

Environmental, Ecological & Sustainable Aspects of Agriculture—An Overview

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Abstract-Environment and Ecologies are most important concern our lives; all of us connected with the environment and all of us depends on environment; directly and indirectly. Environment is one of the important names and concern. All of us within the Environment and there are different living and non-living things within Environment. Environment is an Applied Science and deals with various facets of the Natural Sciences. 'The complex of physical, chemical, and biotic factors (such as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival' & 'The aggregate of social and cultural conditions that influence the life of an individual or community'—according to the Merriam Webster Dictionary. Agriculture is an important part of the environment. Without agriculture surviving is not possible and moreover, there are certain methods, tools and procedure for the agriculture. There are various advancement in the agricultural systems and this include the latest technological and engineering based applications viz. genetics, nanotechnology, information technology etc. However the growing applications of genetics etc may have different bad impact including on agriculture and environment. This paper is a kind of review paper describes the aspects on environment, agriculture, sustainability in agriculture etc. Further paper emphasizes on the aspects on overview, characteristics, nature, issues on towards the concern of the environment and agriculture including the sustainability.

Keywords- Environment, Ecology, IT Applications, Genetics, Sustainability, Sustainable Agriculture, Agricultural Development

I. INTRODUCTION

It is the Environment in which different things are stayed together with the living and also non-living aspects. Among the concern, few important may be the physical, chemical, natural forces etc. Further, Environment is deals with the Atmosphere, Hydrosphere, Lithosphere and Biosphere [1], [15]. And in generally treated as two types viz. Micro environment and Macro environment. Further experts have classified environment into two other—

- Physical
- Biotic environment.

Another term/ concept 'Ecology' is also considered as a part of the Environment and consider as a sub field of Environment. Though it is important to note that ecology and environment; both uses in the organizations and academics but in reality there are certain differences. Ecology is more connected with the both biotic and a biotic components; and it deals with the following issues in generally—

- The aspects of biomass
- Biodiversity and similar aspects

- Populations of the organism,
- Various species
- The eco systems etc.

Agriculture and its various aspects led the development of the Agricultural Sciences which is treated as an Applied Science. The field has uses various scientific methods, tools, procedure and principles for the development of the agricultural systems. In the field, most of the aspects are associated with the science and few are concern with the art for the producing and developing various products such as crops, plants, bio chemical products, livestock and animals etc. Agriculture is an interdisciplinary field and connected with various fields, professionals; additionally it is a multidisciplinary field and incorporated with various subjects as a general facet. It is applicable in applied production of various foods as well as agro products. Agriculture is concerned with various other emerging aspects like agronomy, plant breeding, genetics, soil sciences, environmental science, microbiology etc. Pest management, environmental management & impacts, waste management, horticulture, soil degradation etc are valuable concern of the Agriculture. The development of

the Agriculture into a field gradually incorporated with other subjects and it is still growing beyond the science viz.—

- Agricultural Sciences as a study available with Engineering and Science and Technology nomenclature and available with BSc/BS/MSc/MS in Sciences and BE/BTech/ME/MTech in the field of Engineering Sciences.
- Furthermore, Agriculture is well-connected with the Management Sciences for the agricultural management including the cultivation and products management.
- There are various technologies and nomenclature emerging viz. Genetic Engineering, IT & Computing, Nanotechnology etc and it is still growing.
- Apart from the strong connections with the biological sciences it has strong relations with the economic science, social sciences etc.

The Agricultural development to today's context was not easy and it holds different stages and periods itself. It is a fact that sedentary human civilization is dealt by the agriculture with foods and other products to be survives [3], [9], [23]. It was about thousands years ago when the concept of Agriculture developed i.e. initially around 105,000 years ago. However the nascent farmers were started about 11,500 years and gradually different kind of animals also become part of agriculture systems with domestic pigs, sheep and cattle etc and it was about 10,000 years ago. There after various techniques, procedure added in to the agriculture and becomes a field of study and still growing.

II. OBJECTIVE OF THE WORK

This work entitled 'Environmental, Ecological & Sustainable Aspects of Agriculture—An Overview' is deals with following aim and objectives--

- To learn about the basics of Environment, ecology and there aspects including meaning, relations, components etc.
- To learn about the basic relationship of the environment with agricultural systems; emphasizing issues and impact of environment in agriculture.
- To learn about the basic growth and development aspects of agriculture into transition to the advanced agricultural systems.
- To get a concise picture of the sustainable or environment friendly agricultural systems with basics and steps to be followed.
- To learn about the emerging agricultural issues in respect of environment and essential to bring sustainable agro systems.

III. AGRICULTURAL GROWTH & DEVELOPMENT

The Agriculture in recent past has associated with various emerging subjects and among these genetics engineering considered as important. The development of the Agriculture can be traced with differently

- In the 18th century the experiments was started by the use of fertilizer by the Johann Friedrich Mayer. Gradually researches happened on the field and got core recognition in the year 1843 at RRS, England; and in this regard John Lawes and Henry Gilbert played a led role.
- In America it was according to the 1887 Hatch Act regarding the funding to the farmers and gradually Agriculture led to Agricultural Science [4], [9], [27].
- The USDA, United States had began agricultural entomology research in 1881; and thereafter various other countries of Europe started more work on this. Few other countries viz. Japan, South Korea also did well in respect of the development of the Agricultural Sciences.

Later on the commercialization of Agriculture was noted with different products viz. plants, crops and gradually others also added into this viz. fertilizers, animal hides, leather, sugar, alcohols, cotton, wool, biodiesel, nursery plants, fish production etc. This way, agricultural science become developed and came to more enhanced with 'Agricultural Sciences'. Further radically various other types, methods added into this bring us various new agriculture and many of these are sustainable as well. **Agricultural chemistry** is using various kind chemical fertilizer including the insecticides, chemical fungicides, soil makeups etc. All these are useful and important in the analysis of agricultural products. The modern Agricultural Chemistry thus applicable in modernizing agriculture as well and helpful in sustainable development.

Green revolution had been happen in the western countries and this led to (**Green revolution & agriculture**) many changes and modernization in the farming systems, internationally. The concept of greening agriculture with much production led the concept of Green Agriculture and it was arrived with Proper hydroponics, developed plant breeding, advanced hybridization, easy gene manipulation, effective management of soil nutrients systems, and improved weed control etc. And this trend is going on. Genetic Engineering is an interdisciplinary field and dedicated in modernizing, productivity in agricultural products and crops, plants, and vegetables etc and created **Genetically Modified Foods & Agriculture**. Moreover in animals as well the genetic engineering useful and increasing rapidly throughout, with ethical concern. However, genetic engineering has many issues on health and environment as well and these are essential to consider important as well [5], [13], [26].

Organic farming is another kind of agricultural method in which artificial or chemical based products such as pesticides, fertilizers, antibiotics, growth hormones are avoided or less used and promotes in natural agricultural production. In 20th century with higher agro production practices but with eco friendliness this agro method was started. At present day context, about 70 million hectares practiced this kind of agriculture for the benefits to the humans as well as environment. **Corporate Farming** is a kind of agricultural method are also increasing and mainly

performing by the big companies or corporate giants. This is large-scale farming and corporate bodies or mega corporation play a leading role in such engagement regarding immediate profit. Corporate Farming is going and started widely everywhere for healthy productivity benefits. Though it has few controversies in destroying traditional farming; therefore proper mechanism for conducting corporate farming is essential. **Vertical Farming** is another where cultivation regarding crops and plants and other products happen in vertical manner; and here stacked layers are used for. This type of agriculture thus reduces space related issues, problem and therefore also called as environment agriculture. Various techniques like the aquaponics, aeroponics etc are used here in a controlled condition; in particular places in a building or floor etc. In generally as per the traditional systems agricultural systems can be classified into semi-commercial systems and commercial systems [6], [12], [22].

IV. ENVIRONMENTAL ASPECTS AND AGRICULTURE

There are close connections with the agriculture and environments; that already been studied and depicted here. In terms of effects there are certain issues emergences are noticeable viz. unnecessary uses of the pesticide, chemicals etc are responsible for huge environmental damages and this include the—

- Herbicides
- Insecticides
- Limitless or over water usages
- Balance loss in ecology
- Difficulties in Natural Environments etc.

Moreover, worldwide the external cost in respect of environmental impact management is an important concern. These cost are also connected with the agriculture in some context. The following facts are important in this regard viz.—

- Total costs was of £2,343 (£208 per hectare) million in the year 1996 at UK regarding the assessment of the agriculture
- As far as US is concerned, it has concluded that cropland imposes approximately \$5 to \$16 billion on other hand, livestock production imposes \$714 million, according to a study of 2005.

The modern agriculture is expected to grow the yield and with the reduced cost with the input from the fertilizers and removal of various facets are essentials. There are many harmful gradients viz. pesticides that kill insects, plants as well as fungi. Thus the biodiversity lose become normal. According to the UNEP, 2010 data the environmental impacts of consumption and production are higher and it is also found that agriculture and food these two should be considered as most important facets in the process of environmental pressures and that includes the following—

- habitat change,
- climate change,
- water use and toxic emissions etc [8], [19], [25].

Agriculture further also responsible for the toxins released into the environment and apart from this, insecticides is also very important and this is used in cotton. Further agriculture; excluding the land operations according to the UNEP Green Economy Report, expressed that it is responsible for producing 13% of anthropogenic Green House Gas emission as well. Here it is emitted by the use of inorganic fertilizers agro-chemical pesticides and herbicides etc [10], [21], [24].

Environmental Issues & Concern: The Agro Context

The concern of the environment is increasing day by day and some of the issues are include (but not limited to)—

- Human Overpopulation including the biocapacity in climate change.
- Exploitation including industrialization
- The degradation of the land
- Land reclamation and optimum population
- Ecological aspects in reservoirs, tile drainage
- Hydrology in agriculture
- Landslide and lawn environmental concerns
- Tree cutting & flooding
- Agricultural effects in meat production
- Habitat fragmentation & destruction
- Technological impact in environment due to agriculture (viz. genetic engineering)
- Use of Nanotechnology & biotechnology in agriculture
- Ocean trash including water pollution etc.

However, according to few scientist and experts the following are the core aspects in terms of environment on the agriculture.

Degradation of Land

The degradation of the land is an important concern of the environment and on endangering sustainability of the systems of the agriculture. Due to rain this is may be happen and also for the agricultural scale enhancement. The forest cut is another reason for the degradation of the land as well.

Deforestation

Deforestation is also important reason due to agriculture for the environment and the main reasons for the deforestations may include the higher intension in agricultural growth, higher and growing population, various corporate agro projects, forest fires, afforestation etc.

Biodiversity

Biodiversity is also consider as an important concern on environment due to the biodiversity according to the agro and environmental expert. Internationally India holds a rank in biodiversity i.e. 10th in the globe and 4th in Asia as far as plant diversity is concerned. But due to the mega corporation involvement in agriculture lead the limitation in the space and also limiting the species. Hence here is the concern of the environment it also responsible for limiting the trees and based on this species including the wild animals, birds and insects. According to the scientific study, the issues are noted that following number of animals are also in endangered for this—

- 1500+ Plant species
- 79 mammals
- 44 birds
- 15 reptiles
- 3 amphibians etc

Thus destroying or losing biodiversity can be an important issue in this context agricultural growth without sustainability concerns.

Pest Problem

Pest related problem is also available concern in terms of agriculture over the environment. The increasing under irrigation, higher cropping intensity etc are results pest related problems. The increasing pesticides lead the environmental impact and also risk in human and animal health as well in certain cases [11], [24].

Disposal of Industrial & Agricultural Wastes

Another important concern is over the environment due to the use of industrial wastes regarding agriculture. There is a gap of the demand and happening in terms of the recycling of the agricultural waste. Hence it will help in disposal of the industrial material used in the agriculture. The corporate farming is also an issue for agriculture waste. Thus it should be consider important with proper remedies.

Sustainable Agriculture

Sustainability is an emerging term and concept and growing rapidly; this is also varies from the field to field. As far as agriculture is concerned it is includes with many aspects and most of such are complex in nature. It is including the aspects of economy, developing good, healthy and environmentally agro products and keeping in mind the concept of the higher productivity for all. It is further a good stewardship of the natural systems and furthermore involves in many aspects viz. (also refer Fig: 1)—

- Increasing agro products with minimum input with proper soil systems.
- Use of proper water including its management.
- Healthy and minimum use of the air, water, and climate pollution etc
- Keeping the balance of the biodiversity etc[7], [20].

Agroecology; which is treated as a science of managing farms as an ecosystem also recommends with nature focus first and then managing of such affairs. Here agroecological principles can be used with higher productivity or profitability. Furthermore doing organic farming can also be a good solution in respect of the bad effect of the agriculture.

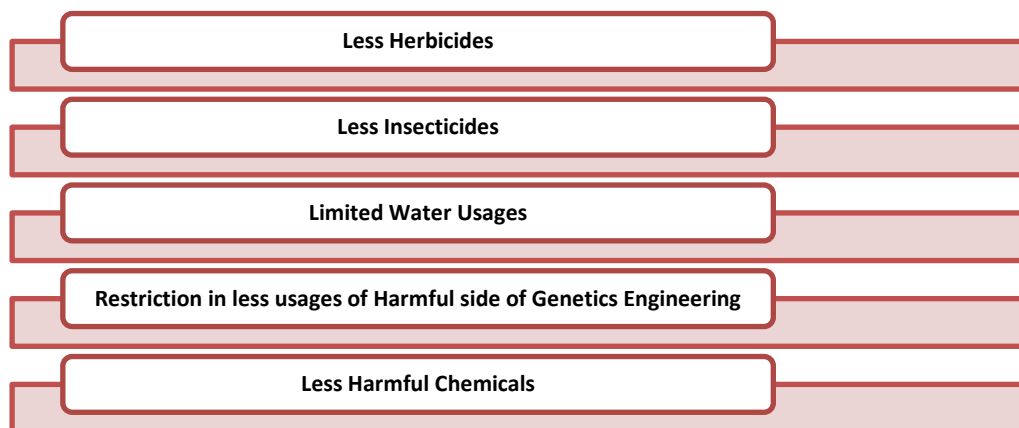


Fig: 1 Few concerns on Environment & Agriculture

Sustainable agriculture practices and Ways

In agriculture for the betterment and healthy practice following could be a healthy tool and way further viz.—

Cultivation of the crops rotation basis and also embracing diversity—

For the sustainable agricultural systems it is expected to have variation of the crops and also rotation based cultivation. It will ultimately helps in healthier soil and improved pest control. Here intercropping including the complex multi-year crop rotations are also expected.

Planting cover crops—

Cover crops is an another solution in healthy sustainability and it is normally practiced in the off-season and thus helps in protect soil health and erosion, improves soil

nutrients etc throughout for the development of the agricultural system [11], [16].

Reducing or eliminating tillage—

Traditional plowing according to the expert is the reason for the weed problems and it lead the soil loss. In this context, uses of the reduced till methods inserted into the seeds and ultimately helps in reduce erosion; directly.

Applying integrated pest management—

There are different kinds of mechanical and biological controls are there in pest controlling and management and under control systems pest management can lead the betterment in the agriculture.

Integrating livestock and crop—

Due to the growth of the industrial and corporate agriculture there is a shortage of land and it also results of the separation of plants with the animals. But integrating livestock with the crops could be best for certain context (such as manure of the animal) and mainly in the process of the more efficient and profitable farms.

Adopting agroforestry practices---

Another good approach is the mixing the operation of the agriculture with the forest in certain cases viz. protect plants, animals, water resources. It will also helps in additional income [14], [17].

Managing whole systems and landscapes—

An integrated approach is best for the controlling erosion, reducing nutrient runoff, and keeping biodiversity. Further the simplicity of the agriculture should be provided as much as possible for the sustainable agriculture.

Different Phases in Sustainable Agriculture

For the sustainable and environment friendly agricultural systems, according to the expert few phase or steps could be follow-up (also refer Fig: 2).

Commitment and Initial Assessment (The Phase I)

This could be treated as a first phase in developing sustainable agriculture, and treated as a benchmark in evaluating current efforts. In this context different aspects should be consider and valuable viz. nature, types, places of the cultivation, management practices, environmental controls, budget, personnel management, cost and financial aspects etc that requires to build a sustainable agriculture. This phase is needed in assessment of the matters and maximizes resources in the agro based operation towards in reducing negative impacts to the environment caused by the environment and keep agricultural food for all or as much as possible.

Planning (The Phase II)

In this phase of sustainable agriculture few important things are include the analysis, planning, as well as documentation. This could be considering as continual improvement program. In this phase some planning could be done on the issues like cropping types & systems, Manure management systems, pest control, equipment used, maintenance and replace, livestock management, on irrigation & drainage systems, on proper storage, transport, supply chain management and marketing systems, healthy and proper financial management etc.

Implementation (The Phase III)

This is the third phase of the sustainable agricultural systems and in this stage various aspects of the agriculture need to implement according to the previous phase i.e. initial assessment and planning.

Checking (The Phase IV)

In this phase the core activity should be on measurement and evaluation of the agricultural systems. Based on requirement further task and requirement can be possible [2], [18].

Reviewing (The Phase V)

The final phase is periodic review and revision. In this phase for sustainable agriculture has to deal with the aspects on each and based on this further can be developed.

These are the basic and general phase could be developed for the purpose of the sustainable agricultural development; which could help in making agriculture for all and also the sustainable environmental systems on agriculture.

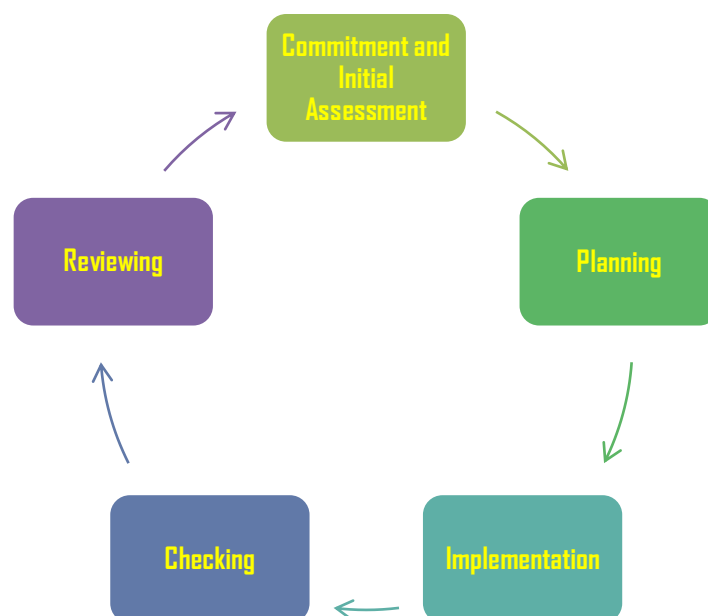


Fig: 2 Steps to be followed in Sustainable Agriculture

V. CONCLUSION

There are certain issues in respect of the developing sustainable agriculture and further development. The sustainable agriculture is with the aspects of the developing agriculture and foods for all keeping in mind environmental concern as well. Sustainable agriculture needs a healthy practice in developing modern agriculture with developing environmental impact. There are various methods are emerging day by day and in this context it is better to practice all such keeping in mind of the betterment of the society, health of the humans and animals. The aspect of the biodiversity is also very important and required in this context. The sustainable agriculture is also called as environmental agriculture in some context due to the wider focus on ecology and environment. Furthermore efforts on organic agriculture and less harmful agro products could be developed based on genetic engineering applications on the agriculture as well. Proper planning, supports and efforts are highly required in practicing environmental and sustainable agriculture for the betterment of the human being.

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