalisation.

## 2. Aspects of Coevolution in Recent Economic Literature and their Relevance to Agricultural Development

Richard Norgaard (1994) has been one of the main proponents of coevolutionary view of the social and natural world. However, it is quite difficult to find in his work any simple definition of coevolution or simple models of the operation of coevolution connecting social and environmental systems. In fact one wonders whether or not his approach amounts to little more

than the proposition that social systems shape environmental systems and environmental systems shape social ones - they are interdependent. Norgaard suggests that more attention should be given to studying the nature of this interdependence, highlighted by Figure 1.

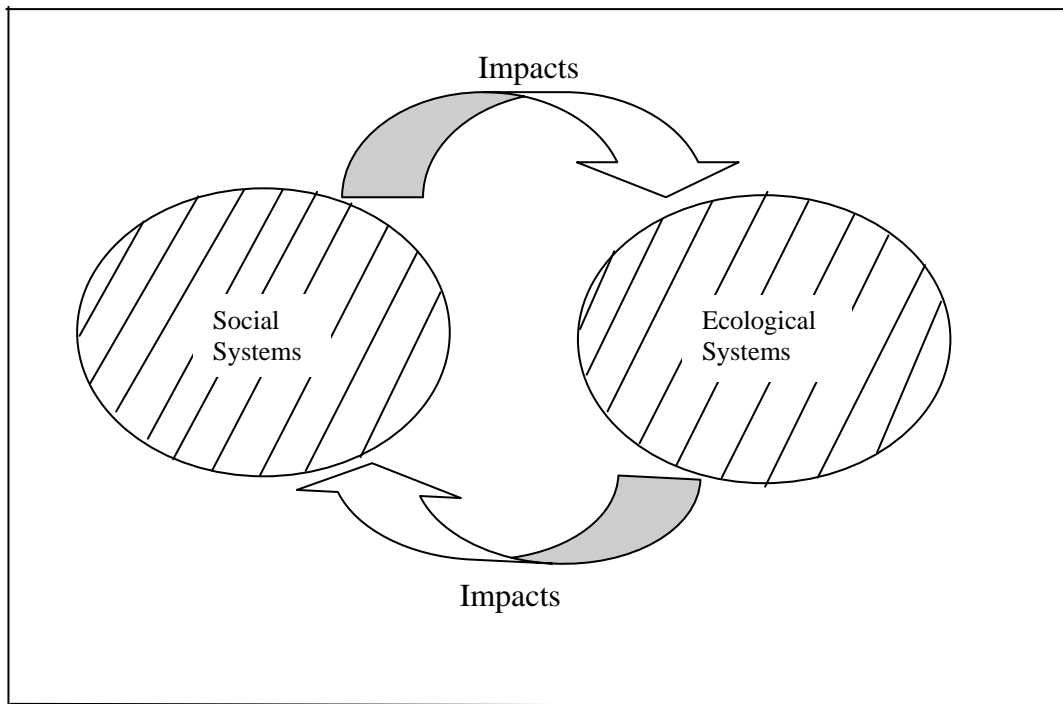


Figure 1 Richard Norgaard has argued strongly that social and ecological systems should be studied as coevolving systems

While some evolutionary processes, described by Norgaard appear not to be based on forces of selection, others are. Nevertheless, he appears to be mostly concerned with selective processes of evolution. In elaborating the coevolutionary process, he states:

"Thinking of the changes in social and environmental systems over time as a process of coevolution acknowledges that cultures affect which environmental features prove fit and that environments affect which cultural features prove fit. In this sense, coevolution accepts both environmental and cultural determinism while recasting them as a selection process" (Norgaard, 1994, p.81)

At the same time, Norgaard rejects historicism or historical determinism and appears to stress that the study of the coevolutionary processes involves a frame of mind (Norgaard, 1994, p.197) requiring that one keep in view the interdependence of social systems and ecosystems and their parts, in an evolving and changing world. While such an outlook has little operational content in itself, it can provide an important perspective when formulating economic policies.

All processes of evolution and change are not based entirely on 'random' selective processes. In reality, a complex mosaic of mechanisms probably play a role in determining the evolution of social and environmental systems and their interdependence. While stochastic selective processes, as in evolutionary biology, can and do play a significant role in social change, it is necessary to identify those social phenomena to which such processes are most applicable, explain exactly how these selection processes operate and be aware that mechanisms other than selective stochastic processes may play a role. While Norgaard's contribution helps to sensitize readers to a coevolutionary perspective, it is disappointing in not going much beyond this in providing an operational framework.

Partial evolutionary models have been explored in economics but little attention has been given to coevolutionary models. For example, Nelson and Winter (1982) used a selective model based on profit (as an indicator of fitness) to explain the emergence of industry structures. However, it was left to Nelson (1987) to more completely develop a theory of industrial evolution, even though he does not develop a coevolutionary theory. Elements of evolutionary industrial theory also are present in some of the works of Schumpeter (1942).

Schumpeter's work suggests that the evolution of capitalist economics will eventually be *dominated* by oligopolies and monopolies. These large firms through their superior abilities in



relation to innovation, technical change and marketing (involving in most cases the use of firm-specific assets which motivates them to become multinationals) eventually become, in my view, an extremely strong force for expanding the production of private economic goods (that is, marketable commodities as opposed to public or collective goods). Therefore, I believe that they accelerate the conversion of natural/environmental resources into man-made commodities and so may threaten economic and ecological sustainability at an earlier time than otherwise (Cf. Tisdell, 1990, Ch.2, 1999a, Ch.6). They do this by accelerating the depletion of the natural resource stock mainly by economic processes of transformation (Tisdell 1999b). In addition, acting in their own self-interest, large corporations may attempt politically to reduce all those activities of the state which limit their ability to transform natural resources into marketable commodities. For this reason, they are likely to be supportive of neoliberal policies.

If the evolutionary process suggested by Schumpeter(1942) is extended in its application, agriculture also becomes transformed from a socioeconomic point of view as economic development occurs. Its development is increasingly dominated by large industrial suppliers of marketed inputs for agriculture, many of these large multinational companies. In addition, agriculturalists may increasingly find, (given the changing marketing chain in agricultural products), that relatively speaking their product is sold to large companies, so that agriculturalists become ever smaller participants in determining the development of their own industry. In fact, if this scenario is correct, the business of farmers can be expected to be increasingly dominated as time passes by the interest of major agribusinesses not directly involved in farming but dependent on selling products (mostly marketed inputs) to agriculturalists, and by large intermediary companies purchasing their products. Casual observation appears to support this theory. Some possible coevolutionary consequences of this trend will be outlined later. There

is another evolutionary factor in the recent economic literature worthy of attention because it has several coevolutionary consequences. Although Demsetz (1968) was one of the first economists to demonstrate that the nature of property rights depends significantly on economic factors, North (1981) developed the concept in an historical context. To the extent that economic development increases the economic value of resources used for private purposes and fosters techniques, which reduce the cost of exclusion from private property, private ownership of resources is liable to increasingly displace open-access communal control of resources. Thus, with economic development, we can predict that private ownership and management of natural resources is likely to grow in relative importance. To the extent that extension of markets promotes economic development and the economic significance of marketed commodities, they reinforce this trend. Private ownership stimulates private investment and is likely to accelerate the conversion of natural areas to man-made purposes or for example, pointed out by Swanson (1994). Natural ecosystems are increasingly modified and in some cases destroyed and entirely replaced to facilitate the production of private and marketable commodities. Biological evolution becomes increasingly dominated and manipulated by human beings to select species and varieties of these with clear shorter-term economic value for human beings in terms of their production of private commodities. Thus domesticated animals and cultivated plants have been increasingly influenced in their evolution and selection by human beings and this in turn has impacted on natural ecosystems. Coevolution has undoubtedly been occurring as noted for example by Swanson (1994).

In this regard however two sustainability problems have emerged or are emerging:

- evolutionary farming practices have reduced genetic diversity and pose a threat to long-term evolutionary possibilities by reducing future options; and

- insufficient weight has been put on the conservation of environmental resources which are not marketable but which have high public value and/or inadequate account has been taken of environmental externalities.

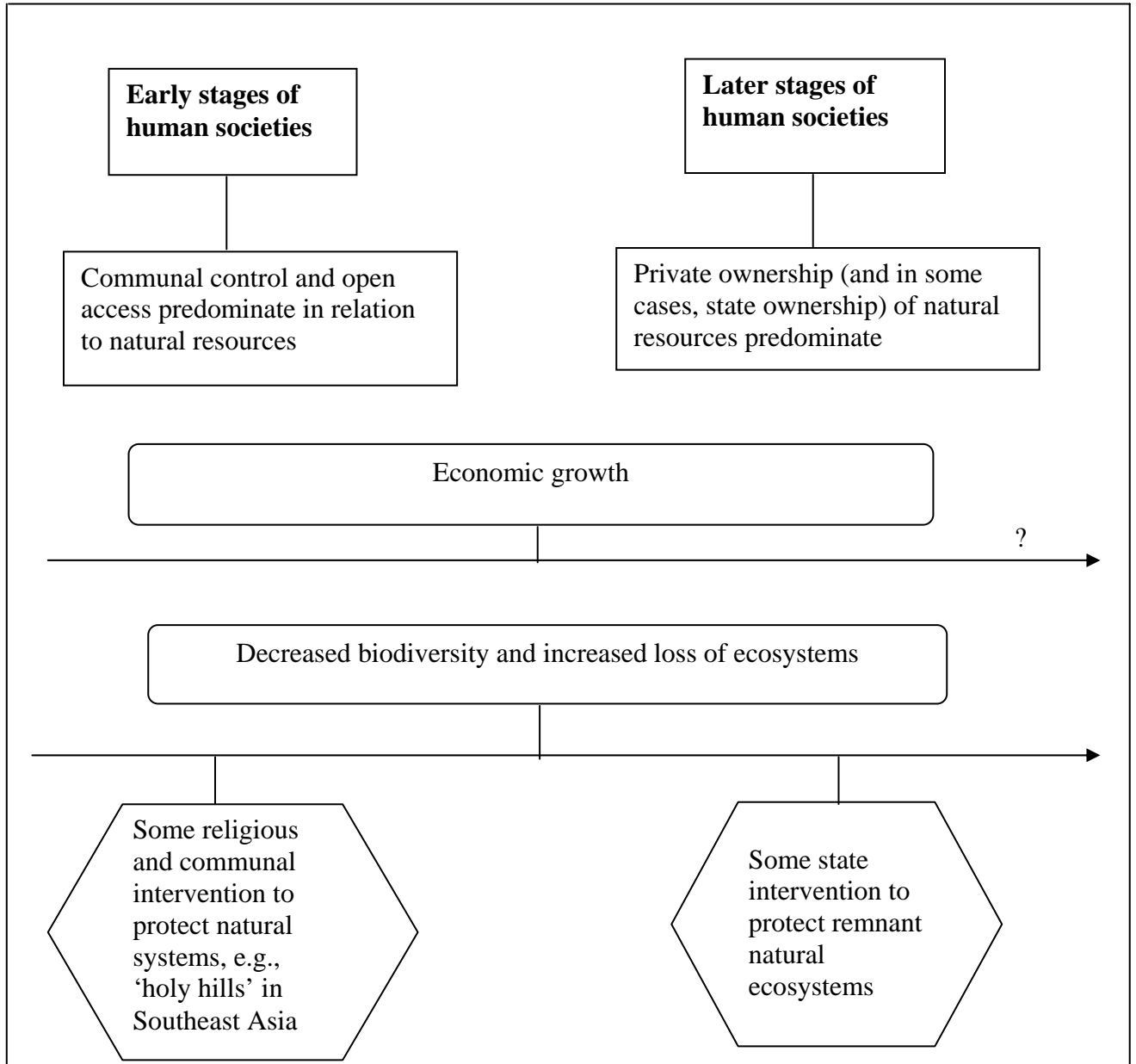
The first factor may be a threat to sustainable development. The second results in an inefficient economic system in satisfying human wants given that some non-marketed commodities are valued. The market system (partly because of its unavoidable gaps, gaps which cannot be all economically filled) is a considerable threat to the conservation of biological diversity. Furthermore, those who see biological diversity as having merit in itself often find that the market system does not represent their values.

Note that market systems are not alone in the above consequences as development occurs – centrally planned economies with an emphasis on material production and with a strong belief in the possibilities of social and technological engineering can (and have had) similar results.

In practice as the economic growth or development process has taken its toll on natural areas, many governments have eventually intervened to protect the last remnants of natural ecosystems by establishing protected areas under state control. In the absence of such intervention, the process of conversion would no doubt continue further.

A rough sketch of the coevolutionary process is given in Figure 2. In the early stages of human societies, most land resources are communal or open-access property but as economic growth proceeds private or in some cases state property comes to dominate land ownership. As a result, natural ecosystems are increasingly threatened and in fact virtually all might disappear in the absence of special government or state intervention to protect them. While private ownership may effectively conserve some natural resources, it will only do so to the extent that this is

profitable, and profitability, depends on the marketability of commodities produced by those natural resources.



**Figure 2** Alienation of natural resources by increasing private ownership or by state ownership is shown as threatening the conservation of natural ecosystems with the passage of time.

In *Development Betrayed*, Noorgaad (1994) suggests that Western cultural imperialism or dominance has unfortunate economic and ecological consequences when it impinges on other societies. However, cultural imperialism is not necessarily limited to Western countries. Non-western cultures have sometimes dominated other cultures eg Chinese culture in parts of Asia. Nevertheless, it is clear that the imposition of foreign cultural practices on recipient communities can have unfortunate consequences for resource conservation and management. European colonial powers, for example, gave little recognition to communal and open-access property in their colonies, and new nation states established at the end of colonial rule seem to have done likewise after their independence (Tisdell and Roy, 1997). This has often resulted in considerable economic hardship for local communities and has eroded cultural mechanisms supporting conservation of natural resources (Gadgil and Iyers, 1989). Externally imposed social change, circumventing naturally evolving social change, can result in many unforeseen adverse consequences for environmental conservation and the welfare of local communities.

### 3. Economic Globalisation, Market-making and Structural Adjustment Policies from a Coevolutionary Perspective

Different local communities are frequently in differing states of coevolution and not all are able to achieve the same coevolutionary paths, partly because of different resource and cultural endowments. Consequently, a form of social organisation which may be appropriate to the evolutionary stage reached by a more developed economy or society may be inappropriate to a less developed one. The rapid introduction of market systems characteristic of Western societies and their associated technologies to lower-income non-Western communities may cause

considerable social disruption and sever their previous relatively harmonious relationships with their environments.

Rapid exposure to structural adjustment policies and economic globalisation often destabilizes slowly evolving social processes and may do more harm than good to some communities, which have not had sufficient time to adjust their institutions and culture to such variations. The experiences of the Russian Federation in economic transition may provide an example. In many developing countries where cash cropping and market forces have been replacing subsistence agriculture, the economic situation of rural women and children has suffered (Cross and Underwood, 1971; von Braun and Kennedy, 1986; Kennedy and Oniango, 1990). In such societies women are responsible for and have control over food produced for subsistence purposes, but men take control of cash from commercial cropping and consequently rural women and children are often economically deprived when market and cash-based economic activities are promoted.

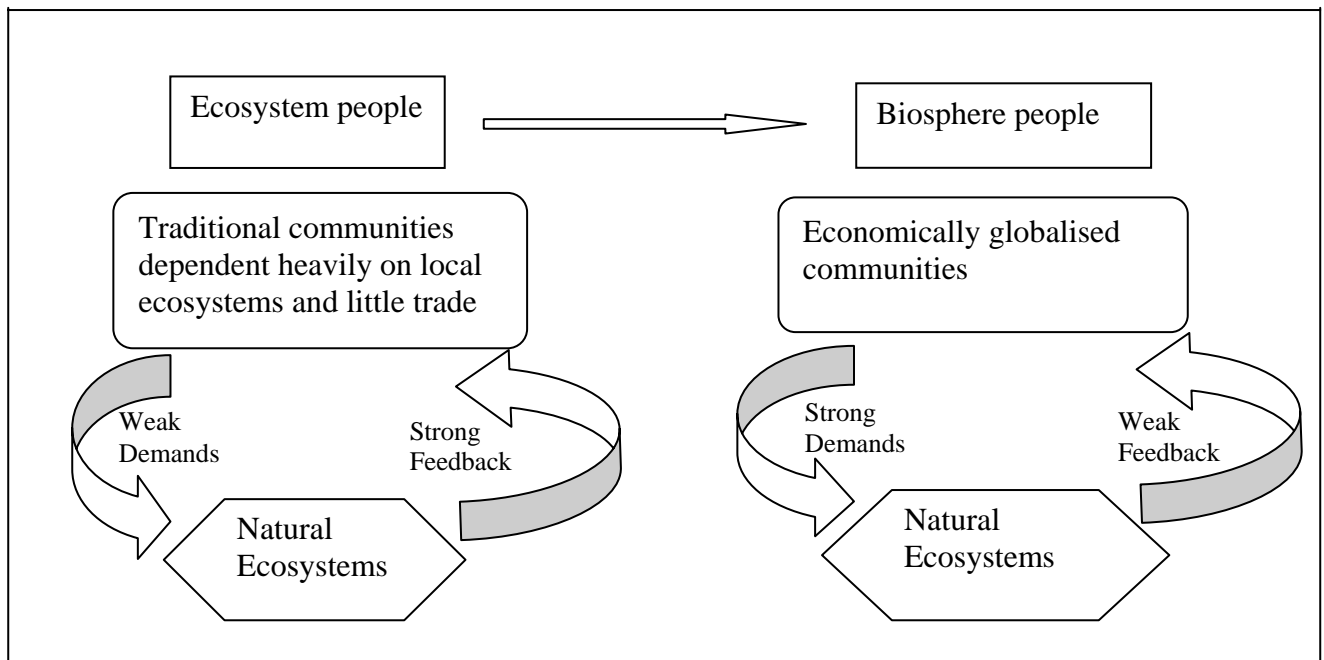
Increased commercial possibilities also accelerate deforestation in some developed countries. This applies both to the harvesting of timber for export and the clearing of land for commercial agricultural crops. For example, Wibowo et al. (1977) found that one of the main reasons for illegal clearing of Kerinci National Park in Sumatra, Indonesia, was for the purposes of growing cinnamon to supply the export market. Cinnamon growing provided a high rate of return on the investment of cinnamon growers in forest clearing plus that on their establishment of cinnamon trees. Using cash income from their initial venture as finance, cinnamon-growers then engaged in further forest-clearing to expand their cinnamon production, Economic globalisation (extension of markets) reduces the extent to which the economic fortunes of local communities depend on their local environment. It is likely to weaken feedback mechanisms for

keeping social and ecological systems in balance. Raymond Dasmann, as discussed by Klee (1980), described this as the transformation of individuals from ecosystem people to biosphere people. Processes of market extension and economic globalisation weaken the bonds between mankind and nature and impersonalise these relationships; these processes became a source of the alienation of man from nature (Cf Tisdell, 1990, Ch.2). Rapid response to such processes, with little time for transitional adjustment in the structure of society, can result in a severe imbalance between the economic activities of mankind and the preservation of natural ecosystems.

In terms of coevolutionary relationships, evolution of local communities from those involving ecosystem dependent people to globalized ones involving 'biosphere' people may imply the situation illustrated in Figure 3. Communities alter from those making weak demands on the resources of natural ecosystems and experiencing strong feedback from changes in natural systems to communities making strong demands on natural ecosystems and receiving weakened feedback from variations in natural systems. Consequently, risks to economic and ecological sustainability grows as economic growth and globalisation proceed. International co-operation may be required to avert economic and ecological disaster once global market-directed economic systems emerge.

Nevertheless, it would be folly to believe that all traditional patterns of economic activity are sustainable. For example, slash-and-burn agriculture (swidden agriculture) while sustainable if long fallows exist between burning and cultivation, can become unsustainable if fallows become increasingly shortened under the pressure of population increases and desires for greater consumption, especially desire for cash to buy marketed commodities to supplement subsistence income. But in some hilly areas where shifting agriculture is still practiced, no economically

viable alternatives to shifting agriculture may exist. If there is an alternative, transition to the alternative is sometimes a slow process, as experience in Mizoram, northeastern India indicates (Tisdell, 1999c). Change to settled agriculture requires communal property to become private property and in general a variation in the structure and cultures of local communities. Such change is not easy to engineer, can cause considerable social suffering and therefore must be sensitively considered in policy proposals. The process of social change as well as its final purpose is important from a welfare point of view – the ends do not necessarily justify the means.



**Figure 3** With increasing globalisation feedback mechanisms between economic activity and natural resource systems weaken at a time when demand on these resources grow. This poses risks for ecological and economic sustainability.



#### 4. Globalisation, Technological Change and Dependence of Agriculture on External Inputs

As economic growth has proceeded, agriculture has become increasingly dependent on inputs external to the farm, that is on marketed inputs. This reflects a market-based bias in processes of economic development in which market systems become increasingly dominant. Such systems encourage market-based transactions because markets provide the main channels through which profits and incomes can be earned. Bias in favour of market-based economic activity partly reflects the efficiency of the market system in meeting wants eg by utilising comparative advantage in production, but in the longer term when combined with the rise of oligopolistic corporations such systems exhibit degenerative economic and ecological features.

Large oligopolistic firms usually occur because they have firm-specific assets such as knowledge and techniques, which give them an economic advantage over their rivals. These economic advantages may exist in relation to the techniques of their production, the special attributes or technologies embodied in their products or occur because of their superior marketing skills or techniques or because of all of these factors. By superior marketing methods and technological change, oligopolies relentlessly try to increase their volume of sales, thereby in the case of farmers, inducing farmers to purchase more of the products of oligopolistic suppliers. These external farm inputs may be substituted for internal inputs by farmers or be a net addition to their total inputs, or both. In most cases where commercial farming develops both impacts are present. Consequently, weak (ecological) sustainability conditions grow in their relative importance in agriculture.

As indicated by Schumpeter, oligopolistic capitalism thrives on technological progress and innovation. But given the profit motive, all efforts in this direction are intended to increase the sale of private commodities, which in the case being considered here are sales of external

inputs to farmers. This process in the longer term coupled with marketing promotion, further increases the dependence of agriculturalists on external inputs. Thus agriculture becomes increasingly commercialized, even industrialized, as a result of the forces generated by large suppliers of agricultural inputs, aided by competitive pressures within agriculture itself and the strengthening of profit-motives amongst commercial farmers. This process usually results in farms increasing in average size and in a radical change in the structure of local communities and their cultures. Social systems undergo radical change. Local communities can become relatively depersonalised, and social alienation of individuals may increasingly occur, as commercial gain becomes the sole arbiter of activity and worth. Thus, rapid economic changes driven by forces external to local communities may undermine communal social stability and generate individual psychological stress and neurosis. .

In the oligopolistically-dominated market system, the following impacts are likely:

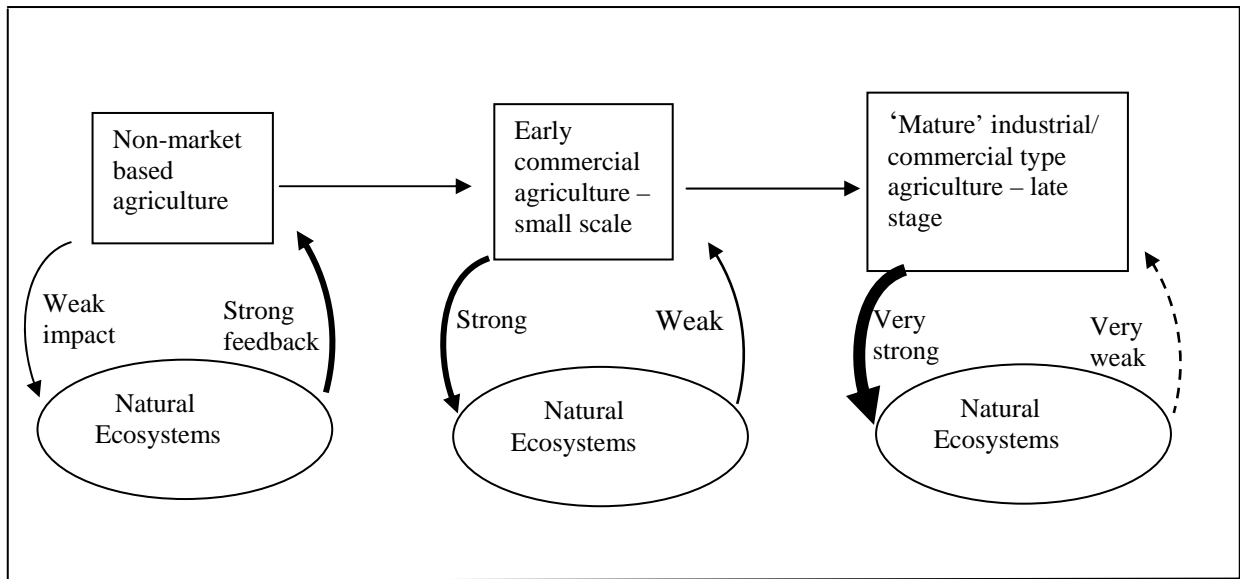
- Technological change (and associated economic change) may get severely out of balance with social systems. It is driven primarily by forces external to local communities, unlike in earlier times. Such technological change takes no account of its disruption to the 'harmony' of local communities.
- In a globalised world (and especially since many of the leading oligopolistic players are multinational), technological and economic change spreads rapidly. Thus trial-and-error mechanisms and precautionary measures may not be used as often as in the past. This may pose increasing threats to the maintenance of natural ecosystems as well as to communal life on a global scale.

- Research and development in this system tends to be biased towards the discovery of saleable private commodities (or improvements in these) with relative neglect of R&D relating to non-marketed commodities.
- Those dependent on markets for their economic gain are likely to agitate politically in favour of the extension of market mechanisms. In the longer term, this is likely to be disadvantageous to the provision of collective and public goods. Imbalance between social and ecological systems becomes increasingly likely under the above conditions.
- Weak rather than strong conditions for economic sustainability are promoted.

The interactions involved in the above scenario are complex, but this does lessen the ecological and social risks stemming from these developments. Figure 4 provides a sketch of the envisaged pattern of these change in a coevolutionary context. Evolutionary developments are explained in its caption.

The above also suggests that agricultural development, the nature of local communities and society generally may be increasingly determined by the results of scientific and technical experts employed by large oligopolistic corporations many of which are multinational in character. The use of new technologies, such as genetically engineered seeds, apart from possibly having adverse impacts on natural ecosystems, also can be expected to have societal impacts. Agriculturalists can be expected to become more dependent on corporations which have patents or similar rights to genetically modified seeds or commodities. One or a few companies could dominate the development of a whole industry eg Monsanto in relation to soya bean production (Enriquez, 1998; Xue and Tisdell, 2000) with implications both for developed and less developed countries. Such companies will also be anxious to sell their product at the

earliest possible time in order to recoup development costs. Therefore, there is always a risk that 'premature' release will occur and irreversible global ecological damage may be done before environmental or health problems are observed from use of such products. One may also anticipate continued loss of biological diversity, as occurred with 'green revolution' crops, due to displacement of traditional varieties and intensification of agriculture as a consequence of the development of biotechnology. How to control such developments in a global setting is a major challenge for governance, especially since the present global thrust is towards the widespread acceptance of the global intellectual rights of corporations. Without an effective system of global government, it may be difficult (given the political predominance of neoliberal thought) to monitor and control such technological developments in the public interest.



**Figure 4** Scenario in which increasing risks to ecosystems and biodiversity occurs with the development of industrial/commercial agriculture under the 'patronage' of growing oligopolistic capitalism. At the same time social systems are likely to come under increasing tension or stress as a result of rapid technological and economic variations driven by forces largely external to local communities.

## 5. Concluding Comments

There is as yet no settled co-evolutionary theory predicting variations in social and ecological systems, nor in relation to the development of agricultural systems in both their social and ecological dimensions. In that respect, however, it is possible to have sympathy with Norgaard's view that if there was a single settled theory, it would probably be inadequate; a more pluralistic approach to social and ecological science seems desirable. Nevertheless, evolutionary and especially co-evolutionary approaches, to considering society's developmental issues and in assessing its policies are of considerable value. They transcend static and mechanistic modes of thinking, which dominated economic thought in the 20th century and which provide little or no insights into 'states of becoming', the essence of developmental concerns. Furthermore, neoclassical economic thought has impoverished economic thought by its failure to take a holistic view of development and to allow for pluralism and social diversity of communities as well as diversity of individuals within communities. This essay illustrates how a coevolutionary approach, in contrast, can provide important insights into major development issues of current concern to agricultural communities.

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