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Research Paper

Possibilities of Optimizing the Pesticides for the Alternative Agricultural Sustainability in India

Agriculture

KEYWORDS : Alternative Agriculture, agricultural sustainability, agro-ecology, bio-intensive farming, grass farming, Good Agricultural Practices and Inclusive growth.

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ABSTRACT

This Review article is a genuine attempt to evaluate the possibilities of the negligible use of pesticides in agriculture in India. Though the data is quite evident that India is among the least users of pesticides, even then for the sustainable agricultural output there are the possibilities of alternative agricultural practices. Moreover, still the authorities are not so serious about this subject therefore the modern technologies are not being welcomed for agro-ecology, bio-intensive farming, grass farming and Good Agricultural Practices (GAP). These alternative agricultural techniques are supposedly bio-friendly and eco-friendly techniques adopted by the developed countries from years ago. Some of the techniques were introduced in 1940's in USA and 1960's in Japan, Australia and Canada. This article is based upon the secondary data available in the published reports, Government records especially policies related to pest control by the apex bodies and competent authorities empowered by the Government of India. The article will conclude that the inclusive growth in agriculture is the need of the hour in India. Where it has been reported that the chemical used for the purpose is sometime dangerous for the health as well as it has the negative impact over the sustainable growth of this sector, it is suggested and argued that the alternative agriculture must be adopted for the overall welfare of future of the humanity.

Introduction:

The term pesticide covers a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators and others. Basically, a pesticide is a substance or a mixture of substances designed for preventing, destroying, repelling or lessening the damage of a pest. Pesticides may be made of a chemical substance or a biological agent such as a virus, bacteria, pest repelling weeds and pest eating insects, fish, birds and mammals. Pesticides refer only to those pesticides that include chemical substances such as phosphamidon, lindane, chlorpyrifos, heptachlor and malathion. Many pesticides are known to be poisonous to humans. The government has banned some pesticides while the use of others has been regulated. Among these organochlorine (OC) insecticides which were used successfully in controlling a number of diseases such as malaria and typhus had been banned or restricted after the 1960s in most of the technologically advanced countries. Ideally a pesticide must be lethal to the targeted pests but not to non-target species including man. Unfortunately, this is not the case so the controversy of the use and abuse of the pesticides has surfaced.

The global population has placed an order to the farmers to produce food for an estimated 9.1 billion people expected to inhabit the earth by 2050. To feed the world, food production has to be scaled up by 70% and this may be achieved through the proper utilization of the available plant -genetic resources in the development of high yielding varieties of crops, improved crop production and protection technologies. Pesticides are the major tool to contain the insect pests and to save the crops from their damage. About 20-30% agricultural produce is lost annually due to insect-pests, diseases, weeds and rodentsetc which in monetary term equals to Rs. 1,00,000 Crore. Therefore the judicious use of pesticides plays a major role in the plants protection. Their use for sustainable crop production was also advocated by the Nobel Peace Prize winner the late Dr. N. E. Borlaug. No doubt pesticides are reliable source to keep the pest population below economic threshold but if they are used injudiciously, they may pose serious health hazards to human beings, domestic animals, natural enemies of crop pests and other forms of life through unwanted contamination of food, feed, water bodies and environment etc. In India, total 248 pesticides and biopesticides have been registered as per Insecticide Act of 1968 as on 2005-2014. The Environmental Protection Agency (EPA) has estimated that about 76 percent of the total pesticides used at national level is for agricultural production with the remaining 24 percent used in the urban, industrial, forest, and public sectors. These chemicals have helped to increase the agricultural production with reduced labor.

Production and the usage of pesticides in India

The production of pesticides was started in India in 1952 with the establishment of a plant for the production of BHC near Calcutta, and India is now the second largest manufacturer of the pesticides in Asia after China and ranks twelfth globally (Mathur, 1999). There has been a steady growth in the production of technical grade pesticides in India from 5,000 metric tons in 1958 to 0.78 million tons (1965-66) to 10.3 million tons (1988-89). The latest consumption of pesticides are confirmed as per Agricultural Ministry of India is 16.9 million tons (Aug-2013).

Pesticide consumption trend in India and the World:

India's pesticide consumption of 600 gram per hectare is far below its major Asian peers -17 kg/ha in Taiwan, 13 kg/ha in China and 12 kg/ha in Japan. Low consumption can be attributed to fragmented land holdings, lower level of irrigation, dependence on monsoons, low awareness.

Judicious use of pesticides in sustainable crop production and PGR Management

S.No.	Name of the Country	Pesticide Consumed (Kg/ha)
1.	Taiwan	17.0
2.	China	13.0
3.	Japan	12.0
4.	USA	7.0
5.	Korea	7.0
6.	France	5.0
7.	UK	5.0
8.	India	0.6

Source: Industry reports, Analysis by Tata Strategic (FY 14)

From the above table it is noted that in India pesticide consumption is far less vis-à-vis other countries. In our country the residue problem in food products is mainly due to use of persistent pesticide as well as non-judicious use of pesticides *i.e.* indiscriminate use of chemical pesticides, non-observance of prescribed waiting period, use of sub-standard pesticides, improper advice and supply of pesticides to the farmers by pesticide dealers, effluents from pesticide manufacturing units, improper disposal of left-over pesticides, treatment of fruits and vegetables with persistent and non-recommended pesticides etc. To minimize the misuse of pesticides we have to follow the "Good Agricultural Practices" exercising a thorough understanding about

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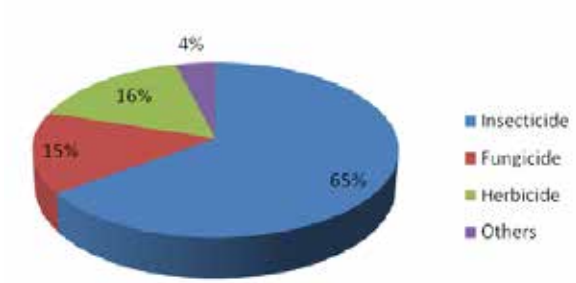
the use of various pesticides in an effective and eco-friendly way.

The following Pie-chart is depicting the percentage of various pesticides used in India-



Source: Industry reports, Analysis by Tata Strategic, Share of different pesticides in India, FY-2014

Factors affecting the growth of bio-pesticides:
However, some of the factors which have restricted the growth of bio-pesticides are:

- Low reliability because of low stability in effect
- Target specificity which distracts farmers
- Slow in action as compared to synthetics
- Shorter shelf life
- Erratic availability of bio-pesticides in the market
- Already established and strong market of the chemical pesticides
- Regulatory system favorable to the chemical pesticides, and
- The gradual disappearance of multiple or mixed cropping which is known to keep away the magic bullet-chemical pesticide.

Government Regulations and Policy:
Today, India has achieved a fivefold increase in food grain production to an all-time record of 257.4 million tons in 2013-14. Ensuring food security for more than 1.27 billion Indian population with diminishing cultivable land resources is a herculean task. A number of factors take a heavy toll on the agricultural produce including insect pests, diseases, weeds, rodents etc. It is estimated that losses due to these factors account to Rs 113,000 crores as reported by the 37th Standing Committee of the Ministry of Chemicals & Fertilizers in the year 2013. It is important to mention that the Ministry of Agriculture, Government of India has set-up a Division "Monitoring of Pesticide Residues at National Level", which continuously monitors pesticides residue in fruits and vegetables available in the markets across the country. A scheme implemented by the Government of India draws random samples of food articles regularly and takes penal action in cases where the samples are found not conforming to the provisions of Food Safety and Standards Act, 2006.

Pesticides and Measures for Alternative Sustainable Agriculture:
The term 'Alternative agriculture ' as it applies to the area of agriculture can be defined as 'A systematic approach to farming intended to reduce agricultural pollution, enhance sustainability, and improve efficiency and profitability. Overall, alternative agriculture emphasizes management practices that take advantage of natural processes (such as nutrient cycles, nitrogen fixation, and pest-predator relationships), improve the match between cropping patterns and agronomic practices on the one hand and the productive potential and physical characteristics of the land on the other, and make selective use of commercial fertilizer and pesticides to ensure production efficiency and conservation of soil, water, energy, and biological resources. Examples of alternative agricultural practices include use of crop rotation, animal and green manures, soil and water conserving tillage systems, such as no-till planting methods, integrated pest management, and use of genetically improved crops and animals. Consonant with sustainable agriculture, alternative agriculture focuses on those farming practices that go beyond traditional or conventional agriculture, though it does not exclude conventional practices that are consistent with the overall system.

Agro-ecology:
Agro-ecology can be defined broadly or narrowly. "Loosely defined, agro-ecology often incorporates ideas about a more environmentally and socially sensitive approach to agriculture, one that focuses not only on production, but also on the ecological sustainability of the productive system."At its most narrow, agro-ecology refers to the study of purely ecological phenomena within the crop field such as predator/prey relations, or crop/weed competition."

"The Alternative Farming/Alternative Agriculture are essentially synonymous terms encompassing a vast array of practices and enterprises, all of which are considered different from prevailing or conventional agricultural activities. They include non-traditional crops, livestock, and other farm products; Service, recreation, tourism, food processing, forest/woodlot, and other enterprises based on farm and natural resources (ancillary enterprises); unconventional production systems such as organic farming or aquaculture; or Direct marketing and other entrepreneurial marketing strategies." [Nancy Grudens Shuck et al.,]

Bio-intensive Gardening/Mini-farming:
John Jeavons and Ecology Action have refined a production system that makes it possible for one person to grow all of his or her family's food using truly sustainable methods that maintain the fertility of the soil without relying on nonrenewable resources like petrochemicals or imported organic matter. [From: John Jeavons, How To Grow More Vegetables, Fruits, Nuts, Berries, Grains, And Other Crops On Less Land Than You Can Imagine (Berkeley CA: Ten Speed Press, 1995). The concepts and practices of bio-intensive gardening were synthesized and introduced to the U.S. by the English master horticulturalist, Alan Chadwick. Important components include double-dug, raised beds; intensive planting; composting; companion planting; and whole system synergy.

Biological Farming/Ecological Farming:
Biological and Ecological Farming are the terms commonly used in Europe and in the developing countries. Although sometimes strictly defined, e.g., "Biological farming is a system of crop production in which the producer tries to minimize the use of 'chemicals' to control the crop pests," [John Pesek, "Introduction," Proceedings of the Management Alternatives for Biological Farming Workshop, comp. by Robert B. Dahlgren (Ames IA: Iowa State University, 1983). Both biological farming and ecological farming are the terms used in the broader sense, encompassing various and more specific practices and techniques of farming sustainability e.g. organic, biodynamic, holistic and natural. Norman et al. pointed to some differentiation between the two terms: "In Europe (e.g., the Netherlands), the term biological often refers to organic farming, whereas the term ecological refers to organic plus environmental considerations such as on-farm wildlife management (i.e., the relationships between parts of the agro-ecosystem."

Biotechnology:
Although the farmers have been practicing biotechnology in the broadest sense (i.e. for plant and animal breeding to achieve certain traits) for thousands of years, it is the recent breaking of the genetic code that has pushed this science into a new era altogether. Genetic engineering differs significantly from traditional

biotechnological techniques in that DNA from different species can be combined to create completely new organisms (Genetically Modified Organisms - GMOs). Whether this technology is compatible with sustainable agriculture and if so in what ways provokes much controversy among sustainable agriculture advocates.

Carbon Sequestration:
"Carbon sequestration is the process through which agricultural and forestry practices remove carbon dioxide (CO2) from the atmosphere. Sequestration activities can help to prevent global climatic change by enhancing carbon storage in trees and soils, by preserving existing tree and soil carbon, and by reducing emissions of CO2, methane (CH4) and nitrous oxide (N2O)."

Carrying Capacity:
Carrying capacity is the theoretical equilibrium population size at which a particular population in a particular environment will stabilize when its supply of resources remains constant. It can also be considered to be the maximum sustainable population size; the maximum size that can be supported indefinitely into the future without degrading the environment for future generations. The Earth's capacity to support people is determined both by natural constraints and by human choices concerning economics, environment, culture (including values and politics) and demography. Human carrying capacity is therefore dynamic and uncertain.

Community Supported Agriculture (CSA):
In basic terms, CSA consists of a community of individuals who pledge support to a farm operation so that the farmland becomes either legally or spiritually the community's farm with the growers and consumers providing mutual support and sharing the risks and benefits of food production. Typically, members or share-holders of the farm or garden pledge in advance to cover the anticipated costs of the farm operation and farmer's salary,in return, they receive shares in the farm's bounty throughout the growing season as well as satisfaction gained from reconnecting to the land and participating directly in food production.

Conservation of Buffer Strips:
Conservation of 'Buffer Strips' are the areas or strips of land maintained in permanent vegetation, designed to intercept pollutants and erosion. Placed around fields they can enhance wildlife habitat, improve water quality, and enrich aesthetics on farmlands. Various types of buffers include Contour Buffer Strips, Filter Strips and Riparian Forest Buffers.

Conservation Tillage:
Conservation Tillage is a term that covers a broad range of soil tillage systems that leave residue cover on the soil surface, substantially reducing the effects of soil erosion from wind and water. These practices minimize nutrient loss, decreased water storage capacity, crop damage and decreased farmability. The soil is left undisturbed from harvest to planting except for nutrient amendment.

Ecological Footprint (EF):
The term was introduced by William Rees in 1992 and was elaborated upon in his book, coauthored with Mathis Wackernagel, "A calculation that estimates the area of Earth's productive land and water required to supply the resources that an individual or group demands, as well as to absorb the wastes that the individual or group produces." (National Geographic's Strange Days on Planet Earth Glossary).

Externalities (Agricultural):
In economics the benefits or costs that are not included in the market price of goods or services. For example, the cost of natural resource depletion, pollution and other environmental and social factors are externalities that often are not factored into the market price of a product." [National Geographic's Strange Days on Planet Earth Glossary].

"Agricultural production affects environmental and human health. Many consequences are borne involuntarily rather than chosen because no formal market trading takes place for ecosystem function or health attributes. These impacts, or externalities, may be quantified indirectly by assigning dollar values through a process called valuation, which informs agricultural production and policy decisions. [Erin M. Tegtmeier and Michael D. Duffy, "External Costs of Agricultural Production in the United States."International Journal of Agricultural Sustainability (2004).

Farmland Preservation/Protection:
"The irreplaceable land that produces our food and provides us with scenic open space, wildlife habitat and clean water is increasingly at risk from urban sprawl and rural subdivisions... According to a 1997 American Farmland Trust study, every state in the nation is sacrificing irreplaceable agricultural resources to urban sprawl. We are converting a total of 1 million acres a year and while the quantity of top-quality agricultural land being lost varies from state to state, the process of conversion increases the pressures on agriculture even beyond the acres that are actually taken out of production." [American Farmland Trust (AFT).

Actions are being taken on many levels. Tactics include focusing on policies related to property tax relief and protection from nuisance lawsuits for farmers, purchase of agricultural conservation easement (PACE) programs, special agricultural districts where commercial agriculture is encouraged and protected, comprehensive land use planning and farm-friendly zoning ordinances.

Good Agricultural Practices (GAP):
"Broadly defined, a GAP approach aims at applying available knowledge to address environmental, economic and social sustainability dimensions for on-farm production and post-production processes, resulting in safe and quality food and non-food agricultural products. Based on generic sustainability principles, it aims at supporting locally developed optimal practices for a given production system based on a desired outcome by taking into account market demands and farmers constraints and incentives to apply practices. However, the term "GAP" is a recognized terminology used in international regulatory frameworks as well as in reference to private, voluntary and non-regulatory applications that are being developed and applied by the governments, civil society organizations and the private sector." ["Executive Summary," Report of the Expert Consultation on a Good Agricultural Practices (GAP) Approach, Rome, Italy, 10-12 November 2003.

Grass Farming/Grass-based Farming:
Grass-based production relies on pasture or rangeland to supply the protein and energy requirements of livestock. "An acceptable level of production can be attained as the ecological connections between ruminants, the soil, and the pasture plants are naturally maintained. Pasture-based animal agriculture promotes environmental stewardship and community development owing to the following management practices:

- Use of off-farm inputs such as diesel, fertilizer, and purchased feed are minimized.
- Use of toxic substances such as herbicides and soluble fertilizers are minimized or sometimes eliminated.
- Limited tillage and the use of perennial pastures which store carbon in the soil while building soil organic matter conserves soil.
- Water and energy resources are conserved through moni-

toring and appropriate technologies such as irrigation monitoring, solar and wind technologies.
- Proper plant and animal genetics such as locally-adapted pasture grasses and low-maintenance animals are selected.
- Planned grazing systems that favor grass growth contribute to biological diversity.
- Marketing food to local communities.
- The development of local processing plants is fostered which adds the value to local animal products while providing employment and economic development.
- A management philosophy is developed that values health in people, animals, plants, and soil.

Integrated Pest Management (IPM):
IPM is an ecologically based approach to pest (animal and weed) control that utilizes a multi-disciplinary knowledge of crop/pest relationships, establishment of acceptable economic thresholds for pest populations and constant field monitoring for potential problems. Management may include such practices as "the use of resistant varieties; crop rotation; cultural practices; optimal use of biological control organisms; certified seed; protective seed treatments; disease-free transplants or rootstock; timeliness of crop cultivation; improved timing of pesticide applications; and removal or 'plow down' of infested plant material." (J. Keith Waldron, "Integrated Pest Management," Long Island Horticulture News (July 1989).

Natural Farming:
Natural Farming reflects the experiences and philosophy of Japanese farmer Masanobu Fukuoka. His farming method involves no tillage, no fertilizer, no pesticides, no weeding, no pruning, and remarkably little labor! He accomplishes all this (and high yields) by careful timing of his seeding and careful combinations of plants (polyculture). In short, he has brought the practical art of working with nature to a high level of refinement." [Robert and Diane Gilman, "Greening the Desert: An Interview with Masanobu Fukuoka," In Context (Autumn 1986) 14: p. 37.

Organic Farming:
The term 'organic farming' was first used by Lord Northbourne who embraced the teachings of Rudolph Steiner and biodynamic farming and had a "vision of the farm as a sustainable, ecologically stable, self-contained unit, biologically complete and balanced. The term thus did not refer solely to the use of living materials (organic manures, etc) in agriculture. The Organic farming was championed in the United States by J.I. Rodale, beginning in the mid-1940s. "The organic farmer and gardener must realize that fertilization is not the only measure for success. He must treat the soil as a living, being entity. He must rotate crops. He must fallow the land at regulated intervals. The organiculturist must not practice one-crop monoculture but must engage in a balanced agriculture with cattle as a part of the general program. He must be smart in the ways of soil and crops by observing the reaction of the land to the actions of man. For instance, he must know when to plant, when to harvest, and what varieties of seed to use. Compost alone does not make a successful gardener any more than does gardening without compost.

Permaculture:
The word "permaculture" was coined by Australian Bill Mollison in late 1970s. One of the many alternative agricultural systems described as sustainable, permaculture is "unique in its emphasis on design i.e the location of each element in a landscape and the evolution of landscape over time. The goal of permaculture is to produce an efficient, low-maintenance integration of plants, animals, people and structure. applied at the scale of a home garden, all the way through to a large farm." [John Quinney, "Permaculture in the United States," The New Alchemy Quarterly (Spring 1986) 23: p. 3.

Precision Farming/Agriculture:
Precision agriculture is a "management strategy that employs a detailed, site-specific information to precisely managed production inputs. This concept is sometimes called Precision Agriculture, Prescription Farming, Site -specific Management. The idea is to know the characteristics of soil and crop unique to each part of the field and to optimize the production inputs within small portions of the field. The philosophy behind precision agriculture is that production inputs (seed, fertilizer, chemicals, etc.) should be applied only as needed and where needed for the most economic production." [Stephen W. Searcy, "Precision Farming: A New Approach to Crop Management". This system requires the utilization of sophisticated technology including personal computers, telecommunications, global positioning systems (GPS), geographic information systems (GIS), variable rate controllers and infield and remote sensing. Although precision agriculture promises the reduced use of chemical inputs in which there are several factors that make it controversial in the sustainable agricultural community including the requirements of large capital outlay and advanced technical expertise.

Regenerative Agriculture:
Robert Rodale coined this term and it subsequently was expanded to "regenerative/sustainable agriculture" by the Rodale Institute and Rodale Research Center. Two reasons given for the emphasis on "regenerative" were (1) Enhanced regeneration of renewable resources is essential to the achievement of a sustainable form of agriculture and (2) The concept of regeneration would be relevant to many economic sectors and social concerns." [Robert Rodale, "Sustainability: An Opportunity for Leadership," in Sustainable Agricultural Systems, ed. by Clive A. Edwards, et al. 1990: pp. 84-85).

The Benefits of Alternative Farming Methods:
Alternatives to conventional farming should be embraced to improve subsistence farmers' yields and to ensure adequate food production for the growing global population. The stark reality, according to the International Food Policy Research Institute, is that the world needs to produce more food with fewer resources.

Agroecology, a farming approach that mimics natural ecosystems, is an alternative method that can produce more food using fewer resources. Small-scale farmers in Africa have used agroecology to more than double crop yields within 3 to 10 years of implementation, according to the UN special rapporteur on the right to food. Farmers also use agroecology to improve soil fertility, adapt to climate change, and reduce farming input costs.

In contrast, conventional farming is characterized by monocropping, green revolution technologies, and synthetic fertilizer. It is resource intensive in terms of capital, land, water, and fossil fuel use. Conventional farming threatens future food production by reducing biodiversity, and contributing to environmental degradation and climate change which lower yields.

Permaculture, a contraction of permanent agriculture, is a promising design system for the application of agroecology. It was developed in Australia in the 1970s based on agroecology and indigenous farming systems. In practice, permaculture farms are organic, low-input, and biodiverse, and use techniques like intercropping trees, planting perennials, water harvesting, and resource recycling.

There are numerous permaculture projects globally. However, they are largely disparate, small-scale projects. While experts have endorsed agroecology's ability to address food and farming problems, permaculture is not widely known, and has failed to draw broader funding and policy support.

Permaculture programs are more multifunctional than typical agricultural development programs. This is important given the growing call for "triple-win solutions" for agriculture, health, and environmental sustainability. For example, Partners in Health ran a model permaculture farmer program in Malawi which helped HIV/Aids patients get the additional caloric and micronutrient intake that they need. Elsewhere, in Malawi and South Africa, permaculture is used "as a sustainable, non-donor dependent tool for improving the health, food and nutrition security, and livelihoods," of orphans and vulnerable children, according to a recent US Aid report. Indonesia, Oxfam funded a permaculture school that taught ex-combatants and tsunami survivors how to improve their food security and livelihoods, while protecting the environment.

As a recent article highlighted, permaculture farmers in Malawi have, on average, better food security and higher crop and diet diversity than conventional farmers. Further, permaculture training builds farmers' ability to devise feasible, simple, and efficient solutions to problems. For instance, Francis, a teenage permaculture farmer, improved his family's health by increasing the safety of their drinking water. He used a free, simple solution, by diverting their bathing water away from their well, into a garden bed. This type of multifunctional impact differentiates permaculture from programs that only teach a few sustainable farming techniques, or give out inputs. Despite the potential of permaculture and agroecology, mainstream agriculture continues to focus on conventional techniques. There are a number of reasons why permaculture has not been more widely adopted, or even considered. First, the small-scale, grassroots nature of permaculture, while part of its strength, has contributed to its slow dissemination and minimal visibility. Second, permaculture is a design system, rather than an easily replicated model, which makes it more difficult to teach and adopt than a typical agriculture project. Further, permaculture challenges how governments and NGOs usually teach people to farm. Indigenous farming knowledge, like that used in permaculture, has been devalued and eroded with the imposition of mono-cropping and green revolution technologies. Third, scepticism remains over whether people's food needs can be met using organic, labour intensive, small-scale farming. To date, there has not been enough rigorous research on permaculture to evaluate its impact, its application on a large scale, or to support its adoption. Academia has not seriously engaged with permaculture, and there are no companies with a profit incentive to research and disseminate it. Permaculture has thus remained marginal, and many see it as idealistic and impractical.

The permaculture community can help encourage and support the use of permaculture, by raising its visibility, disseminating successful project models, and conducting more research. Permaculture lessons opened the possibility that there were other, more beneficial ways she could farm. Likewise, development project managers and policy decision-makers can use permaculture as a framework to open their thinking, and adopt new models that are needed in the context of current resource constraints and climate change. They should seek and evaluate alternative approaches like permaculture to effectively implement creative, efficient, and sustainable solutions in partnership with local populations.

Conclusion:

The data on environmental-cum-health risk assessment studies may be regarded as an aid towards a better understanding of the problem. Data on the occurrence of pesticide-related illnesses among defined populations in developing countries are scanty. Generation of base-line descriptive epidemiological data based on area profiles, development of intervention strategies designed to lower the incidence of acute poisoning and periodic surveillance studies on high risk groups are needed. Our efforts should include investigations of outbreaks and accidental exposure to pesticides, correlation studies, cohort analyses, prospective studies and randomized trials of intervention procedures. Valuable information can be collected by monitoring the end product of human exposure in the form of residue levels in body fluids and tissues of the general population. The importance of education and training of workers is a major vehicle to ensure a safe use of pesticides which is being increasingly recognized.

The economic impact of pesticides in non-target species (including humans) has been estimated at approximately $8 billion annually in developing countries. For the developing countries it is imperative to use pesticides as no one would prefer famine and communicable diseases like malaria. It may thus be expedient to accept a reasonable degree of risk. Our approach to the use of pesticides should be pragmatic. In other words, all activities concerning pesticides should be based on the scientific judgment and not on commercial considerations. There are some inherent difficulties in fully evaluating the risks to human health due to the pesticides. For example there are large numbers of human variables such as age, sex, race, socio-economic status, diet, state of health, *etc. A*ll of which affect human exposure to pesticides but practically a little is known about the effects of these variables. Pesticides are often considered a quick, easy, and inexpensive solution for controlling weeds and insect pests in urban landscapes. Pesticides have contaminated almost every part of our environment. Pesticide residues are found in soil and in air, in surface and ground water across the countries. Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms to insects, plants, fish, and birds. Contrary to common misconceptions even herbicides can cause harm to the environment. In fact, weed killers can be especially problematic because they are used in relatively large volumes. The best way to reduce pesticide contamination is for all of us at our part to use safer, non-chemical pest control (including weed control) methods. The exercise of analyzing the range and nature of benefits arising from pesticide use has been a mixture of dreaming and distillation. There have been blind alleys but also positive surprises. The general picture is as we suspected: there is publicity, ideological kudos and scientific opportunity associated with 'knocking' pesticides while praising them brings accusations of vested interests. At national level the benefits are principally economic with some social benefits and one or two issues of environmental benefits. It is only at global level that the environmental benefits really come into play.

There is a need to convey the message that prevention of adverse health effects and promotion of health are profitable investments for the employers and the employees as a support to a sustainable development of economics. To sum up, based on our limited knowledge of direct or inferential information, the domain of pesticides illustrates a certain ambiguity in the situations in which people are undergoing life-long exposure. There is thus every reason to develop health education packages based on the knowledge, aptitude and practices and to disseminate them within the community in order to minimize the human exposure to pesticides.

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