INTERNATIONAL JOURNAL OF CURRENT MULTIDISCIPLINARY STUDIES

Available Online at http://www.journalijcms.com

VOL. 1, ISSUE, 1, PP. 35-41, JUNE, 2015

IJCMS

RESEARCH ARTICLE

ROLE OF ECO-FRIENDLY APPROACHES IN SUSTAINABLE AGRICULTURE

* Geetanjly, Preeti Sharma, Vijay Laxmi Rai and Ranjeet Kushwaha

Department of Entomology, College of Agriculture, GBPUA and T Pantnagar- 263145, Uttarakhand, India

Keywords:

Article history :

Received on May 8, 2015
Received in revised form, May 10, 2015
Accepted, June 20, 2015
Published June 28, 2015

ABSTRACT:

Sustainability of conventional agriculture have prompted widespread introduction of integrated pest management (IPM), an ecologically-based approach to control of harmful insects and weeds. IPM reduces ecological and health damage from chemical pesticides by using natural parasites and predators to control pest populations. Since chemical pesticides are expensive for poor farmers, IPM gives lower production costs and higher profitability. Sustainable farms produce crops and raise animals without relying on toxic chemical pesticides, synthetic fertilizers, genetically modified seeds, or practices that degrade soil, water, or other natural resources. By growing a variety of plants and using techniques such as crop rotation, conservation tillage, and pasture-based livestock husbandry, sustainable farms protect biodiversity and faster the development and maintenance of healthy ecosystems. Sustainable crop production is in contrast to industrial crop production, which generally relies upon monocropping (growing only one crop in a large area of land), intensive application of commercial fertilizers, heavy use of pesticides, and other inputs that are damaging to the environment, to communities, and to farm workers. In addition, sustainable crop production practices can lead to higher yields over time, with less need for expensive and environmentally damaging inputs.

INTRODUCTION: Over the history of human settlements on the planet earth, agriculture has transformed in tune with the growing population and its challenging needs. India's population has been growing at an annual rate of 1.8 percent, and is expected to touch 1.3 billion mark by 2020. At this rate of population growth, the country would require an additional food grain of about 2 million tonnes a year (Paroda, 1999).

Food and fibre productivity raised due to adoption of new technologies and mechanization, increased fertilizer & pesticide use, specialized farming practices, water resource development & improved irrigation practices and Government policies that favoured maximizing production. It was in the early 1960s, the Green Revolution took shape in developing countries, especially India. It made self-sufficiency in food grain production.

Although in the recent decades, India has achieved self-sufficiency in food grain production, concerns of food security will remain as ever, as the scope to bring additional land under cultivation is limited and the agricultural production technology has started showing signs of fatigue, and has been accompanied by the degradation of natural production resource base. Not withstanding these facts, the incremental production has to come from productivity increases without damaging the ecological foundations of agriculture. This underlies the need for generation and diffusion of new Technologies that produce sufficient food and protect the environment and human health.

Chemical pesticides were increasingly relied upon to limit the production losses. Pesticide use in India increased from a mere 15 g/ha of gross cropped in

QUICK RESPONSE CODE

Corresponding author:
Geetanjaly
Department of Entomology, College of Agriculture, GBPUA and T Pantnagar- 263145, Uttarakhand, India

Article can be accessed online on:
www.journalijcms.com

1955-56 to 90 g/ha in 1965-66. Introduction of green revolution technologies in mid-1960s gave a fillip to pesticide use, and in 1975-76, it had increased to 266 g/ha, and reached a peak of 404 g/ha in 1990-91 (Birthal, 2003).

Although, there is a paucity of reliable time-series information on pest-induced production losses, anecdotal evidences suggest increase in losses (Pradhan 1983, Atwal 1986, Dhaliwal and Arora, 1996), despite increase in the pesticide use. The paradox is explained in terms of rising pest problem, technological failure of chemical pesticides and changes in production systems. Nevertheless, pesticide use has started declining since 1990-91, reaching 265g/ha in 1998-99, without much affecting the agricultural productivity (Birthal, 2003).

The declining trend in pesticide use in agriculture during the 1990s can be attributed to central government's fiscal policy and technological developments in pest management. During 1990s, taxes were raised on pesticides and phasing out of subsidies was initiated. Program on training of both the extension workers and farmers in the Integrated Pest Management (IPM) were started throughout the country. In fact, the Government of India had adopted IPM as a cardinal principle of plant protection in 1985. Notwithstanding these initiatives, adoption of IPM has not been encouraging as bio-pesticides capture hardly 2 percent of the agrochemical market.

This overview provides a synthesis of the papers presented at the workshop and identifies technological, socio-economic, institutional and policy issues important in making IPM work under field conditions. Introduction India's population has been growing at an annual rate of 1.8 percent, and is expected to touch 1.3 billion mark by 2020. At this rate of population growth, the country would require an additional food grain of about 2 million tonnes a year (Paroda, 1999).

Although in the recent decades, India has achieved self-sufficiency in food grain production, concerns of food security will remain as ever, as the scope to bring additional land under cultivation is limited and the agricultural production technology has started showing signs of fatigue, and has been accompanied by the degradation of natural production resource base. Notwithstanding these facts, the incremental production has to come from productivity increases without damaging the ecological foundations of agriculture. This underlies the need for generation and diffusion of new technologies that produce sufficient food and protect the environment and human health.

According to the agricultural scientist, M.S. Swaminathan (1999), agriculture production systems in the 21st century need to be based on the appropriate use of biotechnology, information technology and eco-technology. Integrated Pest Management (IPM) is such a technology. This paper takes a stock of research and development in IPM in India and provides a perspective for the future. Losses due to Insect pests, diseases and weeds are the major constraints limiting agricultural productivity growth. It is estimated that herbivorous insects eat about 26 percent of the potential food production.

Sustainable Agriculture: Sustainable Agriculture refers to a range of strategies for addressing many problems that affect agriculture. Such problems include loss of soil productivity from excessive soil erosion and associated plant nutrient losses, surface and ground water pollution from pesticides, fertilizers and sediments, impending shortages of non- renewable resources, and low farm income from depressed commodity prices and high production costs. Furthermore, "Sustainable" implies a time dimension and the capacity of a farming system to endure indefinitely.

Any definition of sustainability must recognize its multiple dimensions: physical, economic, ecological, social, cultural and ethical. Sustainability can be defined only in the boundaries of a system's framework, that is, after specification of what is to be sustained. Choosing the boundary is difficult because agricultural systems operate at multiple levels: soil-plant system, cropping system or farming system, agro-ecosystem and so on to higher regional, national, and global levels (Lynam, 1994).

Conventional 20th-Century agriculture took industrial production as its model, and vertically-

integrated agri-business was the result. The industrial approach, coupled with substantial government subsidies, made food abundant and cheap in the United States. But farms are biological systems, not mechanical ones, and they exist in a social context in ways that manufacturing plants do not. Through its emphasis on high production, the industrial model has degraded soil and water, reduced the biodiversity that is a key element to food security, increased our dependence on imported oil, and driven more and more acres into the hands of fewer and fewer "farmers," crippling rural communities. In recent decades, sustainable farmers and researchers around the world have responded to the extractive industrial model with ecology-based approaches, variously called natural, organic, low-input, alternative, regenerative, holistic, Biodynamic, biointensive, and biological farming systems.

"Sustainable agriculture" was addressed by Congress in the 1990 "Farm Bill" [Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA), Public Law 101-624, Title XVI, Subtitle A, Section 1603 (Government Printing Office, Washington, DC, 1990) NAL Call # KF1692.A31 1990]. Under that law, "the term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

Pretty (1996) identifies a number of goals of sustainable agriculture, which include:

1. A more thorough incorporation of natural processes.
2. A reduction in the use of off-farm, external and non-renewable resources.
3. More equitable access to resources.
4. Greater productive use of local knowledge and practices.
5. Greater self-reliance for farmers and rural populations.
6. A better match between production practices and climate and landscape.
7. Profitable and efficient production with an emphasis on conservation of the soil, water, energy and biological resources.

Need for sustainable agriculture:

- Overuse of natural resources, causing depletion of groundwater, and loss of forests, wild habitats, and of their capacity to absorb water, causing waterlogging and increased salinity.
- Contamination of the atmosphere by ammonia, nitrous oxide, methane and the products of burning, which play a role in ozone depletion, global warming and atmospheric pollution.
- Contamination of food and fodder by residues of pesticides, nitrates and antibiotics.
- Contamination of water by pesticides, nitrates, soil and livestock water, causing harm to wildlife, disruption of ecosystems and possible health problems in drinking water.
- Build up of resistance to pesticides in pests and diseases including herbicide resistance in weeds.
- Damage of farm and natural resources by pesticides, causing harm to farm workers and public, disruption of ecosystems and harm to wildlife.
- Erosion of genetic diversity – the tendency in agriculture to standardize and specialize by focusing on modern varieties, causing the displacement of traditional varieties and breeds.
- New health hazards for workers in the agrochemical and food processing Industries Added to the above adverse effects, the increasing human as well as cattle population is imposing intense pressure on available natural resources. Accordingly, a challenge has emerged that required a new vision, holistic approaches for ecosystem management and renewed partnership between science and society.

Today we have two challenges**,** (1) the challenge to produce enough food to feed a growing world population and (2) the challenge to make more efficient and prudent use of the world's natural resources, including water, atmosphere, soil, nutrients and the natural heritage in the form of biodiversity.

The Food and Agriculture Organization of the UN (FAO) estimate that the world may need to increase food production by 60% compared to current levels of production, in order to feed a predicted population of more than 9 billion and increase in the per capita

consumption of protein-rich animal produce (Alexandratos and Bruinsma, 2012). Current and projected food deficits are the result of a complex of causative factors that include: (i) lack of income in developing regions (Inter Academy Council, 2004), (ii) high levels of loss during harvest, transport and storage, specifically in developing regions, and (iii) high levels of food spoilage, specifically in developed regions (Gustavsson et al., 2011; Parfitt et al., 2010) and dietary choices (Bellarby et al., 2013). Notwithstanding this complexity, increased global agricultural production will more than likely be part of the required mosaic of solutions.

Elements of sustainability: There are many ways to improve the sustainability of a given farming system, and these vary from region to region, However, there are some common sets of practices among farmers trying to take a more sustainable approach, in part through greater use of on-farm or local resources each contributing in some way to long- term profitability, environmental stewardship and rural quality of life.

Soil conservation: Many soil conservation methods, including contour cultivates contour bunding, graded bunding, vegetative barriers, strip cropping cover cropping, reduced tillage etc help prevent loss of soil due to wind and water erosion

Crop diversity: Growing a greater variety of crops on a farm can help reduce risks from extremes in weather, market conditions or crop pests. Increased diversity crops and other plants, such as trees and shrubs, also can contribute to soil conservation, wildlife habitat and increased populations of beneficial insects

Nutrient management: Proper management of nitrogen and other plant nutrients con improve the soil and protect environment. Increased use of farm nutrient sources such as manure and leguminous cover crops, also reduces purchased fertilizer costs.

Integrated pest management (IPM): IPM is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in way that minimizes economic, health and environmental risks.

Cover crops: Growing plant such as sun hemp, horse gram, pillipesara in the off season after harvesting a grain or vegetable crop can provide several benefits, including weed suppression, erosion control, and improved soil nutrients and soil quality .

Rotational grazing: New management- intensive grazing systems take animals out barn into the pasture to provide high-quality forage and reduced feed cost.

***Water quality & water conservation*:** Water conservation and protection have important part of Agricultural stewardship. Many practices have been develop conserve Viz., deep ploughing, mulching, micro irrigation techniques etc.., protect quality of drinking and surface water .

Agro forestry: Trees and other woody perennials are often underutilized on -covers a range of practices Viz., ogi-silvicuture, silive-pastoral, agri-silvi-pagri-horticulture, horti/silvipastoral, alley cropping, tree farming , lay farm that help conserve, soil and water.

Marketing: Farmers across the country are finding that improved marketing is a way to enhance profitability, direct marketing of agricultural product from farmers to consumers is becoming much more common, including through Rythu bazaar rod side stands.

Status of sustainable Agriculture in India: The survival and well being of the nation depends on sustainable development. It is a process of social and economic betterment that satisfy needs and values of interest groups without foreclosing options. Suitable development of India demands access to state of are 'clean' technologies and have as strategic role in increasing the capabilities of the country both to the environment as well as to provide thrust towards conservation and sustainable agriculture. Current research programmes towards sustainable agriculture are as follows:

Integrated Pest Management (IPM): IPM is an ecologically based approach to pest control, utilising knowledge of pest/crop Relationships, establishment of acceptable economic thresholds for pest populations, and constant field monitoring for

potential problems (Gold, 1994). This approach to agriculture stresses the coordinated integration of chemical, cultural, and biological control practices in particular ecological and socio-productive settings (Carroll and Risch 1990).

Management techniques include "the use of resistant varieties, crop rotation; cultural practices, optimal use of biological control organisms, certified seed, protective seed treatments, disease-free transplants or root stock, timeliness of crop cultivation, improved timing of pesticide applications, removal of infested plant material" (Waldron, 1989). Great potential to restructure important parts of agriculture, but the combined power of the dominant production paradigm and the resistance of the chemical industry has largely transformed integrated pest management into integrated pesticide management."

Most of the synthetic organic insecticides having high toxicity to pest species are often even more toxic to the beneficial insects like spiders, ladybird beetle and earthworms. Pesticides residue above tolerance limits have been reported in food, milk and even in human milk (Dhahiwal and Singh 1993). In view of these facts, the selection of insecticides for use must take account their toxicity to animals, human beings and useful organism, their persistence in air, water, soil and overall environmental impact of their use on agricultural crops (Dhahiwal and Arora, 1993). It is in this context that biological pesticides are being considered as environmentally safe, selective, biodegradable, economical and renewable alternative for use in organic farming system.

Cultural method:

a) Clean cultivation; provides less chances to breed and survive the insects
b) Crop rotation and ploughing potato tuber moth's population is reduced if crop is not grown there for few years. Sugarcane borer, whiteflies, and black bug are greater on ratoon crop than newly planted crop
c) Variation in time of planting e.g. Early planted rice is saved from rice borer
d) Proper use of fertilizers and irrigation
e) Use of resistant varieties
f) Trap crop and intercrop
g) Pruning

Mechanical and physical control:

a. Hand picking of larger size insects eg. Eggs and larvae of cabbage butterflies and larvae of mustard saw fly.
b. Legal control

Biological control: Parasites and predators. Wooly aphids are controlled by a parasite *Apanteles glomeratus*. Similarly ladybird beetle, syrphids, chrysopa, Nabis, Mantids can prey on number of insects

Biopesticides:

a) Fungi- *Beauveria*, *Entomophthora*
b) Bacteria- *Bacillus thuringiensis*
c) Virus- Nuclear polyhedrosis Virus (NPV)

Use of pheromones and hormones; Potato tuber moth

Use of attractants, repellants and sterilants

Botanical pesticides; Margosom a neem product @ 1.5 ml/liter against aphids, whiteflies, jassids, mites and scale insects

Integrated nutrient management:

1. Combined use of organic and inorganic sources of nutrients
2. Use of green manures (Sesbania, Crotalaria etc)
3. Inclusion of pulse crops in crop sequence
4. Use of bio-fertilizer

Build Soil Structure and Fertility:

1. Reduce the use of synthetic fertilizers by increasing on-farm nutrient cycling. Make fertilization decisions based on soil tests.
2. Minimize or eliminate tillage.
3. Think of the soil not only as a physical and chemical substrate but as a living entity; manage the soil organisms to preserve their healthy diversity.

4. Maintain ground cover year-round by using cover crops and mulches and by leaving crop residues in the field.

Maximize Biodiversity on the Farm:

a) Integrate crop and livestock production.
b) Use hedgerows, insectary plants, cover crops, and water reservoirs to attract and support populations of beneficial insects, bats, and birds.
c) Abandon monocropping in favor of crop rotations, intercropping, and companion planting.
d) Plant a percentage of your land in trees and other perennial crops in permanent plantings or long-term rotations.
e) Manage pastures to support a diverse selection of forage plants.
f) Plant off-season cover crops.

Vermi-compost : It is a method of making compost with the use of earthworms, which generally live in soil, eat bio-mass and excrete it in digested form. This compost is generally called vermi-compost.

Traditional method: Dry wood ash applied during early morning hours gave better protection than other time of day. Wood ash soaked in ether for a period of overnight and sieved through fine cloth and mixed with soap water then spray on vegetable crops gives good protection against aphids and soft bodied insects

Manage Pests Ecologically:

a) Use Minimal Pesticides
b) Prevent pest problems by building healthy, biologically active soil; by creating habitat for beneficial organisms; and by choosing appropriate plant cultivars.
c) View the farm as a component of an eco-system, and take actions to restore and enhance pest–predator balances. Understand that the mere presence of a pest does not necessarily constitute a problem; base any intervention on monitoring thresholds.
d) Before intervening with a chemical, positively identify the pest species and learn about its life cycle and ecology. Implement cultural practices that alter the cropping system and surrounding habitat to make life more difficult for the pest and easier for its natural enemies.
e) Use pesticides as the last resort, when biological and cultural controls have failed to keep pest populations below economically damaging levels. If you have to use chemicals, seek out the least-toxic pesticide that will control the pest.

Sustainable agriculture is a holistic view of agriculture that aims to reflect the profound interrelationship that exists between farm biota, its production and the overall environment. Henning *et al*. (1991), adapting the work of MacRae *et al*. 1990, argue that organic agriculture “is designed to work with natural processes to conserve resources, encourage self-regulation through diversity, minimise waste and environmental impact, while preserving farm profitability.” Scofield (1986) stresses that organic farming does not simply refer to the use of living materials, but emphasises the concept of ‘wholeness’, implying the “systematic connexion or co-ordination of parts in one whole.” According to Scofield (1986), the term "organic farming" pre-dates all other labels of an Environmentally-aware approach to agriculture. Steiner's work is the basis of organic farming; he is more commonly associated with the term *biodynamic farming*.

“Sustainability lies at the heart of organic farming and is one of the major factors determining the acceptability or otherwise of specific production practices.” This characterization of the relationship between organic and sustainable farming is repeated in Lampkin and Measure’s 1995/96 Organic Farm Management Handbook (1995). Similarly, Henning *et al*. (1991) precede their definition of organic farming, quoted above, by claiming that “it could serve equally well as a definition of ‘sustainable agriculture’”. Rodale even suggested that “sustainable was just a polite word for organic farming”

CONCLUSION: To sum up, an eco-friendly approach to sustainable agriculture whereas food production should never come at the expense of human health. Application of synthetically

compounded fertilizers, growth regulators, livestock feed additives and pesticides cause environmental and health hazards. The use of pesticides, especially on vegetable crops such as brinjal and tomato has carcinogenic effect on human health. Since sustainable crop farms avoid hazardous pesticides, they're able to grow fruits and vegetables that are safer for consumers, workers, and surrounding communities. Likewise, sustainable livestock farmers and ranchers raise animals without dangerous practices like use of no therapeutic antibiotics or arsenic-based growth promoters. Sustainable farming also protect humans from exposure to pathogens, toxins, and other hazardous pollutants and IPM is one of the best ecological approach that minimize the cost of farming by using bio-fertilizers and pesticides and at the same time it increases quality of the products. Hence play as a tool for safeguarding environment by conserving agro biodiversity in farmer's field.

Reference :

Alexandratos, N., Bruinsma, J., 2012. World Agriculture Towards 2030/2050. The 2012 Revision. FAO, Rome http:// www.fao.org/docrep/016/ap106e/ap106e.pdf. Last accessed 5 March 2013. Bellarby, J., Tirado, R., Leip, A., Weiss, F., Lesschen, J.P.,

Atwal, A.S. 1986. Future of pesticides in plant protection. In: Plant protection in the year 2000 A.D. (Ed. G.S. Venkataraman). Indian National Science Academy, New Delhi.

Birthal, P. S. 2003. Economic Potential of Biological Substitutes for Agrochemicals

Caroll, C R and Risch, S (1990). An evaluation of ants as possible candidates for biological control developing countries, New Delhi: *Commonwealth Publishers.*

Dhaliwal, G.S and Ramesh Arora. 1996. Principles of insect pest management. National Agricultural Technology Information Centre, Ludhiana.

Dhaliwal, G.S. and Arora, R 1993. Changing status of insect pests and their management strategies. In: K.S.Gill, G.S. Dhaliwal and B.S. Hansra (eds). *Changing Scenario of Indian Agriculture. New Delhi: Commonwealth Publishers, pp 98-145*

Dhaliwal, G.S. and Singh, B. (eds). 1993: Pesticides: Thesis Ecological impact in

FAO (Food and Agriculture Organization). 2007. Crop and food supply assessment mission to Ethiopia. In: *Special Report for Global Information and Early*

Gold, M (1994). *Sustainable Agriculture: Definitions and Terms*. SRB 94-05, USDA National Agricultural Library (NAL).

Gustavsson, J., Cederberg, C., Sonesson, U., Van Otterdijk, R., Meybeck, A., 2011. Food Losses and Food Waste: Extent, Causes and Prevention.

Henning, J Baker L and Thomassin P (1991). Economic issues in organic agriculture. *Canadian Journal of Agricultural Economics.* 39: 877-889.

Lampkin, N and Measures, M (1995). *1995/96 Organic Farm Management Handbook.* University

Lynam,J.K (1994). in Opportunities, Use, and Transfer of Systems Research Methods in Agriculture in Developing Countries, (eds: Goldsworthy, P. and Penning de Vries,F.W.T) Kluwer Academic Publishers, Dordrecht, Netherlands, pp 3-28.

MacRae, R, Hill, S, Mehuys, G and Henning, J (1990) Farm-Scale Agronomic and Economic Conversion from Conventional to Sustainable Agriculture. *Advances in Agronomy.* 43: 155-198.

Parfitt, J., Barthel, M., Macnaughton, S., 2010. Food waste within food supply chains: quantification and potential for change to 2050. Philos. Trans. R. Soc. 365 (1554) 3065–3081

Paroda, R.S. 1999. For a food secure future. Survey of Indian Agriculture. The Hindu.

Pretty, J (1995) *Regenerating Agricultue. Policies and Practice for Sustainability and Self- Reliance.* Earthscan, London.

Scofield, A (1986). Organic Farming-The Origin of the Name. *Biological Agriculture and Horticulture.* 4: 1-5.

Smith, P., 2013. Livestock greenhouse gas emissions and mitigation potential in Europe. Glob. Change Biol. 19, 3–18.

Swaminathan, M. S. 1999 ACentury of Hope: towards an era of harmony with nature and freedom from hunger. Chennai, India: East west Books (Madras) Pvt. Ltd.

Waldron, J (1989). Integrated Pest Management. *Long Island Horticulture News.* July 1989: 1.

How to cite this article:
Geetanjaly *et al*.,: Role Of Eco-Friendly Approaches In Sustainable Agriculture, International Journal of Current Multidisciplinary Studies 2015; 1(1): 35-41.