EMERGING THREATS ON ENVIRONMENTAL SUSTAINABILITY

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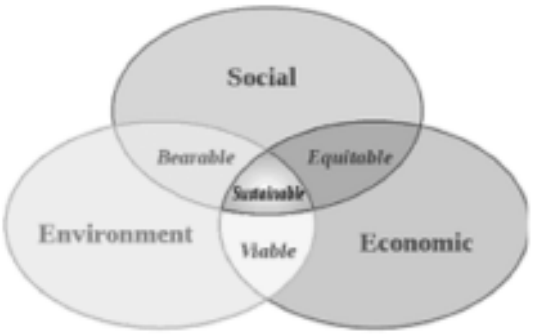
Environmental sustainability is defined as responsible interaction with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality. The practice of environmental sustainability helps to ensure that the needs of today's population are met without jeopardizing the ability of future generations to meet their needs. When we look at the natural environment, we see that it has a rather remarkable ability to rejuvenate itself and sustain its viability. For example, when a tree falls, it decomposes, adding nutrients to the soil. These nutrients help to sustain suitable conditions for the growth of future saplings. When nature is left alone, it has a tremendous ability to care for itself. However, when man enters the picture and uses many of the natural resources provided by the environment, things change. Human actions can deplete natural resources, and without the application of environmental sustainability methods, long-term viability can be compromised.



The goal of environmental sustainability is to conserve natural resources and to develop alternate sources of power while reducing pollution and harm to the environment. Sustainability should lead to social development, economic growth and environmental protection. Social development is about improving the well-being of every individual in society so they can reach their full potential. The success of society is linked to the well-being of each and every citizen. Social development means investing in people. It requires the removal of barriers so that all citizens can journey toward their dreams with confidence and dignity. Economic growth is the increase in market value of goods and services produced by an economy over time. It is conventionally measured as the percent

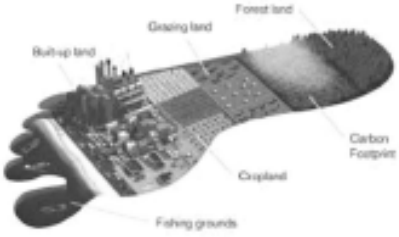
rate of increase in real gross domestic product, or real GDP. Environmental protection is practiced for protecting the natural environment on individual, organization controlled by governmental levels, for the benefit of both the environment and humans.

Earth Overshoot Day

Earth Overshoot Day (EOD), previously known as Ecological Debt Day (EDD), is the calculated illustrative calendar date on which humanity's resource consumption for the year exceeds Earth's capacity to regenerate those resources that year. Earth Overshoot Day is calculated by dividing the world bio-capacity (the amount of natural resources generated by Earth that year), by the world ecological footprint (humanity's consumption of Earth's natural resources for that year), and multiplying by 365, the number of days in one Gregorian common calendar year:

(World Bio-capacity/World Ecological Footprint) x 365

Andrew Simms of UK think tank New Economics Foundation originally developed the concept of Earth Overshoot Day. When viewed through an economic perspective, EOD represents the day in which humanity enters an ecological deficit spending. In ecology the term Earth Overshoot Day illustrates the level by which human population overshoots its environment. In 2018, Earth Overshoot Day is on August 1. Earth Overshoot Day is calculated by Global Footprint Network and is a campaign supported by dozens of other nonprofit organizations.



There are two great emerging threats in environmental sustainability viz., Biodiversity loss and Invasion by Alien Invasive Species

Biodiversity

Biodiversity refers to the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes including diversity within species, between species and of ecosystem. There are 1,435,662 identified species all over the world which includes 751,000 species of insects, 250,000 of flowering plants, 281,000 of animals, 68,000 of fungi, 30,000 of protists, 26,900 of algae, 4800 of bacteria

and 1000 viruses. Approximately 27,000 species become extinct every year. Majority of them are small tropical organisms. Extinction of species leads to further destruction of fragile ecosystems. If this trend of biodiversity depletion continues, one-fourth of the world species may be lost by the year 2050.

The term biodiversity was coined by Walter G. Rosen in 1985 during the first planning meeting of the National Forum on Biodiversity held in Washington DC in September 1986, the proceedings of which brought the notion of biodiversity to the attention of wide field of scientists. However, the credit of popularising this word goes to E.O. Wilson, who is called as Father of Biodiversity. Of the 20 hot spots of the world reported so far, two of them belong to India. The Eastern Himalayas and Western Ghats are the two hot spots of biodiversity in India encompassing rich floral and faunal wealth.

Genetic erosion

The twentieth century has witnessed a loss of 75% of the genetic diversity of crop plants. High yielding varieties have occupied more than 60% area of wheat and rice lands. Out of 3000 food plant species only 150 were commercialized. Agriculture is dominated by only 12 species out of which four yields more than 50% of the total production (Rice, wheat, Maize and Potato). Genetic erosion is a matter of serious concern which could hamper the crop improvement programmes. The maintenance of a diversity of crops with different characteristics gives the community a buffer stock of food in case of droughts, floods, pest attack or disease outbreak.

The major factors leading to extinction of a species and consequent loss of biodiversity are a) habitat loss and fragmentation, b) Introduction of exotic species, c) Invasion by alien species, d) Over exploitation, e) Soil, water and atmospheric pollution, f) Intensive agriculture and monocultures.

Bio-security issues in coconut

Biological invasions, the routine importation (both accidental and deliberate) of harmful non-native organisms occur daily, and are estimated to cost more than $100 billion loss per year world-wide. Nonetheless, the scientists, policy makers and public over the whole world including India are paying considerably less attention and spending far fewer resources than needed to identify and address bio-invasions and their manifold impacts that include chronic damage to societal infrastructure, agro-ecology, fisheries, the environment and human health. Economic losses due to bio-invasions are substantial in many parts of the world including India. Twenty-five percentages of costs of food consumables accessible to customers are attributed to invasive weeds, pests and diseases. Invasive species are second only to habitat

destruction as the major cause of biodiversity loss. In the globalized era, goods and services produced in one part of the world are increasingly available in other parts of the world and people around the globe are more connected to each other than ever before paving way for accidental introduction of invasive pests. International travel is more frequent resulting in several biosecurity threats. Establishing risk-based biosecurity systems in different countries is vital to safeguard the food supply chain.

Quarantine

The word "Quarantine" took shape from the Venetian dialect form of the Italian quaranta giorni, meaning 'forty days', which is the minimum number of days ships were required to be isolated before passengers and crew could disembark during the pandemics of Black Death. In Old Testament the book of Leviticus 13: 46, stated that anyone with leprosy remains unclean as long as they have the disease and that they must live outside the camp away from others (Paul, 2002) indicating the influence of quarantine suppressing disease spread from time immemorial and its impact that is likely to bring forth benefits in the larger interest of the human well-being.

Plant quarantine is a government endeavour enforced through legislative measures to regulate the introduction of planting materials, plant products, soil, living organisms etc., in order to prevent inadvertent introduction of pests (including fungi, bacteria, viruses, nematodes, insects and weeds) harmful to agriculture of a country/state/region, and if they are introduced, to prevent their establishment and further spread. After the Second World War, FAO convened an International Plant Protection Convention (IPPC) in 1951 to which India became a party in 1956. Currently it has 179 signatory countries.

Invasive pests on coconut already reported in the country

a) Coconut eriophyid mite: The exotic pest, coconut eriophyid mite, Aceria guerreronis Keifer was reported from all coconut growing regions ranging from 0.2% in Bay Islands to 57.3% in Karnataka. Ever since the pest was first reported in the country from Kochi, Kerala during 1998, it had spread like a wild fire affecting all coconut plantations in key south Indian states.

b) Asian grey weevil: Myllocerus undatus Marshall (Curculionidae ; Coleoptera), a pest of quarantine importance was registered from root (wilt) diseased tracts of coconut in Kerala. Mild to medium level of infestation damaging 5-10% of leaf area of un-split leaves with typical notching-like symptom along the leaf margins was noticed on majority of the coconut seedlings in root (wilt) endemic zones. In the nursery area with nearly 10,000 coconut seedlings, more than 40% seedlings were found infested by the weevil affecting the marketing potential of seedlings. The characteristic feature of this weevil is the presence of three-spined

hind femur and is considered as an invasive pest from Sri Lanka.

c) Inflorescence moth: Occurrence of non-native inflorescence moth, Batrachedra arenosella (nuciferae) was observed from Port Blair-Bay Island, Minicoy-Lakshadweep Island, Kasaragod-Kerala, Ambajipeta-Andhra Pradesh, Jagdalpur-Chhattisgarh and parts of Karnataka. The pest incidence was quite higher in Niu Leka Green Dwarf at World Coconut Germplasm Centre, Port Blair when compared to other Pacific Ocean collections maintained there.

d) Spiraling whitefly: Sporadic incidence of spiraling whitefly, Aleurodicus dispersus Russel recorded from Minicoy Island, Kerala and Tamil Nadu was effectively bio-suppressed by natural enemies. As the name suggests, adults of A. dispersus has a typical spiralling fashion of egg-laying and found in mild to moderate levels during March-May. It is highly polyphagous pest infesting a wide array of crops in coconut plantations.

e) Rugose spiraling whitefly: The latest entry in this series is Aleurodicus rugioperculatus Martin introduced from Belize, Central America during 2016 in Pollachi and Palakkad area. It was found to feed and breed profusely from the under surface of the palm leaves, numbering more than 10 live colonies in a leaflet. As rugose spiralling whitefly (RSW) is a highly polyphagous invasive species, a biosecurity alarm was sounded to monitor its spread and extent of damage caused. Though RSW initially created panic by its expansive mode of ovipositional damage in different crops including banana, bird of paradise, custard apple, jack, Heliconia sp., etc., it could not sustain feeding on other crops successfully compared to coconut and relatively to some extent, on banana, which are its most favoured host plants. Encarsia guadeloupae Viggiani, an aphelinid parasitoid of spiralling whitefly (Aleurodicus disperses Russell) fortuitously introduced in India in the late 1990s and well established in South India, turned out to be a very effective parasitoid of A. rugioperculatus as well. It parasitized A. rugioperculatus to an extent of 60% and kept the pest under check not allowing it to flare up in any of the South Indian States from where RSW has been recorded so far. Extensive deposits of sooty mould, Leptoxyphium sp. was found on the upper surface of palm leaves and other intercrops, which forms one of the identification features of pest attack. Of late, scavenging associated novel discovery of a Leiochrini beetle, Leiochrinus nilgirianus Kaszab could be identified feeding on the sooty mould and cleansing the palms as Swachh palm Abhiyan.

Impending biosecurity risks

Coconut leaf beetle, Brontispa longissima Gestro and the armoured scale insect, Aspidiotus rigidus ravaging Maldives and Philippines, respectively though could not be encountered so far in our survey, but are impending dangers at our

door steps.

a) Brontispa longissima (Chrysomelidae : Coleoptera)

The outbreak of the B. longissima in Myanmar and Maldives in recent years poses a great threat and concern to the nearby countries such as India, Sri Lanka and Bangladesh. It is feared that the pest will find its way from Maldives to Sri Lanka and Southern parts of India to derail the economy of these important coconut growing regions of the world. Since invasive pests fail to restrict along political / agro-ecological boundaries countries like India, Bangladesh and Sri Lanka are ever in red alert zones. For all those countries, where coconut and coconut based industries support millions of people, the pest incursion would be catastrophic. Coconut leaf beetle (CLB) was originally described in 1885 from Aru Islands in Indonesia and from Papua New Guinea.

b) Wallacea jarawa (Chrysomelidae : Coleoptera)

A close relative of the chrysomelid beetle, B. longissima, viz., Wallacea jarawa feeding on the spear leaf region of coconut seedlings was recently recorded from South and Little Andaman. The feeding niche of Wallacea jarawa confining on coconut spindle is a matter of concern, however, the pest was not observed from any adult palm during the snap survey conducted during October 2014. Though 80-90% of seedlings were infested by the pest damaging about 40% of leaf area, there was no seedling mortality. It is a matter of domestic quarantine.

c) Aspidiotus rigidus (Diaspididae : Hemiptera)

Hard scale, A. rigidus, is a close relative of Aspidiotus destructor, a minor pest reported from Kerala, Tamil Nadu and other coconut growing tracts of the country. Gradient outbreak of coconut scale insect, A. destructor was observed at Chingoli near Kayamkulam, Kerala during August-September 2012. A. rigidus is reported to be a ravaging pest in The Philippines incurring huge loss to coconut growers in that country. It is also reported as an emerging invasive threat in our country. The mobile stage being the crawlers and males are easily drifted away by wind or passively carried through any inert packaging materials, nuts, leaflets, dried spathes, etc.

d) Red ring disease in coconut

It is caused by the nematode, Bursaphelenchus cocophilus (Cobb) Goodey and transmitted by the palm weevil, Rhynchophorus palmarum. Juvenile nematodes are transmitted especially during oviposition and other activities. Young palms between 30 months and 10 years old are susceptible. Yellowing followed by browning and drying of older leaves and premature nut fall are the external symptoms in affected palms. The cross sections of the affected palms show diagnostically, The presence of a reddish brown ring of 2-4 cm width about 2-5

cm inside from the stem periphery is the characteristic diagnostic internal symptom of the disease. This extends throughout the stem but is clearest about 1 m above ground level. Red streaks may appear in the petioles, and the roots become orange to faint red, dry and flaky. The key sign is the presence of the nematode in the reddened tissues and gradually the affected palms die. The disease is distributed in Caribbean area (Grenada, St. Vincent and the Grenadines, and Trinidad & Tobago), Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama), North America(Mexico), South America (Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, and Venezuela).

Sustainable Agriculture

One way environmental sustainability is being applied through sustainable agriculture. This is defined as the use of farming techniques that protect the environment. Sustainable agriculture has grown out of concerns over the industrialization of agriculture that began in the 20th century. Although industrial agriculture has the ability to produce abundant amounts of food at affordable prices, the method of farming can be detrimental to the environment. Industrial agricultural methods are heavily reliant on chemical fertilizers and pesticides and put high demands on soil and water resources. Also, industrial crops are often monocrops, which involves growing a single crop year after year. These methods can lead to water pollution when chemicals run off into waterways, deplete the water resources due to overuse, and soil erosion and poor soil quality due to aggressive planting. With sustainable agriculture, farmers minimize water use and lower the dependence on chemical pesticides and fertilizers. They also minimize tillage of the soil and rotate crop planting each year to ensure higher soil quality.

A crop habitat based pest regression module has been developed at ICAR-CPCRI with Kalpasankara coconut hybrid and intercrops such as nutmeg, rambuttan, banana, curry leaf, jack, marigold, custard apple etc for framing farming to fullness. Pest incidence was comparatively low in the ecological engineering plot compared to that of mono-cropped coconut garden wherein two to four folds increase in pest incidence could be observed. Admixture of volatile cues due to crop pluralism including eco-feast crops disoriented pests away from ecological engineering garden and ensuring a high population of pest defenders and pollinators as well. A significant attraction of honey bees on coconut and coral vines is indicated in ecological engineering plot. Reduction in pest incidence and systematic crop care could boost up the coconut yield averaging 161 nuts per palm per year after five years of planting. A crop pluralism based distraction of pests could thus be accomplished. In addition to pest regression, a sustained income and employment through complementary utilization of

resources was the star attraction of this module that would de-risk farmers who generally adopt for intensive mono-cropping by suppressing diversity.

A holistic approach of crop care, nutrition, water and intercropping is therefore the need of the hour as part of technology integration for inclusive development and doubling income. The yield is faster and fatter in ecological engineering system and accumulation of organic wealth is quite profound. Sustainability mode and ecological viability is well realized in this concept of functional diversity coupled with generation of continuous income and employment making farming lucrative and to reduce risk from eventualities. Such module needs better attention at policy level to augment income and maintain the ecosystem. Not only pests are reduced in the system, the spectrum of pollinators, scavengers and defenders dominate the niche making biotic system well balanced and sustaining the fragile ecosystem as well.