The Concept of Sustainable Agriculture: An Issue of Food Safety and Security for People, Economic Prosperity for the Farmers and Ecological Security for the Nations

Key words: Green revolution by chemical agriculture, curse in disguise, second green revolution by vermiculture revolution, organic farming, backbone of sustainable agriculture, earthworms vermicompost, superb organic fertilizers, miracle growth promoter, bio-villages in Bihar (India) embracing organic farming, sustainable agriculture

INTRODUCTION: THE IMPELLING THREAT OF CHEMICAL AGRICULTURE TO HUMAN HEALTH AND ENVIRONMENT

Chemical agriculture triggered by widespread use of agro-chemicals in the wake of ‘green revolution’ of the 1950s-60s came as a ‘mixed-blessing’ rather a ‘curse in disguise’ for mankind. It dramatically increased the ‘quantity’ of the food produced but severely decreased its ‘nutritional quality’ and also the ‘soil fertility’ over the years. The soil has become addict and increasingly greater amount of chemical fertilizers are needed every year to maintain the soil fertility and food productivity at the same levels. The early response to chemical fertilizers is ‘levelling off’ after a 3% annual increase between 1950-1984. There is evidence that a plateau has been reached in global efforts to increase the yield per hectare through agro-chemicals.

Increased use of agro-chemicals have virtually resulted into ‘biological droughts’ (severe decline in beneficial soil microbes and earthworms which help to renew the natural fertility of soil) in soils in the regions of green revolution in world where heavy use of agro-chemicals were made. Higher uses of agro-chemicals also demands high use of water for irrigation putting severe stress on ground and surface waters. Soil and water pollution due to seepage and drainage especially after heavy rainfall were other ill-effects on farmlands.

Widespread use of chemical pesticides became a necessity for the growth of high-yielding varieties of crops which was highly ‘susceptible to pests and diseases’. Continued application of chemical pesticides induced ‘biological resistance’ in crop pests and diseases and logarithmically much higher doses are now required to eradicate them.

Studies indicate that there is significant amount of ‘residual pesticides’ contaminating our food stuff long after they are taken away from farms for human consumption. Vegetable samples were contaminated 100% with HCH and 50 per cent with DDT (143). Bhatnager (25) reported pesticide residues in wheat flour samples. Contamination with HCH was 70%, Heptachlore 2 was 45%, Aldrin 45% and DDT 91%. 60% of water samples were found to be contaminated with Aldrin and 50% with DDT. They were all higher than permissible limits of WHO. A study made by the Society for Research and Initiative for Sustainable Technologies and Institutions (SRISTI), Ahmedabad, India, to analyse the residual pesticide in soils of croplands of Gujarat found that 41 out of 70 samples contained insecticidal residues of Phosphamidon, DDVP, Methyl parathion, Malathion, Chlorpyriphos and three different pyrethroids. Rao (143) also reported residues of pesticides in meat, fish, eggs, butter, milk including in mother’s milk and human fat. The contamination was 100% with HCH, 69% with DDT and 43% with aldrin. In human fat DDT residue ranged from 1.8 ppm in Lucknow to 22.4 ppm in Ahmedabad; HCH ranged from 1.6 ppm in Bombay to 7 ppm in Bangalore.

Adverse effects of agro-chemicals on the agricultural ecosystem (soil, flora, fauna & water bodies in farms) and also on the health of farmers using them and the society consuming the chemically grown food have now started to become more evident all over the world. According to United Nation Environment Program (UNEP) and the World Health Organization (WHO) nearly 3 million people suffer from ‘acute pesticide poisoning’ and some 10 to 20 thousands people die every year from it in the developing countries (196). US scientists predict that up to 20,000 Americans may die of cancer, each year, due to the low levels of ‘residual pesticides’ in the

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chemically grown food. (196). The farmers today are caught in a ‘vicious circle’ of higher use of agrochemicals to boost crop productivity at the cost of declining soil fertility. This is also adversely affecting their economy as the cost of agrochemicals has been rising all over the world.

EMBRACING THE CONCEPT OF ‘SUSTAINABLE AGRICULTURE’: EMBARKING ON A ‘SECOND GREEN REVOLUTION’ THROUGH ‘ORGANIC FARMING’ BY VERMICULTURE

The term ‘Sustainable Development’ was coined by Bruntland Comission Report ‘Our Common Future’ in 1982 which redefined the concept of human development as the development (both social & economic) to ‘meet the ‘needs’ (but not the ‘greed’) of the present generation without compromising with the abilities of the future generations to meet their own needs and that should improve the total quality of all life (human beings, plants and animals) on Earth now and in the future too, while maintaining the social and ecological integrity (natural and man-made ecosystems) of the earth upon which all life depends and which can provide good quality of life to all the people born on Earth, while protecting their basic life-support systems (air, water, soil, flora and fauna) and also safely disposing all the wastes generated by them’ (195 & 198).

The scientific community all over the world is desperately looking for an ‘economically viable, socially safe & environmentally sustainable’ alternative to the destructive ‘chemical agriculture’ which would not only ‘maintain’ but also ‘enhance’ farm production per hectare of available land as the farmlands all over the world is shrinking in the wake of rapid urbanization. Then, it is not enough to produce ‘sufficient food’ to feed the civilization (which was the primary objectives of chemical based green revolution) but also to produce a ‘high quality of food’ which should be ‘safe’ (chemical free) and also ‘protective’ to human health (good combination of macro and micro nutrients and vitamins) and do it in a sustainable manner to ensure ‘food security’ for all, but most for them in the poor Third World nations in the long term. ‘Food Safety & Security’ is a major issue everywhere in the world. This will amount to embarking on a ‘Second Green Revolution’ and this time by ‘Organic Farming’ practices completely giving up the use of agro-chemicals (33; 44; 77; 78; 102 & 172).

The new concept of farm production against the destructive ‘Chemical Agriculture’ has been termed as ‘Sustainable Agriculture’. This is about growing ‘nutritive and protective foods’ with the aid of biological based ‘organic fertilizers’ without recourse to agro-chemicals. This is thought to be the answer for the ‘food safety and security’ for the human society in future. The U.S. National Research Council (1989) defined sustainable agriculture as ‘those alternative farming systems and technologies incorporating natural processes, reducing the use of inputs of off-farm sources, ensuring the long term sustainability of current production levels and conserving soil, water, energy and farm biodiversity’. It is a system of food production which avoids or largely excludes the use of systematically compounded chemical fertilizers and pesticides and use of environmentally friendly organic inputs. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes and green manures to maintain soil productivity and tilth to supply plant nutrients. It emphasizes on both preventive and curative methods of pest control such as the use of pest resistant cultivars, bio-control agents and cultural methods of pest-control.

In the US, the top 25% of sustainable agriculture farmers practicing ‘organic farming’ now have better gross margins and better yields than the top 25% of their counterparts still practicing chemical agriculture (1). Swedish farmers are practicing the ‘Cleanest Agriculture’ in world now since 1972. They have developed an alternative system of agriculture based upon the vision of ‘kretslopp’—‘agriculture which aims to be in harmony with the cycle of nature’ and therefore, highly sustainable. They have drastically cut the use of pesticides, herbicides and fungicides by 70 per cent since 1985 (196 & 197).

Vermicompost (metabolic products of earthworms feeding on organic wastes) is proving to be highly nutritive ‘organic fertilizer’ and a ‘miracle growth promoter’ rich in NKP (nitrogen 2.3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes and also contain ‘plant growth hormones & enzymes’. Evidences are accumulating all over the world including our own studies (discussed later in chapters) that the earthworms and their vermicompost can do the miracle. They can ‘build up soil’, ‘restore soil fertility’, ‘sustain farm production’ and also deliver ‘safe food’ for the civilization.

Agenda 21 on sustainable agriculture: The Chapter on ‘Sustainable Agriculture’ in Agenda 21 adopted at the Earth Summit in Rio de Janeiro, Brazil, June 1992, makes it obligatory for international agencies and
governments of all nations to give incentives to farmers to shift away from the environmentally destructive high-tech chemical agriculture to the environmentally friendly sustainable agriculture by improving upon the traditional technologies with modern scientific knowledge. The International Movement for Ecological Agriculture held in Penang, Malaysia (Jan. 10-13, 1990) has also called for alternative technology in agriculture.

**MOVEMENT FOR ORGANIC FARMING AND SUSTAINABLE AGRICULTURE**

The International Institute of Environment and Development (IIED), London, examined the extent and impact of ‘Non-Chemical Sustainable Agriculture’ in a number of countries. Sustainable agriculture is synonymous with ‘Cleaner Agriculture’ as the objective is to reduce or even eliminate the use of dangerous agro-chemicals from food production and also to reduce the use of other precious farm inputs like water and energy whose indiscriminate use to boost food production (to feed the growing masses) has led to widespread environmental destruction by way of soil salinity, waste and pollution (139 & 140).

According to IIED there are some 1.82 million households farming 4.1 mha with cleaner chemical-free agriculture technologies in 20 developing countries. All have used resource conserving technologies and practicing organic farming. In the U.S. some 69 large scale farmers had switched over to ‘organic farming’ by 1980 (1). The figure must have increased significantly by now. In India several farmers are being motivated to shift to ‘organic farming & sustainable agriculture’ through vermiculture and give up ‘chemical agriculture’ (172). A number of villages in the districts of Samastipur, Hazipur and Nalanda in Bihar have been designated as ‘BIO-VILLAGES’ where the farmers have completely embraced ORGANIC FARMING by use of earthworms and vermicompost. They have completely given up the use of chemical fertilizers for the last four years since 2005. They are growing both cereal (rice, wheat & corn), fruits (banana, guava, mango & lemons) and vegetable crops (potato, tomato, onion, brinjal, cucumber, okra etc) on vermicompost. Farmers of bio-villages feel proud of their food products and they sell at a higher price in market due to their good appearance and taste (Personal Interview by Rajiv Sinha, December, 2008).

In the OECD countries, a shift to cleaner sustainable agriculture is expected to bring a slight short-term decline in productivity of around 5-15%. But the decline in the ‘cost of input’ of cleaner agriculture is sharper and therefore more profitable to the farmers practicing cleaner chemical-free agriculture than the farmers practicing chemical agriculture where the cost of inputs were several times high (170 & 172). Evidences are gathering that in the long term (5 to 10 years) yields in cleaner chemical-free agriculture will recover to former levels as the soil regenerates slowly with the use of local biological farm inputs (instead of dangerous agro-chemicals), natural soil fertility is renewed, pests becomes isolated, farmers becomes more skilled and able to understand and manage their new production system and agro-ecosystem (139 & 140).

**VERMICULTURE CAN PROMOTE ORGANIC FARMING & SUSTAINABLE AGRICULTURE**

Sustainable agriculture is a process of learning new and innovative methods developed by both farmers and the farm scientist and also learning from the traditional knowledge and practices of the farmers and implementing what were good in them and also relevant in present times. Vermiculture was practiced by traditional and ancient farmers with enormous benefits accruing for them and their farmlands. There is need to revive this ‘traditional concept’ through modern scientific knowledge-a ‘Vermiculture Revolution’. Sir Charles Darwin called the earthworms as ‘farmer’s friends’. There is great wisdom in this statement of the great visionary scientist who advocated to use the earthworms, the ‘nature’s gift’ in farm production.

It is necessary to adopt and implement food & agriculture production system which must ensure:

- Maintenance of soil microbiology and fertility by greater use of biofertilizers.
- High productivity and stability of yield over the years.
- Productivity with ‘minimum’ or ‘no’ tilling; ‘low’ use of agro-chemicals (only as helping hand) and integration with biofertilizers and biopesticides.
- Productivity with minimum use of water and even sustain dryness or heavy rainfall.
Preservation of crop diversity (biotopes).
Preservation of soil, water and air quality in the farm ecosystem.
Preservation of benevolent organisms (predators) flora & fauna in the farm ecosystem.
Preservation of groundwater table.
Preservation of good health for all.
Reduction of water and energy use.

These are the objectives of organic farming & sustainable agriculture. Sustained vermiculture practices and use of vermicompost in farm soil over the years would meet several of the above requirements for a truly sustainable agriculture (168). Vermicompost is rich in microbial diversity and plant available nutrients; improve moisture holding capacity of soils thus reducing water for irrigation; improve physical, biological and chemical properties of soil; increase soil porosity & softness thus requiring minimum tillage. They have been discussed in later chapters.

Environmental and economic benefits of vermiculture: There will also be ample opportunity to reduce energy use and reduction of greenhouse gas (GHG) emissions in vermicompost production locally at farms by the farmers themselves. Huge amount of energy is used and GHG emitted at chemical fertilizer factories apart from ‘toxic and hazardous wastes’ that is generated. Farm energy requirements might be reduced by 40% by more efficient methods of food production through vermiculture technology.

If there is decline in the use of external inputs (agro-chemicals), with more use of locally produced biofertilizers (vermicompost) the costs of food produced by farmers practicing sustainable agriculture will be reduced significantly. There will be more useful trees, more farm wildlife, increased groundwater in wells and ponds, cleaner non-polluted water bodies, more soft & nutritive soils with biological organisms in and around the farmlands in the farm ecosystem where sustainable agriculture is practiced by vermiculture. These will help boost the ‘economic prosperity’ of farmers.

CONCLUSIONS AND REMARKS

Planning global organic farming and sustainable agriculture can truly bring in ‘economic prosperity’ for the farmers, ‘ecological security’ for the farms and ‘food security’ for the people. This will require embarking on a ‘Second Green Revolution’- and this time through ‘Vermiculture Revolution’- by the earthworms - Darwin’s children & the ‘miracle of nature’ (27; 168 & 172).

Organic food products produced through organic farming systems are the fastest growing food sector in the world food market. Australia is a small player in the global organic food market. It was estimated to be AU $ 33 billion in 2003. And the foundation of organic farming is ‘healthy soil’. Organic farming practices aim to increase soil humus (and thus encourage increased biological activity within the soil) and in-built systems of ‘plant protection’ within the farm ecosystem (natural pest control by soil & farm biodiversity) without recourse to agro-chemicals. And both these objectives can be achieved by integrating vermiculture in farming systems.

A shift to organic farming driven sustainable agriculture would require immense patience on the part of farmers during the transition period and till the productivity is restored to original level. It will be another challenge for the scientific community as great as it was in the 1950’ & 60’s when the 1st ‘Green Revolution’ was launched with the aid of ‘agrochemicals’ to boost farm productivity and save the growing human population from starvation (56). It would also require a huge investment by the government in building ‘local capacity’ to the farmers in developing countries. But this investment, would be an investment both in the current as well as in the future ‘capacity building’ of the farmers to feed the world (105; 198; 199 & 202).
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http://www.kvksmp.org (Farmers Training on Vermicomposting at RAU, Bihar, India).
(http://www.wormwoman.com (Mary Appelhof: Author of Classic Book ‘Worms Eat My Garbage-Sold over 3500 copies).
http://www.wormresearchcentre.co.uk (Earthworm Research Center in UK).

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