A MACRO ANALYSIS OF SUSTAINABLE AGRICULTURAL DEVELOPMENT IN INDIA

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Abstract: The present paper delves into the concepts and goals of sustainable agriculture in India. Sustainable agricultural development encompasses a wide range of issues viz. sustainability of agricultural production, sustainability of the rural economy, ecological and environmental sustainability within agricultural systems and sustainability of rural society. India is expected to be the most populous of the world by 2050 if the present growth rate perpetuates. In order to meet the growing needs of the expanding population, it is compelled to produce more than 210 million tonnes of food grains per year. India has not only met its domestic requirement but is also exporting to other countries. It also has a respectable buffer stock of about 40 million tonnes of food grains. The achievement of green revolution was due to the increase in yields through the increased use of high yielding variety seeds. In recent decades, demands for food quantity and quality have been increased sharply in India due to the improvement of people's living standards and continuous economic growth. Thus, the issue of greatest concern in India's sustainable agricultural development at present is whether agricultural production can ensure India's food security for the future. For achieving success in promoting sustainable agricultural development, attention must be given to land, water energy, nutrient supply, genetic diversity, pest management, systems approach and location of specific research and development.

Keywords: Sustainable Agriculture, Economic Growth, Food Security, Nutrient Supply.

Introduction

Indian agriculture is facing with an array of problems such as water scarcity, reduction in cultivable land/capita, high cost of crop inputs, lack of marketing network and avenues for value addition of farm produce and fluctuating market prices. Current conventional farming can however be improved by adopting appropriate technologies of crop production, post-harvest processing and by improving quality so that agriculture becomes not only sustainable in long term

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but a profitable business also by linking production with consumerism.

In India, >65% of the population is dependent directly or indirectly on agricultural activities. As in earlier plans, Central Government envisaged in the tenth 5-yr plan (2002-07), at least 3.5-4 per cent growth rate per annum in agriculture from the present rate of 2 per cent with emphasis on food security and employment opportunities in rural areas. Also, irrigated area increased from 22.5 m ha to 97 m ha during last 50 years. The national agricultural policy aimed to strengthen current economic growth through efficient marketing to accelerate foreign trade from the major crop growing areas where technical know-how and facilities for export have been established. There is a shift from sustainable to commercial agriculture in some areas where farmers can avail the opportunities to increase their income in agriculture. The increasing demand for organic foods and fibre, and the by-products would certainly open a new vista in consumerism. In future, the agricultural production on a large scale by adopting improved farming techniques would transform small farmers into viable commercial producers; link production with consumption would bring about real economic changes in the present conventional non-sustainable agriculture.

Present Situation

At present, the total area available for cultivation accounts for 180 m ha, of this 122 m ha (65%) is in dry land, from where 42-44 per cent of total food and 75 per cent of cotton are produced. The characteristics of these areas are: shallow/light to deep/black alluvial soils with poor fertility levels and low moisture retention capacity, poor crop stand, erratic weather, inadequate crop inputs and farming infrastructure, uncertain and low rainfall (500 mm or less/year) coupled with late onset and early cessation of rains or prolonged dry spells during crop season, subsistence/conventional farming, lack of improved technology, soil salinity or alkalinity, water and soil erosion, low productivity of cattle and lack of fodder and minimum crop yields. These situations result in socioeconomic constraints such as, poverty, illiteracy and poor standard of living. In reality, concerted efforts for maintaining sustainability in these areas are urgently needed.

Sustainability

Sustainable agriculture is often restricted to conventional/traditional farming and creates confusion. In fact, it helps to improve soil health by integrating all possible measures so that crop productivity is maintained for a longer time. According to United Nations Development Programme, sustainable development means national food security, upgrading living standard of farmers, and conservation of the natural resources.

Therefore, various traditional and modern methods of cultivation are included in sustainable agriculture. Nevertheless, unless scientific agriculture is practiced, average per capita income will not attain

to a desirable level and disparity between rich and poor would widen further. For example, government declared in 1999-2000 the population below poverty line (BPL = $ 1/day) at 28.6 per cent whereas international survey reported it at 35.3 per cent ($1/ day) and 80.6 per cent ($2/day) (World Development Report, 2005). Similarly, the National Sample Survey Organization reported the average per capita expenditure of Rs. 503 only (lowest being Rs. 225 in Madhya Pradesh); of which 50 per cent is spent on food alone. These figures denote the present economic status of farmers' families in dry land areas where 60 per cent of the potential remains unexploited for the future needs. Poverty alleviation may be possible only when more broad based approach of village improvement reaches out to these people.

Sustainable agriculture is a type of agriculture that focuses on producing long-term crops and livestock while having minimal effects on the environment. This type of agriculture tries to find a good balance between the need for food production and preservation of ecological system within the environment. In addition to producing food, there are several overall goals associated with sustainable agriculture, including conserving water, reducing the use of fertilizers and pesticides, and promoting biodiversity in crops grown and the ecosystem. Sustainable agriculture also focuses on maintaining the economic stability of farms and helping farmers improve their techniques and quality of life.

The definition of sustainable agricultural development:

"The management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such development conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable."

Agricultural systems, in both developed and developing countries need to use new approaches to increase food supplies while protecting the resources on which they depend. This can be achieved with practices that:

- Fully exploit natural processes such as recycling nutrients, using plants that fix their own nitrogen and achieving balance between pests and predators;
- Reduce the reliance on inputs such as mineral fertilizers and chemical pesticides;
- Diversify farming systems, making greater use of the biological and genetic potential of plant and animal species;
- Improve management of natural resources;
- Rotate crops or develop agro-forestry systems that help maintain soil fertility

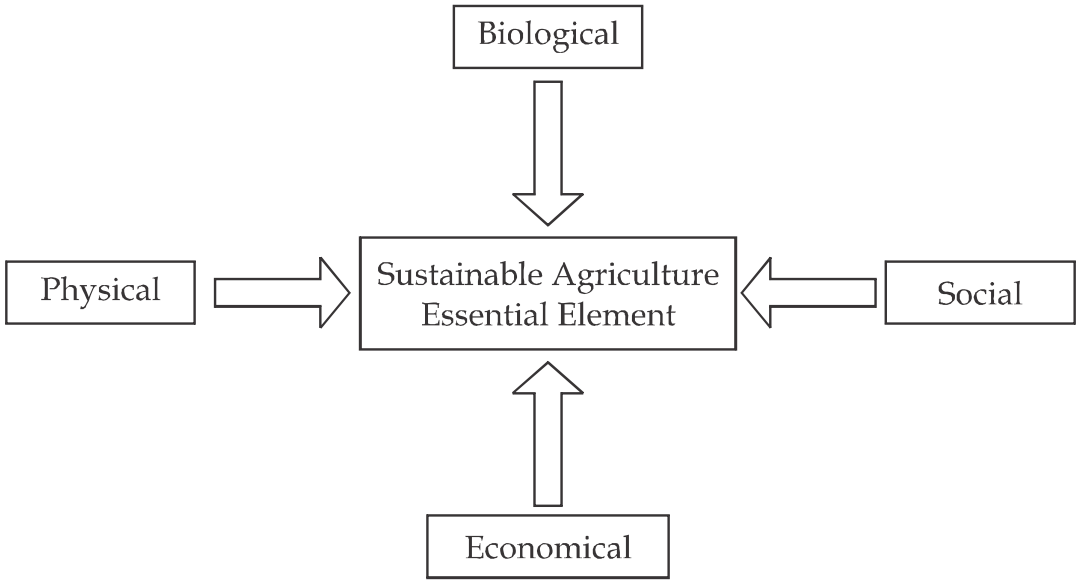

Figure-1

Opportunities & Challenges

Enhancing Food Security through Sustainable Agriculture

Cultivating traditional subsistence cereals is the main occupation of the people in India as about 70 per cent people are involved in its cultivation. Meanwhile, production and yield of cereals are considerably low and thus rural areas are suffering from the menace of food insecurity. The United Nations (2008) defines food security as a state where both the availability and accessibility of food are ensured and it is enough to cover the food demand of the people. The issue of food security emerged in the 1970s when acute food crises occurred at the national and global level. Many countries, mostly underdeveloped, are still facing the menace of food scarcity and malnutrition. According to FAO (2003), about 850 million people are undernourished or chronically hungry in the world, out of which, 830 million people are from the developing world and 212 million people are from Sub-Saharan Africa. In India, 231 million people are facing the same problem, out of which, 175 million people live in the rural areas (FAO, 2008).

There are four food security indicators – food availability, food accessibility, food consumption and sustainability. Food availability is mainly based on the production factor. Higher the production, higher is the food availability. Access to food is another major factor, which includes market access, market price and institutional support. Access to food

means that it is well distributed according to the demand. Food insecurity takes place when the demand grows higher than the supply. Both food availability and its proper distribution may attain food security. It is observed that food insecurity is not only due to population growth and low production of crops but also due to mismanagement in the food grain distribution system. Braun et al. (2003), Chappell and LaValle (2011) and FAO (2011) have noted that the current global food production is sufficient to feed the world if it is distributed according to the need. Food consumption that includes nutritional adequacy and local preferences is dependent on population size and food habits of the people. If these factors are adequate, then economic, social and environmental sustainability can be attained.

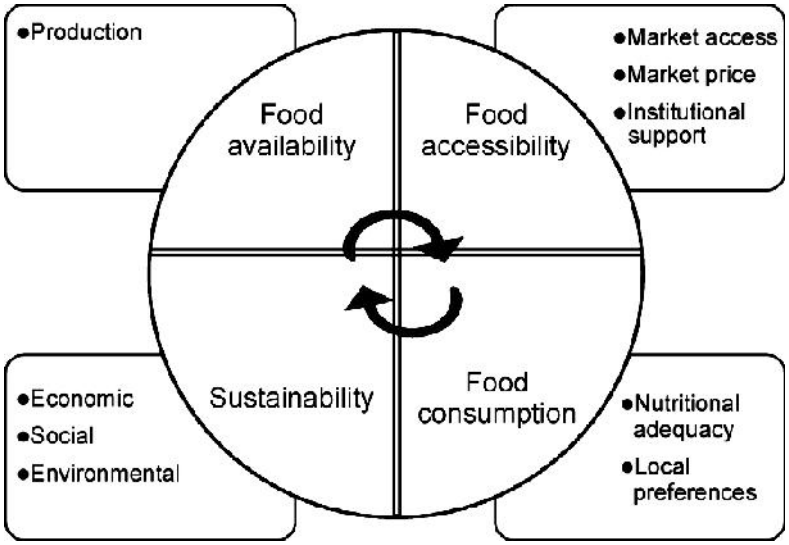

Figure-2

Agricultural diversification, increase in soil fertility, water availability, access to market, transportation facilities, equal distribution of products to access and institutional support can enhance food security and livelihood sustainability. Food security can also be achieved through high-crop diversity in all the altitudinal zones, mainly the cultivation of cash crops, as cash crops throughout the Himalayan region have moved a step forward in terms of generating income and augmenting employment. Several other factors have also affected the level of food security. One of the factors is a rapid technological change in agricultural production, improved rural infrastructure and changes in food demand patterns (Pingali and Rosegrant, 1995). In India, increase in population on the limited

terraced agricultural fields has further accelerated the food insecurity syndrome. It was noticed that the implications of agricultural diversification on food security have been tremendously high. In the past, when the farming community was absolutely dependent on subsistence farming, the phenomenon of food scarcity and malnutrition was high. Changes in cropping patterns, on the other hand, from subsistence crops to paddy, wheat, fruits and off-season vegetables have attained food security. However, the never-ending debate on the suitability of crops for food security still continues. Saxena and Rao (1994) pointed out that preferences for consumption of wheat and paddy are the recent changes in food habits that have caused this situation of food insecurity in the region. The cultivation of paddy and wheat crops demands more water and fertilizers, rendering them into scarcity and adversely affecting the productivity of paddy and wheat crops (Kumar et al., 1998). This point of view has been supported by Singh and Raghuvanshi (2012) as they observe that cultivating traditional subsistence crops is one of the most potential approaches adopted for improving household food security.

Corporate Social Responsibility in Sustainable Agriculture

This paper makes an attempt to study the impact of corporate social responsibility (CSR) its process, conceptual and theoretical understanding. It is also based on the assumption that corporate social responsibility is towards sustainable agriculture & rural infrastructure. The paper also aspires to look the widespread adoption of corporate social responsibility (CSR) policies in developing countries have led to call for a concerted effort to better capture CSR effects. The paper considers the practical implications for the effort to assess CSR contribution to community development in developing countries. Rural infrastructure is crucial for agriculture, agro-industries and overall economic development of rural areas. It also, incidentally, provides basic amenities that improve the quality of life. Corporate Social Responsibility has been attracting attention recently by the corporate world worldwide. The corporations discharge their CSR through social development in various ways in varying degree.

The word 'sustainable' has become very popular these days and is used to describe many different things. In this lesson, we will explore how sustainability is associated with agriculture and the benefits and issues. Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, more so in the vast rural areas. It also contributes a significant figure to the Gross Domestic Product (GDP). Sustainable agriculture, in terms of food security, rural employment, and environmentally sustainable technologies such as soil conservation, sustainable natural resource management, and biodiversity protection, is essential for holistic rural development. Indian agriculture and allied activities have witnessed a green revolution, a white revolution, a yellow revolution and a blue revolution. Furthermore, to give

stagnant agricultural growth a boost, a shift must be made from concentrating on the country's food security to focusing on the farmers' income security. The National Agricultural Policy of 2000 stated that private sector participation will be promoted through contract farming and land leasing arrangements to allow accelerated technology transfer, capital inflow and assured a market

However, development of agriculture continues to remain critical for India's economic growth, poverty reduction and ensuring food security of the country, as over 58% of rural households depend on agriculture as their principle means of livelihood. Green Revolution, which brought food sufficiency to the country was due to combination of technologies viz., hybrids and high yielding varieties, fertilizers and improved agronomic practices and public policy. This revolution was made possible through an organized and committed agricultural extension system that ably supported and supplemented the input-intensive production system.

In spite of significant growth in agriculture, Indian agriculture continues to face serious challenges such as declining soil; water and other natural resources; decreasing size of farm holding; Input use inefficiency; costly and scarce agriculture labour; drudgery in farming operations; growing risks in farming; information, knowledge and skill gaps; poor access to credit and investments; slow diffusion of relevant technologies; competiveness of quality and prices in export & domestic markets; inadequate focus on processing and value addition; Low profitability of agriculture; inadequate rural infrastructure; poor access to resources and services for women in agriculture; weak institutional linkages and convergence; extreme events of climate change etc. The real challenge remains in diffusion of technologies generated by the research system to farmers through an effective extension delivery system to address these challenges. Thus, the extension is strategic to the growth of agriculture and allied sectors and enhancing the farmers' income.

Shift in Cultivation

The statistical profile of Indian agriculture since 1960 reveals a shift in cultivation. This creates imbalances in the cropping system, which has serious economic and environmental consequences for the farm sector and the sustainability of the agrarian economy. A shift in cultivation and the subsequent application of chemical fertilisers and pesticides result in the depletion of inherent nutrients of the soil and create chemical pollution.

There is wide concern on the quantity and quality of surface and groundwater. Sustainability has three important indicators: continued profitability, soil stability overtime and absence of adverse impact on the environment. In this context, the shift in cultivation and the sustainable agriculture are analysed in terms of soil fertility status, groundwater level, chemical pollution and total factor productivity growth etc.

During 1960–61, the order of the first five

crops was rice, coconut, tapioca, rubber and pepper in the descending order of shares to the total cropped area. Table1 reveals that in 2013–14, the first five crops were coconut, rubber, rice, pepper and areca nut. Coconut occupied the second position in the area of cultivation during 1960–61, which in 2013–14 became the first and rubber the second. The main crops that were losing area between 1960–61 and 2013–14 were rice and tapioca. This change clearly established a shift from the traditional subsistence cropping to the recent commercial cropping, like coconut and rubber. From Table1, it is clear that among the four plantation crops, rubber has emerged as the most significant crop with largest area in the state next only to coconut.

Table-1: Shift in Cultivation (Rank of Each Crop in the Total Cropped Area)

Crops	1960–61	1970–71	1980–81	1990–91	2000–01	2013–14
Rice	1	1	1	2	3	3
Coconut	2	2	2	1	1	1
Areca nut	6	7	7	10	8	5
Rubber	4	4	4	3	2	2
Pepper	5	5	6	4	4	4
Cashew nut	6	6	5	6	7	9
Tapioca	3	3	3	5	7	7
Coffee	10	11	8	7	9	8
Tea	8	10	11	11	11	11
Cardamom	9	9	9	8	10	10
Ginger	11	12	12	12	12	12

Current Situation

Overuse of Land

The available cultivable land is presently overused mainly due to fragmentation, e.g. nearly a half of the population in farming communities own only 0.01-0.04 ha of land, respectively (Table-2). These lands had been exploited through intensive agriculture introduced during GR era. Cropping system with monoculture became predominant as it replaced the traditional systems.

Table-2: Farms Owned by Farmers

Farm Size (ha)	Farmers (%)
0.01 - 0.40	**48.7**
0.41 - 1.00	**18.8**
1.01 - 2.00	**11.2**
2.01 - 4.00	**07.1**
4.01 - >	**03.9**

Intercropping, mixed cropping, crop rotations, and made the soil infertile. Fields were used for 2-3 crops/year without rest. This system yielded in higher production and greater profits than in conventional farming but failed to sustain for a longer time. Also, this concept was successful only in fields of progressive farmers who could cope up with yield losses and natural calamities.

Low Crop Productivity

Although soil fertility decreased to a greater extent, farm inputs are not applied in required quantity and at proper stage of plant growth natural calamities are frequent. As a result, crop production remains standstill. The average productivity of major crops is below global average (Table-3) even after putting some wasteland under cultivation and with irrigation facilities.

Table-3: Global Ranking in Area, Production and Productivity of Indian Crops

Crop	Area	Production	Productivity
Wheat	3	3	32
Rice	1	2	51
Maize	5	9	105
Sorghum	1	2	51
Potato	3	6	51
Pulses	1	1	118
Sugarcane	2	2	34
Cotton	1	3	57

Looking at the present situation of availability of food and fodder, it is evident that requirement for essential goods and foods has increased and it would be difficult to feed ever-increasing population of over 109 crore because the

population is growing at 1.9 per cent annually as against the 1.5 per cent growth in food grain production. At present, food availability is only 400 g per capita against normal quota of 500 g and pulses (major source of protein) are available only at 26 g per capita. Country may therefore face the hunger due to non-availability of essential foods.

Also, farmers need income support through agriculture although a fourth of the rural population is landless and needs help to survive.

Imbalance between prices of farm inputs and market sale

With GR philosophy, farmers have become totally dependent on others. Unless they buy these inputs, land cultivation is impossible. The Swadeshi Movement disappeared fast and farmers have to buy at least seeds, fertilizers and pesticides at enormous price. Apart from these inputs, labour cost has gone up in rural areas also. To compensate these costs, farmers expected the proportionate rise in the Minimum Support Price (MSP) of farm produce and commodities but again they were disappointed as input rates are increasing every year reaching up to 300 per cent whereas prices of farm produce increased up to 60 per cent (Table-3).

Table-3: Minimum Support Price (Rs. /q) of Major Food Crops

Crop	1998-99	2003-04	% increase
Cotton	1140-1650	1725-1925	15-20
Soybean	795	930	19
Wheat	550	630	15
Paddy	440	550	25
Chick pea	895	1400	56
Mustard	1000	1600	60

Future Needs

Diversification in Agriculture

Any cropping system comprising crops with varied maturity period, crop canopy, high yielding potential is today's need for an average farmer. Single crop system consisting of red gram, cluster beans, French beans, castor, setaria, groundnut, pearl millet, ragi, mustard, sunflower are best suited. However, several cropping systems depending upon the soil type, total rainfall and commencement of the rains in the region have to be executed so that soil and water conservation, full utilization of ground water, maintenance of soil fertility is possible.

Although the cropping systems would depend upon the agro-climatic factors, it is certainly profitable to adopt double cropping, intercropping and mix cropping since these systems help to increase land use efficiency. In fact, any cropping system comprising crops with varied maturity period and crop canopy, having high yield potential is today's need in dry land areas where double crop system proved to be potential and cost-effective .

Appropriate Technologies

The low cost technology is essential considering the financial burden for a marginal farmer whose earning source is only farming. Farmer has to arrange for seed procurement, seed treatment, growing green maturing crops, preparing compost from farm waste or vermicompost from vermiculture, purchase of bio fertilizers, bio control agents, bio pesticides, chemicals etc. with his limited financial resources.

Organic farming is proved to be economical as many inputs are prepared on the farm itself by the farmers. This strategy needs to be verified and advocated for varied cropping systems in both rain fed and irrigated agriculture in which it can be profitable. Farmer should however, be able to bear the yield losses that are incurred during first few years.

Infrastructure Development and Reforms of Agricultural Policies

In terms of investment in rural infrastructure, India comes next to the US, but there is a dearth of storage godowns, distribution network and services critical to a comprehensive and integrated food security system. Post-harvest losses up to 40 per cent in vegetables and other perishable goods have been reported. The value addition through processing may help raise the farmers' income.

Thus, Food parks, Agro-based industries, cold storage structures etc. should be established in crop growing zones. In Maharashtra, the government adopted resolution to change the present acts of Agriculture Produce Marketing Committee into Model Act which may be an ideal step towards marketing in rural areas.

Conclusion

A small number of farmers are practicing alternative agriculture and derive significant and sustained economic and environmental benefits. A wide range of federal farm, conservation, and regulatory policies significantly influence farmers' choices of agricultural practices. As a whole, federal policies work against environmentally benign practices and the adoption of alternative agriculture systems.

A systems approach to research is needed to advance the effectiveness and profitability of alternative agriculture, and agriculture as a whole; and farmer-innovators are driving the development and adoption of alternative agricultural systems, but to achieve wider adoption, farmers need to receive information and technical assistance. It demonstrates that improvements in agriculture are occurring through one or more of five different mechanisms:

1. Intensification of a single component of farm system (with little change to the rest of the farm) - such as home garden intensification with vegetables and/or tree crops, vegetables on rice bunds, and introduction of fish ponds or a dairy cow.

2. Addition of a new productive element to a farm system, such as fish or shrimps in paddy rice, or agroforestry, which provides a boost to total farm food production and/or income, but which do not necessarily affect cereal productivity.

3. Better use of natural capital to increase total farm production, especially water (by water harvesting and irrigation scheduling), and land (by reclamation of degraded land), so leading to additional new dry land crops and/or increased supply of additional water for irrigated crops (so increasing cropping intensity).

4. Improvements in per hectare yields of staples through introduction of new regenerative elements into farm systems (e.g. legumes, integrated pest management).

5. Improvements in per hectare yields through introduction of new and locally-appropriate crop varieties and animal breeds.

Thus a successful sustainable agriculture project may be substantially improving domestic food consumption or increasing local food barters or sales through home gardens or fish in rice fields, or better water management, without necessarily affecting the per hectare yields of cereals. In the dataset, the most common mechanisms were yield improvements with regenerative technologies or new seeds/breeds, occurring in 60 percent of the projects, by 56 percent of the farmers and over 89 percent of the area.

Home garden intensification occurred in 20 percent of projects, but given its small scale only accounted for 0.7 percent of area. Better use of land and water, giving rise to increased cropping intensity, occurred in 14 percent of projects, with 31 percent of farmers and 8 percent of the area. The incorporation of new productive elements into farm systems, mainly fish and shrimps in paddy rice, occurred in 4 percent of projects, and accounted for the smallest proportion of farmers and area.

In assessing the relative sustainability of current agricultural production systems it is necessary to define 'sustainable agriculture', but again there are many interpretations to this ambiguous term due to a host of apparent conflicting ideas and heavily value laden concepts. The popularity of the term sustainable agriculture has led to a broad interpretation of the meaning sustainable [Reeve, 1990]. Again the interpretation of sustainable agriculture as farming forever brings into question a broader consideration of what makes an agricultural system sustainable. Australian farmers are becoming more conscious of the term sustainable agriculture and are making a conscious effort to address this situation i.e. Land Care [Roberts, 1995]. As farmers' attitudes are changing so is their interpretation as to the meaning and relevance of sustainable agriculture [Roberts, 1995].

This study has started by outlining some of the basic and time honoured principles of sustainable agriculture. The proceeding synthesis, concerning the variant ways and vectors in which these principles have been (contentedly) grounded and conceptually developed by scholars, has demonstrated their continual and growing relevance. For much of the latter half of the twentieth century agricultural sustainability debates concentrated on both the recognition, definition, as well as the oppositional significance of these principles. This led to considerable vitality and energy in creative conceptual development. More recently, the political and economic vector for sustainable agriculture has dramatically widened and deepened into what some scholars have termed the 'real green revolution'.

There may now be a real shift occurring, not least in places like Europe, from an emphasis on oppositional and ontological politics toward really embedding and 'sustaining the sustainable' as opposed to 'sustaining the unsustainable'. That is, focusing upon the rebuilding of new spatial and ecological configurations for sustainable rural and agricultural development sui generis. This is becoming more probable and realistic not only because we have seen, the gradual moves toward ecological modernization by the state apparatus (especially in Europe). Agricultural sustainability, or rather agri food sustainability (taking in whole complex supply chain factors rather than just the farm), is now recognized as a central dynamic in the broader political economy and governance of what we might call the macro economy.

In the first decades of the twenty first century: (1) the real effects of the growing scarcity of the carbon based resource are becoming clearer, and having both corporate and geopolitical effects; at the same time (2) the real effects of 150 years of the carbon based economy are being realized with regard to climate change. In this changing context the positioning and political power of sustainable agriculture, agro ecology, and the rural development paradigm can only grow in ways which should see these principles become a more powerful vehicle for reintegrating both sustainable production and consumption, and also re-equating the fast growing urban world with its diverse rural ecological hinterlands. However, in the face of reignited global concerns about food security, vast disparities in the volumes and types of food consumption, and the persistence of the agri industrial model in attempting to find new technological 'fixes', we should not expect this to be an easy or unproblematic journey.

Conflict of Interests

The authors declare that there are no conflict of interests that are directly or indirectly related to this research work.

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