

INDIGENOUS KNOWLEDGE SYSTEMS FOR SUSTAINABLE DEVELOPMENT : THE CASE OF PEST CONTROL BY TRADITIONAL PADDY FARMERS IN SRI LANKA

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ABSTRACT :

The view of sustainable development has emerged as an alternative to the conventional development which has apparently failed to alleviate poverty in the Third World countries. The view of sustainable development emphasizes the significance of the conservation of ecosystem productivity for the sustainability of development. Therefore indigenous knowledge which represents the successful ways in which people have dealt with their environment over centuries, has a greater potential value to the sustainable development. This study explores the Sri Lankan paddy farmers' indigenous knowledge of the pest control, and points out its relevance to the sustainable development. It also suggests that modern technology should be integrated with the indigenous knowledge in order to develop environmentally sound, economically viable and effective technologies which could contribute to the sustainable development.

INTRODUCTION

Conventional view of development overlooks the limitations of the natural resources base which supports all the human activities. It assumes that the growth, the central requirement of development, continues for an indefinite period of time, and it will eventually bring about material and social benefits to the people. Benefits of development first reach the higher ranks of the society and then they gradually "trickle down" to the lower ranks. This process would result in social equality. But, development experience in the Third World countries demonstrates that the conventional approach to development has failed to succeed. It was nearly three decades ago that the UN General Assembly designated the 1960s as a 'development decade' to hasten economic development in the Third World countries. But today after thirty years of massive investment of capital, equipment, and modern technology, many people of the Third World have yet to benefit. Millions of people in the Third World have no access to adequate food supplies, clean water, decent housing, clothing, health and education services. Benefits of the growth have not 'trickled down' to the marginal groups as initially expected. Consequently, the gap between the rich and the poor has widened. On the other hand, over exploitation of natural resources for short term benefits in these countries has resulted in environmental degradation and depletion of natural resources. Therefore, the development has failed to be sustainable.

The new view of development which is termed 'sustainable development' has emerged as an alternative to the conventional view of development. Goal of the sustainable development is to meet the present needs and wants without compromising the future. This goal is achieved by conserving the ecosystem productivity and by utilizing the natural resources in a sustainable way. Therefore, sustainable development represents a combination of development and conservation. It requires ensuring that productivity of the ecosystem has not been sacrificed for short term production gains. Sustainable development is defined as the modification of our environment in careful, deliberate ways to satisfy more of our needs and wants, but without impairing its ability to support us, now and in the future (WWF, 1982).

INDIGENOUS KNOWLEDGE AND SUSTAINABLE DEVELOPMENT

Indigenous knowledge is local knowledge . . . that is unique to a given culture or society. This knowledge is the information base for a society. Codified in the language of the society, it facilitates communication and decision making. (Warren, 1989). Each society has a variety of types of knowledge systems; some deal with the natural and physical environment, some with the cognitive and ideational environment, and others with the social environment. All these knowledge systems are passed down from generation to generation, usually verbally.

The indigenous people have a wide knowledge of the ecosystem they live in and ways to ensure that natural resources are used sustainably. Therefore, the indigenous knowledge which has been accumulated over centuries has a greater potential value for sustainable development. It can help all the people learn how to live in the natural world in a sustainable fashion. The potential values that the indigenous knowledge systems have for sustainable development can be summarized as follows :

- (1) Historical evidence proves that the indigenous people have utilized natural resources over centuries without impairing their capability to support them and their successive generations. Therefore, the indigenous knowledge of resource management could provide a valuable information base which could be used in the management of natural resources for sustainable development.
- (2) If development is to be sustainable, the development projects should always involve indigenous people as partners so that they could participate fully in designing, planning, implementation and evaluation. Use of indigenous knowledge for development projects facilitates the participation by indigenous people.
- (3) The knowledge developed by indigenous people over centuries can be integrated with the modern scientific knowledge in order to create appropriate technologies leading to sustainable development. Agroforestry system is one example.

- (4) Communication gap which exists between project personnel and indigenous people in the Third World countries often impedes sustainable development. Indigenous knowledge can facilitate communication by providing a better understanding of how people perceive their environment and organize their perceptions.

INDIGENOUS KNOWLEDGE OF PEST CONTROL

Prior to the introduction of conventional chemical pesticides, paddy farmers used a wide range of traditional pest control methods. They used various botanical, biological, and mechanical pest control methods which were developed by their ancestors. They were aware of a wide range of plant species with pesticide effects, and animal species which predate on harmful insects. They were also aware of various materials and devices which could be used to trap, chase or destroy the pests or to keep the pests away from their crops. Besides, they used to perform some religious ceremonies to protect their crops from pests. However, most of these indigenous pest control methods are now not in use. They have rapidly disappeared after the introduction of high yielding rice varieties and chemical pesticides. But the knowledge still remains with some old aged farmers. This section of the present study is an attempt to explore this knowledge. In order to collect information on indigenous pest control methods used by paddy farmers, thirty old aged farmers selected from Ratnapura, Badulla and Hambantota district were interviewed. For the sake of brevity and simplicity, the collected information on indigenous pest control methods has been categorized as biological methods, botanical methods and mechanical methods.

BIOLOGICAL PEST CONTROL METHODS :

The farmers identify a large number of vertebrates reptiles, birds and mammals predated on pests. They, therefore, protect the habitat required for these beneficial species. Birds are the major biological agents which traditional farmers use for pest control. They have developed various methods to attract birds which feed on harmful insects. To attract such beneficial birds to the field, places are provided for the birds to perch in the field. In this case, either coconut fronds larger ends up or sticks joined to coconut husks are planted so that the birds can perch on them. It is believed that these methods attract owls which feed on rats. Supply of food for birds is another method to attract the beneficial birds to the field. For instance, to attract Common Babbler (*Demalichcha*) coconut refuse is crushed and spread in each corner of the paddy field. This bird would come to feed on the crushed coconut and at the same time would eat paddy husks and worms that happen to be living around. The farmers also protect the habitat required for these beneficial species. Big trees are allowed to grow in and around the paddy fields to provide nesting places and safe breeding grounds for the beneficial birds.

Apart from these devices, it has been found that some religious practices that they perform to protect their crops from pests, also attract such beneficial species to the field. A few examples are given below.

- (1) Offering to local deities: The offering consists of a mixture of roasted pulse, food, flowers, and lighted oil lamps. While the roasted pulses and food attract birds, the lighted oil lamps attract insects. Then birds feed on insects, thus reducing the insect population.
- (2) Offerings of food and lighted oil lamps are placed on unstable plantain disk fitted to a stake. When the birds attracted by the food and light attempt to perch on the plantain disk, the food falls. Then when the birds go after the fallen food, they find caterpillars, and eat them.
- (3) To control worms which eat paddy leaves, the farmers boil a pot of milk and prepare milk-rice. Then the milk-rice is spread in the affected part of the paddy field. The birds which come to the field to eat the milk-rice eventually find the worms around there and eat them.

The traditional farmers recognize the *Ptyas mucosus* (rat snake) which feeds on rats as a beneficial creature. In fact, the farmers welcome this snake as it comes into the fields at grain ripening time to feed on rats. It has been estimated that a single rat snake can consume over twenty rodents per month (Senanayake, 1983). This snake has been deemed as one of the most important biological control agents of the small mammalian pests of paddy farmers. The snake which is non-venomous is always left unharmed by the farmers, and also they maintain the habitat required for breeding of this snake. The rat snake is incapable of breeding or maintaining its population in paddy fields and open areas. It requires a wooded habitat or dense thicket to serve as a safe nursery area for the juveniles. Such a habitat is found around the pool which was maintained at the end of paddy tract where the water drained from the paddy tract was accumulated. This same habitat is used by the lizard *Varanus salvator* which feed on the fresh water crabs that weaken and destroy the bunds of the paddy fields.

The farmers encourage the growth of aquatic fauna in paddy fields. Paddy fields are normally kept flooded during the early stage of the growing season, and this practice provides a habitat required for a large number of fish species. The pool that farmers maintain at the end of the paddy tract contains water throughout the dry season and it contributes to the continuous existence of fish in the paddy fields. As the paddy fields dry out completely during the harvest season, majority of the aquatic fauna in the paddy fields die out. At the onset of the rains the fish in the pool migrate upto the newly formed streams to breed. The juvenile fish quickly colonize all the paddy fields and grow to adulthood during the paddy growing period. The insectivorous fish species act as a biological agent to control pests. Spiders are also allowed to survive

in the paddy fields so that spiders would catch insects into their webs. The farmers also encourage the growth of frog population in the paddy fields since they feed on a wide range of harmful insects. It is also said that some farmers collect frogs from other places and throw them to the paddy fields. The farmers consider Swifts (*Wehi Lihiniya*) as another beneficial species because it feeds on *Nilapawata lugens* (Keedewa) which cause serious damage to the paddy plant. When the farmers notice that these birds are in their paddy fields, they keep away from the paddy fields to allow the birds to feed on the pest.

BOTANICAL PEST CONTROL METHODS :

Many plants have a natural protective mechanism which assists them in resisting and repelling pests. Some plant species produce substances which repel or poison the insects. The traditional paddy farmers possess a sound knowledge about such species. They identify a wide range of plant species which can be used effectively to control pests. Most of these plant species are naturally grown in jungles and scrublands on communal lands. They use various products of these plants i.e. fruits, leaves, bark, seeds etc., in various ways to control pests. They identify which parts of the plants contain substances which have repelling or poisoning effects. While such some parts are incorporated into paddy soils, some are added to the standing water in paddy fields. In some cases, they hang leaves or twigs of some plant species around the affected paddy fields to control pests.

Some of the plant species which are added to the paddy fields to control pests, are *Diospyros affinis* (Kaluwel) *Anamirta cocculus* (Tithtawel), *Ananas comosus* (Pineapple) and *Euphorbia antiquorum* (Daluk). Leaves of these plants are chopped, crushed and placed at the point of impounding water (*wakkada*) so that their poisonous substances spread everywhere in the field. While the first three species are believed to be effective in controlling the flies such as *Orceolia oryzae* (Gop Massa) and *Atherigona exigua* (Kanda Massa), the last is believed to be effective in controlling *Tryporisa insertulas* (Puruk Panuwa). The farmers believe the seeds of *Caryota urens* (Kitul) have a pesticide effect. They crush the seed of this species and add it to the impounded water. To destroy worms which cause damage to the paddy plants, leaves of *Pongamia pinnata* (Karadha) are underearthed at the time of land preparation. It is widely believed that leaves of this plant develop some poisonous effect to worms. In some cases, dried leaves of *Crotolaria retusa* (Keppitiya) are added to the paddy soil to control pests.

The traditional farmers identify some plant species which have a repelling smell. *Cycas circinalis* (Madu) and *Cymbopogon citratus* (Seru) are examples in this regard. The farmers believe that the *Cycas circinalis* (Madu) flower generates a smell which repels pests, and therefore they plant these trees near the paddy fields. In some cases, Madu flowers are cut into pieces and joined to sticks which are planted in the paddy fields. Branches of *Cymbopogon*

citratus (Scru) which also generate a repelling smell are hung in and around the field. They also believe that insects dislike yellow-coloured flowers. They plant these trees around and near the field. Although the effect is not clear, it is worthwhile to mention that some farmers hang **Areca catechu** (arecanut) flowers and young leaves of **Cocus nucifera** (coconut) on ropes used to demarcate the insect affected area.

Damage to the harvest by rats is a serious problem during the ripening period. To control rats, raw fruits of **Carica papaya** (papaya) are chopped, and pieces are spread in the paddy fields. It is believed that the raw papaya has a chemical substance which causes wounds in rats' mouth when they eat it. When rats eat the pieces of raw papaya, the mouth gets wounded so that they cannot feed on paddy till the paddy yield is harvested. Wood ash is a popular pesticide which has been widely used by indigenous farmers to control a wide range of pests. In this case ash is put into a cloth bag, and it is tied to the end of a long stick. Then the bag is held over the crop and ash is sprinkled on the crop by beating the stick with another. The farmers believe that the ash of **cymbopogonnardus** plants are particularly effective in controlling **Spodoptera maurefia** (Godawella). To protect the field from the wild boar, some farmers crush the leaves of **Coleus amboinicus** (Kapparawalliya) and keep them around the field. It is believed that the wild bores do not approach the field due to the strong smell emanating from the crushed leaves.

MECHANICAL PEST CONTROL MEDHODS

Food traps and light traps are major mechanical methods which are popularly used to control pests. Rodents which damage paddy are controlled by the use of food traps, while insect pests are caught in light traps. In the case of light traps, a bright light is used to attract insects to a certain point where they can be trapped. The farmers set light traps in various ways to control harmful insects. Some of these methods are as follows :

- (1) An oil lamp is hung upon a lower point in the field which is filled with water. The insects attracted by the light get trapped in water under the lamp.
- (2) An oil lamp is kept in a big pot with a lot of holes on it, and the pot is hung somewhere in the field. The rays of light which spread from the holes attract the insects into the pot where they eventually get trapped.
- (3) Oil lamps are kept around the field, and the insects resting on paddy are chased by dragging a long rope across the field. The insects which rise into the dark are attracted by the light and get destroyed.
- (4) The litter around the field are collected and burned at night. The light of the burning litter attract the insects and destroy them, and also the burning of litter clears the breeding grounds of the insects.

Lighting oil lamps has a religious significance too. The villages offer oil lamps in the shrine of the village-temple and around the sacred Bo tree. In the same way, when their paddy harvest is threatened by pests, they light oil lamps in and around the affected area of the paddy field in the night, and pray. In this case, Mee oil, the oil extracted from the seeds of *Madhuca longifolia* (Mee) and wicks made of saffron robes are traditionally used. In some cases, a flame which is made by tying up pieces of saffron robes soaked in Mee oil is lighted in the affected area. In both cases, the use of saffron robes accentuates the religious significance of these practices. However, these practices are said to be effective in controlling insects. It seems that the bright light of the oil lamp and the flame act as a trap and control the insect population.

They also use a very sticky substance derived from *Artocarpus heterophyllus* (Jak) to trap some harmful insects. To control flies, they apply this sticky substance on the winnowing fan and it is dragged along on the crop so that flies get stuck on it. This has to be done twice a day every morning and evening during the grain ripening period. It is, therefore highly time consuming, and extremely difficult to practise in large fields. In such cases, a long rope impregnated with the sticky substance is dragged across the field so that hogs in the field get stuck to it. The same substance is applied on sticks which are planted in the field to get flies stuck on them. The farmers are also in the habit of causing physical disturbances to chase the harmful insects. To chase flies, they brush the standing crop with a rough large broom made of bamboo tops or strong twigs. In some cases, to chase flies, a long bamboo is drawn across the field by two persons who walk on both sides of the field. The farmers are very much affiliated to the village temple, and they believe that the sand collected from the base of the sacred Bo tree in the temple is effective in controlling insects. So, they throw such sand at the crop and control insects. The truth behind this may be different. When sand is thrown with a physical force at the crops, insects may fall into the water and die.

The traditional farmers have developed various devices which generate frightening sounds to chase harmful animals. While some of these devices are operated by the power of blowing wind, some are operated by the power of flowing water. For example, the Water Ghost (Diya holmana) is operated by the flowing water (Fig. 1). the Wind Ghost (Sulang holmana) is operated by the blowing wind (Fig. 2). Both provide an intermittent beat that scare rats and birds. To frighten harmful birds and rats, the farmers keep puppets or scarecrows on the field. While some puppets are given human appearance, some puppets are given the appearance of the natural enemies of some pests. For example, cat-like puppets are kept in the field during the grain ripening period to frighten and chase rats. To chase wild boars, some specific methods are adopted. One of these methods is to draw a twine rubbed with sulphur around the farm. It is believed that sulphur generates a repelling smell which keeps the wild boars away from the farm. In some cases, a black twine is drawn around the farm. It is said that the boar refrains from entering the

farm fearing it to be a death trap. In the same way, to keep rats away from the field, pineapple leaves are kept around the field. The farmers believe that the rats see the pineapple leaves like snakes which feed on rats, and therefore they refrain from entering the farm. The farmers also often walk through their fields in order to observe the insects in their fields, and to chase other harmful animals.

INDIGENOUS KNOWLEDGE OF PEST CONTROL AND SUSTAINABILITY :

The indigenous methods of pest control which have so far been discussed, had been in use over thousands of years and have proven their effectiveness. The long existence of these methods itself prove their validity. It is evident that most of these methods are in consistence with the natural ecological processes because they use natural enemies of pests and the substances which have naturally developed in certain plant species. They also do not generate any poisonous substances to the environment. Therefore these indigenous methods of pest control assist to keep the environmental pollution at a minimum level. Furthermore, for all these indigenous methods, locally available materials are used. Most of the herbs which are used for pest control are freely available within the locality. Hence, these methods do not involve any cost. Therefore, it can be concluded that the indigenous pest control methods are time-tested, environmentally sound, and economically viable, and hence they have greater potential value for sustainable development.

There is no doubt that these indigenous methods were capable of controlling paddy pests when old rice varieties were planted. But, it seems that now these methods are inadequate to cope with the pest problem since almost all farmers now plant high yielding varieties which are highly susceptible to pests. These new varieties have lost their resistance to pests because the plant breeders have given priority to the yield and not to their resistance to pests. Therefore, chemical pesticides have now become inevitable. It seems that the heavy dependence on chemical pesticide has counter-sustainable effects due to the following reasons.

- (1) It is evident that the application of chemical pesticides bring about ill-environmental effects. Its adverse effects on the productivity of the natural resources such as soil, water, air, and living organisms, reduce the regenerative capacity of these natural resources which is a major requirement for sustainable development.
- (2) **Chemical approach to pest control is only a short-term solution. Though the application of chemical pesticides give immediate results, in the long-term it is ineffective because the target pests biologically get adapted to the pesticide. Hence, chemical control is not a sustainable solution to the pest problem.**

- (3) Prices of chemical pesticides and all other chemical inputs have been rapidly increasing since recent times, and it seems that they will continue to increase perhaps at a higher rate. Escalating price of chemical inputs will absorb a considerable share of the farm income, and it will continue to keep the farmers below the poverty line.
- (4) Use of chemical pesticides which are produced externally increases the farmers dependence on external inputs. Any farming system which is heavily dependent on external inputs is not sustainable since the input supply is beyond the control of local farmers. Dependence on internal inputs is a major requirement for sustainable development,

Though the modern chemical inputs are effective, they are counter-sustainable and ecologically disastrous. On the other hand, the traditional methods of pest control are ecologically sound but now they are less effective in controlling the pest problem in modern farming. Therefore, some sort of combination of modern and traditional methods of pest control may lead to an effective and ecologically sound alternative. Integrating new technology into indigenous pest control methods would increase the effectiveness of the latter. For instance, modern technology, i.e. machinery and sprayers, could be used to process and spray the traditional botanical pesticides in a better way. In the same way, modern technology could be used to promote the effectiveness of traditional mechanical and biological methods of pest control. For instance, in a recent experiment carried out in India with the use of different lights, it was revealed that the white light trap was about the most effective while other colours-yellow, blue, green and red-have been almost equal in attraction, catching about one-third the number of insects caught in the white light trap (Widanapathirana, 1983). Attempts should be made to incorporate the modern technology into the indigenous knowledge in order to develop environmentally sound and effective pest control methods which could contribute to the sustainable development.

CONCLUSION :

The indigenous knowledge which has been brought down from generation to generation has now reached its end because it is now suppressed by the modern scientific knowledge. It is being forgotten as it is replaced by modern education and technology. The present young generation who are already accustomed to the modern technology are not prepared to bring the indigenous knowledge to hand it over to the next generation. Therefore, in view of its value to the sustainable development, immediate steps should be taken to collect, documents and to preserve the indigenous knowledge. Scientists are trying to preserve the world rich plant genetic diversity in gene banks. It is important to do the same for the world indigenous knowledge base before it is lost forever.

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Figure Captions :**Figure 1 :**

Water Ghost (Diya Holmana) : When the upper part of the bamboo which is lighter gets filled with water, it becomes heavier than the lower part and moves down. Then, the water flows out of the bamboo, and it becomes lighter again and moves up. As the upper part moves up, the heavier lower part moves down and knocks on the stone, making a frightening sound. This process continues as long as there is water in the paddy field.

Figure 2 :

Wind Ghost (Sulang Holmana) : When the palm leaf is moved by the blowing wind, the nail which is attached to it knocks on the bottle, making a intermittent beat that scare rats and birds.