Endosulfan issue: science verses conscience

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Right to life, guaranteed under Article 21 of the Constitution of India, is the most fundamental of all human rights, and any decision which may put an individual's life at risk, calls for the most anxious scrutiny. A slew of articles, reports and comments/notes were published on the issue of endosulfan and several relevant RTI revelations – all of these by pro- and anti-endosulfan lobbies have their own merits and demerits, flaws and faults in their claims. What is lacking largely is a real neutral approach. An extremely pertinent question in the endosulfan episode is why adverse health effects similar to those seen in the villages of Kasaragod, Kerala and later in Karnataka; have not been reported from other parts of the country, where the pesticide is used in much larger quantities. A quite neutral stance is offered taking both sides into consideration. The motive is not to blame endosulfan outright. Sreekumar and Prathapan[1] failed to even read this first sentence of our earlier commentary[2]. Endosulfan issue is an exemplary case of science verses conscience, rather than science verses common sense. If science frequently corrects common sense, conscience always shapes science in the right direction. Science is for society, not that society is for science.

Stating that the amount of endosulfan at 1.34 l/ha/year used in the cashew estates in Kasaragod, is far less than other crop situation such as rice, vegetables, tea or cardamom, Sreekumar and Prathapan[1] overlooked the most important fact that endosulfan was not used unilaterally in those annual crops, unlike in cashew where it was used for at least two decades continuously and that too aerially. In toxicology, risk or hazard is the product of toxicity and exposure.

Sreekumar and Prathapan[1] claimed that unusually high incidence of health problems as widely perceived in Kasaragod, would have been certainly reflected in the total figures for the district too, as 11 out of 39 panchayaths are allegedly affected. There is no guarantee that when 11 panchayats (28%) are affected, this will surely be reflected in the total figure. This shows how the authors[1] are assuming, and arguing absurd, and instead alleging others for superimposition and presumptions of facts.

The endosulfan tragedy in Kasaragod is not only natural fallout of the disaster phase, but a complex situation. We never stated the pesticide treadmill in isolation, but rather in the right context of fallout of other cardinal factors of crop intensification such as improved varietal introduction, younger trees, softwood graftings, etc. Denying the pesticide developmental phases in cashew, they opined, 'lack of continuous exposure and lower rates of application are the key factors which prevent the development of crisis and disaster phases in cashew'. It means that they themselves accept at least the first two stages – the subsistence, the exploitation phase. Why did farmers shift from cashew to rubber then? It was because the former crop was no more remunerative. A trend analysis[3] observed that cashew cultivation declined in Kerala from 1.37 lakh ha in 1985–86 to 81,154 ha in 2004–05. Kerala's share in cashew farming in the country downscaled from 23% (1987–88) to 5.4% (2011–12). The production share declined from 31% to 5.3% in the same time-span[4]. In contrast, farming area and production are increasing steadily in other cashew-producing states. Cashew crop productivity in Kerala, which was around 900 kg/ha in late 1980s, declined from 1995–96 touching 562 kg/ha in 1998–99 and thereafter hovering around 800 kg/ha. Fall in cashew productivity clearly indicates the crisis phase (Figure 1). Concerted efforts by the State Directorate of Cashew and Cocoa Development, and National and State Horticulture Missions have resulted in stabilized growth after 1998–99. This indicates that cashew plant protection is in the Integrated Pest Management phase.

The criticism by Sreekumar and Prathapan[1] that more than 99% of the chemical insecticide goes waste is grossly an unsubstantiated generalization. It is imperative to note that this is not our generalization, but research reports by international authorities[5,6]. The reports have pointed out that in a broadleaved tree crop, the thick cashew canopy would act as a sponge that absorbs a significant portion of the spray fluid. Such absorbed spray fluid only added the pollutant-pesticide as sink in the targeted foliage, that amounts certainly wastage only.

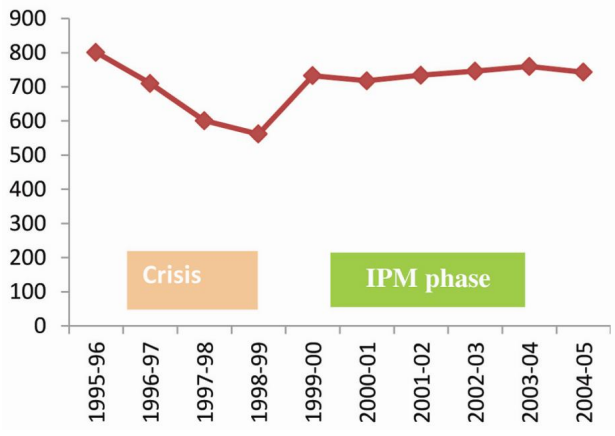

Figure 1. Declining cashew productivity (kg/ha) in Kerala witnessed crisis phase.

Critical crop coverage

Cashew trees of various age-categories, viz. young seedlings/trees of 0–5 years (13%), and trees of 5–15 years old (23%) – comprised around 36% of total crop coverage in India. Young trees are affected by tea mosquito bugs (TMB) throughout the year; seedling trees are less affected compared to grafted ones and mature plantations (>25 years) are less prone to TMB attack[7]. Naturally PCK plantations are not all seedling-originated trees. Even young plants are prone to TMB. Aerial spray could not have discriminated such semi-wild mixed plantations.

The Achyuthan Committee[8] reported that PCK resorted to endosulfan aerial-spray on 4696 ha cashew plantation in Kasaragod district. In our calculation, we have taken a figure of 3500 ha, just for showing an example, for which Sreekumar and Prathapan[1] picked an RTI revelation that the area under spray was 2350 ha. PCK has 6361 ha plantation inclusive of high-yielding cashew varieties which are scientifically managed[9]. It comprises of Mannarghat Estate (Palakkad district, 544 ha), Alakode Estate (Kannur, 80 ha), and three major cashew estates, viz. Cheemeni (856 ha), Rajapuram (1523 ha) and Kasaragod (2190 ha) covering a total of 4569 ha for Kasaragod district. This report[8] states that the same pesticide was used by PCK for about two decades, without following the protocol for aerial spraying. Thanks to RTI Act, we procured the information independently from concerned PCK which supports our viewpoints. Even the unsuitability of undulating topography and abundant water bodies with human habitation is cited in the report[8].

We want to clarify that neither do we support endosulfan nor oppose it. We have no intention to state anything against the Government as well. We have not raised any question regarding whether estimation procedures by Calicut Medical College (CMC) and NIOH are right or wrong. Sreekumar and Prathapan[1] can certainly point out shortcomings of those methodologies. But, it is unscientific to conclude that there was four-fold increase in residues in one decade time (NIOH, 2001 to CMC report, 2011), as protocols and analytical procedures adopted might have been different.

Aerial spray – the cardinal factor

Sreekumar and Prathapan[1] have mentioned, three-round blanket spray[10] of pesticides a year against TMB, that was later reduced to need-based applications[11]. This was advocated widely by Kerala Agricultural University 2002 onwards, after the ban of endosulfan in the state. They have overlooked the fact that the same package of practice suggests a rational rotation of insecticides to counteract the tendency of the pest to develop field resistance. Contrary to this, endosulfan was unilaterally used by PCK, that too aerially. Moreover, what is need-based spraying? It must be based on economic threshold level (ETL). For TMB, no ETL has been worked out in the Indian context, though one claims that it is a well-studied pest. Even if one curtails from three sprays, the wide coverage of pesticidal solution sprayed over the canopy using aircraft is much more to blame. It is obvious that not only endosulfan is the culprit, but several other confounding factors – aerial spraying with improper operations, utter lack of care and cautions, etc. – a 'lethal mix' of all.

Exit endosulfan: eco-logic

According to experts, India is one of the largest horticultural producers in the world, but a failed exporter. Any toxic chemical that importing nations recognize will not help our farmers in exporting their commodities. Farmers should aim for export commodities (tea, coffee, vegetables, etc.) as well. In that case, when endosulfan is banned in most of the countries, who will come forward to purchase our commodities, if we still insist in endosulfan usage? One should have a broader futuristic view. Phase-out policy can be worked out for economic profits, but with appropriate care and consensus for our products to maintain good reputation and competitiveness in quality in international market. No doubt, initially we may have problems getting cheaper alternatives. Such dilemma occurred after DDT was restricted/banned in agriculture way back in the eighties. But now everyone knows we are standing taller without DDT. Any new-generation pesticide (like Rynaxapyr®) today will be obsolete tomorrow, and will be phased out in due time.

We hail the Central Government's positive policy on toxic pesticides like monocrotophos, which was found in the mid-day meal served in a Bihar school killing 23 children (*Business Line*, 30 August 2013). The Central Government had banned its use on vegetables, and has plan for further restricting the usage of monocrotophos. We welcome any governmental or non-governmental epidemiological investigations if needed, to prove allegations on endosulfan, but then such committees should include members from social groups, and human right activists as well. Not only endosulfan, but all other synthetic insecticides are to be avoided as far as possible. Chemicals are to be used as the last line of defence only. It is a welcome step by Kerala Agricultural University (KAU) that after field trials in its cashew plantations, scientists vouch for the efficacy of bio-agents and botanicals. Organic cashew nuts fetch higher price than the chemically grown ones. Biocontrol agents like red ants *Oecophylla smaragdina* can be used as ant-technology for pest management in cashew. We had initiated ant technology scientifically[7] in 2005–06, before the Kerala farmers took it up in cashew farms, as claimed in the media[12]. In Cashew Research Station (KAU), unsprayed plantation/fruit trees were found to harbour a large number of red ant nests (Figure 2). We witnessed in our tours to the PCK Mannarghat estate (2006) that after cessation of chemical sprays, cashew trees harboured red-ant nests naturally with reduction in insect pests.

Risk assessment is logically followed by risk communication and risk management. Certainly, India lags behind in this sector. It is high time that we shed our orthodox approach. We ought to know our limitations in the label claim procedures/provisions in the Indian territory. For example, the restricted-entry-interval (REI) is not included in our labels of pesticidal products. REI in insecticides like endosulfan is of utmost importance. There is always scope for improvement, but one should be prepared mentally for this in a positive manner.

Epidemiological study – limitations

Estimates of risk associated with any chemical are arrived at often through epidemiological (prospective and retrospective) studies. The former looks forward into the future, while the latter looks back into the past to discover factors which may have influenced the incidence and distribution of a particular disease. Whether endosulfan-based companies or other private agencies conducted such studies earlier needs to be known. The CMC report[13] was a retrospective one, and we are not denying possible flaws in it. Risk is inversely related to the degree of knowledge we possess concerning the particular event involved. At the same time, predictive toxicology is the science of risk assessment based on experimental data dealing with bioassay in experimental animals, interpretation of the data of these tests,

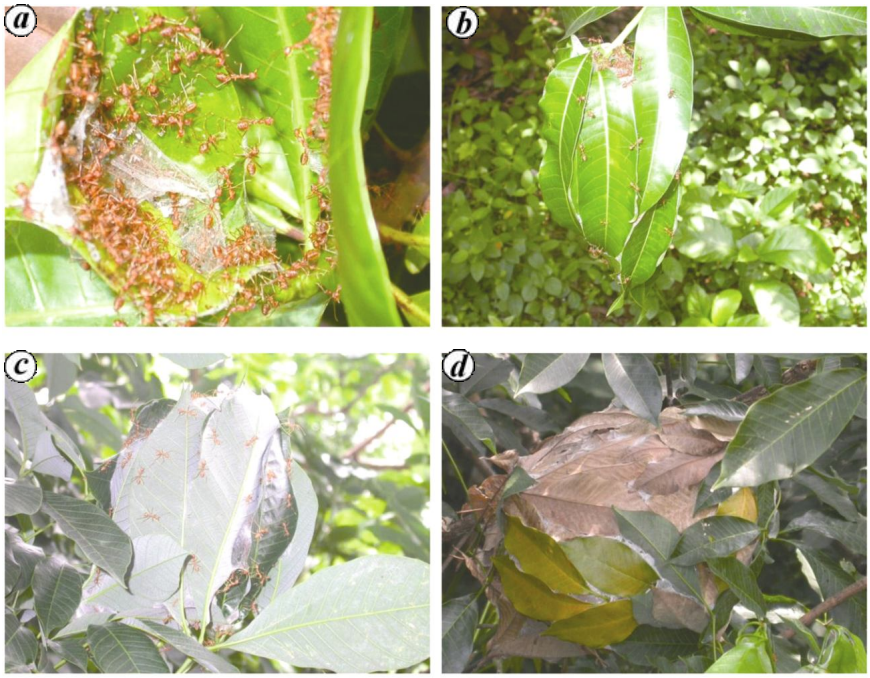

Figure 2. Red ant (*Oecophylla smaragdina)* nests: ants are the promising biocontrol agents harboured in unsprayed orchard trees in Kerala. ***a***, Ant-nest on cashew, opened to show the aggressive ants; ***b***, nest on mango; ***c***, nest on rubber; ***d***, nest on jack tree.

and subsequent risk estimation based on the test data. In extrapolating animal data to human populations, a safety factor of 100 is often used in setting human exposure limits. The NOAEL (no-observable-adverse-effect-level) in experimental animals is determined, and human exposure levels set at 100-fold less. This is a complex area involving science, philosophy and economics and thus, views of 'acceptable risk' (safety) often relate to an individual's subjective bias. As is often the case, there is strong animal evidence, but few epidemiological tests of predictions based on the animal experiments. We are not shying away from this fact, but that is the limitation of science.

Endless ill-effects of endosulfan

Sreekumar and Prathapan[1] state that latest studies rule out the possibility of endocrine disruption by endosulfan at doses normally used in agricultural situations. However, we can also cite several studies supporting the endocrine disrupting effects of endosulfan.

Our Stolen Future[14] is a critically important book that forces us to ask questions on synthetic chemicals (not only endosulfan) that we have spread across this earth. It narrates how synthetic chemicals released into the environment mimic hormones of the endocrine system, and because of their wide ranging effects, eventually threaten human intelligence, fertility and survival. Wildlife is a sentinel for future effects on humans. In this context we would like to mention an article published in *Current Science*[15], on the suppressive growth and reproduction of zebra fish by endosulfan.

The most disturbing case is the capacity of endosulfan undergoing long-range transport to remote locations such as the Arctic[16]. Temporal trends from ice/snow cores as well as mountain lake sediments reveal a marked increase in endosulfan accumulation from 1980 onwards. Residues of endosulfan have been detected in marine biota in different geographical regions of the Arctic, with higher bioaccumulation factors (10^3–10^7) for zooplankton and various species of fish. Endosulfan does fulfil several of the criteria under the UNEP Stockholm Convention for designation as a persistent organic pollutant[16]. In an exhaustive review[17] on endosulfan, numerous citations are given on the harmful effects of endosulfan as a potential endocrine disruptor.

A committee[18] appointed by the Government of Gujarat cites that WHO, FAO, IARC (International Agency for Research on Cancer) and US EPA (US Environment Protection Agency) have indicated that endosulfan is not carcinogenic, not teratogenic, not mutagenic and not genotoxic. We mention here that even US EPA has withdrawn endosulfan. Regarding its potential endocrine disruption status the OH&S Report[19] is worth reading. For endosulfan registrations of all products were cancelled in Australia in 2010. This decision was followed by an assessment that the prolonged use of endosulfan was likely to lead to adverse environmental effects via spray drift and run-off.

Social cost ignored

Endosulfan manufacturers often argue that a ban would necessitate import of costly patented pesticides. Though this may be true in the case of some crops, the price of the pesticides in the market is not often decided by whether they are patented or not, according to anti-endosulfan campaigners. If royalties are to be paid, it affects the profits of the manufacturer and not necessarily the costs of farmers.

As argued, the reported sale of Rynaxypyr® was Rs 650 crores in 2012 in the Indian market. This filled up the vacuum created by endosulfan ban. This is an assumption by Sreekumar and Prathapan[1], not mentioned in the news (*Business Line*, 27 June 2013). How the said molecule could garner popularity in a short span is surely due to its field efficacy not only in India, but at global scale. Launched in late 2008, the global sale of chlorantraniliprole (Rynaxypyr®) – a patented insecticide from DuPont crossed US$ 750 million in 2012.

The quote 'toxic dumping by the MNCs of the developed countries into the developing countries' is their over-upgraded statement; we are neither against nor for any MNC. But certainly one should think earnestly, if some chemical is banned for use in one's country, how can we export it to other nations, at least from a human rights point of view. In case we accept that European countries want to get out of their crisis at the cost of developing countries by capturing their markets (as 60% of the world pesticide market is controlled by the

European multinationals); we all should strive for appropriate alternatives from domestic sector and more emphasis on non-chemical methods should be prioritized, properly utilizing the phase-out period. One ought not to ignore the social and health costs of continued use of toxic pesticides. The cost of phasing out the pesticide is a global one, and if India uses the right diplomatic efforts, we could get the cost supported by international funding and phase in robust alternative systems using that money.

End of endosulfan: albeit all debates

The truth appears hazy in a fog of conflicting claims and counter-claims from farmer associations, environmental groups, Central and State Governments and scientific and socialist fraternity. The misuse and overuse of endosulfan could be the culprit. At the fifth global conference on the Stockholm Convention (April 2011), the Indian Government back tracked from its earlier stance of opposing a global ban, and agreed to a compromise of gradually banning endosulfan over a 11-year period, while finding a cost-effective alternative.

We reiterate our stance that we cannot afford avoiding global phase-out of hazardous persistent pollutants/chemicals. A rational approach is the need of the hour. The basic and foremost purpose of science is to improve the quality of life and to reduce the miseries and sufferings of the people. If we use the knowledge of science with conscience, we can make this earth a much better place to live. Otherwise we would only contribute to its destruction. Tacit and stubborn attitude in the name of science, showing scant regard to otherwise valid viewpoints are no more acceptable by the society. Tools of science must be applied at the right time with the right perspective of human values, lest it may lead to major mistakes and irreparable injury to mankind and nature.

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