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# Status of Agroecology in India

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**ABSTRACT**

In India, the scenario of agricultural production and farmer's livelihood status is experiencing a setback due to the loss of soil biofertility and biodiversity due to various social and cultural changes. Even though many milestone achievements like green revolution in India have resulted in high yielding varieties and advanced farming technologies, inappropriate usage of synthetic fertilizers had led to various ecological concerns. Agroecological approach is distinct from other initiatives towards agricultural sustainability in that it analyses and addresses the problems and challenges of agricultural food systems in a sequential manner from the bottom level to other higher grade issues. The impetus of agroecology can be ascertained by the stand of the Food and Agricultural Organization (FAO) of United Nations in framing the sustainable developmental goals for achieving zero hunger, to end poverty, food security and ensure peace and prosperity by 2030. This paper focuses on the concept of agroecology, awareness about agroecology in India, the traditional roots associated with it and the modern amendments needed for sustainable agriculture in the near future. The paper reviews about the basic concept of Agroeoclogy and its implementation status in India, which will help the nation to move steadily towards agricultural sustainability and to promote our country's progress in successfully achieving Sustainable developmental goals (SDG) framed by FAO.

***Key words*** *: Agroecology, FAO, Sustainability, SDG, Soil biofertility, Synthetic fertilizers*

## Introduction

India is basically agriculture dependent country owing to its rich bio resources and varied biodiversity and have the past history of successful farming practices for many generations, by means of applying their indigenous traditional methodologies. In 1960s, the successful implementation of green revolution by Prof. Swaminathan in Indian agriculture, indeed improved the agricultural status by the introduction of high yielding varieties and advanced farming technologies (Das, 1999). However, long term usage of synthetic fertilizers, changes in social and cultural aspects have led to depletion of soil fertility and biodiversity, reduction in soil organic matter and a decline in the agricultural production and development (Raghunvansi and Kuldeep, 2015). Improper handling of the chemical fertilizers and pesticides have led to the pollution of ground water and associated health issue concerns (Pepper and Daniel, 2015) and to a drastic fall in agricultural investment in mid 2000s (Herdt, 2010).

In India, the agricultural policies are more focused on rapid industrialization and export of crops, which mostly favors commercial promotion of agriculture. However, the small and marginal farmers are the most affected by various factors such as indebtness, low crop productivity, uncontrolled expenditure, pressure from bank personnel and local

money lenders stands the major reasons for suicide of farmers (Sonawane, 2016) and for the purpose of survival they are in a situation to join hands with larger farmer unions in order to face the escalating farming input needs and marketing process. Thus numerous ecological and socio-economic issues urge that the present agricultural crop production system and its organization needs to be recalled and reframed in India. Now the need of the hour is to focus more intensively on small and marginal farmers and in improving the soil biofertility by finding suitable alternate, permanent and sustainable solution to protect our agricultural systems and our farmers.

Agroecology is one such approach towards sustainable agriculture that has gained international attention among agricultural scientists, research organizations, academic institutions and many agricultural reforms. The impetus of agroecology can be ascertained by the stand of the Food and Agricultural Organisation (FAO) of United Nations in framing the sustainable developmental goals for achieving zero hunger, to end poverty, food security and ensure peace and prosperity by 2030 (FAO, 2017). Agroecological approach is distinct from other initiatives towards agricultural sustainability in that, it analyses and addresses the problems and challenges of agricultural food systems in a sequential manner from the bottom level to other higher grade issues.

Agroecology serves as an ecofriendly agricultural practice, an integrated approach that involves education, research, action and sustainable ecological, economical and social changes along with community participation (Miguel, 2002). The UN report on Agroecology (Report of FAO'S WORK On AGROECOLOGY – A pathway to achieving the SDGs, 2018, Pg.8-23) have stated that Agroecology echoes the goals of 2030 agenda in achieve zero hunger, abolishing poverty and inequality, coping up with climate changes and to protect and promote agro-biodiversity. Further, it is an holistic approach in creating a perfect balance between humans and planet, concentrating on social, economic and environmental sustainability and in addition improving the life quality of small and marginal farmers, women folk and youngsters. Thus it holds true that Agroecology contributes directly to multiple sustainable developmental goals (SDGs) through integrated farming practices.

Thus Agroecology could be considered as a transdisciplinary, participatory and action oriented approach applied to ecological processes in agricultural systems (Fig.1) (Ernesto *et al*., 2013). It can be defined as the ecology of the entire food system ( Francis *et al*., 2003) and stands as the building relationship-based market systems that are equitable and accessible to all (Gliessman, 2007).

This paper focuses on the concept of agroecology, agroecological models practiced and the current scenario of agroecology in India.

**Agroecology – Principles and Agroecomodels**

Conventional farming is characterized by monocropping, green revolution technologies, and synthetic fertilizers. It is resource intensive in terms of capital, land, water, and fossil fuel use. Conventional farming always holds a threat for the future food production by affecting the biodiversity, ecological degradation climate change and thus affecting the overall yields.

Whereas, **AGROECOLOGY** mimics the natural ecosystems, and serves as an **ALTERNATIVE AGRICULTURE METHOD** that can produce more food using fewer resources (Gliessman, 2015). Small-scale farmers around the world have started applying 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 report that agroecology have improved soil fertility, adapt to climate change, and reduce farming input costs ( Miguel Altieri, 2015). Alternative forms of agriculture could prevent farmers suicides by adopting short term measures like organic farming, thereby surpassing the private institutional and formation of farmers self help group (Anneshi, 2018).

**Agroecological principles** can be implemented based on ten important elements as framed by Food and agricultural organization (FAO (2018b)

- Diversity
- Co-Creation and Sharing of Knowledge
- Synergies
- Efficiency
- Recycling
- Resilience
- Human and Social Values
- Culture and Food Traditions
- Responsible governance
- Circular and Solidarity economy

**Agroecology models**

Agro ecology is the application of ecological prin-

ciples to the farm land with emphasizing the interactions between human begins and their environment, as well as their consequences, with the goal of minimizing the negative effects of certain human activities. Some of the working of agro eco models are discussed below.

- Sustainable agriculture
- Biodynamic agriculture
- Permaculture
- Future farming
- LEISA
- ZBNF
- Conservation agriculture
- Alternative agriculture
- Resilient agriculture
- Natural farming

**Sustainable agriculture**

Sustainable agriculture is the form of farming (that includes long term crops and livestock) which produces sufficient food to meet the needs of the present generation without affecting the ecological assets and productivity of life supporting systems of future generations (Altieri, 2002). It uses the principles of agroecology and enable in healthy food production without comprising future generations ability to follow the same. Sustainable agriculture also focuses on maintaining economic stability of farms and helping farmers improve their techniques and quality of life .The agricultural practices followed includes Integrated pest management, Crop rotation, Employing biotechnology tools, Use of organic fertilizers and Conservation tillage. The highlights of this practice includes environmental preservation, protection of public health, sustaining vibrant communities and upholding of animal welfare (Pretty, 2008). Systematic better practices of crop and livestock production and care for natural resources can usher higher sustainability of agriculture and safeguards the environment ( Hegde and Sudhakara Babu, 2009).

**Biodynamic agriculture**

Biodynamic agriculture is an advanced organic farming system that is gaining increased attention for its emphasis on food quality and soil health. Biodynamic farming is based upon five important farming practices such as Mulching, crop rotation, assortment of animal life, Composting, growing of compassion plants, application of green manure and homeopathic preparations based on extracts from animal, plant and mineral manure, each diluted into sprays and used sparingly to homeopathically treat compost, soil and plants in a process called dynamization (Turinek *et al*., 2009) .

The practice of rotating crops from field to field and raising varied animal species, along with cover crops and green manures, promotes healthy soil , reduces parasites and pest infestation, controls weeds and pests and promotes production of good quality crops ( Sanjeev Kumar *et al*., 2020).

**Permaculture**

Permaculture is a type of farming that includes harmonious integration of the landscape with people providing their food, energy, shelter and other material and non-material needs in a sustainable way (Simin Fadaee, 2019). The farming is based on the three ethical principles of earth care, people care and fair share (Suh, 2014) and adopts composting , mulching, green manure and mixed cropping for cultivation of crops ( Meenakshi *et al*., 2016). Permaculture holds true for principles related to the diversity of habitats, species, genes, the cycling of biomass, building up of soil and water fertility and intregartion of different elements to create synergies (Julius Kreb and Sonja Bach, 2018).

**LESIA - Low External Input Sustainable Agriculture**

Continuing rural poverty, the high cost of purchased inputs and environmental problems, all support the view that farmers should rely as much as possible on locally available inputs to enhance the productivity of their soils. The excess use of costly chemical fertilizers in agriculture have resulted in serious environmental problems.

Thus technologies using low levels of external inputs readily available either on-farm or from nearby off-farm sources is the need of the hour for sustainable agriculture. This approach often referred to as low external input sustainable agriculture (Ibeawuchi *et al*., 2015).).

LEISA is a form of agriculture that optimize local resource utilization, including social and human resources, but the use of external inputs are not excluded and seen as complementary to the use of local resources to reduce the cost of cultivation and to attain sustainability in agriculture (Franjaya *et al*., 2015). LESIA works by adapting to the agricultural system to the environment of the region, including soil, water, climate and biota present at the

site and by optimizing the use of biological and physical resources in the agro-ecosystem (Das, 2013). Soil and nutrient management is achieved by the adopting composting, green manuring, liquid organic manures, crop rotation. The flow of solar radiation, air and water is managed by mulching, wind breaks, water harvesting, Strip cropping and water ponds. Trap and decoy crops, Repellents, biological control and constructed traps are used for pest and disease management. An Integrated farming approach such as Contour farming , Integrated crop -livestock- fish farming , Integrated forage production and Integrated resource management in the semi arid zone are followed in LEISA.

By adopting the principles of LEISA farming, guaranteed sustainable income with chemical free crop production can be achieved (Madhu Ramakrishnan, 2006).

**ZBNF - Zero Budget Natural Farming**

ZBNF is self-nourishing and symbiotic in nature and do not depend on external inputs but utilizes biodegradable materials saturated with scientific knowledge of ecology and modern technology with traditional farming practices based on naturally occurring biological processes (Palekar, 2014). This agroecomodel promises to end the reliance on loans and drastically nullify the production costs, ending the debt cycle for poor and marginal farmers (Mural, 2016). A majority of respondents have reported improvements in yield, soil conservation, seed diversity, quality of produce, household food autonomy, income, health and reduced farm expenses (Sarma, 2016).

**Conservation Agriculture**

Conservation agriculture is a recent agricultural management system that is gaining popularity in many parts of the world (http://www.fao.org/ag/ca/la.html) with minimum or no-till soil disturbance and permanent soil cover (mulch) combined with crop rotations, supporting agricultural sustainability (Peter *et al*., 2007). The technologies of Conservation agriculture provides opportunities to reduce the cost of production, save water and nutrients, increase yields, increase crop diversification, improve efficient use of resources and benefit the environment (Suraj Bhan, 2014).

**Resilient agriculture**

Agriculture has been and will continue to be significantly affected by changes in climate conditions. Improving the resilience of agricultural systems to climate change requires protection of the natural resource base (water and soil) and biodiversity, and development of new policies, strategies, tools, and practices for adaptation (Carpenter *et al*., 2001). The basic principles adopted in resilient agriculture are persistence, transformation and adaptive towards the changes in climate patterns (Barbara Sawicka, 2019). Climate resilient agriculture contributes to sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change and reducing and eliminating green house gas emissions, where possible (FAO, 2010).

Though the concept of agroecology has been initiated in India, is not followed to the full extent and properly implemented, probably due to raised hand of commercial or industrial based agriculture, that trusts on heavy external input, with the intention of good profit within a short period of time. Whereas Agroecomodels needs only less external inputs, but takes time to create sustainable agriculture, which the rich and commercial farmers do not entertain.

**Table 1.**

| S. No. | Sustainable Development Goals | Positive impact recorded | |
|---|---|---|---|
| | | No.of Cases | % of Cases |
| 1 | No Poverty | 27 | 54 % |
| 2 | Zero Hunger | 50 | 100 % |
| 3 | Good Health & Well Being | 11 | 22% |
| 4 | Quality Eduation | 31 | 62 % |
| 5 | Gender Equality | 17 | 34 % |
| 6 | Clean Water & Sanitation | 15 | 28 % |
| 7 | Decent Work & Economic Growth | 27 | 54 % |
| 8 | Responsible Consumption & Production | 33 | 66 % |
| 9 | Climate Action | 21 | 42 % |
| 10 | Life on Land | 33 | 66 % |

Thus more awareness and knowledge about agroecomodels and agroecology should be delivered to our farmers and agriculturists.

**Agroecology and SDGs**

In 2015, the United Nations Member States adopted the 2030 agenda for sustainable development built upon the principle, "leaving no one behind", the agenda includes 17 Sustainable Developmental Goals (SDGs).

A meta-analysis of about 50 case studies from 22 African studies documented the contribution of agroecology towards the sustainable development goals (SDGs). The results revealed the potential of agroecology to sustainably increase food sovereignty while conserving biodiversity and respecting indigenous farmer's knowledge and innovations (Michael Farrelly, 2016). The study concluded that agroecology conttibutes positively in various ways to ten of the 17 SDGs as given in the Table 1.

**National missions supporting and promoting Agroecology in India**

The Indian government have formulated many policies and missions for promoting agroecology and for successfully implementing the SDGs by 2030. Some of them are discussed briefly.

**NMSA - National Mission for Sustainable Agriculture**

Understanding the efficiency of agroecological practices, National Mission for sustainable agriculture (NMSA), approved by the Prime Minister's council on Climate Change (PMCCC) has been set up, which focuses on judicious utilization of our resources through community based approach and aims at promoting sustainable agriculture. NMSA emphasizes on adoption of comprehensive soil health management by employing soil fertility maps, optimization of water utilization through efficient water management practices and to link and improvise the communication of farmers and stake holders in conjunction with other national operations like National Mission on Agriculture Extension & Technology, National Initiative for Climate Resilient Agriculture (NICRA) etc., towards climate smart agriculture and in carrying out other mitigation measures (Amrit Patel, 2016).

**NICRA – National Innovations on Climate Resilient Agriculture**

ICAR have launched the network project NICRA, which aims at enhancing the resilience of our Indian farming system to fluctuating climatic changes and vulnerability by strategic research policies and technology demonstration. State of art research facilities have been developed under NICRA along with significant features and applications, to monitor and carry out advance scientific research, for strengthening the climate resilient agriculture (Rajkhowa *et al*., 2019). Some of the advanced techniques developed under NICRA project includes Carbon dioxide-Temperature Gradient Chamber(CTGC), Free Air Temperature Enrichment (FATE), Automatic rain out shelter facility, Root imager, Portable Photosynthetic system(PPS), etc.,

**National Mission on Agriculture Extension and Technology (NMAET)**

NMAET focuses on improving agronomic practices by improvised use of ICT, that includes SMS, Farmers portal and other web based applications. It concentrates on seeds supply, Extension programmes and agricultural mechanization for improved agricultural productivity ( Ravi Nandi, 2019).

**National Food Security Mission (NFSM)**

This mission is centrally sponsored scheme, initiated for achieving the target under SDG-2 and marching with the objective of "End Hunger, achieve food security and improved nutrition and promote sustainable agriculture" (Poornima Varma, 2017).

**Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)**

MGNREGA is considered as a "core of the core" scheme for achieving SDG 1 – No poverty (End poverty in all its forms everywhere) , which aims at implementing social protection systems and appropriate measures at national, regional and international level and to achieve overall coverage of the poor and most vulnerable (Arya *et al*., 2017).

**Integrated watershed management Programme - IWMP**

Integrated watershed management programme (IWMP) works with the objective of restoring ecological balance by harnessing, conserving and developing degraded natural resources (Rupender Kumar *et al*., 2017).

**Rashtriya Krishi Vikas Yojana - RKVY**

Rashtriya Krishi Vikas Yojana is one of the core and centrally sponsored scheme that work towards achieving the "SDG 2 – Zero Hunger", which aims at achieving food security, improving nutrition and promoting sustainable agriculture (Kerry Ann Brown et al., 2020) .

Thus our Indian government had laid many initiatives for achieving the SDG by agroecological approaches for sustainable agriculture. These can be employed as the pathway towards greater sustainability, but further extensive research should be promoted in terms of both inter and transdisclipinary approaches for remarkable progress and achievement.

Even though the basic laystone for agroecology principles have been laid in India, its steady foundation and implementation is a matter of action and involvement along with support by the people, government and NGOs.

## Conclusion

**Agroecology – "An integrated approach towards sustainable agriculture – Need of the hour"**

Agroecology should be a blend of our traditional agriculture knowledge and modern scientific updates (with the exception of chemical fertilizers and pesticides, transgenic and genetically modified crops) that needs lot of participation from different sections of the agricultural community ranging from local farmers, researchers, students, academicians and agricultural scientists.

As we are entering the final decade for achieving the SDGs, it remains as a Decade of action for implementing Agroecology by taking the following factors into consideration.

- Even though many missions and organizations support and work in hands with agroecology, taking the concept to people, especially rural farmers are a herculean task. Scaling up agroecology to a mass population, will result in dramatic effect on sustainable agriculture and would enhance food system.
- However, successful scaling up of agroecological principles needs great attention and commitment at policy making level. Hence a firm governing body is needed, that will frame and manage the laws, regulations, public awareness and training programmes across different sectors of the society. In addition, supporting funds are needed for establishing and maintaining the agroecomodels.
- This is possible only forming groups and communities, comprising academicians, researchers, students and farmers practicing agroecology, who can do the job efficiently.
- The concept of agroecology should reach every nook and corner of all villages, rural and all areas of agricultural practice.
- This can be achieved by organizing awareness programmes, hands on training, creating agroecological model farm and explaining its need and importance to farmers and other agriculturists and make them understand agroecology.
- Each farmer should understand the SDG framed by FAO for zero hunger and evergreen sustainability of future agriculture.
- The government should support by funding the educational and research institutes to promote agroecology.
- Agroecology should become the way of farming to be followed by all Indian farmers.
- Slow and steady we can definitely accomplish the concept and principles of agroecology which no doubt will save the future farming.

Even though our government focuses and put efforts on achievieing the SDGs, more emphasiss should be given in implementing the agroecological principles and in following successful agroecomodels and urge the farmers and researchers to find out more and more of innovative, eco friendly agroecomodels blended with our ancestral traditional knowledge.

Successful implementation and practice of agroecology, will promote eco-friendly, innovative, improved soil fertility and crop nutrition, extended agro- biodiversity, creation and promotion of local markets and lot of job opportunities.

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