

HI-TECH PRACTICES FOR SUSTAINABLE AGRICULTURAL GROWTH

Pinki*

Abstract

Economic development of a nation is directly dependent on the performance of its agricultural sector and the optimum utilization of its available resources. Improvement in the productivity and profitability of agricultural sector has always been a major issue for policymakers. The paper highlights the challenges faced by farmers under traditional method of cultivation vis-a-vis conceptual framework regarding greenhouse farming, its structure, functioning, suitability and sustainability. It also provides a brief outline of the advent and progress of greenhouse farming in various other nations along India so far. The present paper also makes an attempt to rethink about agriculture sector as an industry and suggests further improvement.

The present paper is divided into 5 sections. Section-I contains introduction, Section-II presents conceptual framework of agricultural growth, sustainable development and greenhouse farming. Section-III presents a list of empirical studies being carried out in this context. Further section-IV describes a model for its functioning and provides a list of factors that are responsible for this leading innovative technique. At the last section-V presents a list of key findings and implications being beneficial for future research.

Keyword: Commercial Farming, Agricultural Growth, Sustainability, Greenhouse Farming, Traditional Farming.

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I) Introduction

Agriculture sector was providing employment to more than 70% population at the time of independence (Josef Sayer, 2006) (Tripathi and Prasad, 2009). There is no doubt that it still provides employment to a majority of the population (>60%)(Pandey, 2007)(Josef Sayer, 2006). But what is happening today even farmer's sons are not going to adopt farming as their livelihood. They are switching to other professions/business where they get better opportunities and higher returns. The reason of such shift is our present agricultural system which is considered as more labour intensive and less revenue generating profession. Even due to urbanization, agricultural land is being shrinked and it is becoming problem to get maximum output from the limited land (Josef Sayer, 2006). Farmers are committing suicide due to unfavourable agricultural policies. Farmers need protection through protective legislation as nothing is typically done to help them settle their debts or tackle the unprecedented price rise that leads them to commit suicides (Deshmukh, 2011). The challenge is to improve the workings of markets for outputs, inputs, and financial services to overcome market failures. Meeting this challenge calls for innovations in institutions, for joint work between farmers, private companies, and NGOs, and for a new, more facilitating role for ministries of agriculture and other public agencies (Hazel et al, 2007). There needs for identifying proper opportunities to promote rural employment, including non-farm employment, encourage diversification within and out of agriculture, develop value addition activities such as agro processing in rural areas in a way that benefits farmers (Deshmukh, 2011). Emphasis needs to be laid on traditional investments such as land development, irrigation and farm mechanization and integration of small and marginal farmers in the mainstream in the case of marketing and exports which is being supported by Mumbai Expert Group, 2005.

There With the increasing demand for value added and high quality niche products, Indian agriculture has been forced to step up and adopt commercially, technically and economically viable agribusiness solutions (Pandey, 2011). Commercialization – measured as the degree of participation in markets (usually focusing on cash incomes) – could be relevant for any size of farm and any type of market. Farmers will benefit from participating wherever the opportunities are – domestic or export markets – and respond to any opportunities available (CAADP Policy, 2011). Commercialization has contributed to increase in income levels of farmers through increases in the production and resulting in higher proportion of marketed surplus. Advent of Green Revolution technology in mid-sixties, which had resulted in rapid rise in yields of rice and wheat, has ensured our internal food security (Josef Sayer, 2006) (Satyasa & Viswanathan, 2007).

II) Conceptual Framework

Agricultural output, sustainable and inclusive agricultural practices are considered as key parameters for agricultural growth. This section is further sub-divided into three sections. Part A discussed agricultural growth in India so far, Part B discussed indices for sustainable development and Part C discussed conceptual framework of Hi-tech agricultural practices.

A) Agricultural Growth

Agriculture and allied sectors contributes 13.9% of the total GDP in the year 2011-12 as compared to 14.5% in 2010-11. As per Economic survey 2011-12, the growth rate in

agriculture sector is expected to be 5.4% in 2013. The 11th Five year plan (2007-12) shows an annual average agriculture growth rate at 3.6% whereas the target rate was 4%. On the other hand GCF as per tenth plan had a growth rate of 2.7% and as shown by eleventh five year plan it is 9.7%.

Table -1 Agriculture Sector Key Indicators

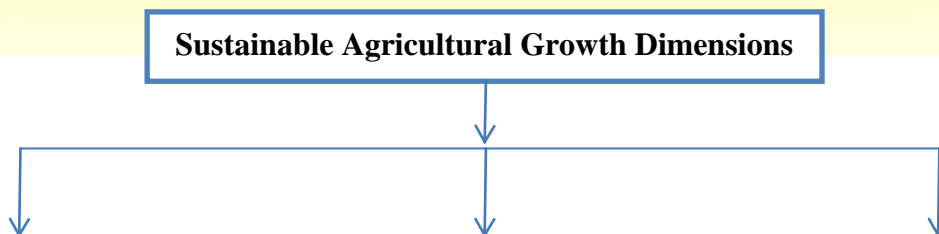
(% at 2004-05 prices)

Sr. No.	Item	2007-08	2008-09	2009-10	2010-11	2011-12 Ist Revision
1	Growth in GDP in Agriculture & Allied Sector	5.8	0.1	0.8	7.9	3.6
	Share of Agriculture & Allied Sectors in total GDP	16.8	15.8	14.6	14.5	14.1
	Agriculture	14.3	13.4	12.3	12.3	12.0
	Forestry and Logging	1.7	1.6	1.5	1.4	1.4
	Fishing	0.8	0.8	0.8	0.7	0.7
2	Share of Agriculture & Allied Sectors in total Gross Capital Formation(GCF)	6.4	7.8	7.3	6.2	6.8
	Agriculture	5.9	7.2	6.7	5.6	6.2
	Forestry and Logging	0.1	0.1	0.1	0.0	0.1
	Fishing	0.5	0.5	0.5	0.5	0.5
3	GCF in Agriculture & Allied Sectors as % to GDP of the sector	16.1	19.4	20.1	18.4	19.8
4	Employment in the agriculture sector as share of total workers(Census 2001)	58.2				

Source: Central Statistics Office, Directorate of Economics & Statistics (Department of Agriculture and Cooperation) and Population Census 2001.

B) Sustainable Growth Indices

Josef Sayer (2006) Member of the German Council for Sustainable Development defined the term “Sustainability” in international perspective considering its three major dimensions Ecological, Economical and Social Sustainability as poverty reduction tool. Josef further focusing on small farmers concluded that by mean of sustainable agricultural practices yield can be increased by 100%, which results in reducing poverty.



Ecological Sustainability	Economic Sustainability	Social Sustainability
<ul style="list-style-type: none"> • Conserve Soil Fertility • Improve Soil Structure • Biodiversity • Preserve Natural Resources • Reduce the use of hazardous chemicals • Significance to Global Climate 	<ul style="list-style-type: none"> • Export vs Local Orientation • Debt • Risk • Niche Market • Employment 	<ul style="list-style-type: none"> • Inclusiveness • Political Unrest • Local Acceptance • Indigenous Knowledge • Gender • Food Security • Participation

Source: Josef Sayer (2006)

Figure 1: Dimensions of Sustainable Growth

Figure 1 shows the three major dimensions of sustainable agricultural growth in the form of ecological, economic and social sustainability as explained below:

Ecological Sustainability

Ecological sustainability means preservation of environment for the next generation. agricultural practices that results in conservation of natural resources, soil fertility, reducing the use of harmful chemicals, biodiversity, and contributing to global climate etc. considered as ecologically viable. How to conserve our valuable resources for the coming generation is an important concern. Many traditional farm practices were not considered ecological due to various shortcomings like wastage of natural resources, use of harmful chemicals, negative impact on global environment etc.

Economic Sustainability

Economical sustainability functions towards reducing the gap in between the rich and the poor. Economic sustainability measures whether the available reforms results in increasing income level or not. Agricultural practices are considered as economic viable when it has export and local orientation, reducing farmer debt; secure employment and results in risk reduction.

Social Sustainability

Social sustainability functions for overcoming the problem of starvation. An agriculture practice is considered good only when it is going to reduce poverty and having the acceptance according the social norms and customs. It should provide quality products and improved nutritional value.

C) Greenhouse Farming

Modern technological era brought numerous changes in our present agriculture system which ensures sustainable and inclusive agricultural growth. One such technological advancement in agriculture sector is 'Greenhouse Farming'. Greenhouse farming shows a strong appeal not only to change the picture of the present agriculture sector by increased productivity but it can

also provide favourable share in export of agricultural produced. It is a technique of providing favourable environment condition to the plants by making a detailed inquiry regarding the plant requirements.

It provides protection to the plant from the adverse climatic conditions such as wind, cold, precipitation, excessive radiation, extreme temperature, insects and diseases. It creates a micro environment around the plants. It is possible only by mean of greenhouse that proper monitoring and control of plants can be made to improve productivity. It frames such conditions that one can grow any plant in any place at any time with minimum labour.

In India greenhouse farming started during 1980's but it still in its initial stage due to various reasons such as the requirement of technical knowhow, high formation cost, lack of awareness among farmers, risk factor attached and so on. More than 50 countries now in the world were using Greenhouse farming for commercial purpose. Netherlands export greenhouse grown quality flowers and vegetables in various countries. In Saudi Arabia, greenhouse grown Cucumbers and tomatoes production contributes >94% of the total production. In USA near about 4000 ha is covered under greenhouses cultivation mostly used for floriculture with a turnover of > 2.8 billion US \$ p.a. Dutch greenhouse industry covers near about 89,600 ha area. Israel (with 15,000 ha) and Turkey (with 10,000 ha) are the largest exporter of vegetables and cut flowers in the world.

Features of Greenhouses/Polyhouse Farming

- 1) **Increased Productivity** - The yield here under Greenhouse farming may be 10 to 12 times higher than that of outdoor / traditional cultivation.
- 2) **Reliability** - Reliability of crop increases under greenhouse cultivation.
- 3) **Useful for Multiple crops cultivation**- It provide suitable environment for multiple crops cultivation.
- 4) **Throughout Year Production** - Year round production of floricultural crops.
- 5) **Increased Earning** – Income can be increased by producing off seasonal vegetables and fruit crops.
- 6) **Balanced Economy** – Proper balance can be established in between demand and supply by producing off seasonal products.
- 7) **Best use of pesticides and chemicals** to control diseases.
- 8) **Efficient use of available water resources** – By mean of Drip Irrigation System water is provided to the plant as per its requirement.
- 9) **Quality crop production and Low Labour cost.**
- 10) **Proper monitoring and controlling** of ecological system around the plant.

Greenhouse farming provides a new height in the cultivation of non-seasonal vegetables and flowers even in the hilly areas of north India by providing the suitable environment for the growth of the plant. Greenhouse structures these days are widely used for commercial purpose to supply non-seasonal flowers and vegetables (like cauliflower, colorful cucumber, cabbage, tomato, radish etc.) of good quality to different parts of the country and also for export purpose.

Major Challenges in Greenhouse Farming

In spite of too many advantages of greenhouse farming there are some major challenges that farmers have to face while establishing greenhouses. Some of these are as follows:

- 1) **Expensive** – It is quite expensive to install greenhouse due to heavy initial cost of investment. Huge capital is required to establish a greenhouse.
- 2) **Requirement of technical knowhow** – High level of managerial skill required to operate greenhouse. Therefore farmers should be trained about these techniques.
- 3) **High Production Cost** – This one is a costly affair. The production cost can be reduced by establishing low cost greenhouses and by availing Govt. subsidies.
- 4) **New Technology** – Although this concept is centuries old but this is new to Indian farmers. So it's a big challenge to convince them about this project.
- 5) **Farmers Limited Capital Sources**- Due to limited capital source and unawareness about this technology farmers generally hesitate to invest money in greenhouses.
- 6) **Lack of Awareness**- Farmers are unaware with these modern agricultural techniques.
- 7) **Loss due to natural calamities**- Farmers generally think about the losses due to natural disasters like flood, strong winds, earthquake etc.
- 8) **Uncertainty** – Farmers were quite uncertain about the success of these greenhouses.

All these are the major thrust areas where proper attention should be taken thereof. No doubt, Polyhouse farming reduces rainfall dependency and makes optimize use of available resources like land, water etc. Polyhouse farming can help the farmer in generating income around the year by growing multiple crops.

III) Literature Review

A number of literatures are reviewed to have insight for hi-tech agricultural practices. These articles reveal the opportunities and challenges for hi-tech agribusiness.

Sr.no.	Title	Name of the Author	Year	Findings of the Study
1	Contracting and Agricultural Finance for Small Holders- Hi-Tech Farming and a Case for Public Private Partnerships	Tushar Pandey	2011	Contract farming would be the enhancement of processing & value addition and the integration of the Food Value Chain. R&D activities, technology transfer and commercialization of agriculture are the three important building blocks for sustainable contract farming.
2	Report of the Working Group on Horticulture, Plantation	Dr.K.L. Chadha & Dr.M.L. Choudhary,	2007	<ul style="list-style-type: none"> • Use of Plastics in Horticulture • Bio-technology-leaf, soil & water analysis • Landscaping and gardening • Production and processing of medicinal and

	Crops and Organic Farming for the XI Five Year Plan (2007-12).			<p>aromatic crops</p> <ul style="list-style-type: none"> • Mass propagation of Horticulture crops • Post harvest and value addition • Hybrid seed production for vegetables • Course on marketing intelligence for horticulture produce • Course on Floriculture
4	Linking agribusiness and small-scale farmers in developing countries: is there a new role for contract farming	Johann Kirsten & Kurt Sartorius	2002	<p>This article briefly highlights the main problems normally associated with contract farming ventures, which lead to many failures and mistrust between agribusiness and smallholder families. These problems are:</p> <ol style="list-style-type: none"> i) Poor enforcement of contracts (ii) High transaction costs in dealing with many smallholders (iii) Strict demands for consistency (no variation), quality, food safety, due diligence, etc. (iv) Business attitudes and ethics referring to non-payment, delayed payments or even reduced payments (v) High rate of product rejection by agribusiness (vi) Weak bargaining position of farmers vis-a-vis a limited number of traders
5	Hi-tech Horticulture in India	National Academy of Agricultural Sciences (NAAS)	2000	<p>Need for simplification of policies and issues such as plugging of loopholes in the land acquisition law. Priority treatment of hi-tech floriculture as an industry needs to be given. Availability and importing of quality inputs such as water-soluble fertilizer, pesticides, throughout the year, across the counter should be ensured. The high cost of finance, sudden increase in quarantine duty and duty on plastics which have been hampering the growth of the industry, need to be reviewed.</p>
6	System for Polyhouse Farmers and Consultants	Neha Madame, Anirudha Joshi	2009	<p>The farmers liked the idea of receiving the daily schedule and getting consultant's advice on the phone on an ongoing basis. Farmers wanted information about supplies such as manufacturers, suppliers, contacts etc. The consultants felt that the product would allow them to manage the farmer's schedules better. They felt this will help them do learn from their past mistakes and give better decisions in future.</p>
7	Floriculture-A Sector Study	EXIM Bank	2006	<ol style="list-style-type: none"> i) Fierce competition between major players, ii) Infrastructure and policy have major parameters in judging international competition, iii) Producers must invest in labour saving techniques to increase profit,

				iv)In order to compete, Indian exporters must be able to supply products of consistent quality and on a regular base,etc.
8	Annual Report 2007-2008 All India Coordinated Research Project on Application of Plastic in Agriculture	Central Institute of Post-Harvest Engineering and Technology Ludhiana(Punjab)	2007 - 2008	Salient Achievement of Polyhouse Cultivation: The yield of strawberry cultivated in Polyhouse at Sri Nagar and Jammu & Kashmir was almost double and about 35 days earlier as compared to outside cultivation. Also vegetables growth was 12 to 42 days earlier than traditional cultivation fetch good market price by making goods available even in off season.It also result in energy saving and beneficial in the cultivation of various products.
9	Environment Monitoring and Control of a Polyhouse Farm through Internet	YogeshR. Sonawane , Sameer Khandekar , Bipin Kumar Mishra , K. K. Soundra Pandian	2008	Internetbased application for control and monitoring of a Polyhousefarm has been successfully developed and demonstrated. he system can beexpanded and implemented in other agro-based industries likeFloriculture, Horticulture, Poultry farming, Dairy farming, etc.
10	Success story on Greenhouse Technology(A case study on School & Community Horticulture Project)	Ministry of Agriculture, Govt. of India	2007	This study reveals success story of greenhouses which ultimately results in improvement in cultivation technologies. Further, i)Greenhouse held to increase quality, yield, optimum use of farm input (ii)it enhanced women empowerment etc.
12	Setting up of Hi-Tech Demonstration Agribusiness farm(HTDFI):P PP Model	Tushar Pandey	2007	Govt. objective maximize service to the common man at an affordable price with minimum use of govt. funds best achieved through public private partnership in provision in infrastructure and enabling services. Three models are available for public private partnership.
13	Evaluation of agricultural development projects of Syngenta foundation India	Dr. Dibyendu Sen	2008	1)Vegetable farming more readily accepted : need to step up promotion 2)Need for capacity building of extension personnel through tailor made trainings3) Rain water harvesting need to be taken as compulsory intervention4) Supply of quality seeds and planting materials to continue 5) Need for stricter follow-up action to check utilization of seeds & plantingMaterials6) Need for

				linkage with development departments for facilitating convergence of schemes for the benefit of the targeted farmers
15	Integrated Agribusiness Development Policy 2011	Government of Karnataka	2011	The policy hopes to provide an enabling framework leading to increase in yield, reduction in consumer prices in the domestic front, grading and food safety practices, increase in exports, reduction in post-harvest losses, sustainable farming practices and Government. Further it will enable i) Sustainable Agriculture Activity, enhanced productivity and better realization to farming community, ii) Development of Agri-infrastructure, iii) Development of Agro based Industry including Food Processing Units, iv) Investments in agriculture and allied sectors, etc.

The above cited literature shows that Greenhouse Farming is a new and innovative agricultural technique widely used in foreign countries on large scales but in our country it still in its initial stage due to so many reasons. A very few efforts have been made in our country in exploring agricultural potential in Greenhouse Farming.

Comparison between Traditional farming and Greenhouse Framing

Josef Sayer (2006) Traditional farming practices are going to be unfit on sustainability parameters due to so many reasons like it cause soil erosion, reduced soil fertility, impact on global environment whereas Greenhouse farming support multiple crop production, year around production, make efficient use of available water resources, eliminate usage of harmful chemicals and also have the potential to preserve rural jobs. It's a new and innovative technique that maintains food safety by improving the quality and nutritional value. Under Greenhouse farming after making a detailed study of the plant type, its nature and all kinds of other requirements such as fertilizers, soil type, climate, temperature, etc. such kind of micro climate is created around the plant which provide favourable growth and nourishment opportunities to the plant. Under this type of farming each and every activity is carried out in a planned manner or we can say in a protected manner. Adverse conditions like wind, temperature, sunshine, disease, radiation effect, etc. remain under control at here. Due to Greenhouse farming it's become possible to grow any plant at any time at any place. It has the potential to increase the yield 10 to 12 times higher than that of outdoor / traditional cultivation. Also through proper monitoring and control effective utilization of available resources are made. Not only it has the capacity to increase productivity, it also assures increased earning capability in comparison to traditional format.

A typical, traditional farm of 500 square meters would generate an estimated annual income of Rs. 10,000 -20,000, compared to estimated annual income from similar sized polyhouse of Rs. 45,000 - 50,000. It's the strength of Greenhouse farming to increase the yield by 300%, but farmers were still unaware to this modern Agri-technique. The problem of high cost

attached with Greenhouse farming can be sought by mean of co-operative farming. Also Government of India gives 50% subsidy for low, 20% for medium and 10% for high cost polyhouses as an incentive. Currently, farmers from the states of Himachal Pradesh, Punjab and Maharashtra are taking interest in polyhouse farming. Popularity of Polyhouses will naturally lead to increase in demand for better control and automation. Polyhouse system protects the agricultural crops from sudden change in weather and regulates the environment inside the Polyhouse. This helps the farmers to grow the crops without any external obstruction. Thus, monitoring and control forms the core element of a Polyhouse deployment. Control of internal thermal environment is achieved by managing several elements like air movement, sliding louvers, exhaust fans, heaters, air conditioning systems, sunroof, etc.

IV) Model Showing factor considerations and traditional reforms on Agricultural Growth

The total reforms till now in our agriculture sector has got its merits and demerits inside. These reforms come into existence only because these are the requirement of the present time which have an impact of various factors on its working. For example, if major factors needs to analyze for such changes then these were social, economic, technological and geographical factors. Due to the impact of these factors time to time reforms comes in our agriculture sectors. In other words, it can be said reforms are the outcome of such factor impact. From the traditional land reforms to green revolution (which is considered as Food Security era) and from green revolution to new agriculture system and from NAS to greenhouse farming suitability of each reform can be measure in term of impact on agricultural output, productivity, sustainability and inclusive growth indices. Josef Sayer (2006) Green revolution fails to solve the problem of food security as the principle of sustainability was not taken into account and it further trap the farmers into debt.

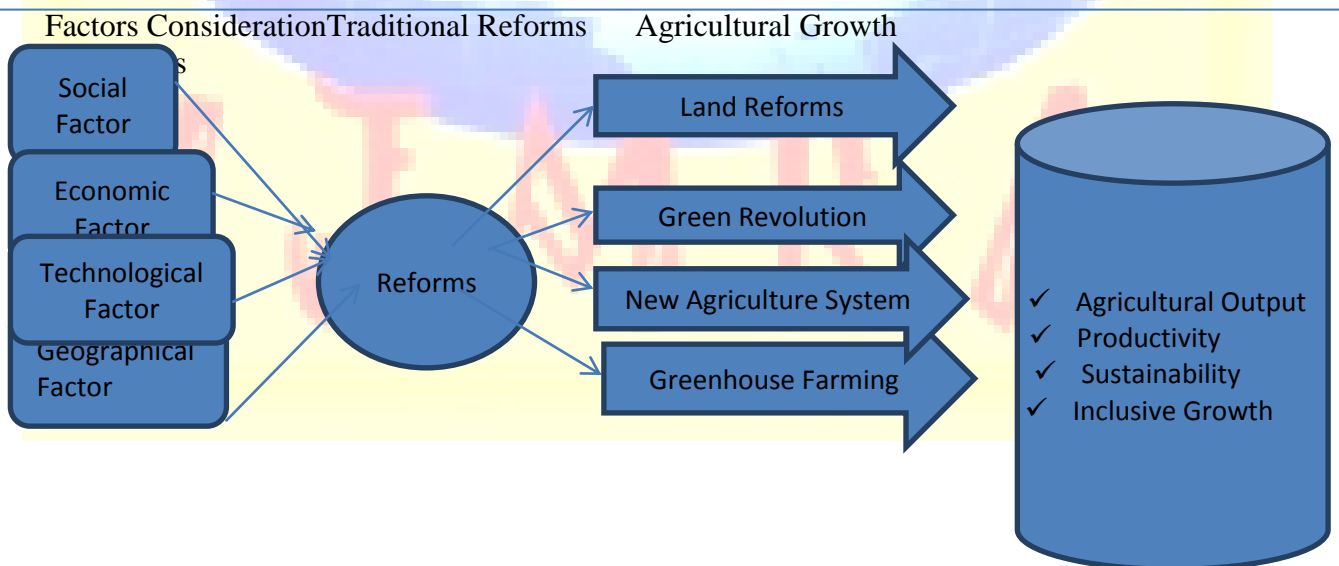


Figure 2: Model showing factor impact on Agricultural Reforms which results in Agricultural Growth

V) Key Findings and Implications

Although greenhouse farming has a great potential to function but it still need to popularize in our country. Farmers afraid form risk taking if they were convinced about its economical aspect it has the caliber to change the picture of present agriculture system being specially designed to provide favourable environment to the plant. Proper training should be provided to the farmers have favourable results.

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