Traditional ecological knowledge and sustainable use of natural resources

A recent publication of the UNESCO discusses 'TEK' – traditional ecological knowledge and its functioning in tropical countries[1]. It identifies three broad categories of TEK, viz.

1) knowledge about specific components/aspects of environment: plants, animals, soils and environmental phenomena which are comparable to systematics,

2) development, evolution and use of appropriate technologies for farming, forestry, hunting, fishing and trapping, and

3) understanding of and intimate relationship with environmental systems as a whole; the most complex and least understood.

TEK has gained much more attention and importance in the field of conservation of biodiversity recently than during the past. Worldwide, a number of government and nongovernment institutions are studying the various dimensions of this natural product both generally and specifically, attempting to build it into the numerous conservation strategies that are being suggested every day. For example, a lot of debate on biodiversity, trade and IPR (Intellectual Property Rights) related issues have stemmed from the overall awareness of TEK; the various round tables on assessment, conservation and sustainable use of genetic resources (prior to the Bahamas Conference of Parties organised by the Stockholm Environment Institute in Latin America, Africa and Asia) and more recently the Seville Strategy of the UNESCO's Man and Biosphere (MAB) programme that was held in Spain (20–25 March 1995). TEK is believed to have been recorded in a variety of ways. They include symbols, phonetics, narratives, rituals, music and dance. Subsistence technology (involving a wide range of natural products), fertility control, settlement patterns, social structure with specific values and norms, acceptance and practice of sorcery, reliance on shamanic powers, forest spirits and supernaturally protected areas (sacred groves) are all considered as tell-tale signs of prevailing TEK in human communities[2].

In the midst of all the emphasis laid on TEK and how best science can acknowledge it, there has always emerged the question 'What do we really know about TEK?' and the statement 'there is a greater need to have information and clearcut examples and case studies'. The best thing at this time would, therefore, be to analyse the Indian TEK that we are familiar with in the context of the conservation and sustainable use of biodiversity and natural resources including air, soil and water.

In India, TEK of medicinal plants and conservation of crop genetic resources in the form of seed banks and locally grown land races have attracted the attention of conservation biologists. Some of these knowledge systems and practices are being systematically documented, especially in the light of developing rewarding systems to the indigenous people who possess them.

Traditional knowledge of macroorganisms in local humans is a fact. For instance, analysis of local names collected of birds in the Uttara Kannada district in the state of Karnataka between 1983 and 1988 suggest that the humans traditionally practised some nomenclatural system as that of modern taxonomy. 169 specific Kannada and Konkani names of birds used by local humans in the district clearly refer to 84 species; a few common and game birds having as many as 7 names. Of these, 38% have a generic identity referring to birds in the same taxonomic family. Another 12% was based on superficial resemblance to unrelated birds, which are rather similar to referring to the coucal as 'crow pheasant' or the chloropsis as 'green bulbul' in English.

Whereas TEK of the various components of the ecosystem and an intimate association with them have been quite convincingly recorded, 'appropriate technologies' for farming, harvesting, etc., that we frequently search for amongst the indigenous people are as yet not fully authenticated although there is little doubt that TEK does include appropriate technologies for harvest of natural resources.

Personal experience suggests that the supportive evidences quoted relating TEK and sustainability of natural resource use by traditional humans are anecdotal and equivocal. For example, some forest dwellers of the Annamalai Hills in south India called *Malasars* are subsisting largely as hunter–gatherers even today. Ethnobotanists who have visited and studied TEK in the use of local plant resources have highlighted the prudent behaviour of these humans with regards harvesting. Tubers of wild plants such as *Dioscorea* are collected only when the plants show signs of maturity. After removing a substantial portion of the tubers, the remaining parts along with the vines are planted back carefully to allow for regeneration. In case where the available tubers are very large, they are shared amongst more members of the community and so on. However, watching the same *Malasars* catching fish in a small river does not provide any evidence of being prudent.

A few men and women together block the flow of the water to start with. An old *saree* is dragged by a pair of *Malasars* along the bottom of the pool and everything that cannot possibly pass through the saree or jump over it is collected, brought to the shore and emptied on the sand. The choice fish are picked up and put inside a small pit dug beside the pool, while the rest including tadpoles and smaller species of fish are just allowed to perish on the shore. Further, the pool remains as such till probably the next rains. Such fishing methods are also practised elsewhere in the tropics of Asia, viz. Northern Thailand[3].

Traditional fishermen catch fish with nets, bamboo traps, pots and even bare hands in many parts of south India. Incidental killing of nontarget organisms is considerable in all these methods. (In our opinion, it is only a magnified form of this practice that we see in modern mechanized fishing wherein 27% of the global harvest is of nontarget species.)

Other examples may be quoted of *Irulas*, hunter–gatherers around Madras. These people randomly set up pit-fall traps and nets in large areas which collect a wide variety of small vertebrate animals. *Irulas* pick up only the choice prey leaving the others in the pits to die. As per the optimal foraging theory, any organism would try to maximize the benefits

derived from the harvested food by way of reducing the energy spent on searching and handling it. A selective mode of harvest of mobile organisms in large areas as that of fish in extensive water involves a greater expenditure of energy than collective harvest and discarding the unwanted. Hence, it is justifiable that humans will naturally resort to the second method of harvest although it involves considerable wastage. In this regard, both traditional and modern approach, as one would expect, would not vary considerably.

Having mentioned a couple of negative examples regarding sustainable harvest of natural resources we may now consider a few positive cases. In south India, the month of July (the onset of southwest monsoon) traditionally used to be a closed season with little harvest of sea fish. Incidentally, this is also the season when most of the choice fish such as seer and pomphrets breed. They come closer to the shore for spawning. Mechanized boats which are being used currently all through the year in all our coastal waters are netting large females and males ready to spawn, considerably reducing the potential for future generations. Although the sea is usually rough during this season, discouraging the use of traditional rafts and boats, one may very well interpret the closed season that used to be observed in the past as a prudent TEK in favour of sustainable harvest of fish.

Instances of local humans using plant poisons to temporarily paralyse fish in pools of freshwater, collecting the select individuals and allowing the rest to 'recover' from the shock are in favour of TEK of sustainable harvest. This is a common practice over most of the south Indian hills. (No effort has, however, been made to record the incidental killings in this method.)

Thus, one can argue back and forth quoting examples which either support or contradict the 'TEK of sustainability' hypotheses. If there are positive examples, there certainly exists an equal number of opposing evidences in this context. Yet the purpose of this article is not to make the readers feel that there is no truth in TEK when it comes to sustainable use of natural resources. This system which has been tried and practised over a few thousand years cannot be ignored altogether. What is needed, however, is an emphasis on more carefully collected and analysed data which is scientifically scrutinized and interpreted. Kenneth Ruddle, writing for UNESCO, says 'study of tribal knowledge in my opinion is not going to tell us more about sustainable harvest but help us understand that they are ecofriendly and can be allowed to exist even within protected areas'. Quoting Ruddle further while closing this brief article on TEK, it is appropriate to state the following. 'The romantic and uncritical espousal of traditional ecological knowledge and management is as extreme and almost as unfortunate as that of dismissing it. Traditional peoples have not lived in some preternatural state of harmony with nature. Some of their abuses of natural resources have been and remain substantial'[4].

1. Inglis, J., *Nat. Res.*, 1994, 30(1), 2–4.
2. Harp, W., *Nat. Res.*, 1994, 30(1), 23–27.
3. Kunstadter, P., in *People of the Tropical Rainforest* (eds Denslow, J. S. and Padoch, C.), University of California Press, 1988, pp. 93–110.
4 Ruddle, K., *Nat. Res.*, 1994, 30(1), 29–37.

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Endophytes – A crucial issue

Microorganisms are known to interact with plant surfaces as well as interior tissues. Microbes which live with interior tissues of healthy plants without causing disease symptoms are called 'endophytes', the term synonym of 'mutualists'. Although this concept was confined initially to fungi, later it was expanded to include all microbes which colonize internal plant tissues without causing harm to their hosts[1,2]. In the last decade, major attention was focused on studying the plant interactions with rhizobia and vesicular–arbuscular mycorrhizae (VAM). A few years ago it was understood that a wide range of plants was infected with endophytic fungi. Endophytic fungi have been reported from different plants such as mosses and ferns[3], conifers[4,5], palms[6], and monocots[7]. To date, the ecological role of endophytic fungi is poorly understood. The purpose of this note is to emphasize the gaining importance of endophytes other than rhizobia and VAM.

Endophytes occupy a unique ecological niche and have major influences on plant distribution, ecology, physiology and biochemistry. The studies on the endophytes of grasses, conifers and other woody perennials indicated several beneficial effects. Endophytic infection enhances the resistance of host plants against insects[8]. It was hypothesized that endophytes of conifers and woody perennials decrease palatability for grazing insects and antagonize pathogens[5,9,10]. Thus, to improve their fitness in a given environment, plants might have acquired/accommodated the endophytes.

Endophytes so far isolated were either ascomycetes or their anamorphs and zygomycetes, whereas those belonging to basidiomycetes or their anamorphs or other fungi were rarely reported[3,11]. Several fungi adapted endophytic lifestyle possibly because of the competition of different fungi on suitable substrates. Endophytes are in an advantageous position to colonize the plant parts starting from the initiation of senescence. Endophytes usually bear fruit after the host has died, hence, senescent or dead twigs might be excellent materials to establish anamorph–teleomorph connections.