Organic and Natural Farming in Context to Indian Agriculture

PROCEEDINGS OF THE NATIONAL CONFERENCE

13 – 14 May, 2022

Editors

Munish Kumar
Sarvesh Kumar
Jagannath Pathak

Arvind Kumar Singh
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Organized by

Alumni Association

Chandra Shekhar Azad University of Agriculture & Technology,
Kanpur 208 002 (U.P.) India

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NIKHIL PUBLISHERS & DISTRIBUTORS, AGRA

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Published by
NIKHIL PUBLISHERS & DISTRIBUTORS
37, 'Shivram kripa' Vishnu Colony Shahganj, Agra (U.P.)
Mob. : 9458009531-38
Email : nikhilbooks.786@gmail.com
www.nikhilbooks.com

Edition :
Ist Edition : 2022
Price : 150/-

ISBN : 978-93-5552-353-2

Type Setting
Rudra Graphics

Printed by :
Shree Pooja Offset

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Foreword

Natural and organic farming is a modern and sustainable form of agriculture that provides consumers with fresh natural farm products. The objective is achieved by using techniques to improve crop yields without harming the natural environment as well as the people who live and work in it. Organic agriculture offers an exclusive combination of environment-friendly practices, which require low external inputs, thereby contributing to increased food availability. Organic farming has a very positive influence on soil fertility leading to a stabilization of soil organic matter and a sequestration of carbon dioxide into the soils. Sustainable agriculture is the successful management of resources to satisfy changing human needs while enhancing the quality of the environment and conserving natural resources. Organic farming is the best alternative to avoid the ill effects of chemical farming. It also has more advantages over conventional and other modern agricultural organic farming and sustainable agriculture. There is an urgent need to involve more and more scientists to identify the thrust area of research for the development of eco-friendly production technology.

To discuss these issues, the National Conference on "Organic & Natural Farming in Context to Indian Agriculture during May 13–14, 2022 at C.S. Azad University Kanpur, U.P. In these two days of the national event more than 300 participants participated from all over the country and 10 lead lectures were delivered which threw light on the changing agricultural scenario and improved agro-technologies. The participants enthusiastically discussed and presented 75 oral presentations under ten technical sessions and 135 poster presentations.

I am sure, that the deliberations made and recommendations that emerged from this forum will prove to be useful for policymakers, planners, researchers, students, experts, and representatives from the public and private sectors and other stakeholders.

I congratulate the organizers of the National Conference especially, Prof. Munish Kumar, Organizing Secretary, and his team for organizing this important event at CSA University.

December 2022

(D. R. Singh)
Vice Chancellor

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Preface

The Alumni Association, C.S. Azad University of Agriculture and Technology, Kanpur Organized a two-day National Conference on National Conference on Organic and Natural Farming in Context to Indian Agriculture on May 13-14, 2022 at CSAUA&T, Kanpur. This Conference was organized in order to address the emerging scenario of organic farming in the country. Farmers, entrepreneurs, researchers, administrators, policy makers and of course consumers are showing increasingly greater interest in promotion and development of organic farming in the country. Organic food products are considered to be much safer and nutritious than the products produced by the conventional farming. Organic farming also helps to restore the soil health, protect environment, enhance biodiversity, sustain crop productivity and enhance farmers' income. Seeing the long-term benefits of organic farming, the Government of India has taken many important steps for its promotion in the country. The event was inaugurated by Sri Surya Partap Shahi ji, Hon'ble Minister of Agriculture, Agril. Education and Research, Govt. of Uttar Pradesh.

It is a matter of great pleasure for us to record our deep sense of appreciation and thanks to all the participants of the National Conference and specially to Authors who have contributed their papers for this volume. We are extremely grateful to Dr. D.R. Singh, Hon'ble Vice Chancellor, CSAUA&T, Kanpur to have faith in us to organize this National Conference and gave us all freedom and space to organize this important event.

We thankfully acknowledge the financial help rendered by esteemed sponsors - ICAR, New Delhi, U.P. Council of Agricultural Research, Lucknow, NABARD Lucknow, UP Beej Vikas Nigam and IFFCO for successfully organizing this important event. We also acknowledge special thanks to Council of Science & Technology, UP, Lucknow for extending financial support without which this would have never been possible to bringing out the proceedings of the conference. It was thought worthwhile to bring out the proceedings of this Conference for the benefit of scientists engaged in research and development of Agriculture and farmers.

We hope that the proceedings are going to be of immense help to scientists, technologists, research scholars and all those who are concerned with the research and development in this area.

Munish Kumar
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Content

Role of Organic Farming for Sustainable Agriculture

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ABSTRACT

Considering the insufficient usage of natural resources, ecological crisis, rising population and limitations of the traditional food security in the 21st century, it is extremely important to search for methods to achieve sustainable development Indian agriculture. Organic farming is a modern and a sustainable form of agriculture that provides consumers fresh natural farm products. This objective is achieved by using practices to improve soil fertility and soil health (soil physico- chemical and biological properties of soil) without harming the natural environment. Organic forming provides solutions to the problems associated with degradation of soil health and quality production as well as the people who live and work in it. Organic agriculture offers low external inputs, like as different type of manures (farm yard manure (FYM), Vermicompost, green manure, bio- fertilizers, minerals like gypsum, rock phosphate, neem cake, etc.thereby contributing to increased food availability. As compared to conventional agriculture, organic farming produces cost effective food products, free of synthetic fertilizers and pesticides. In addition, organic farming preservation of the health of the nation, environmental protection and natural resources, employment of young people and women in rural areas, positive impact on slowing down migration to urban areas, and strengthening of the competitiveness of national agriculture and economy, enough evidence is available to prove that organic crops are a better source of nutrition than their corresponding conventional forms.

1. INTRODUCTION

There are several definitions of organic farming but the most coherent definition is given by the US Department of Agriculture (USDA). According to it, organic farming is defined as a system that is designed and maintained to produce agricultural products using methods and substances that maintain the integrity of organic agricultural products until they reach to the consumers. Organic farming is a production system which avoids, or largely excludes, the use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives. The objectives of environmental, social, and economic sustainability are the basics of organic farming. **Stockdale *et al,* (2002).** This is accomplished by using substances, to fulfill any specific fluctuation within the system to maintain long term soil biological activity, ensure effective peak management, recycle wastes to return nutrients to the land, provide attentive care for farm animals and handle the agricultural products without the use of extraneous synthetic additives or processing in accordance with the act and the regulations in this part. The origin of organic farming goes back, to more than 4000 years, and organic farming is very much native to this country. As mentioned in Arthashastra, farmers in the Vedic period

possessed a fair knowledge of soil fertility, seed selection, plant protection, sowing seasons, and sustainability of crops in different lands **Sofia *et al* (2006).** The farmers of ancient India adhered to the natural laws and this helped in maintaining the soil fertility over a relatively longer period in its recent history, to 1940s**. Chandra *et al*, (2004).**Organic farming seems to be more appropriate, as it considers the most important aspects like sustainability of natural resources and environmental safety. It is a production system which favor maximum use of organic materials (like crop residue, animal residue, legumes, on and off farm wastages, growth regulators, bio-pesticides) and discourages the use of synthetically produced agro-inputs for maintaining soil productivity, fertility and pest management under conditions of sustainable natural resources and healthy environment. In this study, a review of literatures on organic farming is focused as an alternative for sustainable crop production. The key characteristics include protecting the long-term fertility of soils by maintaining organic matter levels, fostering soil biological activity, careful mechanical intervention, nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, effective recycling of organic materials including crop residues and livestock wastes and weed, and diseases and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, and resistant varieties. A great emphasis is placed to maintain the soil fertility by returning all the wastes to it chiefly through compost to minimize the gap between NPK addition and removal from the soil, **P. K. Chhonkar (2002).**

1.2. Scenario of World and Indian in Organic Farming : Organic agriculture is practiced in 187 countries, and 72.3 million hectares of agricultural land were managed organically by at least 3.1 million farmers. With the most organic agricultural land in Australia (35.69 m hectares) followed by Argentina (3.63 m hectares) and the Spain (2.35 m hectares). There has been an increase in organic agricultural land in all regions. According to the latest FiBL survey on organic agriculture worldwide, organic farmland increased by 1.1 million hectares, and organic retail sales continued to grow. Organic farming is in a nascent stage in India. About 2.30 million hectares of farmland was under organic cultivation as of March 2019. This is two per cent of the 140.1 million ha net sown area in the country. A few states have taken the lead in improving organic farming coverage, as a major part of this area is concentrated only in a handful of states. Madhya Pradesh tops the list with 0.76 million ha of area under organic cultivation — that is over 27 per cent of India's total organic cultivation area. The top three states — Madhya Pradesh, Rajasthan, and Maharashtra — account for about half the area under organic cultivation. The top 10 states account for about 80 per cent of the total area under organic cultivation.

1. 3 Principles of Organic Farming

The main principles of organic farming are as follows **(Chandrashekar, 2010):**

- To work within a closed system and draw upon local resources as much as possible
- To maintain long-term fertility of soils
- To avoid all forms of pollution that may result from agricultural techniques
- To produce foodstuffs in sufficient quantity and having high nutritional quality
- To minimize the use of fossil energy in agricultural practices
- To give livestock conditions of life that confirm to their physiological needs
- To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human being.

1.4 The main pillars of organic farming are:

- Organic threshold standards
- Reliable mechanisms regarding certification and regulatory affairs

- Technology packages
- Efficient and feasible market network

2. MAJOR PILLARS OF ORGANIC FARMING-BASED AGRICULTURE

There are four major pillars of organic agriculture and they are as follows (IFOAM, 2010):

2.1 Principle of Health : Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. This principle points out that the health of individuals and communities cannot be separated from the health of ecosystems-healthy soils produce healthy crops that foster the health of animals and people. Health is the wholeness and integrity of living systems. It is not simply the absence of illness, but also the maintenance of physical, mental, social and ecological well-being. The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems from the smallest organisms in the soil to the human beings.

2.2. Principle of Ecology : Organic agriculture should be based on living ecological systems and cycles, work, emulate and help to sustain them. This principle roots organic agriculture within living ecological systems. It states that production is to be based on ecological processes and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment. For example, in case of crops this is the living soil; for animals it is the farm ecosystem; for fish and marine organisms it is the aquatic environment. Organic farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature. These cycles are universal but their operation is site-specific. Organic management must be adapted to local conditions, ecology, culture and scale. Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity.

2.3. Principle of Fairness : Organic agriculture should be built on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings. This principle emphasizes that those involved in organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties-farmers, workers, processors, distributors, traders and consumers. Organic agriculture aims at providing a good quality of life to everyone involved with it and contribute to food sovereignty and reduction of poverty. It aims to produce a sufficient supply of good quality food and other products. Natural environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations.

2.4. Principle of Care : Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations as well as the environment. Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and well-being. The incomplete understanding of ecosystems and agriculture should be taken care of. This principle states that precaution and responsibility are the key concerns in management, development and technology choices in organic agriculture. Science is necessary to ensure that organic agriculture is healthy, safe and ecologically sound. Organic agriculture should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering etc.

Table 1. Conventional farming Vs Organic farming

Conventional farming	Organic farming
• It is based on economical orientation ,heavy mechanization, specialization and misappropriates development of enterprises with unstable market-oriented programme • Supplementing nutrients through fertilizers, weed control by herbicides, plant protection measures by chemicals and rarely combination with livestock • Based on philosophy of to feed the crop/ plants. production is not integrated into environment but extract more through technical manipulation, excessive fertilization, and no correction balances • Low input: output ratio with considerable pollution • Economic motivation of natural resources with out considering principles of natural up gradation.	• It is based on ecological orientation, efficient input use efficiency, diversification and balanced enterprise combination with stability • Cycle of nutrient within the farm, weed control by crop rotation and cultural practices, plant protection by non-polluting substances and better combination of livestock. • Feed the soil to the plant is the watch word and slogan of organic farming • production is integrated into environment balanced conditions for plants and animals and deficiencies need to be corrected • high input: output ratio with no pollution • Maximum consideration of all natural resources through adopting holistic approaches

3. COMPONENTS OF ORGANIC FARMING

There are assumptions throughout the organic literature of differences between organic and conventional systems with respect to their effects on soil physical properties, soil insect fauna and nutrient flow within the soil, crop health and nutritional value of the harvested crop. Different components of organic farming are as follows.

3.1. Crop and Soil Management : Organic farming system encourages the use of rotations and measures to maintain soil fertility. Carefully managed soil with a high production of humus offers essential advantages with respect to the water retention capacity, ion exchange, soil erosion and animal life in the soil. Green manuring and inter-cropping of legumes is another important aspect for biological farming systems. It not only helps in controlling weeds but also in improving its chemical and physical properties by reducing the leaching of nutrients and reducing soil erosion. Depending on the green manure mixture or the legumes used for under sowing, there may be an increase in soil organic matter, soil N2 as well as increase in other nutrient level. Researches have shown that yields of maize improve in rotation system with soybeans, often by as much as 80% **(Carscy *et al*, 1997).**

3.2. On-farm Waste Recycling : Increase in price of chemical fertilizers has enabled organic wastes to regain an important role in the fertilizer practices on the farm. Good manure management means improved fertilizers value of manure and slurry and less nutrient losses. Composting of all organic wastes in general and Farm Yard Manure (FYM) or feedlot manure in particular is important in organic farming.

3.3. Non-chemical Weed Management : Weed Management is one of the main concerns in organic agriculture. Generally, all aspects of arable crop production play an important role in a system approaching to problems. The elements to consider in preventing weed problems are crop rotation, green manuring,

manure management and tillage. Mulching on a large scale by using manure spreaders may also be useful in weed control.

3.4. Domestic and Industrial Waste : Recycling Use of sewage and sludge for crop production can form an important component of organic farming if treatment and application methods are improved further.

3.5. Energy Use : The energy required for production, measured per rupees of produce for organic farms is only one third compared to their conventional counterparts. Because N_2fertilizer and pesticides are not used by biological farmers, the comparison of total energy input/ha with total energy output favors biological farming systems.

3.6. Food Quality : Food quality is one of the main issues, which concerns both scientists and consumers. Nitrates in water and farm produce, desirable components, pesticides residues, keeping quality and physiological imbalances are some of the important aspects of food quality.

3.7. Ecological Agriculture : The growing concern about environmental degradation, dwindling natural resources and urgency to meet the food needs of the increasing population are compelling farm scientist and policy makers to seriously examine alternatives to chemical agriculture. Integrated Intensive Farming System (IIFS) IIFS involves intensive use of farm resources. To be ecologically sustainable, such intensification should be based on techniques which are knowledge intensive and which replace to the extent possible, market purchased chemical inputs with farm grown biological inputs.

4. ORGANIC SOURCES FOR SUSTAINABLE AGRICULTURE

4.1 Organic Sources of Plant Nutrients : At present, most optimistic estimates show that about 25–30 percent of nutrient needs of Indian agriculture can be met by various organic sources. Supplementation of entire N through FYM sustains crop productivity at more than use of conventional N fertilizers. Since the estimates of NPK availability from organic sources are based on total nutrient content, efficiency of these sources to meet the nutrient requirement of crops is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality, and productivity on long-term basis [3]. These organic sources besides supplying N, P, and K also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients, and decomposed plant residues into an available form to facilitate the plants to absorb the nutrients. The N, P, and K contents of fresh FYM range widely from 0.01 to 1.9 percent on dry weight basis due to variable nature of manure production and storage **(Inoko and Zhu, *et al* (1984).** The farmers can in turn, get good remuneration from organically produced crops and if included in high value crop rotations, that is, aromatic rice (Oryza sativa L.), table pea (Pisum sativum L.), and onion **(Allium cepa L.)** due to their heavy demands in domestic, national, and international markets. In particular, soil, water, and nutrient management strategies, such as reduced tillage and use of raised beds, that avoid the deleterious effects of puddling on soil structure and fertility, improve water- and nutrient-use efficiencies, and increase crop productivity, may be appropriate **J. Timsina *et al* (2001)**

4.2 Effect of Organic Nutrition on Crop Productivity : Addition of organic matter in the soil is a well-known practice to increase crop yields. Sharma and Mitra [14] reported that the application of organic materials increased grain and straw yield of rice. **Ranganathan and Selvaseelan (1997)**. Found that application of spent mushroom and rice straw compost though comparable with FYM increased rice grain yields by 20 per cent over NPK fertilizer. Singh et al. [16] reported that the application of 7.5 t FYM ha^{-1}

produced significantly more grain, and straw yields over unfertilized fields. All of the yield attributing characters of rice increased with increasing rates of FYM. Vermicompost provided macroelements such as N, P, K, Ca, and Mg and microelements such as Fe, Mo, Zn, and Cu [20]. The vermicompost contained 0.74, 0.97, and 0.45 per cent nitrogen, phosphorus, and potassium, respectively **Pal, (2002).** In low-input agriculture, the crop productivity under organic farming is comparable to that under conventional farming. Agroeconomic study of practices of growing maize with compost and liquid manure top dressing in low-potential areas showed significantly better performance than those of current conventional farmer practices of a combined application of manure and mineral fertilizers. Maize grain yields were 11–17 per cent higher than those obtained with conventional practices **Onduru *et al* (2002).**

4.3 Effect of Organic Nutrition on Quality Parameters of Crops : Yadav and Vijayakumari (2004).carried out an experiment to assess the effect of vermicomposted vegetable waste on the biochemical characters of chilli and found that the protein was higher at 60 (113 mg g”1) and 90 DAS (79 mg g”1). The carbohydrate content was higher in vermicomposted treatment at 60 DAS (15.34 mg g”1). Chlorophyll (2.61 mg g”1) and total chlorophyll (3.62 mg g”1) contents were observed at 60 DAS, while chlorophyll a (1.01 mg g”1) was higher at 90 DAS as compared to inorganic fertilizers. In another experiment, **Haase *et al* (2007)**. suggested that tubers from organic potato cropping may be expected to have sufficiently high tuber dry matter concentrations (19 per cent) for processing into French fries without impairing the texture of the fries when concentrations exceed 23 per cent.

4.4 Effect of Organic Nutrition on Soil Fertility : Minhas and Sood (1994) also reported that the organic matter after decomposition release macro- and micronutrients to the soil solution, which becomes available to the plants, resulting in higher uptake. Organic farming could sustain higher crop productivity and improving soil quality and productivity by manipulating the soil properties on long term basis. It was reported that organic and low-input farming practices after 4 years led to an increase in the organic carbon, soluble phosphorus, exchangeable potassium, and pH and the reserve pool of stored nutrients and maintained relativity stable EC level **Clark *et al* (1998) and Gaur *et al* (2002).** Organic farming improved organic matter content and labile status of nutrients [71] and soil physicochemical properties. The materials reduced water content and raised the C: N ratio. However, under Indian conditions, joint composting of the manure slurries with plant residues was more viable and profitable than its separate composting. Use of FYM and green manure maintained high levels of Zn, Fe, Cu, and Mn in rice-wheat rotation.

4.5 Effect of Organic Nutrition on Soil Biological Properties : Compost contains bacterial, actinomycetes, and fungi; hence, a fresh supply of humic material not only added microorganisms but also stimulated them **Balasubramanian (1972) Gaur *et al* (1973).** Besides, compost played an important role in control of plant nematodes and in mitigating the effect of pesticides through sorption. Sorption is the most important interaction between soil/organic matter and pesticides and limits degradation as well as transport in soil. Pesticides bound to soil organic matter or clay particles are less mobile, bio available but also less accessible to microbial degradation and thus more persistent **Prasad *et al* (1972)** and **Gaur *et al* (1975).** reported that organic fertility amendments enhanced beneficial soil microorganisms, reduced pathogen population, total carbon, and cation exchange capacity, and lowered down bulk densities, thus improved soil quality Field experiment conducted with P solubilizers like Aspergillus awamori, Pseudomonas striata, and Bacillus polymyxa significantly increased the yield of various crops like wheat, rice, cowpea (Vigna sinensis

L.), and so forth in presence of rock phosphate and saved 30 Kg P_2O_5 ha^{-1} with the use of phosphate solubilizing microorganisms. Vegetable crops, in general, responded better to Azotobacter inoculation than other field crops.

5. ADVERSE EFFECT INDIAN FARMING FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT.

The extensive use of agro chemicals in modern farming by the developed and under developed countries, cause various adverse effect on soil, water, food and atmospheric environment which are reviewed below.

5.1. Fertilizer Pollution : In the developed countries, there has been intensive use of fertilizers since the last four decades. The polluting effects of fertilizers are being observed now; similar problems in the developing countries should be expected soon. Some important problems associated with fertilizers pollution are Nitrate Pollution Application of N_2 fertilizers such as urea and ammonium sulphate to soils produces acid by two processes. Firstly, the natural process of oxidation of ammonium ions to nitrate ions release acid. Part of acid produced is neutralized by alkaline ions released by plants during the subsequent uptake of the nitrate ions. Secondly, since nitrate ions are not strongly absorbed by the soil they are liable to leach or move down through the soil. The negatively charged nitrate ions carry positively charged basic cataions such as Ca, K, Mg and Na in order to maintain the electric charge on the soil particles. A high nitrate concentration indicates the likely presence of harmful bacteria as well. In condition, to high enrichment, NO_3 may produce a state known as methemoglobinemia (blue babies) which generally affect the infants under six months of age. Repeated heavy dose of nitrate on ingestion may likely cause carcinogenic diseases. Consumption of high dose of NO_3 may develop symptoms of dizziness, abdominal cramps, vomiting, weakness, convulsion, mental impairment and even nitrosamine which causes stomach cancer. Apart from this, overuse of N_2 fertilizers leads to swindling of earthworms from the particular area. Earthworms have always been considered a farmer's friend and their absence means loss to the soil fertility.

5.1.2. Accumulation of Heavy Metals : Contamination of soil by heavy metal through fertilizers such as cadmium from phosphate fertilizers is catching the increasing attention of environmentalists (**Kostial, 1977).** Health hazards associated with heavy metals entering the food chain through soil is demanding attention. Fertilizers contain heavy metals as impurities. The application of rock phosphate or its produce to soil always implies the addition of significant amount of lead and cadmium into the soil. Analysis of several commercial fertilizers commonly used revealed that a combination of low analysis and straight fertilizers can add more lead and cadmium to soil than high analysis and mixed fertilizers **(Arora et al., 1995).**

5.2. Pesticide Pollution : The use of different types of poisonous substances as pesticides, contribute towards imbalances in the ecosystem and polluting the environment. Pesticides are extremely used nowadays to control various pests which are harmful to the crops raised by man for food, feed and fiber production. However, most of the chlorinated pesticides are non-biodegradable and leave residue which are detrimental to human beings, animals and the environment.

5.3. Insecticide Pollution : The presence of residues of insecticides in food commodities and other components of the environment is a matter of serious concern. Even small quantities of the residues ingested daily along with food can build up to high levels of body fat **(Dhaliwal and Koul, 2010).** During the 1900's, there was little information available on the bad impose of pesticide on soil and water quality. Organochlorine insecticides such as chlorine, dieldrin, DDT and heptachlor were widely used in agriculture to control insect/

pests in different countries. Since 1960's, the organochlorine use was progressively restricted and is finally banded now. Nevertheless, their residues are still found in soil and continue to cause problems of food and food contamination.

5.4 Herbicide Pollution : The use of chemicals for controlling weeds started with the introduction of 2,4-D in 1940's. The usage of herbicide is higher than any agro-chemicals. Farming has now realized the importance of herbicide usage for harvesting higher crop yields.

5.**4.1. Negative Effect on Soil Ecosystem :** Herbicide plays an important role in the disturbance of soil ecosystem where soil micro-flora and fauna lies in the breaking down of organic matter, incorporating it into the soil and releasing nutrients for plant growth. The herbicide can have direct effect upon decomposing micro-organisms, rhizosphere micro-organisms, root pathogens and disease antagonists such as parasites and predators as well as organisms pathogenic to invertebrates.

5.4.2. Bad Effect in Farmer's Health : The increased uses of herbicides in recent years have caused more concern due to their effect on farmer's health. While herbicide technology has made remarkable progress in terms of developing sage herbicides that are less toxic to human beings, many farmers still suffer from chemical poisoning after applying herbicides.

5.4.3. Soil, Water and Environment : Effect We can probably assume that herbicides applied over many years are always going to have some adverse impact on the environment. They not only affect many species of plants and animals in and around farmland but also cause pollution of underground as well as surface water. New ecotypes of weed which are resistant to herbicides have developed.

CONCLUSION

This chapter has focused on organic agricultural sustainability, and its relationship to various alternative agricultural approaches. organic farming is suited to improve soil fertility and nutrient management markedly on the farm level. With reference to biodiversity, organic agriculture is committed to conservation of biodiversity within agricultural systems. The organic agriculture movement had its roots in a philosophy of life and not in the agricultural science **(Kirchmann, 1994**). In any case, one fundamental reason for increasing interests in organic agriculture is due to the requirements and attention of health, environmental protection, and food safety. Agriculture remains the key sector for the economic development of most developing countries, because for development, any country should be self-sufficient for food shelter and cotton. To make a country self-sufficient, there has been intensive use of fertilizer for the last four decades, which has created several problems linking excessive fertilizer use with environment. Increased amount of nitrate in drinking water is due to excessive and improper use of nitrogen fertilizers, which is most important fertilizer related pollution issues. Agriculture is not sustainable if its resource base declines, or if it has an adverse impact on the environment or leads to economic hardship for farmers especially for farmers with limited resources and landless tenant cultivators. To overcome such problems, organic farming receives the top priority in sustainable agriculture. Experiments conducted on different legume crops grown under varying agro-ecological conditions proved the potentiality of bio-fertilizer and organic wastes as important source of plant nutrients. So, from the different reviewed study, organic farming is practical proposition for sustainable agriculture if adequate attention is paid to this issue. There is urgent need to involve more and more scientists to identify the thrust area of research for the development of eco-friendly production technology.

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Significance of Liquid Organic Manures in Indian Agriculture –A Review

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INTRODUCTION

Use of agro-chemicals in agriculture has weakened the ecological base in addition to degradation of soil, water resources and quality of the food. Awareness has to be created on the adoption of organic farming as a remedy to makeover the ill effects from modern chemical farming (Kannaiyan, 2000). Enough organic sources like; legume-based crop rotations with BNF, non-symbiotic nitrogen fixation, crop residues, composts, green manures, animal dung and urine, plant based nutrients, nutrient transformations, mineralization of nutrients etc, are the greater options available with us on the farm to replace with the demand of chemical fertilizers up to some extent in organic farming. The proper management of these make it possible to increase the efficiency of soil and added nutrients. Now, it is essential to develop a strong workable, feasible and compatible package of nutrient management through organic resources for various crops based on scientific facts, local conditions and economic viability. The use of fermented liquid organic manures, effective microorganisms and fermented plant extracts as foliar fertilizers have been introduced to modern agriculture in recent years to produce food with good quality and safely (Galindo et al., 2007). Liquid manure is often regarded as the best among manures. Organic composts and other solid manures are great but they have one drawback over conventional soluble manures that they take a break down in the soil and become available to plants. So, for the successful growing of heavy feeding crops the judicious use of liquid manures has an effective tool and can be applied to all crops such as pulses, oilseeds, rice, sugarcane, vegetables, fruits, flowers, etc. Use of fermented curd, rich in beneficial microorganisms, is also practiced elsewhere both to augment plant growth and suppress pest load on crop plants. Of late, use of fermented cow dung, urine, milk fat, curd and milk with the name of Panchagavya is getting adaptive popularity in Indian agriculture largely through the efforts of small groups of farmers. Role of foliar applied Panchagavya in production of many plantation crops had been well documented in India (Selvaraj, 2003). Panchagavya, an organic input, can act as a growth promoter and immunity booster. Panchagavya was the most cost-effective growth promoter for small and marginally profitable vegetable crop growers (Bindumathi, 2008). Its role as plant growth promoter has already been reported by Subhashini et al. (2001) and Sreenivasa et al. (2009). Foliar spray of Panchagavya + neem leaf extracts registered significant improvement in chlorophyll content, nitrate, reductase activity, root nodule weight, dry matter accumulation, nutrient content and uptake, yield attributes and yield of groundnut when compared with control and Panchagavya alone (Kumawat et al., 2009).

Liquid manures in Indian Scenario- Panchagavya acts both as fertilizer and biopesticide (Anonymous, 2005a). Nene (1999) reported that cow's ghee had been used in ancient and medieval times (Kautilya 321-296 BC and Someshwara Deve 1126 AD) for managing seedling health. The ghee contains vitamin A, Vitamin B, Calcium, fat and also glycosides, which protects cut wounds from infection. Cows curd is rich in microbes (Lactobacillus) that are responsible for fermentation (Chandha, 1996). Pathak and Ram (2002) reported that Rishi Krishi, a system of traditional agriculture practiced in Maharashtra is using Amrit pani (prepared by mixing 20 kg cow dung, 0.125 kg butter, 0.50 kg honey, 0.25 kg ghee) and kept overnight to treat seeds and for spraying on field crops to maintain soil fertility and crop yield.

Panchagavya- It is a promising natural liquid manure is being used by many organic farmers in many agricultural and horticultural crops in different parts of our country (Anonymous, 2005 b). Panchagavya has got reference in the scripts of Vedas (divine scripts of Indian wisdom) and Vrkshayurveda (Vrksha means plant and ayurveda means health system). The texts on Vrkshayurveda as systematization of the practices that the farmers followed at field level, placed in a theoretical frame work and it defined certain plant growth stimulants, among them Panchagavya was an important one that enhanced the biological efficiency of crop plants and quality of fruits and vegetables (Natarajan, 2002). In Sanskrit, Panchagavya means a combination of five products obtained from cow viz., cow dung, cow urine, cow milk, cow ghee and cow curd. Panchagavya has the potential to play the role of promoting growth and providing immunity in plant system. Panchagavya was tested for different crops such as turmeric, paddy, onion, gingely, sugarcane, banana, vegetables and curry leaf and it was found that it enhanced the growth, vigour of crops, resistance to pest and diseases and improvement of keeping quality of vegetables and fruits (Natarajan, 2002). Panchagavya is used in different means such as foliar spray, soil application along with irrigation water, seed or seedling treatment etc. For foliar spray, 3% concentration is being adopted by organic farmers using hand-operated sprayers with high pore sized nozzle (Natarajan, 2002).

Physico-chemical and biological properties of fermented liquid manures- The nutrient status and microbial load present in Panchagavya, Jeevamrutha, Beejamrutha and Bio-digester are analysed by many scientists/institutes. Presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi were detected in organic liquid manures (Swaminathan, 2005).

Panchagavya- It contained Pseudomonas (45 x 103 cfu/ml) and saprophytic yeasts (35 x 104 cfu/ml) which might have contributed to plant protection because Pseudomonas on plant surfaces have been found to induce pathogenesis related protein, siderophores, antibiotics and HCN in groundnut and rice thus, enabled its use as a bio-controlling agent (Meena et al., 2000). Swaminathan et al. (2007) reported that Panchagavya is a fermented liquid of 5 main ingredients viz., cow dung, cow urine, cow's milk, ghee and curd and this ultimate product had total N (302 g/kg), total P (219 mg/kg), total K (355 mg/kg), total organic carbon (0.80%), bacteria (34 x 106 cfu/ml), fungi (22 x 104 cfu/ml), Actinomycetes (3 x 102 cfu/ml), Zn (0.26 mg/kg), Fe (0.83 mg/kg), Mn (0.23 mg/kg), Cu (0.20 mg/kg), pH of 6.02 and electrical conductivity 3.02 dS/m. Sreenivasa et al. (2011) reported that Panchagavya had pH 6.8, soluble salt 1.88 ds/m, total nitrogen 0.1%, total phosphorus 175.4 ppm, total potassium 194.1 ppm, total zinc 1.27 ppm, total copper 0.38 ppm, total iron 29.71 ppm, total manganese 1.84 ppm, bacteria (26.1 x 105 cfu/ml), fungi (18 x 104 cfu/ml), Actinomycetes (4.2 x 103 cfu/ml), Phosphate solubilising organisms (5.7 x 102 cfu/ml) and free living N2-fixers (2.7 x 102 cfu/ml).

Presence of naturally occurring, beneficial, effective microorganisms in Panchagavya predominantly, lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi besides beneficial and proven fertilizers such as Azetobacter, Azospirillum and Phosphobacterium were detected which have the beneficial effect especially in improving soil quality, growth and yield of crops (Xu and Xu, 2000 and Papen et al. (2002).

Jeevamruta- It is a fermented liquid product prepared by mixing up cow dung (10 kg) with cow urine (10 litre), jaggery (2 kg), legume flour (2 kg) and handful of soil brought from the bunds of the lands where cultivation is to be taken up (Palekar, 2006) and kept for one-week incubation. Jeevamruta also contains enormous amount of microbial load which multiply and act as a soil tonic. It is said to enhance microbial activity in soil and ultimately ensuring the availability and uptake of nutrients by the crops. Sreenivasa et al. (2011) reported that Jeevamruta had pH 7.07, soluble salt 3.40 ds/m, total nitrogen 770 ppm, total phosphorus 166 ppm, total potassium 126 ppm, total zinc 4.29 ppm, total copper 1.58 ppm, total iron 282 ppm, total manganese 10.7 ppm, bacteria (20.4 x 105 cfu/ml), fungi (13.8 x 104 cfu/ml), Actinomycetes (3.6 x 103 cfu/ml), Phosphate solubilising organisms (4.5 x 102 cfu/ml) and free living N2-fixers (5 x 102 cfu/ml).

Beejamruta- It was prepared using the different ingredients cow dung, cow urine, water and lime. Cow dung (5 kg) tied in a cloth was dipped in a bucket containing 50 liters of water overnight. Next day morning, the tied dung was frequently squeezed and dipped in the water. Five litres of cow urine, a handful of soil and 50 g of calcium chloride was added to this extract. Sreenivasa et al. (2011) reported that Beejamrutha had pH 8.2, soluble salt 5.5 ds/m, total nitrogen 40 ppm, total phosphorus 155.3 ppm, total potassium 252 ppm, total zinc 2.96 ppm, total copper 0.52 ppm, total iron 15.35 ppm, total manganese 3.32 ppm, bacteria (15.4 x 105 cfu/ml), fungi (10.5 x 104 cfu/ml), Actinomycetes (6.8 x 103 cfu/ml), Phosphate solubilising organisms (2.7 x 102 cfu/ml) and free living N2-fixers (3.1 x 102 cfu/ml).

Bio-digester- Bio-digester was prepared by adding botanical plants mainly neem, calotropis, vitex, lantana, adothoda, ipomea, custard apple and agave (5 kg each) to the bio-digester tank containing urine (10 litres), dung (10 kg), little quantity of soil and 200 litres of water. The digested liquid manure was ready in 3 weeks. Sreenivasa et al. (2011) reported that Bio-digester had pH 7.29, soluble salt 1.09 ds/m, total nitrogen 255 ppm, total phosphorus 79 ppm, total potassium 42 ppm, total zinc 0.52 ppm, total copper 1.24 ppm, total iron 9.6 ppm, total manganese 8.3 ppm, bacteria (12.9 x 105 cfu/ml), fungi (9.2 x 104 cfu/ml), Actinomycetes (3 x 103 cfu/ml), Phosphate solubilising organisms (1 x 102 cfu/ml) and free living N2-fixers (2.1 x 102 cfu/ml).

Effect of liquid manures on growth and yield- Effect of Panchagavya on germination and growth of spinach (Tetragonia tetragonoides) in showed that Panchagavya foliar spray on 10th, 20th, 30th, 40th and 50th DAP alone gave 18% higher yield over the conventional method (Natarajan, 1999). Balasubramanian et al. (2001) reported that dipping of rice seedlings in Panchagavya solution before transplanting enhanced the growth and yield. Oparaeke et al. (2001) recorded more pod intensity per plant with application of neem leaf extract in cowpea. Increased yield with Panchagavya application due to augmentation in the biological efficiency of crop plants was observed by Natarajan (2002). Selvaraj (2003) also reported 36% increase in yield of French bean with application of vermicompost + Panchagavya. Increase in yield of sunflower, maize and green gram was also observed with Panchagavya spray (Somasundaram, 2003). Louduraj et al. (2005) observed that Panchagavya @ 3% spray 4 times for okra augmented the yield level in treatment

receiving poultry manure over the control. Similarly, Panchagavya applied @ 3% spray at 0, 30, 50 days after planting in rice crop recorded significantly higher grain yield over no Panchagavya spray (Ramanathan, 2006). Increase of 7-11% in grain length, 100-grain weight, grain and stover yield of rice with the foliar spray of Panchagavya was reported by Yadav and Louduraj (2006). They had also reported higher tillers per hill in rice with Panchagavya spray. All growth parameters, yield attributes and yield of soybean were recorded significantly higher under the plots receiving organic manures in combination with fermented liquid manures viz., Beejamruta, Jeevamruta, Panchagavya over organic manures alone (Shwetha and Babalad, 2007). Increased number of leaves/plant of ashwagandha was recorded with the application of Panchagavya (3%) solution by Mohanalakshmi and Vadivel (2008). Chandrakala (2008) observed higher dry chilli yield over the control with combined application of Beejamruta + Jeevamruta + Panchagavya and spray of Panchagavya alone plots. Growth, nutrient uptake, yield and andrographolide content in kalmegh (Andrographis paniculata) were appreciably improved with the application of farmyard manure and Panchagavya spray in conjunction (Sanjutha et al., 2008). Two sprays of Panchagavya at 30 days after sowing and flowering stage in sesame recorded higher seed yield by 3.2% over the control (Ravusaheb, 2008).

Amazing development in consumptive use of water, water use efficiency, yield and yield attributes of maize was recorded due to green manure incorporation and foliar spray of Panchagavya twice in the standing crop (Meena et al., 2009). Higher number of seed sized tubers and the yield of potato tubers were registered with spraying of Panchagavya at 15 days' interval in the fields and soaking the tubers in 3% Panchagavya solution before storage over the control by Ravichandran et al. (2011). Three foliar sprays of Panchagavya (3%) and soil application of Jeevamruta brought significant improvement in growth and yield parameters as well as yield of greengram resulted in 15.6 and 14.4% increase in grain yield over the control, respectively (Yadav and Tripathi, 2012). Soil application of Panchagavya solution (3 l/m2) significantly enhanced pod and haulm yield of groundnut to the tune of 85.3 and 93.2%, respectively, over the control (Kumawat et al., 2013). The possible reason might be due to that the application of organic sources of nutrients as foliar spray would have induced the endogenous synthesis of native auxins resulting in active growth. Moreover, the interaction with the synthesis of native cytokinins in the root cells and its transport at later stages to axilary buds, led to formation of more growth. The other possible explanation might be due to the favourable effects of IAA, GA3, major and micronutrients and also microorganisms present in these liquid manures (Somasundaram, 2003). Similarly, the beneficial effects of Jeevamruta reported by Palekar (2006) and Vasanthkumar (2006) was attributed to huge quantity of microbial load and growth hormones which might have enhanced the soil biomass, thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately resulted in growth and yield of crops.

Effect of Panchagavya blended with leaf extracts on growth and yield- Three foliar sprays of Panchagavya (3%) + neem leaf extracts (1:1) brought significant improvement in growth and yield parameters as well as yield of greengram resulted in 10.5 and 27.7% increase in grain yield over Panchagavya alone and the control, respectively and this might be owing to presence of growth promoting substances in Panchagavya might have produced a positive effect on physiological growth of the crop and in turn helped in increased yield attributes and yield of greengram (Yadav and Tripathi, 2012). Kumawat et al. (2013) reported that foliar spray of Panchagavya in combination with datura (Datura metel) leaf extract at 1:1 ratio enhanced pod yield of groundnut significantly over the control.

Effect of liquid manures on quality parameters- Quality parameters such as crude fibres, protein, ascorbic acid, carotene content and shelf life of annual moringa (Moringa oleifera Lam.) were found higher in organic manure applied with Panchagavya spray (Beaulah et al., 2002). Yadav and Lourduraj (2006) revealed that foliar spray of Panchagavya and organic manures recorded better cooking qualities and physical characteristics of rice as well as higher sensory score as compared to recommended N, P and K through fertilizers. Vennila and Jayanthi (2008) revealed that application of 100% recommended dose of fertilizer combined with 2% foliar spray of Panchagavya in okra resulted in higher crude protein, ascorbic acid and Barletts index. Concentrations of ascorbic acid, total soluble solids, oleoresin, capsaicin and capsanthin in paprika (Capsicum annuum var. Longum) were increased due to application of Panchagavya @ 4% (Kumar et al., 2008). Combined application of Beejamruta + Jeevamruta + Panchagavya and spray of Panchagavya alone had higher ascorbic acid, oleoresin and colour value in chilli over the control (Chandrakala, 2008). Ravi Kumar et al. (2011) reported that quality parameters like protein and oil content as well as protein yield were recorded significantly higher with the application of FYM (7.5 t/ha) + Rhizobium + PSB + Panchagavya (3% at 30, 60 and 75 DAS) as compared to other integrated organic treatments.

Effect of liquid manures on soil properties- Pathak and Ram (2002) observed that Rishi krishi, a system of agriculture practice in Maharashtra uses Amrit Pani (prepared by mixing 20 kg cow dung, 0.125 kg butter, 0.5 honey, 0.25 kg ghee) and kept overnight to treat seeds and for spraying on field crops to maintain soil fertility and crop yield. Application of liquid organics such as organic booster @ 1 litre/m2, cow dung urine slurry @ 1 litre/m2 along with vermicompost @ 5 t/ha recorded higher organic carbon content than the recommended dose of fertilizer; whereas, the pH and EC were decreased after harvest of chilli compared to initial values (Hangarge et al., 2004).

Shwetha and Babalad (2007) reported that soil properties viz., organic carbon and available soil nutrients (N, P2O5 and K2O) after harvest of soybean and wheat crops were significantly higher with organic manures alone or in combination with fermented organics viz., Beejamruta + Jeevamruta + Panchagavya; however, microbial and enzymatic activity was significantly higher in same treatments. Poyyamoli (2008) reported that the combined application of FYM @ 12.5 t/ha along with Panchagavya and Amutha karaisal registered highest amount of available macronutrient and K, higher exchangeable K, exchangeable Ca, exchangeable Mg and lower exchangeable Na and ESP at post-harvest of rice. Ravusaheb (2008) reported that two sprays of Panchagavya at 30 DAS and flowering stage recorded higher microbial population and available N, P2O5 and K2O content in the soil.

Influence of Panchagavya on soil fertility- Microbial flora of soil plays an important role in soil health. The microorganisms present in the rhizospheres environment around the roots affect the plant growth and crop yield. The beneficial microorganisms from Panchagavya and their establishment in the soil improved the sustainability of agriculture. Kumawat et al. (2013) suggested that soil application of Panchagavya may possibly be recommended for yield improvement in a high pH soil as it helped in temporarily moderation of undesirable soil chemical properties. Further they reported that soil application of Panchagavya solution (3 l/m2) significantly decreased the soil pH from 9.0 to 8.3 during initial 5 days' period, whereas it increased soil organic carbon content by 50% and availability of P, Fe, Cu, Zn and Mn in the rhizosphere by 17%.

CONCLUSION

Plant growth substances present in fermented liquid manures help to bring rapid changes in phenotypes of plants and also improves the growth and ultimately enhance the productivity of the crops. The microorganisms present in soil rhizospheres environments around the roots affect the plant growth and crop yield. The beneficial microorganisms found in liquid manures and develop in the soil enhance the sustainability of organic and natural farming of agricultural and horticultural crops.

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A Study About the Level of Farm Mechanization in Etawah District of Uttar Pradesh

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ABSTRACT

Agricultural system all over the world has undergone changes in terms of cropping system, type of power sources used and application of inputs to achieve high level of productivities. Even in India, mechanization of agriculture has advanced considerably. In certain region, the level of mechanization has gone far ahead of the average level in the country. Human and animal power sources are no longer the predominant sources on Indian farms. The shortage of labourer and high labourer wages are the factors which strongly propel mechanization. Consequently, the more labourer intensive operations, such as pumping of irrigation water, land preparation and threshing are the first operations, which are mechanized. Large amount laborer or draft power, which can be replaced through machines, provides a strong incentive to mechanize. The three stages sampling technique was done for the selection of Blocks, Villages and farmers. All the 08 Blocks of Etawah District, 40 Villages (05 Villages from each Block) and 160 farmers (04 farmers from each Villages) were selected purposively. Data were collected / recorded on structured schedule & questionnaires by the personal interview method after then data were tabulated and analysed for the purpose. The findings of the study were revealed that the mechanization level of farmers regarding the milling and water lifting tubewell (ranked first) was highest followed by carrying / transporting, threshing, seedbed preparation / tillage (ranked second), digging (ranked third), shelling (ranked fourth), hauling, planting (ranked fifth) and crushing, winnowing /cleaning / grading (ranked six). The highest cost of farm machinery / equipment was the most important constraint followed by small size and fragmented land holdings, lack of appropriate farm machineries / equipments suited to small and marginal farmers and lack of interest in rural youths as agricultural entrepreneurs.

Key words: Mechanization, Cropping System

INTRODUCTION

Farm Mechanization- Farm Mechanization is the process of using agricultural machinery to mechanize the work of agriculture and greatly increasing the farm workers' productivity. The effective mechanization contributes to increase production in two major ways, firstly the timeliness of operation and secondly the good quality of work.

Scope of Mechanization- It is quite true that the Indian farmers have the lowest earnings per capita because of the low yield per hectare they get from their holdings. One of the few important means of increasing farm production per hectare is to mechanize it. Mechanization in India may have to be done at various levels.

History indicates that the development in farm mechanization is very closely related to the shortage of human labourer and industrial development in the country.

Agricultural system all over the world has undergone changes in terms of cropping system, type of power sources used and application of inputs to achieve high level of productivities. Even in India, mechanization of agriculture has advanced considerably. In certain region, the level of mechanization has gone far ahead of the average level in the country. Human and animal power sources are no longer the predominant sources on Indian farms. The shortage of labourer and high labourer wages are the factors which strongly propel mechanization. Consequently, the more labourer intensive operations, such as pumping of irrigation water, land preparation and threshing are the first operations, which are mechanized. Large amount labourer or draft power, which can be replaced through machines, provides a strong incentive to mechanize.

OBJECTIVES

1) To study the level of farm mechanization.

2) To study the problems of farm mechanization and possible strategies for promoting farm mechanization

RESEARCH METHODOLOGY

1. MethodandtimeofInvestigation.

The survey method was adopted for the collection of primary data. The data were collected from the farmers through the direct interview on structured schedule in the year 2019-20.

2. Sampling Technique

1. The Multi stage (three stage) sampling technique was done for the selection of blocks, villages and farmers.
2. All the 08 blocks of Etawah district, namely Jaswantnagar, Saifai, Basrehar, Barhpura, Takha, Bharthana, Chakarnagar and Mahewa were selected purposively.
3. The 05 villages from each block (total number of 40 villages) were selected purposively.
4. The 04 farmers from each village (total number of 160 farmers) were selected purposively for the study.

3. Methods of data Analysis

The data were analysed by using percentage, average (mean) and rank order.

$$\text{Percentage (\%)} = \frac{\text{the frequency of a particular cell}}{\text{the total no. of respondents}} * 100$$

$$\text{Average (\%)x} = \frac{\sum x}{n}$$

$$\text{Mechanization level (\%)} = \frac{\text{obtained score}}{\text{maximum score}} * 100$$

RESULTS AND DISCUSSION

The level of farm mechanization in different farm operations

The level of farm mechanization in different farm operations of Etawah district (U.P.) tabulated as under.

Table 1 : Level of farm mechanization in different farm operations: N=160

S. No.	Farm Operations	Level of farm mechanization		
		Number	Percentage	Rank
1.	Seedbedpreparation/tillage	152	95	02nd
2.	a)sowing	24	15	11th
	b)planting	128	80	5th
	c)transplanting	03	02	15th
3.	Weedingandhoeing			
	a) weeding	17	11	12th
	b) interculture	16	10	13th
4.	Bund/furrowmaking	104	65	07th
5.	Plantprotection			
	a) spraying	80	50	09th
	b)dusting	48	30	10th
6.	Irrigation			
	a)waterliftingtubewell	160	100	1st
	b)applicationof water(sprinkling&dripping)	08	05	14th
7.	Harvesting/digging/uprooting			
	a)harvesting	96	60	08th
	b)digging	144	90	03rd
	c)uprooting	08	05	14th
8.	Threshing/shelling/crushing etc.			
	a) Threshing	152	95	02nd
	b) Shelling	136	85	04th
	c) Crushing	120	75	06th
	d) Hauling	128	80	05th
	e) Milling	160	100	01st
9.	Winnowing/cleaning/grading	120	75	06th
10.	Packaging	02	01	16th
11.	Carrying/transporting	152	95	02nd

It reveals from table 1 that the level of mechanization in different farm operations was established by deriving a relationship between the various farm implements and operations. The study reveals that the mechanization level was highest in milling and water lifting tubewell i.e. 100% and ranked 1st, Carrying / transportation, threshing & seedbed preparation/tillage i.e. 95% at 2nd rank and digging i.e. 90% at 3rd rank and followed by shelling, hauling, crushing, winnowing/ cleaning/grading, bund / furrow making, harvesting,

spraying, dusting, showing, weeding, interculture, application of water & uprooting, transplanting and packaging, i.e. 85%, 80%, 75%, 65%, 60%, 50%, 30%, 15%, 11%, 10%, 5%, 2% & 1% , respectively. Thus, the highest level of mechanization in milling and water lifting tubewelli.e. 100%, the lowest level of mechanization in packaging i.e. 1%.

Table 2 : TheProblemsfacedby thefarmers infarmmechanization

S. No.	Problems	Respondents		OATMS=160 OATS(OAR)
		MF(MS=80) S(R)	NMF(MS=80) S(R)	
1.	Smallsize&fragmentedlandholdings	73	75	148(02)
2.	Lowriskbearingcapacityof farmers	64	70	134(06)
3.	Lowinvestmentcapacityoffarmers	62	68	130(08)
4.	Facilitiesarenotavailableforskilltraining of farmers/ruralartisans/entrepreneurs	68	42	110(11)
5.	Enough and easy availability ofbullockpowerfordifferentfarmoperations	48	30	78(15)
6.	Highcostof farmmachineries	78	80	158(01)
7.	Poorcreditsupportsystem	72	68	140(04)
8.	Lackofsparepartsandservicecentreswithin easyreach	56	42	98(13)
9.	Nonpromotiontosmallandmarginal farmers bydealers/manufactures	50	58	108(12)
10.	Pooravailabilityof agriculturalinput	65	67	132(07)
11.	Lack of appropriate farmmachineries/ equipmentsuitedtolocation	63	60	123(09)
12	Lack of appropriate farmmachineries/equipmentsuitedtosmallandmarginal farmers	67	71	138(05)
13.	Non availability of farmmachineries/ equipmenttimelyoncustomhire	50	72	122(10)
14.	Poor extension/information/ knowledgedisseminationsystem	56	40	96(14)
15.	Lackofinterestinruralyouthsasanagriculturalentrepreneurs	76	69	145(03)

It reveals from table 2 that the high cost of farm machinery/equipment was the most important constraint with 1st rank, small size and fragmented land holdings with 2nd rank, lack of interest in rural youths as an agricultural entrepreneurs 3rd rank followed by poor credit support system, lack of appropriate farm machinery equipment suited to small & marginal farmers, low risk bearing capacity of farmers poor availability of

agricultural inputs, low investment capacity of farmers, lack of appropriate farm machinery / equipment suited to location, non availability of farm machineries / equipment timely on custom hire, facilities are not available for skill training to farmers / rural artisans, non promotion to small & marginal farmers by dealers / manufacturers, lack of spare parts and service centres within easy reach, poor extension / information dissemination system and enough & easy availability of bullock power for different farm operations, respectively.

Thus the high cost of farm machinery/equipment was the most important constraint with 1st rank and Enough and easy availability of bullock power for different farm operations 15th rank, was less important constraint faced by farmers.

CONCLUSION

The Mechanization level of farmers regarding the milling and water lifting tubewell were the highest level of mechanization followed by carrying/transporting & threshing, seedbed preparation/tillage operations, digging, shelling, hauling, and crushing operations. Still there are some problems in farm mechanization faced by the farmers such as high cost of farm machineries, small size and fragmented land holdings, low investment capacity of the farmers and poor extension/information/knowledge dissemination system, lack of interest in rural youths as an agricultural entrepreneurs and poor credit support system to the farmers.

RECOMMENDATIONS

1. Technical know-how should be provided to the farmers with respect to appropriate use of farm machinery / equipment / tools.
2. The farm machinery, equipment and tools suitable for different types of soil and operations for important crops should be developed and manufactured.
3. Skill Training relating to farm machinery and equipment should be imparted to the farmers and artisans.
4. Farm mechanization service units should be encouraged and mobile service units should be started.
5. Adequate and soft loans should be provided to farmers for farm mechanization.
6. Increase interaction among farmers, researchers, extensionists, department of agriculture and industry.
7. Custom hiring system for farm machinery/ equipment / tools is required to encourage in rural areas at local level through Govt. (central/state) organization.
8. Need to develop eco-friendly farm machinery/ equipment / tools by research organizations.

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Mitigating Strategies to Combat Malnutrition

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ABSTRACT

Malnutrition is the condition that develops when the body is deprived of vitamins, minerals and other nutrients it needs to maintain healthy tissues and organ function. Malnutrition occurs in people who are either under nourished or over nourished. Since these adolescent females are the emcee of upcoming future generation, their health is of utmost importance. The various factors that are revealed in the present study could further be targeted in routine health-care settings through counseling and guidance clinic under the direct supervision of primary-care physicians. In primary health-care settings apart from providing curative services, direct involvement of medical professionals and primary-care physicians in implementation of opportunity strategies like adolescent's behavioral change toward inculcation of healthy lifestyle, their counseling for optimal physical activities, and augmentation of knowledge regarding importance of proper balanced diet will be the most cost-effective way to deal with the problem. Also, among higher socioeconomic group who use to prefer private medical professionals for health seeking and where the proportion of obese children is comparatively more, these physicians could play a significant role through concurrent counseling of parents and their children to bring out desired behavioral change substantially so as to prevent forthcoming complications associated with over nutrition. Strengt hening public health interventions for mild malnutrition cases and vulnerable groups, effective implementation and evaluation of the strategies at regional level, research on overweight, obesity and its etiological factors and steps for improving socioeconomic development are the prerequisites for tackling malnutrition in India.

Keywords: Malnutrition, strategies, adolescent girls, India, future generation

INTRODUCTION

There is an old Arab adage "One's stomach is the one's illness." This implies that most illness and health problems come from the eating and dietary habits. The majority of people in modern times have problems with their health because of poor eating habits. There was a time when people die due to famine and hunger but now a day's people die from either eating too much orby eating too little that harms their body and health. In modern era especially in developed and industrial countries people are dying from eating too much where as in developing and under developed countries people are dying from eating very little. When the body of the people living in any country suffers from problems associated with nutrition, they are called suffering from malnutrition. The word malnutrition is derived from the Malus (bad) and Nutrire (tonourish). It includes not only under nutrition (deficiency of one or moreessential nutrients) but also over nutrition (an access of one or more nutrients).

World Health Organization (WHO) defined malnutrition as the cellularim balances between the supply of nutrients and energy and the body demand for them to ensure growth, maintenance and specific function. India is one of the fastest growing economies in the world but Indian children are suffering with world's worst levels of malnutrition.

The Global Hunger Index Has ranked India 100 out of 117 countries. The prevalence of malnourishment in children in India is nearly double that in Sub-Saharan Africa and affects the mortality rate, productivity and economic growth. Each year, nearly half of the children in India are malnourished and almost a million children die before reaching one month age. In India 43 percent of the children under five are under weight and 48 per cent are stunted, due to severe malnutrition (3 out of every 10 children are stunted ice are malnourished and almost a million children die before reaching one month age. In India 43 percent of the children under five are under weight and 48 per cent are stunted, due to severe malnutrition (3 out of every 10 children are stunted. According to recent data about 40 per cent children under five are stunted 21 per cent of children under five are severely wasted or under nourished. According to UNICEF, India was at the 10th spot among countries with the highest number of under weight children and at the 17th spot for the highest number of stunted children in the world. Malnutrition in not only prevailing among children in India but also crippled the adults irrespective of gender. Among adults 23 per cent of women and 20 per cent of men are considered under nourished in India. On the other hand, 21 per cent women and 19 per cent men are over weight or obese. This under nutrition and over nutrition indicates that adults in India are suffering from dual burden of malnutrition (abnormal thinness and obesity).

MALNUTRITION

Medical science and most of the doctors believe that nutrition is the mostserious threat to human health and even more serious than cancer or heart diseases. Malnutrition does not only due to the lack of nutritional materials needed by the body, but also to any lack of balance in the individual's diet. Therefore, a person who takes in too much or too little nutrition suffers from malnutrition.

Malnutrition is of different types. Very few people are aware that malnutrition can be due to nutrients, but also by their excessive in take. But itis the malnutrition due to lack of essential micronutrient that is major concern throughout the world. The main type of malnutrition disease are growth failure malnutrition and micronutrient malnutrition. There are three form of growth failure malnutrition. Marasmus, which occurs when the body fat and tissue degenerate excessively to compensate for the lack of nutrients which in turn internal processes of the body begins to slow down very fast. Kwashiorkor, it is characterised by bilateral pitting oedema (fluid retention) in the legs andfeet which in turn leads to undernourished children look plump. Marasmic-Kwashiorkor characterised by both severe wasting edema. Chronic malnutrition or stunting occurs over a long period of time and has long lasting consequences. It starts before birth due to nor maternal health and result intostunted growth. Poor breast feeding, infections and lack of availability of proper nutrients are the main reasons of its cause. Stunting is very dangerousas it becomes irreversible after an age. Therefore, it is important to eradicate it in the early age by providing medical treatment to pregnant women and young girls. Micronutrient malnutrition entails severe to moderate lack of Vitamin A, B, C, D, Calcium, Folate, Iodine, Iron, Zinc and Selenium. These vitamins and minerals are essential in various body processes and their deficiency leads to malnutrition. Iron deficiency causes anemia, poor brain development and cardiac malfunctioning. Iodine deficiency causes impaired Chyroid functioning and mental retardation. Vitamin D

deficiency leads to rickets and other bone development related disorders. Selenium deficiency leads to mal cardiac functioning, week immunity and osteoarthritis. Vitamin A deficiency cause poor vision, poor bone development and lack of immunity. Vitamin B12 deficiency leads to nerve degeneration and poor BC formation.

Folate or Vitamin B9 deficiency causes slow growth and anemia. Zinc deficiency can cause poor immunity, sensory perception and anaemia.

MALNUTRITION INDEX

As per United Nation and Food and Agriculture Organization one in every eight people suffers from malnutrition. 32.5 per cent of children in developingnations are undernourished and about 14.5 per cent death of children between ages 0-5 are due to starvation.

EFFECTS OF MALNUTRITION

Effects of malnutrition and starvation are severe. Malnutrition increases the risk of infectious disease by weakening the immune system and also impairs cognitive and motor functions in growing children. These children die from childhood condition like diarrhea and illness including tuber culosismeasles, pneumonia and malaria. According to some study the last few monthof gestation and first two years of life after birth are critical for growth and development of babies. The first 1000 days (conception to 2 years post-parturn) are considered a window of opportunity' for addressing malnutrition. Malnutrition also affect metabolic and organ function as well as children's behavior. One third of death in children under age five are due to undernutrition. Malnourished children having low resistant to infection and proneto disease ultimately influence economic growth of the country.

Malnutrition Status and Mitigating Strategies inIndia

According to Food and Agricultural Organization (2014-16) sub-Saharancountries of Africa have the highest prevalence of hunger whereas, India hasthe highest number of undernourished people of the world which constitute 194.6 or 15 per cent of India's total population.

Preventing malnutrition in India has always been government agenda.The realization that early childhood nutrition of an individual has permanent consequences for future life strategies, Indian government introduced not onlypolicy measures but also plans, programme and missions. Under the directpolicy measures India has expanded the safety net through Integrated Child Development Services to cover all vulnerable groups' viz. children, adolescentgirls, mothers and expectant women, fortification with appropriate nutrients of essential food items like iodized salt, popularizing low-cost nutritious food and controlling micronutrient deficiency among different vulnerable groups. Whereas, under the indirect policy measures India has ensured food security through increased production of food grains, promoted improved dietary pattern by increasing per capita availability of nutritious diet, improved the purchasing power of landless, rural and urban poor, expanded public distribution system, reduced vulnerability of the poor by implementing landreforms, increased health and immunization facilities, improved knowledge of nutrition, prohibited food adulteration, monitored nutrition programme,strengthen nutrition surveillance and community participation.

Nutrition Education as a Mitigation Strategy

The science of teaching nutrition related knowledge to individuals or community with the primary aim of improving the knowledge and bringing about behavioral changes which in turn help improve the nutritional

status of individuals and community is called Nutrition Education. This not only involves combination of educational strategies but also aims at supporting the environment thatbrings about voluntarily changes in behavior and overall well-being of the individuals and community. Nutritional research has made several advances and new knowledge is coming up.

However, this factual knowledge needs to be transmitted to the common population for some kind of effect to take place. Here is when nutrition education comes into role. Initiation of nutrition education in the early years not only helps in development of children but also helps shape their habits and eating patterns, resulting in more educatedand healthier individuals. Faulty food habits affect the child's growth, cognitive development and their academic performance as well. Studies have shown that, a higher inclination towards consumption of fast food, fried food and food high in sugar/salt results in an imbalance between macro and micro nutrients, resulting in micronutrient deficiencies. Appropriately planned and implemented education can increase then utritional knowledge of individuals not only in formal way but also informally. Studies have also shown that the cross-curriculum education, i.e., inclusion of nutrition education in association with other subjects can result in better adaptation and learning among the students.Various authors have shown that introducing early interventions in paedia tricpopulations ensures promising results in comparison to the adults. An important period in which obesity and problem of overweight occurs is the childhood and adolescence age. Occurrence of obesity associated comorbidities has proven to be higher in individuals who have a history of childhood obesity.

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Cropping Pattern of Farm Families in Five Agro-Climatic Zones of Punjab

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ABSTRACT

In Punjab, majority of the population lives in villages where main occupation is agriculture or its allied occupation. The present study was conducted in Punjab state to analyse the cropping pattern of 200 farm families representing five agro climatic zones of Punjab namely zone I (sub - mountain undulating zone), zone II (undulating plain zone). Zone III (central plain zone), Zone IV (western plain zone) and zone V (western zone) through structured interview schedule. Crops ranged between one to six crops with majority (65.5%) of farmers cultivating one to two crops. Prevalence of monocropping pattern was observed with vast majority growing wheat and paddy. All crops except fruits, sugarcane and trees (agro-forestry) were sold in the nearest Mandi (market.) Sugarcane was directly sold to the nearest sugar mill. Agro forestry mainly comprised of poplar trees which were auctioned in the fields to contractors/ commission agents. Produce was mostly sold in raw form without processing with negligible percentage of those processing mustard. Farming families should be motivated to work together in small groups for sometimes and then move them to form FPO's. Extension workers should guide and facilitate farmers in producing and marketing high value crop.

Keywords: Farm families, Monocropping, Mandi, Raw and Agro-climatic zones.

INTRODUCTION:

Agriculture plays a significant role in the Indian economy. Over 70.0 per cent of the rural families bank on agriculture. It plays a significant role in Indian economy as it contributes about 17% to the total GDP (Shagun 2021) and provides livelihood to over 60% of the population (Kant 2019). In Punjab, majority of the population lives in villages where main occupation is agriculture or its allied occupation. These sectors play a pivotal role in the economy of Punjab. The Punjab state in India has, in the last three decades, been one of the world's most marvellous paradigms of agricultural prosperity. Agricultural success in Punjab has been closely linked with the renowned "Green Revolution", which resulted in the development and adoption of new, high-yielding varieties of rice, wheat and other food crops. However, present decade was a witness to decreasing percentage contribution of agriculture to the state income and increasing farmers' suicides (Sharma 2007).

Farming can also be a lucrative option. Organic agriculture is economically viable (Bowman and Zilberman 2013). By marketing the organic products, cost go down and profits increase. Multi-storey cropping is also a promising technology and there are many benefits as profit per unit area rises considerably and assure a more even distribution of employment and income throughout the year by harvesting diverse crops in different seasons, besides minimizing possibility of crop failure. This system generate jobs and provide better labour use pattern. It helps to maximize land use by fitting different sized crops together through vertical, horizontal and underground cultivation.We can increase the income of farmers by promoting farming systems that can provide more income to farmers through horticulture, animal husbandry, agro-forestry and other mixed farming systems involving high value crops. Precision farming techniques also help to enhance productivity and reduce the cost of production. It provides opportunities for attracting and retaining youth in farming. It can be adopted by a group of farmers who can organise themselves into a precision farming group. This would help to reduce expenditure and enhance productivity and profitability. Keeping this in view, the study was conducted to know the cropping pattern of farmers in Punjab.

MATERIAL AND METHODS

The study was conducted in Punjab state represented by all the five agro climatic zones of Punjab. Punjab has 23 districts. Out of these, two districts were selected randomly from each zone, thus total ten districts were selected for the study. From each selected districts, one block in which main city or some other main city is situated and second block away from the district headquarters was selected. Hence, twenty blocks were selected for the study.

Selection of districts:

Selected Zones	Selected Districts
Sub – mountain undulating zone	Gurdaspur, Hoshiarpur
Undulating plain zone	Rupnagar, SBS Nagar
Central plain zone	Tarn Taran , Ludhiana
Western plain zone	Faridkot, Ferozpur
Western zone	Bhatinda, Sri Muktsar Sahib

Ten farm families actively engaged in farming as their major family occupation were selected from each block through proportionate random sampling on the basis of operational landholding in Punjab. Data was collected from active farmer who represented the farm family as respondent.

1. CROPPING PATTERN FOR COMMERCIAL PURPOSES

Number of crops cultivated : Data given in table 1 recorded number of crops cultivated annually and types of crops cultivated since last three years by the family. Crops ranged between one to six crops with majority (65.5%) of farmers cultivating one to two crops, nearly one third (32.5%) of sample families cultivated three to four crops and only 2.0 percent were cultivating five to six crops.

Zone wise cropping pattern indicated that a large majority in zone III (65.0 %), zone IV (75.0 %) and V (95.0 %) were growing one to two crops. In zone I (40.0%) and zone II (52.5%) the percentage was lesser. More than half of the families of zone I (57.5%) and 40.0 percent in zone II were cultivating 3-4 crops. Five

to six crops were cultivated by only 2.5 percent families in zone I and 7.5 percent in zone II. Data clearly pointed towards mono cropping system pursued by the majority.

Table 1: Distribution of farm families according to their cropping pattern for commercial purposes (last 3 years), (n=200)

Cropping pattern (last03 years)	Agro climatic zones					Total
	Zone I (n_1=40)	Zone II (n_2=40)	Zone III (n_3=40)	Zone IV (n_4=40)	Zone V (n_5=40)	
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
No. of crops cultivated						
1-2	16(40.0)	21(52.5)	26(65.0)	30(75.0)	38(95.0)	13(65.5)
3-4	23(57.5)	16(40.0)	14(35.0)	10(25.0)	2(5.0)	65(32.5)
5-6	1(2.5)	3(7.5)	0	0	0	4(2.0)
Crops cultivated						
Paddy	23(57.5)	30(75.0)	38(95.0)	37(92.5)	37(92.5)	165(82.5)
Wheat	38(95.0)	39(97.5)	39(97.5)	37(92.5)	40(100)	193(96.5)
Maize	15(37.5)	15(37.5)	3(7.5)	4(10.0)	0	37(18.5)
Barley	2(5.0)	0	0	0	0	2(1.0)
Pulses	0	1(2.5)	6(15.0)	0	0	7(3.5)
Cotton	1(2.5)	0	0	0	16(40.0)	17(8.5)
Sugarcane	8(20.0)	6(15.0)	6(15.0)	0	0	20(10.0)
Mustard	1(2.5)	1(2.5)	7(17.5)	0	3(7.5)	12(6.0)
Vegetables	10(25.0)	7(17.5)	6(15.0)	0	0	23(11.5)
Fruits	0	0	1(2.5)	7(17.5)	0	8(4.0)
Barseem	3(7.5)	7(17.5)	2(5.0)	0	3(7.5)	15(7.5)
Agro forestry	6(15.0)	4(10.0)	3(7.5)	0	0	13(6.5)

Crops cultivated: The prevalence of monocropping pattern of wheat and paddy was evident from the data given in table 1 with 96.5 percent families growing wheat and 82.5 percent growing paddy. More than 92.0 percent families in all zones were growing wheat and paddy was grown by more than 90.0 percent families in zone III, zone IV and zone V and by 75.0 percent in zone II. Maize was grown by 18.5 percent of the families with their largest concentration (37.5%) in zone I and zone II.Barley was only grown by 2.0 percent of the families with all of them in zone I, Pulses by only 3.5 percent with none in zone I, zone IV and zone V.

The other crops grown by the selected families were cotton (8.5%), sugarcane (10.0%), vegetables (11.5%), fruits (4.0%), Even barseem and trees for agro forestry were cultivated by 7.5 percent and 6.5 percent of the families respectively. Cotton was grown mostly in zone V (40.0%) and by very few families (2.5%) in zone I. Sugarcane, vegetables and agro forest trees were not grown by any family in zone IV and zone V.

Agro-climatic conditions can be the reason for this trend. However, vegetables and agro-forestry can be cultivated across the states. The highest growers of sugarcane (20.0%), vegetables (25.0%), trees for agro forestry (15.0%) were found in zone I, followed by zone II and zone III whereas 15.0 percent of the farmers in zone III were growing sugarcane and vegetables.

Data in Statistical Abstract of Punjab (2014) indicated that wheat was cultivated by 44.4 percent farm families and paddy was cultivated by 36.0 percent families, cotton (6.0%) maize (1.0%) and pulses (0.24%) out of total cropped area in Punjab. Rice and wheat occupied 90.1% of the area in Punjab and contributed 76.9 percent towards production in 2014-15. According to Punjab State Agriculture Profile (2016), Punjab had paddy-wheat cropping system which may be attributed to effective implementation of agricultural price policy with minimum support price (MSP) and relative profitability of these crops as compared to other crops.

2. MARKETING PATTERN OF THE PRODUCE

Data given in table 2 revealed the marketing pattern of crops produced by farm families, place of marketing and form of produce sold. It was found that all the crops except fruits, sugarcane and trees (agro-forestry) were sold in the nearest Mandi. Sugarcane was directly sold to the nearest sugar mill. All these crops were sold in raw form except mustard which was processed but only by 8.33 percent of the farm families.

Table 2: Distribution of farm families according to marketing pattern of their produce (last 3 years)

Crops	Place of marketing			Form in which produce sold	
	In field	Nearest *Mandi* within the District	Other District *Mandi*	Raw	Both raw and processed
	f (%)	f (%)	f (%)	f (%)	f (%)
Cereals					
Paddy (n=165)	0	165(100)	0	165(100)	0
Wheat (n=193)	0	193(100)	0	193(100)	0
Maize (n=37)	0	37(100)	0	37(100)	0
Barley (n=2)	0	2(100)	0	2(100)	0
Pulses (n=7)	0	7(100)	0	7(100)	0
Cotton (n=17)	0	17(100)	0	17(100)	0
Sugarcane (n=20) At sugarmill	0	20(100)	0	20(100)	0
Mustard (n=12)	0	12(100)	0	11(91.66)	1(8.33)
Vegetables (n=23)	0	23(100)	0	23(100)	0
Fruits (n=8)	0	4(50.0)	4(50.0)	8 (100)	0
Barseem (n=15)	0	15(100)	0	15(100)	0
Agroforestry (n=13)	13(100)	0	0	13(100)	0

Half of the families growing fruits (n=8) were selling them locally and other half in other Mandi of other district where they could fetch better price. Barseem was sold in the village by the farmers mainly to the dairy owners or families who owned animals but had no land to grow it. Agro forestry mainly comprised of poplar trees which were auctioned in the fields to contractors/ commission agents.Data indicated that farm families prefer to sell the produce without adding any value to it. This may be done because of convenience, lack of motivation and knowledge to process and lesser risk taking ability. Even the traditional processing of sugarcane into jaggery was no longer done at the village level. Processing of mustard was also done for family use.

CONCLUSION

Mono-cropping pattern is followed with produce from the farm mostly sold in the nearest Mandi within the district in raw form without processing.

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Effective Extension Strategies and Mobilisation of FPO'S to Market

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ABSTRACT

Small holder farmers are haveto suffer market uncertainties as most policies and institutional supports favours large and progressive farmers and smaller farmers are devoid of them increasing wider gap between producers and consumers. In such situation Farmer Produces Organization plays an important role in promoting and strengthening member based institution of farmers. This business form allows 10 or more producers to form an organisation as per its memorandum of association. FPO's can link smallholder's farmers to local, regional, national and international markets effectively if there is no political interference. FPOs which are formed as Farmer Producer Company (FPCs) allow its member to access financial and other input services. To surpass this effective and viable profit making FPCs needs to be competent with other companies and rivals in the market and has a huge potential to capture the future food retails not only in India but in theworld.

Keywords:Agriculture, FPCs, market, strengthen, agriculture etc.

FARMERS PRODUCER ORGANIZATIONS IN INDIA

Agriculture plays an important role in growth of developing countries like India where agriculture contributes around 15.4% Gross Domestic Products in the year 2017. Also, according to 2011 census of India, 54.6% of people are directly or indirectly working in agriculture sector. The small and marginal land holding if taken together it contributes around

86.21 % of total land holding in 2015-16. Small and marginal land holding means the farmers who are having land holding up to 2 ha. So because of this issue of small land holding of farmers the bargaining power of those farmers are very less while selling of their crops and also while purchasing inputs for cultivation of crops. To solve this issue and to minimize the gap between farmers and consumer, Govt. of India, on the recommendations of Y. K. Alagh Committee in 2001 has introduced certain amendments to Companies act,

1956 and introduced the concept of Farmer Producer Organizations. The concept of Farmer Producer Organizations can be seen as the mixture of two types of venture i.e.Private Companies and Cooperative Society. The basic concept of Farmer Producer Organizations is bulk buying of inputs used in farming like Fertilizers, Pesticides and seeds etc. and them distributing it to the member farmers to benefit them. Farmer Producer Organizations try to bring small and medium farmers together to reduce the cost of their supply chain so that farmers will be benefited for their producer.

Also to increase the bargaining power, the Farmer Producer Organizations work on economies of scale concept. The Farmer Producer Organizations are run by farmers and owned by Farmer Members are they are the shareholder according to their contribution in share capital. Farmer Producer Organizations are financially supported by two main Govt. organizations in India, namely Small Farmers Agribusiness Consortium (SFAC) & National Bank for Agriculture and Rural Development (NABARD). Small Farmers Agri Business Consortium, New Delhi is the main Nodal Agency and link between the different states and single point of contact for all the technical advice and investment related requirements of Farmer Producer Organizations in India. NABARD has specially created Producer Organization Development Fund (PODF) to promote Farmer Producer Organizations (FPOs) which are outside the domain of SFAC, if any. As a part of major reforms for Farmer Producer Organizations, Government of India in 2018 has introduced cent percent tax holiday for all the FPOs below 100 crores up to five years so that they should emerge as a major step towards the Prime Ministers Doubling Farmers Income Scheme by 2022. And recently in this year's budget of 2020 Finance Minister of Government of India, has announced formation of 10,000 new FPOs in next five years. Advantages to member farmers of Farmer Producer Organization are as follow.

1. Increasing bargaining power in buying inputs and marketing of produce by bringing farmers together
2. Capacity building of farmers through regular training programmes of farmers
3. Helping farmers in reducing post-harvest losses by storage and valueaddition
4. Assisting farmer for getting benefitted by different government schemes related to agriculture and horticulture
5. Fast dissemination of Good Agricultural Practices (GAP) among the farmer members and access to extension services.
6. By the means of contract farming if possible,in some area and for cash crops, distress sale can beavoided

Real meaning of farmer producer organizations : Farmer Producer Organizations are the companies established under Companies Act of 1956 now 2013 (as amended in 2002). Members and shareholders of those companies are farmer and these companies are supported by Small Farmer Agribusiness Consortium. Producer Organization is specific name given to them as Producer of various agricultural commodities like agricultural farmers, milk producer for dairy based FPOs, fisherman, tea growing farmers and crafts man etc. are the members of these Farmer Producer Organizations.

Need of producer companies : The most basic reason is that as we know 86% of farmers in India who are having land holding lesser than 2 ha during agricultural census 2015. So we have small producers who don't have huge volumes when it comes to production of crop. That's the main reason they are not getting a fair price for their produce and also due to that reason farmers are getting only a small portion of the total money paid by final consumer to their produce because in agricultural marketing large numbers of market intermediaries are working like village agents, commission agent, whole seller, retailer and finally consumers.

With a target of mobilization of 2.50 Lacs farmers all across the country into 250 FPOs having approximate 1000 farmers each, Ministry of Agriculture, Government of India launched a pilot programme during 2011-12 with partnership with Small Farmers' Agribusiness Consortium, New Delhi, under two sub schemes Vegetable Initiative for Urban Clusters and the Programme for Pulses Development, which are part of Rashtriya Krishi Vikas Yojana (RKVY).

DIFFERENT WAYS IN WHICH FPOS ARE HELPING FARMERS :

I. Input Supply Services: Farmer Producer Organization provides basic agricultural inputs to the member farmers on lesser rates as compared to market rates like fertilizers, pesticides, seedssprayers.

II. Procurement and Packaging Services : Procurement of agriculture produce after harvesting from fields is done and as and when required FPOs will process it for value addition such as raw turmeric, to make turmeric powder and then after packaging it will be sold inmarket.

III. Marketing Services : Due to aggregation and bulkiness of produce FPOs farmers willbetterpriceandalsobecausebythisacttheyhavebypassedlargeno.of

intermediaries present in the agricultural value chain.

IV. Custom Hiring Service Centre : FPOs provides agricultural implements like tractors, cultivators, tillers, harvester and other equipment on rental basis. Farmers with small land holdings it's useful because for them it is difficult to buy those agricultural implements by theirown.

V. Insurance Services : Insurance services related to crop and livestock and other agricultural machineries like crop insurance, Livestock insurance of milking animals like cow and buffalo are provided by FPOs to the farmermembers.

VI. Technical & Networking Services : FPOs are made by farmer and farmers are the member so it'stheir responsibility to provide latest information on new techniques of farming to the member farmers and to updates their knowledge skill and attitude towards farming. Also FPOs are working for connecting farmer and providing them network linkage with financial institution, traders and consumers.

VII. e-NAM & NCDEX Services : Due to National Agricultural Market they are getting more no of buyer so getting a competitive price. And,NCDEX helps them by providing them hedging and leveraging against price fall during harvestingtime.

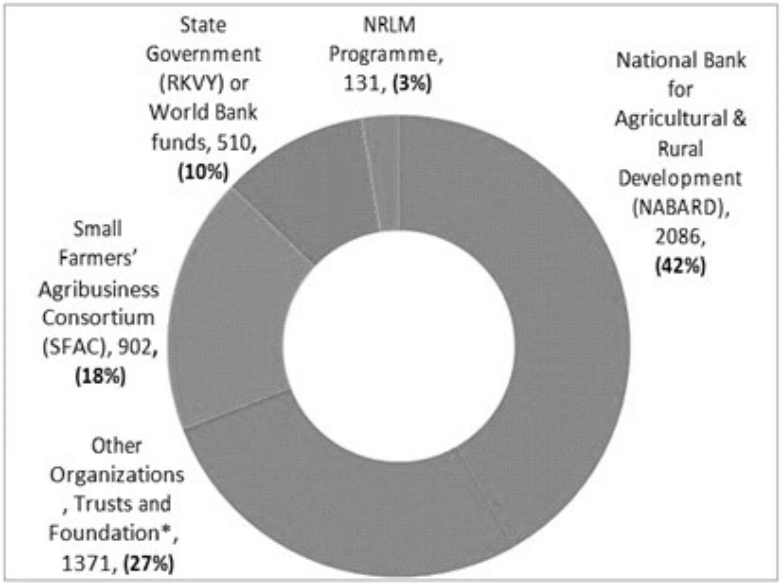
Current status of FPOs in our country : Small Farmers' Agribusiness Consortium is the nodal agency in India promotes Farmer Producer Organization in India as appointed by Department of Agriculture, Cooperation & Farmers' Welfare, and Ministry of Agriculture & Farmers' Welfare. Since 2011, when government has introduced the concept of Farmer Producer Companies, they are being promoted in country under various schemes of central and state government. As off now, In India 5000 Farmer Producer Organizations are promoted. All these FPOs are established under different central and state government schemes and are formed under various initiatives of Centre Government, State Government, NABARD, and under Corporate Social Responsibility programs of different privatecompanies.

DIFFERENT PROMOTING AGENCY AND PERCENTAGE OF FPOS PROMOTED BY THEM TILL 2019

From this exploded doughnut, it is simplified that NABARD is having highest percentage share in total FPOs promoted with 42% followed by other organization and trusts and foundation with 27%, SFAC is 3rd

highest with 18% contribution and State Governments have a share of 10% and at 4th place and at last with 3% we have National Rural Livelihood Mission supported by Ministry of RuralDevelopment.

*Other Organisations includes- Bill & Melinda Gates Foundation, Reliance Foundation, Ambuja Cement Foundation, HDFC Foundation, C&A Foundation, HSBC CSR, Axis Bank Foundation, Jindal Steel & Power Limited, Syngenta Foundation and TATA Trust.



***Source**: Strategy Paper for promotion of 10,000 Farmer Producer Organisations (FPOs), 2019*

Key issues & challenges faced by FPOs : At current time around 1000 FPOs are facing problems for even survival even. FPOs are facing so many problems related to skills of CEOs and BODs, related with farmers, also related to document process and because it's a long list some of the key issue faced by FPOs are mentioned here:-

I. Mobilization of farmers : Every FPO is having their respective Resource Institution and one promoting agency. Both of them are facing issue with manpower attrition, so they are facing problem in formation of FPOs that leads to less no. of farmer mobilization into FPOs. Due to less farmers are being mobilized share capital of FPOs are less than as expected and that leads to several other financialproblems.

II. Skill set of Board of Director & Chief Executive Officer : As Farmer Producer Organization are formed and run by farmers only. So they democratically decide their Board of Directors & CEO is appointed by BODs. BODs and CEO are having very less managerial skills and limited exposure to entrepreneurship and business development. So various training programmes should be organized time to time to enhance theseskills.

III. Problems related to financing : As Farmer Producer Organizations are not having anything other than farmer member's equity to leverage borrowings, its' very difficult for any banking system to provide them capital in huge amounts. And because of this banking system has toanalyses that how these FPOs are able to raise the margin money required to mobilize the loans. Some alternative approaches should be tried on how to finance Farmer Producer Organizations as they do not have a lot of physical as sets and have only

tangible assets. Two main challenge sinfinancing FPOs from the prospective of Financial Institutions are increasing equity capital through mobilization of farmers and lack of tangible security and physical assets.

IV. Equity Grant : Current SFAC scheme of equity grants provides equal equity share to FPOs. This means in a ratio of 1:1 that too subjected to a minimum share limit of Rs.

1000 per share holders. And maximum amount that can be availed is Rs. 15 Lacs. At farmer level contributing an amount of Rs. 1000 is also an issue because of small land holding of the farmers. And also if someone is interested to become a shareholder its' tough for the Board of Directors to gain his trust and convince him to be a shareholder.

V. Challenges related to policy: - FPOs are unable to take benefits of several schemes launched by SFAC and other related organization because they of lack of particular directionof flow of information. This is in terms of reforming the state APMC act, facilitating direct market license to FPOs, relaxation in Mandi cess, relaxation in filing statutory compliances including those related to the Registrar of Companies as well as tax authorities. Penalty of delayed compliance is a burden, particularly on FPOsin theirinfancy.

STRATEGIES TO OVERCOME & ROAD MAP

For mobilization of farmers and to improve the skills of skills of Board of Directors and other staff related to Farmer Producer Organization, there is need of time to time training and development programmes. In India, we have different institute supported by Government of India who provides training and development programmes related to entrepreneurship development. Some of them are National Institute of Agricultural Marketing Jaipur, National Institute of Agricultural Extension Management (MANAGE), National Academy of Agricultural Research Management (NAARM) in Hyderabad, Entrepreneurship Development Institute of India in Ahmedabad, Gujrat, Kerala Institute for Entrepreneurship Development– KIED, National Institute for Entrepreneurship and Small Business Development Noida, Vaikunth Mehta National Institute of Cooperative Management (VAMNICOM) Pune etc.

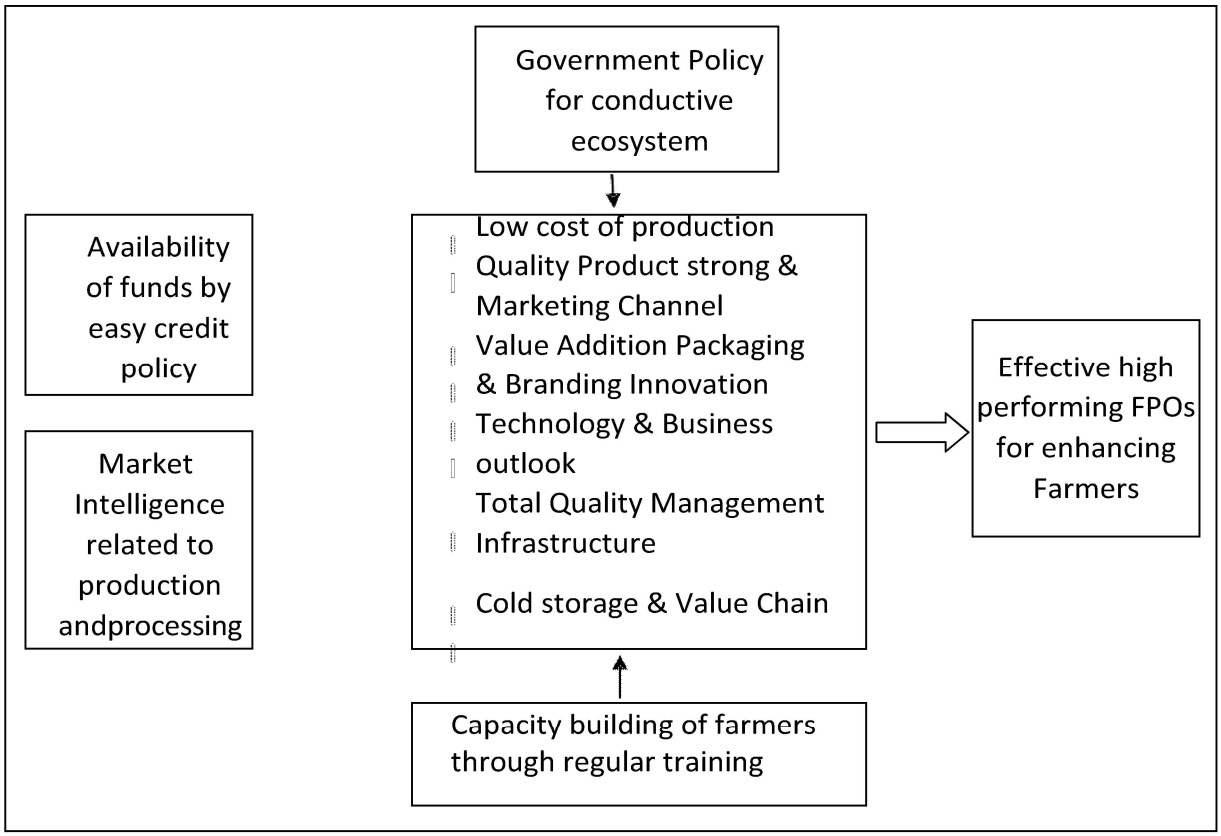
To overcome the problem of finance, FPOs has todevelop such system that they should earn round the year by different method. In starting what they can do it they should is as they can take dealership with public and private companies workingin fertilizer sector, pesticide industry and seed selling company a so that by supplying these three inputs should be supplied to farmers and this way farmer are also benefitted with company. And by taking very less margin as compared to retailers and wholesaler present in market they can improve their finance as FPOs are having number offarmers attached with them. And in both the waysi.e. backward and forward linkage they can save money which works as working capital for theFPO.

FPOs should be financed according to their need. During initial time FPOs should besupported by different incubation and hand holding of their business. Training and seed funding are the types of funding can be given during this time. After some years when FPOs will set start doing their business normally for their growth, funds can be given to them in form of equity financing or by venture capitalists. During the maturity stage of the business, FPOs can be given term loan as they are doing well business around 6-7 years after registration of company and commencement of business.

SOME OF THE STRATEGIES AS GIVEN BY SFACARE

I. Equity share per farmer will be increased to Rs. 2000 which is before Rs. 1000 per farmer member. But his equity grant ratio will be same as before that will be in 1:1 and subjected to an upper limit of Rs. 15Lacs.

II. On priority basis FPOs should have APMC license and dealerships. And as much as possible all the government schemes related to farmer should be implemented via FPOs. Also, Reforms in APMCAct



Strategies for Effective Farmer Producer Organizations

Source : *Modified by author based on Mukherjee et al (2018)*

CONCLUSION

Farmer Producer Organizations are having enough potential to help small and medium farmers'of India, either they are registered as FPCs or Co-operatives, they are helping farmers. But they do have certain limitations related to finance and managerial skills like negotiation and leadership, so necessary steps should be taken by NBFC and by entrepreneurship development institute to overcome both the issues respectively. Other than this Board of Directors of FPOs should also be trained in how to prepare a business plan. That's the most basic step. Promoting Institutes should involve themselves more and more with FPOs so that they can help them in networking the business. Still, a large portion of farmers who belong to the small and marginal land holding category are facing problems due to market intermediaries, FPOs should find some permanent solution of this problem like registration with APMC and eNAM. By using different extension techniques if FPOs can taught to their farmers about Good Agricultural Practices (GAP) and time to time update them with latest technologies and researches related to agriculture and allied sciences this can help them producing crops in efficient and effective way. At the end, if we really talks about ground reality, Government of India does not actively promoted these FPOs and leaves their setup to resource institution like NGOs present in that area. So, help from Policy making institute like SFAC will be advantage to farming community especially to smallfarmers.

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Farmers Income : Trends for Future Growth

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ABSTRACT

Indian agriculture is passing through difficult times due to two consecutive drought situations in several parts of the country, thereby resulting into wide spread distress among farmers. Past strategy for development of the agriculture sector in India has focused primarily on raising agricultural output and improving food security & did not explicitly recognise the need to raise farmers' income and did not mention any direct measure to promote farmers welfare. The net result has been that farmers income remained low, which is evident from the incidence of poverty among farm households. Low level of absolute income as well as large and deteriorating disparity between income of a farmer and non-agricultural worker constitute an important reason for the farmers' suicides during 1995 to 2004, and is also forcing more and more cultivators, particularly younger age group, to leave farming. This can cause serious adverse effect on the future of agriculture in the country. To provide a solution for all these, in February 2016, Prime Minister Narendra Modi announced a scheme "Doubling farmers' income" by 2022 by spelling out 6 points strategy.

Keywords: Poverty; Income; Non agriculture workers.

INTRODUCTION

Historically, India has been an agrarian country. But it was only after we attained independence that the future of the sector brightened. One of the brightest spots in the history of Indian agriculture was between the 1950 and the late 1960s – the Green Revolution resulted in incremental increase in production of food grains, especially wheat and paddy. However, we must have taken that improvement for granted, and did not make enough efforts to help that growth sustain longer than it did. The crisis we see today was building for decades, and skipped our notice – farming has lost the joy and has become a source of income for those who cannot opt for any other means to earn. The rural areas are facing food and livelihood crisis, more specifically the shortage of fodder and drinking water. Government needs to proactively address the situation and make more long term farmers centric policies related to irrigation, farm diversification, farm profitability and community support programs so as to socially and economically empower farmers.

Past strategy for development of the agriculture sector in India has focused primarily on raising agricultural output and improving food security. The net result has been a 45 per cent increase in per person food production, which has made India not only food self-sufficient at aggregate level, but also a net food exporting country. The strategy did not explicitly recognise the need to raise farmers' income and did not mention any direct measure to promote farmers welfare. The net result has been that farmers income remained low, which is evident from the incidence of poverty among farmhouseholds.

Low level of absolute income as well as large and deteriorating disparity between income of a farmer and non-agricultural worker constitute an important reason for the emergence of agrarian distress in the country during 1990s, which turned quite serious in some years. The country also witnessed a sharp increase in the number of farmers suicides during 1995 to 2004 - losses from farming, shocks in farm income and low farm income are identified as the important factors for this. The low and highly fluctuating farm income is causing detrimental effect on the interest in farming and farm investments, and is also forcing more and more cultivators, particularly younger age group, to leave farming. This can cause serious adverse effect on the future of agriculture in thecountry.

In February 2016, Prime Minister Narendra Modi had said farmers' income would be doubled by 2022 to mark 75 years of India's independence & gave a call to the nation of doubling farm income by spelling out 6 points strategy. The government constituted an inter- ministerial committee on April, 2016 to examine issues relating to 'Doubling of Farmers' Income' and recommend strategies to achieve the same. The Committee has identified seven sources of income growth namely,

- Focus on irrigation with sufficient budget, with the aim of "Per Drop More Crop".
- Provision of quality seeds and nutrients based on soil health of each field.
- Heavy investments in Warehousing and Cold Chains to prevent post-harvest crop losses.
- Promotion of value addition through food processing.
- Creation of a National Farm Market, removing distortions and e-platform across 585Stations.
- Introduction of a New Crop Insurance Scheme to mitigate risks at an affordable cost.
- Promotion of ancillary activities like poultry, beekeeping, and fisheries.

2. VARIOUS SCHEMES AND PROGRAMS INITIATED BY THE GOVERNMENT TO ACHIEVE THE TARGET OF DOUBLING OF FARMERS'INCOME

- Pradhan Mantri Krishi SinchaiYojana,
- Pradhan Mantri Fasal BimaYojana,
- Paramparagat Krishi VikasYojana,
- Soil Health Card
- Neem-Coated Urea and e-NAMSchemes

PRADHAN MANTRI KRISHI SINCHAYEE YOJANA (PMKSY), 2015

Government of India is committed to accord high priority to water conservation and its management. To this effect Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation 'Har Khet ko pani' and improving water use efficiency 'More crop per drop' in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities.

PMKSY has been formulated amalgamating ongoing schemes viz.

- Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of WaterResources,
- River Development & Ganga Rejuvenation (MoWR,RD&GR),
- Integrated Watershed Management Programme (IWMP)

- Department of Land Resources(DoLR)
- On Farm Water Management(OFWM)
- Department of Agriculture and Cooperation(DAC).

PMKSY has been approved for implementation across the country with an outlay of Rs. 50,000 crore in five years. For 2015-16, an outlay of Rs.5300 crore has been made which includes Rs. 1800 crore for DAC; Rs. 1500 crore for DoLR; Rs. 2000 crore for MoWR(Rs. 1000 crore for AIBP; Rs. 1000 crores for PMKSY).

PRADHAN MANTRI FASALBIMA YOJANA (PMFBY), 2016

With a view to provide better insurance coverage to crops for risk mitigation, a crop insurance scheme namely Pradhan Mantri FasalBima Yojana (PMFBY) was launched. This scheme provides insurance cover for all stages of the crop cycle. The PMFB replaces all the prevailing yield insurance schemes in India. The scheme has been launched with an impetus on crop sector. The scheme has extended coverage under localized risks, post-harvest losses etc. and aims at adoption of technology for the purpose of yield estimation. Through increased farmer awareness and low farmer premium rates the scheme aims at increasing the crop insurance penetration in India. The PMFBY will replace the existing two schemes National Agricultural Insurance Scheme as well as the Modified NAIS.

The scheme covers Kharif, Rabi, annual commercial as well as horticultural crops.

- There will be a uniform premium of only 2% to be paid by farmers for all Kharif crops
- All Rabi crops1.5%
- In case of annual commercial and horticultural crops, the premium to be paid by farmers will be only5%.
- The premium rates to be paid by farmers are very low and balance premium will be paid by the Government to provide full insured amount to the farmers against crop loss on account of natural calamities.
- There is no upper limit on Government subsidy. Even if balance premium is 90%, it will be borne by the Government.

This scheme provides insurance cover for all stages of the crop cycle including post- harvest risks in specified instances. Claims of Rs. 8,665 crore were paid to 553.01 lakh farmers in the year2018-19.

PARAMPARAGAT KRISHI VIKAS YOJANA(PKVY), 2015

PKVY Scheme aims at development of sustainable model of organic farming through a mix of traditional wisdom & modern science to ensure long term soil fertility buildup, resource conservation & helps in climate change adaptation & mitigation. This scheme primarily encourages the farmers to adopt eco-friendly concept of cultivation & reduce their dependence on fertilizers.

PKVY aims at empowering farmers through institutional development through cluster approach not only in the farm practice management, input production, quality assurance but also in value addition & direct marketing through innovative means.

- Fifty or more farmers will form a cluster having 50 acre land to take up the organic farming under the scheme. In this way during three years 10,000 clusters will be formed covering 5.0 lakh acre areas under organic farming.

- There will be no liability on the farmers for expenditure on certification.
- Every farmer will be provided Rs. 20,000 per acre in three years for seed to harvesting of crops and to transport produce to the market.
- Organic farming will be promoted by using traditional resources and the organic products will be linked with the market.
- It will increase domestic production and certification of organic produce by involving farmers

SOIL HEALTH CARD SCHEME, 2015

Under this scheme, the government plans to issue soil cards to farmers which will carry crop- wise recommendations of nutrients and fertilisers required for the individual farms to help farmers to improve productivity through judicious use of inputs. All soil samples are to be tested in various soil testing labs across the country. Thereafter the experts will analyse the strength and weaknesses (micro-nutrients deficiency) of the soil and suggest measures to deal with it. The result and suggestion will be displayed in the cards.

The government plans to issue the cards to 14 crore farmers.

An amount of 568 crore (US$82 million) was allocated by the government for the scheme.

In 2016 Union Budget of India100 crore (US$14 million) has been allocated to states for making soil health cards and set up labs.

As of July 2015, only 34 lakh Soil Health Cards (SHC) were issued to farmers as against a target of 84 lakh for the year 2015–16.

NEEM-COATED UREA AND E-NAM SCHEMES,2016

The electronic market pilot across India was launched on 14 April 2016 is an online trading platform for agricultural commodities in India. The market facilitates farmers, traders and buyers with online trading in commodities. The market is helping in better price discovery and provides facilities for smooth marketing of their produce. The market transactions stood at 36,200 crores by January 2018, mostly intra-market. Over 90 commodities including staple food grains, vegetables and fruits are currently listed in its list of commodities available for trade. The eNAM markets are proving popular as the crops are weighed immediately and the stock is listed on the same day and the payments are cleared online. In February 2018, some attractive features like MIS, dash board, BHIM and other mobile payments, enhanced features on the mobile app such as gate entry and payment through mobile phones and farmers database is helping adoption even more. The present trading is done mostly for intra-market, but in phases, it will be rolled out to trade in inter-market, inter-state, creating a unified national market for agricultural commodities.

NATIONAL AGRICULTURE MARKET SCHEME FEATURES:

- A National e-market platform for transparent sale **tr**ansactions and price discovery in regulated markets, kisan mandis, warehouses and private markets. Willing States to accordingly enact provision for e-trading in their APMCAct.
- Liberal Licensing of traders / buyers and commission agents by State authorities without any pre-condition of physical presence or possession of shop / premises in the market yard.
- One license for a trader valid across all markets in the State.

- Harmonization of quality standards of agricultural produce and provisions of assaying (quality testing) infrastructure in every market to enable informed bidding by buyers.
- Restriction of agriculture Produce Marketing Committee's (APMC) jurisdiction to within the APMC market yard / sub yard instead of a geographical area (the market area) at present.
- Single point levy of market fees i.e. on the first wholesale purchase from the farmer.

SFAC will implement the national e-platform and will cover 400 and 185 mandis during 2016-17 and 2017-18 respectively.

The government is planning to link 22,000 mandis across the country with the National Agriculture Market (e-NAM), an online trading platform for agricultural commodities by 2021-22, budgetary outlay of the Agriculture Ministry has been increased to Rs 2,11,694 crore during 2014-19, to develop and implement schemes to improve the farmers' situation in the country.

3. OTHER MEASURES TO ACHIEVE DOUBLING FARMERS' INCOME SCHEME

- 'Operation Greens' to address price volatility of perishable commodities like Tomato, Onion and Potato (TOP).
- PM Kisan Sampada Yojana to promote food processing in a holistic manner.
- Giving a major boost for the farmers' income, the Government has approved the increase in the Minimum Support Price (MSPs) for all Kharif & Rabi crops for 2018-19 seasons at a level of at least 150 percent of the cost of production.
- With a view to provide income support to all farmers' families across the country, to enable them to take care of expenses related to agriculture and allied activities as well as domestic needs, the Central Government started a new Central Sector Scheme, namely, the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN). The scheme aims to provide a payment of Rs. 6000/- per year, in three 4-monthly installments of Rs. 2000/- to the farmers, subject to certain exclusions relating to higher income groups. An amount of Rs. 12646.579 crore has been distributed to 632.32895 lakh farmers in the year2018-19.
- With a view to provide social security net for Small and Marginal Farmers (SMF) as they have minimal or no savings to provide for old age and to support them in the event of consequent loss of livelihood, the Government has decided to implement another new Central Sector Scheme for providing old age pension to these farmers. Under this Scheme, a minimum fixed pension of Rs. 3000/- be provided to the eligible small and marginal farmers, subject to certain exclusion clauses, on attaining the age of 60 years. The scheme aims to cover around 5 crore beneficiaries in the first three years. It would be a voluntary and contributory pension scheme, with entry age of 18 to 40 years. The Government has approved a budgetary provision of Rs. 10774.50 crore for the scheme till March,2022.

CONCLUSION

The rural areas are facing food and livelihood crisis, More Specifically The Shortage of Fodder And Drinking Water. Government Needs To Proactively Address The Situation and Make More Long Term Farmers Centric Policies Related To Irrigation, Farm Diversification, Farm Profitability And Community Support Programs So As To Socially And Economically Empower Farmers.

To provide a solution for all these, In February 2016, Prime Minister Narendra Modi announced a Scheme "Doubling Farmers' Income" By 2022 By Spelling Out 6 Points Strategy.

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A Review : Organic Farming Improve Sustainability in Soil and Environmental Health with Era of Climate Change

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ABSTRACT

Organic farming is a modern and sustainable form of agriculture that provides consumers fresh natural farm products. Objective is achieved by using techniques to improve crop yields without harming the natural environment as well as the people who live and work in it. Organic agriculture offers an exclusive combination of environment friendly practices, which require low external inputs, thereby contributing to increased food availability. Organic farming has a very positive influence on soil fertility leads to a stabilization of soil organic matter and a sequestration of carbon dioxide into the soils. Sustainable agriculture can be defined as management practices of crop and animal production that secure long-term ecological productivity without degradation of their natural resource and human health. Sustainable agriculture is the successful management of resources to satisfy the changing human needs while enhancing the quality of environment and conserving natural resources Organic farming has lower global warming potential as a result of global climatic changes and their negative effects on the environment are manifested through soil erosion, water shortages, stalinization, soil contamination, genetic erosion, Organic farming is the best alternative to avoid the ill effects of chemical farming. It also has far more advantages over the conventional and other modern agricultural organic farming and sustainable agriculture. There is urgent need to involve more and more scientists to identify the thrust area of research for the development of eco-friendly production technology.

Key words: Climate change, Sustainable, Contamination.

INTRODUCTION

Organic farming entails holistic production systems that avoid the use of synthetic fertilizers, pesticides, and genetically modified organisms, reducing their negative environmental impact. Organic farming covers 0.03 percent of agricultural land in India and 11.3 percent in Austria. Organic farming is defined by the USDA as a system that is designed and maintained to produce agricultural products using methods and substances that preserve the integrity of organic agricultural products until they reach consumers. This is achieved by using substances to meet any specific fluctuation within the system in order to maintain long-term soil biological activity, ensure effective peak management, recycle wastes to return nutrients to the land, provide attentive care for farm animals, and handle agricultural products in accordance with the act and the regulations in this section. Organic farming has a recent history dating back to the 1940s. Organic

agriculture has been shown to contribute to long-term conservation of soil, water, air and the protection of wildlife, their habitats, as well as genetic diversity. However, the prolonged and excessive use of chemicals has resulted in human and soil health risks and cause environmental pollution.

Agriculture is not only affected by climate change, but it also contributes to it. Human food production accounts for ten to twelve percent of global greenhouse gas emissions. Furthermore, intensive agriculture has resulted in deforestation, overgrazing, and the widespread use of pesticides that degrade soil. These changes in land use contribute significantly to global CO2 emissions.They must increase agricultural production's ability to adapt to more unpredictable and extreme weather conditions such as droughts and floods, reduce greenhouse gas emissions in primary food production, and halt or reverse carbon losses in soils. Sustainable agricultural management practices include the preservation of soil organic matter (e.g., conservation tillage and residue management) and the selection of crops that are ecologically adapted to local climate regimes. The enhancement of agro-biodiversity (e.g., intercropping and agro- forestry), and the prevention of soil erosion.

Principles of Organic Farming

The main principles of organic farming are as follows (Chandrashekar, 2010):

To work within a closed system and draw upon local resources as much as possible

- To maintain long-term fertility of soils.
- To avoid all forms of pollution that may result from agricultural techniques.
- To produce foodstuffs in sufficient quantity and having high nutritional quality.
- To minimize the use of fossil energy in agricultural practices.
- To give livestock conditions of life that confirm to their physiological needs.
- To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human being.

1: ORGANIC FARMING AND SUSTAINABLE AGRICULTURAL DEVELOPMENT

1.1 Organic Sources of Plant Nutrients : Currently, most optimistic projections show that various organic sources can meet roughly 25–30% of Indian agriculture's nutrient needs. The use of FYM to supplement all of the N in the soil increases crop productivity more than the use of conventional N fertilisers. Since the estimates of NPK availability from organic sources are based on total nutrient content, efficiency of these sources to meet the nutrient requirement of crops is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality and productivity on long-term basis.Nutrient concentrations in FYM are usually small and vary greatly depending upon source, conditions, and duration of storage. The N, P and K contents of fresh FYM range widely from 0.01 to 1.9 percent on dry weight basis due to variable nature of manure production and storage. (**Tandon, 1998)** reported that on an average, well-rotted FYM contains 0.5 per cent N, 0.2 per cent P2O5, and 0.5 per cent K2O. An application of 25 t ha^{-1} of well- rotted FYM can add 112 kg N, 56 kg P2O5, and 112 kg K2O ha^{-1} **(Gaur,1992)**. Several researchers all over the world have shown various benefits of the application of FYM on soil properties and productivity of crops. **(Kalembasa and Deska, 2007**) obtained significantly higher yield of sweet pepper (*Capsicum annum* L. var. grossum) with

vermicompost. **(Reddy *et al,* 1998)** recorded maximum plant height at harvest, days to first flowering, and branches plant^{-1} with the application of vermicompost (10 t ha^{-1}). Similarly, (**Tomar *et al.* 1998**) reported that the application of vermicompost significantly increased leaf area in carrot (*Daucus carota* L.) plants.

1.2 Effect of Organic Nutrition on Crop Productivity : Increasing crop yields by adding organic matter to the soil is a well-known practice and using organic materials boosted rice grain and straw output **(Sharma and Mitra ,1990)**, **(Ranganathan and Selvaseelan,1997**) reported that using them boosted rice grain yields by 20% over using NPK fertiliser. **(Singh.*et al*. 1998)** found that applying 7.5 t FYM ha^{-1} to unfertilized fields resulted in significantly higher grain and straw yields. With rising rates of FYM, all of the rice yield contributing features rose. Rice and chickpea grain yields increased significantly when organic farming with dhaincha (*Sesbania aculeata* L.) was used. 2001, **(Stockdale *et al,* 2001)** narrated the benefits of organic farming to developed nations (environmental protection, biodiversity enhancement, and reduced energy use and CO2 emissions) and to developing countries (sustainable resources use, increased crop yield without over reliance on costly inputs, and environmental and biodiversity protection).

Many researchers reported that in an organically managed field activity of earth worm is higher than in inorganic agriculture. In the biodegradation process earthworms and microbes work together and produce vermicompost, which is the worm faecal matter with worm casts. Vermicompost provided macro elements such as N, P, K, Ca, and Mg and microelements such as Fe, Mo, Zn, and Cu. The vermicompost contained 0.74, 0.97, and 0.45 per cent nitrogen, phosphorus, and potassium, respectively. In low-input agriculture, the crop productivity under organic farming is comparable to that under conventional farming. **(Tamaki *et al,* 2002)** reported that the growth of rice was better under continuous organic farming than with conventional farming. Agro-economic study of practices of growing maize with compost and liquid manure top dressing in low-potential areas showed significantly better performance than those of current conventional farmer practices of a combined application of manure and mineral fertilizers. Maize grain yields were 11–17 per cent higher than those obtained with conventional practices

1.3 Effect of Organic Nutrition on Soil Fertility : The organic matter after decomposition release macro and micronutrients to the soil solution which becomes available to the plants resulting in higher uptake of nutrients **(Minhas and Sood, 1994)**. Organic farming is capable of sustaining higher crop productivity and improving soil quality on long term basis. It was reported that organic and low-input farming practices after 4 years led to an increase in the organic carbon, soluble phosphorus, exchangeable potassium, and pH and also the reserve pool of stored nutrients and maintained relativity stable EC level Normal composting takes a long time leading to considerable loss of organic materials as CO2 or does not contribute to the organic pool **(Bulluck *et al* 2002)** reported that the use of compost raised soil pH from 6.0 without compost to 6.5 with compost and reduced the broadleaf weed population by 29 per cent and grassy weed population by 78 per cent. Degradation of soil organic matter reduced nutrient supplying capacity, especially, on soils with high initial soil organic matter content in rice-wheat cropping system. Organic farming improved organic matter content and labile status of nutrients and also soil physicochemical properties. Addition of carbonaceous materials such as straw, wood, bark, sawdust, or corn cobs helped the composting characteristics of a manure. These materials reduced water content and raised the C : N ratio. However, under Indian conditions, joint composting of the manure slurries with plant residues was more viable and profitable than its separate composting. Use of FYM and green manure maintained high levels of Zn, Fe, Cu, and Mn in rice-wheat rotation

1.4 Effect of Organic Nutrition on Soil Biological Properties : Compost contains bacteria, actinomycetes, and fungi besides, play an important role in control of plant nematodes and in mitigating the effect of pesticides through sorption. Sorption is the most important interaction between soil- organic matter, pesticides and limits degradation as well as transport in soil. **(Singh and Bohra, 2009)** reported that rice-pea- black gram (*Vigna mungo* L.) cropping system recorded higher population of bacteria, actinomycetes, and fungi than rice-wheat cropping system. Field experiment conducted with P solubilizers like *Aspergillus awamori, Pseudomonas stria*ta, and Bacillus polymyxa significantly increased the yield of various crop yield like wheat, rice and cowpea in presence of rock phosphate and saved 30 Kg P_2O_5 ha^{-1} with the use of phosphate solubilizing microorganisms. Vegetable crops responded better to *Azotobacter* inoculation than other field crops. Nevertheless, yield increase in case of wheat, maize, jowar cotton and mustard crop using *Azotobacter chrooccocum* culture was 0–31 per cent higher than control.

2. AGRICULTURE AS CAUSE AND VICTIM OF CLIMATE CHANGE

The current change in global climate is a phenomenon that is largely due to the burning of fossil energy (coal, oil, natural gas) and to the mineralization of organic matter as a result of land use. These processes have been caused by mankind's exploitation of fossil resources, clearing of natural vegetation and use of these soils for arable cropping. Of these emissions, methane accounts for 3.3 Gt equivalents and nitrous oxide for 2.8 Gt CO_2 equivalents annually, while net emissions of CO_2 at only 0.04 Gt CO_2 equivalents per year, are small.

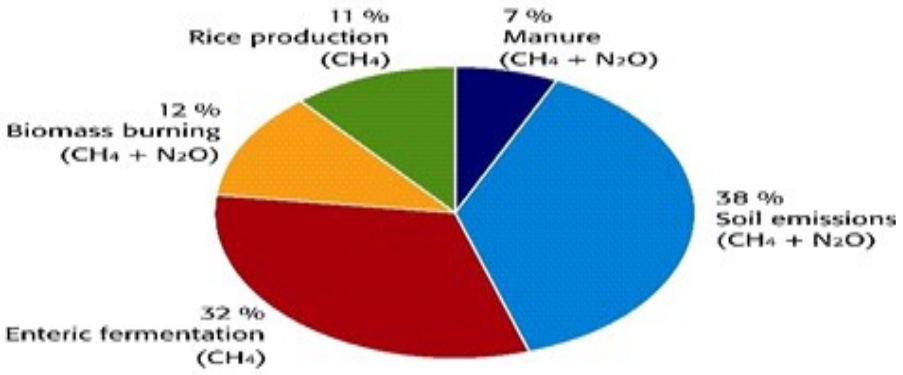

Fig: Main sources of greenhouse gas emissions in the agricultural sector in 2005 (Smith *et al,*2007)

2.1 Further increase in emissions expected unless agricultural practices change : Predictions concerning the future global trends for greenhouse gas emissions from agriculture largely depend on physical and economic parameters that have a strong influence on total emissions.These parameters include: cost of fuel, economic development, evolution of livestock numbers, increase in productivity, new technology, availability of water, deforestation, and consumer attitudes and diet (**Smith *et al,* 2007**).According to current projections, total greenhouse gas emissions from agriculture are expected to reach 8.3 Gt CO_2 equivalents per year in 2030, compared to the current level of approximately 6 Gt CO_2 equivalents annually **(Smith *et al.* 2007).**

2:2 Higher risks due to more unpredictable weather : Current scientific models predict substantial environmental changes caused by increased emission of greenhouse gases. These changes will affect

agriculture both in positive and negative ways. The forecast increase in global temperature of between 1.4º C and 5.8º C will result in alterations in precipitation patterns **(Smith *et al.* 2007).** Extreme weather events (droughts, floods) are expected to occur more frequently. Seasonal variations in weather events may pose risks to traditional methods of crop production either due to water constraints or surplus of water and erosion. Soil stability will become crucial in order to store water in the soil profile, to resist severe weather events and minimize soil losses. Vulnerable regions such as tropical and subtropical areas and high mountain regions are expected to suffer most from climate change. 1.4 Measures proposed by IPCC to mitigate the global warming impact of agriculture

3. THE POTENTIAL OF ORGANIC FARMING TO MITIGATE CLIMATE CHANGE

Reduction of greenhouse gas emissions. Organic farming has lower global warming potentiall.The global warming potential (GWP) of agricultural activities can be defined as greenhouse gas (GHG) emissions in CO_2 equivalents per unit land area or per unit product. The global warming potential of organic farming systems is considerably smaller than that of conventional or integrated systems when calculated per land area. This difference declines, however, when calculated per product unit, as conventional yields are higher than organic yields in temperate climates **(Badgley *et al.* 2007).** When losses and gains of soil carbon stocks (mineralization or sequestration) are considered in the calculations, the global warming potential is considerably reduced for organic agriculture as shown in recent studies.

- Scheyern experimental farm: decrease of 80% **(Küstermann *et al,*2007).**
- Bavarian survey of 18 commercial farms: 26% **(Küstermann *et al,* 2007).**
- Station experiment in Michigan: 64% **(Robertson *et al.,* 2000).**

CONCLUSIONS

- Enhanced soil fertility leads to a stabilization of soil organic matter and sequestration of carbon dioxide into the soils.
- Increases the soil's water retention capacity, thus contributing to better adaptation of organic agriculture under unpredictable climatic conditions with higher temperatures and uncertain precipitation levels.
- Organic Farming accept climatic challenges particularly in those countries which most susceptible to change climatic condition and reduced soil erosion that important source of CO_2 losses.
- Organic systems are highly adaptive to climate change due to the application of traditional skills and farmers knowledge, soil fertility-building techniques and a high degree of diversity.

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Brief Review on Hydro Power Plant

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ABSTRACT

In nature, energy cannot be created or destroyed, but its form can change. In generating electricity, no new energy is created. Actually one form of energy is converted to another form. To generate electricity, water must be in motion. This is kinetic (moving) energy. When flowing water turns blades in a turbine, the form is changed to mechanical (machine) energy. The turbine turns the generator rotor which then converts this mechanical energy into another energy form electricity. Since water is the initial source of energy, we call this hydroelectric power or hydropower. Hydropower is not only a renewable and sustainable energy source, but its flexibility and storage capacity also makes it possible to improve grid stability and to support the deployment of other intermittent renewable energy sources such as wind and solar power.As a result, a renewed interest in pumped-hydro energy storage plants (PHES) and a huge demand for the rehabilitation of old small hydropower plants are emerging globally. As regards PHES, advances in turbine design are required to increase plant performance and flexibility and new strategies for optimizing storage capacity and for maximizing plant profitability in the deregulated energy market have to be developed. During the upgrading of old small hydropower plants, the main challenges to be faced are the design of new runners that had to match the existing stationary parts, and the development of optimal sizing and management strategies to increase their economic appeal. This paper traces an overview of the prospects of pumped-hydro energy storage plants and small hydro power plants in the light of sustainable development. Advances and future challenges in both turbine design and plant planning and management are proposed. Peculiarities of the new design strategies based on computational fluid dynamics, for both PHES and small hydropower plants.

Keywords: Hydropower Pumped-hydro energy storage plant, Small hydro power plant, CFD, Variable-speed pump-turbine, optimal management strategies

INTRODUCTION

Small scale hydro power is an important energy source with multiple advantages over other forms of renewable energy if designed and installed correctly. The kinetic energy of moving water is readily available 24 hours a day, *small scale hydro power* systems can exploit this free energy providing a low cost and reliable source of "green electricity".

Generally, all you need for a "small scale hydro power" system is a stream or a river with enough water running through it at the right volume or pressure that can feed a water turbine connected to a generator that will supply power your home. Just as you can with a solar energy or a wind energy renewable system, you

can also design a small hydro energy system that is either grid connected, grid connected with battery backup or stand alone.

But what do we mean by a "small scale hydro" system. Small scale hydro power systems are scaled down versions of the much larger hydro generating stations we see using big dams and reservoirs to supply power to millions of people. Depending upon the physical size, head height and electrical power generating capacity, small hydroelectric schemes can be categorized into small, mini and micro scale hydro schemes as follows:

- Small Scale Hydro Power: is a scheme that generates electrical power of between 100kW (kilo-watts) and 1MW (mega-watts) feeding this generated power directly into the utility grid or as part of a large standalone scheme powering more than one household.
- Mini Scale Hydro Power: is a scheme that generates power between 5kW and 100 kW, feeding it directly into the utility grid or as part of a battery charging or AC powered standalone system.
- Micro Scale Hydro Power: is usually the classification given to a small homemade run-of-river type scheme that use DC generator designs to produce electrical power between a few hundred watts up to 5kW as part of a battery charging standalone system.

Hydropower, or hydroelectric power, is a renewable source of energy that generates power by using a dam or diversion structure to alter the natural flow of a river or other body of water. Hydropower relies on the endless, constantly recharging system of the water cycle to produce electricity, using a fuel—water—that is not reduced or eliminated in the process. India has a history of about 120 years of hydropower. The first small hydro project of 130 kW commissioned in the hills of Darjeeling in 1897 mark the development of hydropower in India. The Sivasamudram project of 4500 kW was the next to come up in Mysore district of Karnataka in 1902, for supply of power to the Kolar gold mines. Following this, there were number of small hydro projects set up in various hilly areas of the country. Till the Independence (1947), the country had an installed capacity of 1362 MW, which included 508 MW hydropower projects, mainly small and medium. As per MNRE, the estimated potential of small hydro power plant is 20 GW across the county.

Hydropower is based on the principle that flowing and falling water has a certain amount of kinetic energy potential associated with it. Hydropower comes from converting the energy in flowing water, by means of a water wheel or a turbine, into useful mechanical energy. This energy can then be converted into electricity through means of an electric generator. The energy from the flowing/falling water can also be used directly by suitable machines to avoid the efficiency loses of the generator. Recently, small-scale hydropower systems receive a great deal of public interest as a promising, renewable source of electrical power for homes, farms, and remote communities. Micro hydro systems refer specifically to systems generating power on the scale of 5 kW to 100 kW. Small Hydro is the development of hydroelectric power on a scale serving a small community or industrial plant. The definition of a Small Hydro project varies but a generating capacity of up to 25 megawatts (MW) is generally accepted as the upper limit of what can be termed Small Hydro. In hydroelectric power plants the potential energy of water due to its high location is converted into electrical energy. The total power generation capacity of the hydroelectric power plants depends on the head of water and volume of water flowing towards the water turbine.

OBJECTIVES

- To increase the percentage contribution of hydroelectricity to the total energy mix.
- To extend electricity to rural and remote areas, through the use of mini and micro hydropowerschemes.
- To conserve non – renewable resources used in the generation of electricity.
- To diversify the energy resources base.
- To ensure minimum damage to the ecosystem arising from large hydropower development.

POWER WHICH A SMALL SCALE HYDRO DESIGN CAN EXTRACT

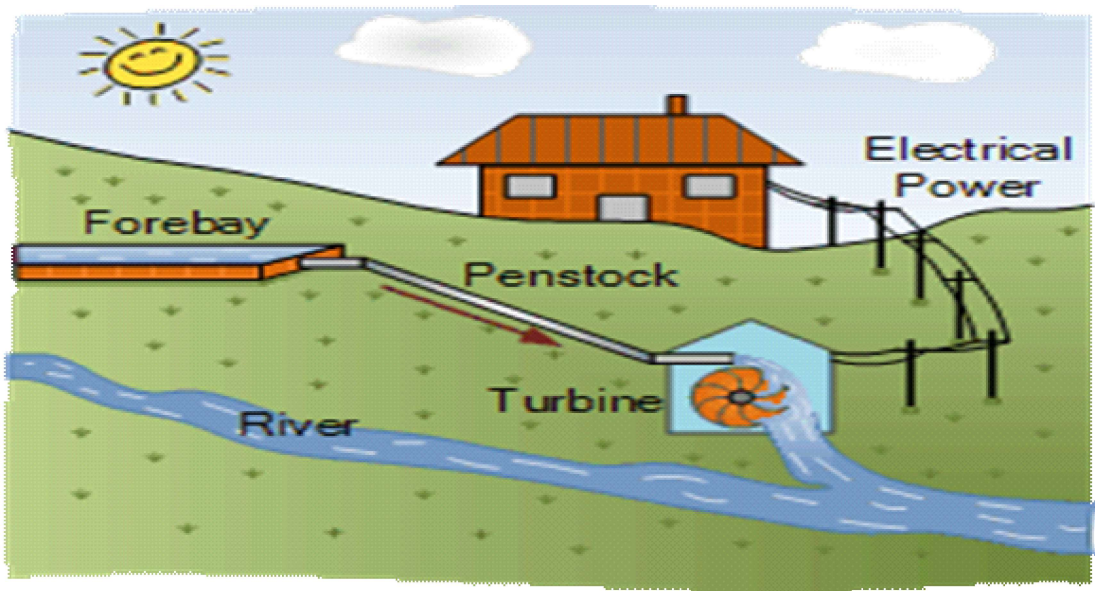
Waterwheels and water turbines are great for any small scale hydro power scheme as they extract the kinetic energy from the moving water and convert this energy into mechanical energy which drives an electrical generator producing a power output.

The maximum amount of electrical power that can be obtained from a river or stream of flowing water depends upon the amount of power within the flowing water at that particular point. As the water is moving a hydroelectric system converts this kinetic input power into electrical output power.

In order to determine the power potential of the water flowing in a river or stream, it is necessary to determine both the flow rate of the water passing a point in a given time and the vertical head height through which the water needs to fall. The theoretical power within the water can be calculated as follows:

Power (P) = Flow Rate (Q) x Head (H) x Gravity (g) x Water Density (ñ)

Where Q is in m^3/s, H in meters and g is the gravitational constant, 9.81 m/s^2 and ñ is the density of water, 1,000kg/m^3 or 1,0kg/litre.



MICRO HYDRO POWER PLANT MAIN PARTS

Then we can see that the maximum theoretical power that is available in the water is proportional to the product of "Head x Flow", as the pull of gravity on the water and the water density is always a constant. Therefore, P = 1.0 x 9.81 x Q x H (kW).

But the water turbine is not perfect and some input power is lost within the turbine due to friction and other such inefficiencies. Most modern water turbines have an efficiency rating of between 80 and 95%, depending upon the type, *reaction* or *impulse* so the effective power of a small scale hydropower system can be given as:

Importance of hydro power plant : Small hydro power Projects (SHPs) are an important, appropriate and profitable than other energy supply options and is a part of the full menu of energy options to be considered in meeting the needs of rural people more so in the remote and isolated locations in the hilly terrain of the state of Uttarakhand. SHPs compare well with the alternative energy supply options and has an important niche in the range of decentralized energy supply options. This niche is tightly demonstrated defined by the availability of adequate small-scale resource and as sufficiently concentrated density of demand, consisting of a need combined with purchasing power, to take advantage of a centralized, albeit small, power plant. SHPs have a great social bearing as it can provide rural people with electricity and create a sense of belonging to the modern world besides providing energy that can assist in securing the livelihoods of marginalized people. The SHPs are financially sustainable under the following conditions:-

- A high load factor
- A financially sustainable end-use
- Costs are contained by good design and management. Government of Uttarakhand as well as Government of India are facilitating the development of small hydro projects in the state of Uttarakhand. The Small hydro projects have following distinct advantages:
- Hydro power involves a clean process of power generation.
- It is a renewable source of energy and contributes to the upliftment of the rural masses, especially projects located in remote and inaccessible areas.
- It is the most cost effective option for power supply because it does not suffer from the limitation on account of fuel consumption.
- Most small hydro projects in Uttarakhand are being developed in remote and backward areas where substantial support for economic development is actually needed.
- Small hydro power contributes in solving the low voltage problem in the remote hilly areas and helping reducing the losses in transmission and distribution.
- In certain cases projects are helpful in providing drinking water and irrigation facilities.
- It helps in promoting the local industries in remote areas.
- The development of small hydro projects requires minimum rehabilitation and resettlement as well as environmental problems.
- Small hydro projects help in generating self-employment in remote areas of the state.
- Small hydro power projects helps in providing stable electricity supply at remote areas where such facility by other source shall be much costlier and unreliable.

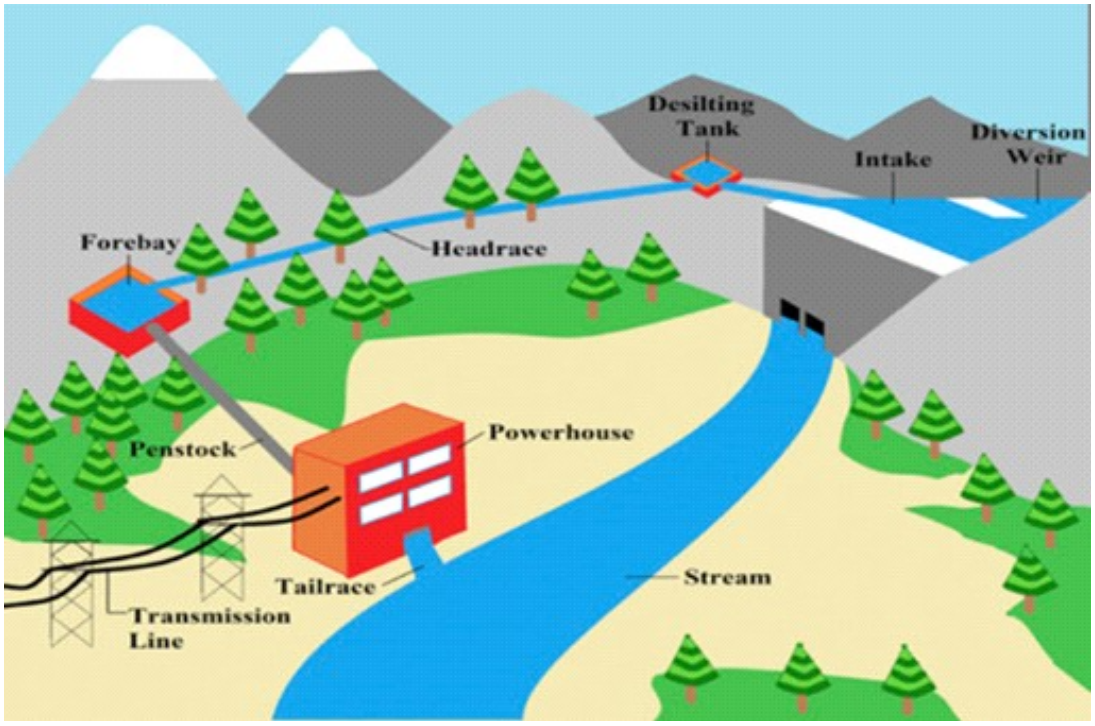
In Short we can say that SHP's are

- Simple to operate
- Non Polluting

- Minimum Maintenance
- Environment friendly
- Utilizes local resources
- Take less time in construction
- Can be used at places where grid is not possible.
- The viability can be improved by incorporating the benefits of Carbon Trading

FUTURE POTENTIAL

What is the full potential of hydropower to help meet the Nation=s energy needs? The hydropower resource assessment by the Department of Energy=s Hydropower Program has identified 5,677 sites in the United States with acceptable undeveloped hydropower potential. These sites have a modeled undeveloped capacity of about 30,000 MW. This represents about 40 percent of the existing conventional hydropower capacity. A variety of restraints exist on this development, some natural and some imposed by our society. The natural restraints include such things as occasional unfavorable terrain for dams. Other restraints include disagreements about who should develop a resource or the resulting changes in environmental conditions. Often, other developments already exist where a hydroelectric power facility would require a dam and reservoir to be built. Finding solutions to the problems imposed by natural restraints demands extensive engineering efforts. Sometimes a solution is impossible, or so expensive that the entire project becomes impractical. Solution to the societal issues is frequently much more difficult and the costs are far greater than those imposed by nature. Developing the full potential of hydropower will require consideration and coordination of many varied needs.



SIMPLE LAYOUT SMALL HYDRO POWER PLANT

HYDROPOWER, THE ENVIRONMENT AND SOCIETY

It is important to remember that people, and all their actions, are part of the natural world. The materials used for building, energy, clothing, food, and all the familiar parts of our day-to-day world come from natural resources. Our surroundings are composed largely of the Built environment@ — structures and facilities built by humans for comfort, security, and well-being. As our built environment grows, we grow more reliant on its offerings.

To meet our needs and support our built environment, we need electricity which can be generated by using the resources of natural fuels. Most resources are not renewable; there is a limited supply. In obtaining resources, it is often necessary to drill oil wells, tap natural gas supplies, or mine coal and uranium. To put water to work on a large scale, storage dams are needed. We know that any innovation introduced by people has an impact on the natural environment. That impact may be desirable to some, and at the same time, unacceptable to others. Using any source of energy has some environmental cost. It is the degree of impact on the environment that is crucial.

Some human activities have more profound and lasting impacts than others. Techniques to mine resources from below the earth may leave long-lasting scars on the landscape. Oil wells may detract from the beauty of open, grassy fields. Reservoirs behind dams may cover picturesque valleys. Once available, use of energy sources can further impact the air, land, and water in varying degrees. People want clean air and water and a pleasing environment. We also want energy to heat and light our homes and run our machines. What is the solution? The situation seems straightforward: The demand for electrical power must be curbed or more power must be produced in environmentally acceptable ways. The solution, however, is not so simple. Conservation can save electricity, but at the same time our population is growing steadily. Growth is inevitable, and with it the increased demand for electric power. Since natural resources will continue to be used, the wisest solution is a careful, planned approach to their future use. All alternatives must be examined, and the most efficient, acceptable methods must be pursued.

1. Hydroelectric facilities have many characteristics that favor developing new projects and upgrading existing power plants:
2. Hydroelectric power plants do not use up limited nonrenewable resources to make electricity. They do not cause pollution of air, land, or water.
3. They have low failure rates, low operating costs, and are reliable.
4. They can provide startup power in the event of a system wide power failure.

LITERATURE REVIEW

Zubli et al-Renewable energy is a common topic that has been discussed continuously since the past few decades. The process of generating and restoring energy needs to be developed, without neglecting the effect towards the environment itself. As for this research, the basis is to verify a concept; whether the fluid motion in normal pipeline; is able to be utilized and converted into sufficient electrical output or not. In this concept, each time the user runs the taps, the water flow shall initiate the system by moving the inner mini blades and convert rotational motion to the shaft, which links to the DC generator. The changes from kinetic energy shall then be converted to electrical energy, which shall be preserved for later use. As a result, this system is able to provide an economical way to produce electrical energy without affecting the environment.

Bilal *et al* - Micro-hydro power plant is a type of renewable power plant that is environment friendly, easy to be operated and low operation cost. Hink River is a river in Manokwari, Indonesia. The result of initial survey shows that the river has hydraulic potency about 29.5 kW. According to the result, a micro-hydro power plant has been planned to this location. The power plant will use 25.2 Kw of the hydraulic potency based on flow rate 0.3 m3/s and head height 8.6 m. Turbine for the power plant is cross flow turbine type T-14 D-300 and the turbine will be coupled with a 3 phases synchronous generator to produce electrical energy about 17.32 kW. The energy will be transferred via 3 phase distribution lines to some villages around the power plant in radius of 4km According to economic analysis, payback period of this power plant is about 17.32 years at benefit factor 1.94; therefore the power plant has feasibility to be built.

Yuliane *et al* - India is a developing nation with 1.35 billion populations living in varied strata of living standards. Therefore, the energy demand is constantly increasing in an effort to accelerate industrial activities and boost the economy. The country mostly meets its electricity demand from fossil fuel. It has large generation capacity but in some remote and rural areas only 53% of the villages get electric supply for less than 12 hours a day. This is because of hilly and mountainous terrains especially in the north and north-eastern regions of the country and absence of utility grid owing to economic reasons. It is estimated that about 15% of country's population do not have access to electricity. With huge hydro potential in the country, especially in the Himalayan States, hydropower generation may be emphasized and pressed in to augment ever increasing energy demand. The emphasis should be on small hydropower (SHP) as construction of large hydropower involves huge capital cost and they are associated with various techno-economic and social issues. The article aims to provide important information for appropriate policy making in developing small hydropower in India.

Emmanual *et al* - Nigeria as of today generates less than 4000MW of electricity but has the capability of increasing her generation through small hydropower (SHP) considering unharnessed potentials in the country. In other to increase the percentage contribution of hydroelectricity to the total energy mix and to extend electricity to rural and remote areas, considering the economic, social and environmental benefits, this paper presents verifiable data to show that generated power can be increased by over 80 percent if areas of SHP potentials in different states of the federation of Nigeria are properly harnessed

Jahindual *et al* - Depletion of fossil fuel and the inability to meet the rising demand of electricity are some drawbacks for the economic development of Bangladesh. Carbon emission done by developed world is also troubling the country. This paper focuses on the potential of Micro-hydropower plant in Bangladesh due to its numerous rivers and canals providing off-grid power to the remote areas and also to the areas that are still outside the main grid network. This paper reflects on the current energy scenario in Bangladesh, the need to explore green energy thus proving how the establishment of widespread micro-hydropower plant can help overcome the current power crisis and play a role in the economic progress of the country. The existing potential sites are mentioned and the means to identify new sites are outlined by performing hydrology studies, topographic studies, head calculations, turbine selection, and so forth.

Pinto agrwal *et al* - This study investigates the climate change impacts on micro hydro power generation in Bayang catchment, KabupatenPesisir Selatan, West Sumatra. There are three micro hydro power systems in operation today, namely Pancuang Taba (40 kW); Mauro Air (30 kW); and Koto Ramah (30 kW). The Water Evaluation and Planning (WEAP) system is applied to simulate hydrological model and micro hydro

power projection under different scenarios of greenhouse gas emissions (A_2 and B_2) from IPCC reports. The model is performed for the 2013–2025 period. Results demonstrate that climate change will reduce micro hydro power production. Changes in power generation vary up to 7.6% under B2 scenario and up to 15.7% under A_2 scenario at the last projection year.

MATERIAL AND METHODS

The major components of a Hydroelectric Power Plant are:-

- Dam/Barrage

  Head works i.e. power intake, head regulator and desilting chambers etc.
- Head race tunnels/channels
- Surge shaft/surge chambers
- Pressure shaft/Penstock
- Underground and surface power house
- Tailrace channel or tailrace tunnel.

Hydro Projects based on Installed Capacity?

Micro : up to 100 KW

Mini : 101KW to 2 MW

Small : 2 MW to 25 MW

Mega : Hydro projects with installed capacity >= 500 MW

Thermal Projects with installed capacity >=1500 M

ENERGY IS GENERATED IN HYDROELECTRIC POWER PLANT?

A hydroelectric power plant consists of a high dam that is built across a large river to create a reservoir, and a station where the process of energy conversion to electricity takes place.The first step in the generation of energy in a hydropower plant is the collection of run-off of seasonal rain and snow in lakes, streams and rivers, during the hydrological cycle. The run-off flows to dams downstream. The water falls through a dam, into the hydropower plant and turns a large wheel called a turbine. The turbine converts the energy of falling water into mechanical energy to drive the generator After this process has taken place electricity is transferred to the communities through transmission lines and the water is released back into the lakes, streams or rivers. This is entirely not harmful, because no pollutants are added to the water while it flows through the hydropower plant.

The hydro power potential of India is around 1,48,701 MW and at 60% load factor, it can meet the demand of around 84,000 MW.

We have proposed a method of using water energy from a stream passing through a structure in the form of a new patented micro-hydro power plant design with Banks on flat gates of a hydraulic structure [20], which will allow more rational use of energy systems. Flat gate of hydraulic structures serves for blocking the outlet opening and water passage from the upper to the lower one according to the task of the control center. The disadvantage of this shutter is the inability to use the hydraulic energy of the transmitted water to produce electrical energy [2, 3, 4]. The task is solved by the fact that the gate containing the super

structure, the under carriage additionally contains guide covers and a thre shold, a well for placing electric power equipment and a micro hydroelectric power station that has Banks as a hydro engine. The gate of the hydraulic structure contains the span structure 1, support and running parts 2, two turbines of the micro-hydroelectric power plant 3, installed at the bottom of the structure behind the span structure 1, generator 4, connected to the turbine by means of the transmission mechanism 5, a streaming cover 6 and a threshold 7, a well to accommodate the electric power equipment 8 (Figure1). The gate of the hydraulic structure works as follows. At opening of the gate span structure 1, water directed by the lid 6 and threshold 7 enters turbines of small hydroelectric power plant 3, which provides their rotation with generator 4 by means of transfer mechanism 5. Generator 4 and other equipment (pulleys, multiplier, ballast, etc.) are located in well 8, located in the center of the plumbing chamber between the turbines of small hydropower 2 E3S Web of Conferences 320, 04009 (2021) ESEI 2021 https://doi.org/10.1051/e3sconf/202132004009 plants. The well is hermetically sealed along the perimeter with metal walls, and its bottom is located at the bottom of the structure. To pass the water flow rate, which is larger than the capacity of the turbine, the lift of the span structure 1 of the gate is performed and the water is supplied to the lower elevator through the span located above the stream lids 6.

When performing repairs, it is possible to lift the turbines up, since their axis is installed in the embedded parts of the structure and the well, and the guide cover is removable. In the proposed design of the gate, guide covers and a threshold, a well for placing electric power equipment, and a Bank turbine are additionally installed. This ensures: a) the possibility of supplying large water flows to the lower stream during the growing season, which is not present in conventional gate designs; b) the efficiency of a small hydropower plant increases, since there is no turbine pipeline and valve, and the associated energy loss, in contrast to traditional designs of a small hydropower plant; c) the turbine is located directly in the receiving zone of the water flow without any intermediate elements and the use of the guide cover and threshold provides a high degree of energy supply to the turbine, and all this, as a result, increases the efficiency of micro hydroelectric power station; d) the use of the Bank's turbine due to the simplicity of manufacture and, accordingly, lower material costs of manufacturing, significantly reduces the cost of micro hydroelectric power stations. A prerequisite for the wide spread use of such hydraulic installations is their feasibility study, that is, the determination of the technical and economic parameters of micro hydroelectric power plants installed on the gates of hydraulic structures of hydroelectric power systems [2, 3, 11, 12]. The technical and economic parameters of micro-hydropower plants installed in the gate of the hydraulic structure of the hydroelectric power system should include [6, 7, 11, 12]:

1. head of micro-hydroelectric power station;
2. micro-hydroelectric power plant capacity;
3. annual electricity generated by micro-hydroelectric power plants;
4. capital investments to create micro-hydroelectric power plants at the existing gate;
5. operating costs for micro-hydroelectric power plants;
6. cost of electricity generated by micro-hydroelectric power plants;
7. saving fuel resources;
8. net profit from the use of micro-hydroelectric power plants;
9. payback period of micro-hydroelectric power plants.

DISCUSSIONS

The research and calculations made it possible to determine a number of technical and economic indicators that allow not only to recommend approaches to the selection of parameters of micro-hydroelectric power plants at hydraulic structures, but also to justify their application in specific conditions of the region.

CONCLUSION

The conducted calculations allowed us to justify the use of micro-hydroelectric power plants in specific conditions of the region on the basis of a number of technical and economic indicators. The use of micro-hydroelectric power plants is almost always profitable, where watercourses provide installation of micro-hydroelectric power plants with a capacity of more than 10 kW. At the same time, it is desirable to divide micro-hydroelectric power plants into two groups, the first group – with a capacity of up to 10 kW and the second group with a capacity of more than 10 kW. Micro-hydroelectric power plants of the first group can be installed on small watercourses with a flow rate of up to 1 m3 / s, and the second group - on watercourses of more than 1 m3 /s.

Micro-hydroelectric power plants of the second group with a capacity of more than 10 kW can be installed on almost all hydraulic structures with flat gates, on many water intake and culvert structures of water nodes, rivers and channels. Moreover, many water intake and culverts in our Republic can be installed micro –, mini-and small hydroelectric power plants with a capacity of 100 kW or even more, up to 500 kW.

With such plants, i.e. the use of micro hydro on gates hydraulic structures, it is possible to solve the issues of energy supply, conservation, and preservation of ecological purity, rural area problem etc

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Socio-Economic Evaluation of Cropping Systems for Small Holder Farmers in Begusarai Dist. of Bihar - Challenges and Options

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ABSTRACT

The exact identification of smallholder farmers varies widely worldwide depending on location and intensification of farming systems. Generally, a smallholder farmer is viewed as a person involved in farming a small piece of land, most of them do subsistence farming. In many localities, smallholder farmers practice mixed crop-livestock farming, whereby the number of large ruminants kept is around. Keeping this in mind, the present study was based on the analysis-Economic Evaluation of Cropping Systems for Smallholder Farmers in Begusarai Dist. of Bihar– Challenges and Options. The primary data of Socio-Economic Evaluation of Cropping Systems for Smallholder Farmers were collected from 120 farmers of Begusarai district from a cluster of three villages each from two blocks for the agricultural year 2020-21 through SRSWOR Technique and secondary data were collected from DES (Department of Economics and Statistics), Govt. of Bihar. Primary data on various aspects related to socioeconomic and personal characteristics were collected through personal interviews with help of a pre-tested interview schedule. It consists of information on age, education, size of family, size of operational holdings, prevailed cropping system, source of income, cost incurred on the cultivation of crops, gross income, net income received and farmer level constraints, etc. The sample was dominated by semi-medium farmers followed by medium, marginal & small, and large farmers. In the study area, observed that maize and wheat were the two most important crops in the cropping system. The cropping intensity on sample farms was 190 percent. It was found in order of category of farms, i.e. a minimum of 185 percent on marginal & small farms followed by 190, 195 and 193 percent on semi-medium, medium and large farms, respectively. It may be due to the land situation of the marginal & small farmers which restricts them from intensive farming. For the sake of nation and enhancement of small & Marginal Farmers income, there is a need to step up investment in agricultural research, education, extension to reach among an unreached section of society emphasizing quality of production and value addition.

Keywords: Small Holder farmers, cropping pattern, Cropping system, Income etc.

1. INTRODUCTION

India holds a top-ranking in the world not only in terms of rich diversity of oilseed crops but also in terms of area as well. Oilseeds occupy an important position in the Indian economy as they account for 14 per cent of the gross cropped area and contributing more than 4 per cent to the Gross National Product (GNP) as per Directorate of oilseed Development (DOD). India is the third largest rapeseed-mustard producer in the world after China and Canada with 16 per cent of world's total production. The area under rapeseed-mustard in the country was 6.23 Million hectares, produced about 9.34 million tonnes with 1499 kg/ha productivity during the year 2018-19. Bihar ranked ninth among the states, in rapeseed-mustard production, with a growth rate of 7.34% during the eighties whereas Rajasthan state with top ranked. It is the most important crops among oilseeds in terms of both area (0.08 million ha) and production (0.11 million tonnes) in Bihar. (DES, Government of Bihar Patna, 2018-19). Production of oilseeds and oils has not fluorescing with increasing demand for edible oils and due to this widening demand-supply gap has necessitated imports of edible oils. With competing demands on agricultural land from various crops and enterprises, the production of oilseeds can be increased only if productivity is improved significantly and farmers get remunerative prices and assured market access. However, farmers face various constraints in oilseeds production. For the Socio-Economic Evaluation the primary data were collected by using personal interview method. The study found that the sample was dominated by semi-medium farmers followed by medium, marginal & small and large farmers. In the study area, observed that maize and wheat were the two most important crops grown during Rabi season. The area under maize ranged from 0.68 ha on marginal & small farms to 4.61 ha on large farms with overall average of 2.56 ha. Moreover, the cropping intensity on sample farms was 190 per cent. It was found in order of category of farms, i.e. minimum of 185 per cent on marginal & small farms followed by 190, 195 and 193 per cent on semi-medium, medium and large farms, respectively. It may be due to land situation of the marginal & small farmers which restrict them from intensive farming. In the problems/constraints sides, they were facing the Unavailability of good Variety seeds, Severe Agro-ecological, technological, institutional, and socio-economic constraints, small holding, getting very low income from their cropping system that was adopted by growers, also inhibit exploitation of the yield potential of crops and need to be addressed. Taking into account the changing policy regarding small & Marginal Farmers, small holders, environment, input cost incurred, availability of nutrition by household, Low Income, to bridge gap between demand & supply should be address. Therefore the study attempts to analyze the Socio-Economic Evaluation of Cropping Systems for Smallholder Farmers in Begusarai District of Bihar – Challenges and Options.

2. RESEARCH METHODOLOGY

For the study of socio-economic status and cropping pattern under rapeseed-mustard growers were conducted in two blocks in Begusarai district of Bihar. Three villages from each block consisting of 20 rapeseed-mustard growers from each village were selected randomly. Thus, the data were collected from 120 farmers through a semi-structured interview schedule by using personal interview technique.

Table 1: Sampling framework

STAGE	STUDY (SAMPLE) UNIT	
I	Selection of District	Begusarai, District was Selected purposively, being major rapeseed-mustard growing district of the state.
II	Selection of Block	From the selected district, two blocks were selected randomly under rapeseed-mustard cultivation.
III	Selection of cluster/village	One cluster consisting of three villages were selected randomly from each selected block.
IV	Selection of Rapeseed-Mustard growers	Samples of rapeseed-mustard 20 growers were selected randomly from each cluster. Thus the total sample size was 120 for the study.

Source: ***www.dse.bih.nic.in***

The primary data were collected from selected rapeseed-mustard growers in study area. Primary data on various aspects related to socioeconomic status and personal characteristics were collected, It consists of information on age, education, size of family, size of operational holdings, size of land holding, cropping system, cropping Pattern, source of income, cost incurred on cultivation of crops, gross income, net income received, farmer level constraints or problems and challenges they were facing in production of rapeseed-mustard. The data consisting of the physical quantities viz., seed, manures, fertilizers, pesticides, weedicides, land preparation, human labour (family and hired), machine labour etc., and their costs, yield and price received were also collected from sample rapeseed-mustard growers for the crop grown during *Rabi Season* 2020. Thereafter data were compiled, tabulated, analysed and interpreted as per theme of the study.

2.2 Garrett Ranking Method : were used for analyzing the constraint according to the severity of the problem facing by household. In this method to the farmers the given rank 1 means most important problem and vice versa. In the next stage rank assigned to each reason by each individual were converted into per cent position by using the formula:

$$\text{Percentage Position} = 100\ (Rij - 0.5) / Nj$$

Where,

Rij = rank given for ith item by jth individual

Nj = number of items ranked by jth individual

The percentage position was then converted to Garrett Score using Garrett Ranking conversion table. The individual score then obtained were added and mean value were calculated and ranked in descending order.

3. RESULTS

The socio-economic characteristics of sample farmers of Begusarai districts have been presented the following sections:

3.1 Classification of sample farmers based on operational holding of rapeseed-mustard growers

The classification given by CACP in their manual used to categories the sample farmers based on operational holdings and presented below (Table 2). The respondents were further categories into marginal & small farmers having operational holding size less than equal to 2.0 ha, semi-medium farmers with holding size ranging from 2.0 ha to 4.0 ha and medium (4-10 ha) and large farmers (more than equal to 10 ha) and presented in the table 4.1. Table indicated that the out of total 120 sample farmers, 25 farmers were of marginal& small farmers (20.83 percent) followed by 49 farmers of semi-medium (40.83 percent) and 33 farmers were belonged to medium (27.5 percent) whereas only 13 farmers were large (10.84 percent) farmer's categories.

Table 2: Classification of sample farmers based on operational holding of rapeseed-mustard growers (ha)

Category of Rapeseed-Mustard farmers	Operational holding (ha)	Number of Farmers	
		Number	Percentage
Marginal & Small	Less than 2 .00 ha	25	20.83
Semi-Medium	2.00 - 4.00 ha	49	40.83
Medium	4.00 - 10.00ha	33	27.5
Large	More than 10.00ha	13	10.84
Total		120	(100.00)

3.2 Average size of land holding and area under rapeseed-mustard : The table 3 indicated that average total cultivated area of the four categories of sample rapeseed-mustard farmers were 0.57 ha, 1.07 ha, 1.08 ha and 2.73 ha, respectively with overall mean of 1.15 ha.

Table 3: Average size of Land holding for different categories of sample farmers (ha)

Particulars	Category of farmers				
	Marginal & Small	Semi-Medium	Medium	Large	Overall
	n_1=25	n_2=49	n_3=33	n_4=13	N=120
Owned Land	1.08	3.04	4.84	10.92	4.97
Leased-in Land	1.16	0.9	2.23	6.02	2.57
Leased-out Land	0.00	1.33	2.33	4.00	1.91
Operational holding	2.24 (100)	2.61 (100)	4.74 (100)	12.94 (100)	5.63 (100)
Area under Rapeseed-Mustard	0.57 (25.45)	1.07 (40.99)	1.08 (22.78)	2.73 (21.10)	1.15 (20.43)
Area under another crop	1.67 (74.55)	1.54 (59.01)	3.66 (77.22)	10.21 (78.90)	4.48 (79.57)

Note- Figure in Parentheses shows percent to total.

The table also revealed that marginal & small and semi-medium farmers were taken land on lease-in with an average of 1.16 and 0.9 ha, respectively while medium and large farmers leased out their land, with mean of 2.33 and 4.00 ha, respectively. The table also indicated that the large farmers devoted maximum area under rapeseed-mustard cultivation, followed by semi-medium, medium and small & marginal category of farmers. Area under another crop was in reverse order on four categories of farmers. On overall basis 20.43 per cent area were under rapeseed-mustard crop while 79.57 per cent under another crop such as wheat, maize, gram and other *Rabi season* crops.

3.3 CROPPING PATTERN ON SAMPLE FARMERS

Table-4 Cropping pattern on sample farmers (ha)

Particulars	Category of farmers				
	Marginal & Small	Semi-Medium	Medium	Large	Overall
	n_1=25	n_2=49	n_3=33	n_4=13	N=120
Net Area Sown	1.79	5.23	6.24	15.97	6.55
(A) Kharif					
Soybean	0.95	1.98	3.54	8.5	4.67
Rice	1.06	1.47	2.27	4	2.2
Maize	0.82	1.75	1.42	2.48	1.04
Total (A)	2.83	5.2	7.23	14.98	7.91
(B) Rabi					
Rapeseed-Mustard	0.33	1.18	1.38	2.73	1.32
Wheat	0.78	1.83	2.53	8.63	2.67
Maize	0.68	2.22	2.33	4.61	2.56
Total (B)	1.79	5.23	6.24	15.97	6.55
(C) Zaid					
Green gram	0.5	1.63	1.31	2.5	1.36
Total (C)	0.5	1.63	1.31	2.5	1.36
Gross Cropped Area (A+B+C)	4.62	10.93	13.97	31.95	14.96
Cropping Intensity (%)	185	190	195	193	190

The table 4 showed that maize and wheat were the two most important crops grown during *Rabi* season in the study area. The area under maize ranged from 0.68 ha on marginal & small farms to 4.61 ha on large farms with overall average of 2.56 ha. Moreover, the cropping intensity on sample farms was 190 per cent. It was found in order of category of farms, i.e. minimum of 185 per cent on marginal & small farms followed by 190, 195 and 193 per cent on semi-medium, medium and large farms, respectively. It may be due to land situation of the marginal & small farmers which restrict them from intensive farming.

3.4 Area under rapeseed-mustard varieties grown on sample farmers : The table 5 represented area (ha) under different rapeseed-mustard and varieties cultivated by sample farmers. It was observed that overall share of local variety was 66.03 per cent while Varuna, Pusa Jai Kisaan, Pusa bold, & others varieties was cultivated on 46.32 per cent area. It may also be inferred from the table that marginal & small and semi-medium category of farmers preferred local Varieties (85.31 % & 73.52 %) while medium farmers preferred both varieties (69.48 %) and the large farmer preferred to grow improved varieties (54.08 %).

Table 5: Area under rapeseed-mustard varieties on sample farmers (ha)

Name of the Variety	Category of farmers				
	Marginal & Small	Semi-Medium	Medium	Large	Overall
	n_1=25	n_2=49	n_3=33	n_4=13	N=120
Local	12.20 (85.31)	38.75 (73.52)	24.68 (69.03)	16.03 (45.92)	91.66 (66.03)
Varuna, Pusa bold & others	2.10 (14.68)	13.95 (26.47)	11.07 (30.97)	19.20 (54.08)	46.32 (33.97)
Total area of Rapeseed-Mustard cultivated	14.30 (100.00)	52.70 (100.00)	35.75 (100.00)	35.50 (100.00)	138.25 (100.00)

Note- Figure in Parentheses shows percent to total.

3.5 Problems and Challenges faced by different categories of rapeseed-mustard sample farmers: The constraints faced by different categories of sample farmers are presented in table 4.13 the marginal & small farmers faced lack of improved varieties of seed as the most important constraint (GS: 89.96) followed by high transportation cost (GS: 77.20), agro-ecological constraints (GS:71.68), high fluctuation in market prices (GS: 63.96) and lack of subsidy on inputs (GS:58.76). On overall basis the first two most important constraints were lack of improved varieties of seed and high transportation cost with Garrett score of 89.3 and 76.58, respectively and sample farmers also reported about cost and non-availability of quality seeds on time, because of this most of the farmers use their local seeds. Agro-ecological constraints, high fluctuation in market prices were next two important constraints on overall basis. Lack of subsidy on inputs for rapeseed-mustard cultivation ranked 5th constraint (GS: 53.27). With respect to problems of marketing, the lack of market information ranked 6th with Garrett Score 49.92 and high fluctuation in market prices ranked 4th with Garrett Score 63.2 of the sample farmers.

Problems of weed management and High pest & disease Incidence were ranked as 10th and 11th constraint with Garrett Score of 38.75 and 35.13, respectively in cultivation of rapeseed-mustard by the sample farmers. Lack of marketing facilities in rural area, Fertilizers and nutrients management, Lack of co-operative and Lack of storage facilities in rural areawere the least concerned constraint as these facilities and inputs were available in plenty along the study area, therefore the sample farmers ranked them as 12th, 13th, 14th and 15th with Garrett Score of 35.13, 32.59, 30.72 and 30.31, respective.

Table-6 : Major Problems faced by sample farmers in rapeseed-mustard cultivation

Source: Compiled by Author (Year 2020-21)

Sl. No	Farmers level constraints of rapeseed-mustard Growers	Overall (N= 120)	
		Garrett Score	**Rank**
1.	Lack of Improved varieties of seed	89.3	1
2.	High transportation cost due to small quantity	76.58	2
3.	Agro-ecological constraints	72.06	3
4.	High fluctuation in market prices	63.2	4
5.	Lack of Subsidy on inputs	53.27	5
6.	Lack of market information	49.92	6
7.	LabourAvalibility	49.62	7
8.	Long distance of regulated market	48.8	8
9.	Low market price	44.32	9
10.	Problems of Weed Management	38.75	10

4. DISCUSSION

The total cultivated area of the four categories of sample farmers was 2.24, 2.61, 4.74, and 12.94, respectively with overall mean of 5.63 ha (Table 4.5). The marginal & small and semi-medium farmers had taken land on lease with an average area of 1.16 and 0.9 ha, respectively while semi-medium and medium farmers leased out their land, with an overall mean of 1.33 and 2.33 ha, respectively, which is obvious because the medium and large farmers normally lease out their land due to larger fragmented area. The average area under rapeseed-mustard ranged from 0.57 ha on marginal & small farms to 2.73 ha on large farms with overall average as 1.15 ha. The semi-medium farmers devoted maximum (40.49 per cent) area under rapeseed-mustard cultivation, while marginal & small, medium and large category of farmers allocated 25.45, 22.78 and 21.10 percent area under rapeseed-mustard cultivation, respectively. This clearly indicating that agro-ecology was not appropriate for cultivation of rapeseed-mustard at large scale as only 21.10 percent of total area were devoted by large farmers on cultivation of rapeseed-mustard crop.

The cropping intensity on sample farms was 185 per cent. It was found in order of category of farms, i.e. minimum of 190 per cent on marginal farms and semi medium farmers followed by 195 and 193 per cent on medium and large farms, respectively. It may be due to inability of marginal & small farmers as well as semi-medium farmers to adopt intensive farming due to land situation. The cropping intensity was usually high i.e. 185 percent indicating that farmers of study area were using double cropped in which farmers were cultivating rapeseed –mustard based or other crops based farming system.

It was observed that Local varieties were important rapeseed-mustard varieties cultivated on 66.03 per cent area by the sample farmers it may be due to unavailability of improved seed varieties. It was also revealed that marginal & small (85.31 per cent) and semi-medium farmers (73.52 per cent) preferred Local traditional varieties while medium and the large farmer preferred to grow both varieties equally.

5. CONCLUSION

Overall the study observed that the socio-economic status of rapeseed-mustard growers in study area along with Bihar state is below average but rapeseed-mustard crop production having the potential to bridge the gap between demand and supply of edible oils. However, Inclusion of rapeseed-mustard cultivation in cropping system may improve the living standard of household. It's thrust area to conduct study in the field of oilseeds crops. Instead of having the great opportunities in the cultivation of oilseeds crops, farmers in the study area are more likely to prefer to grow bold cereals crops- mostly 'Rabi Maize', farmers are not giving priority to oilseeds crops (Rapeseed-Mustard) it may be due to the shortage or unavailability of improved varieties of seeds (As per table 6). Thus, these findings will be useful for rapeseed-mustard growers to prefer IVS (Improved Varieties of Seeds) instead of Local Seeds from research stations or KVKs. The finding may also be useful for efficient utilization of resources to reduce the cost of cultivation of rapeseed-mustard. As well as, the technology should be targeted in these areas as cost effective or/ less costly than the competitive crop so that the farmers could get the net returns equivalent to that they get from the competitive crops especially from wheat and maize so that they can rise their social status.

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Effect of Trench Method of Sowing In Sugarcane Crop in District Lakhimpur-Kheri

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ABSTRACT

Sugarcane is one of the important cash crops in district Lakhimpur Kheri. It occupied more than 3 lakhs hectare with avg. productivity of 818 q/ha. During training programme farmers had discussed about the germination and lodging problem in sugarcane setts in village- Sujaikunda, Block-Ramiabehar, Then during interaction, trench method has been advised to farmers. After that farmer had realized that germination percentage increased 70-80% which was previously 35-40%.It was due to better contact of sugarcane setts with the moist soil. The depth of trench is one feet and one feet wide with interspaces of three feet and it resulted into reduction of lodging with more appropriate support from crop base as well as ample scope for better intercultural operations. The increases in cane yield from 960 q/ha to 1200 q/ha have been recorded (25% increase in yield) with approximate horizontal spread of this technology 122000 hectare in blocks like Ramiabehar, Dhaurhara&Ishanagar.

INTRODUCTION

Trench-Method : This method is usually adopted in coastal areas as well as other areas, where the crop grows very tall and the strong winds during rainy season cause lodging of cane. Trenches are dug at a distance of 90 cm, with the help of ridger or by manual labour. The trenches should be about 30 cm deep. The mixture of fertilizers (NPK) should be spread uniformly in the trenches and mixed thoroughly in the soil. The setts are planted end to end in trenches. Drenching of setts with chlorpyriphos 20 EC (1 kg ai/ha or 5 litres/ha) to protect from the soil borne insects is required. The trenches are filled up with loosened soil after planting.

Ridge and Furrow Method : This method is usually adopted in areas of moderate rainfall having drainage problems. In this method, the furrows are made in 'V' shape about 60-75 cm apart and 20-25 cm deep. The setts are placed in horizontal position, usually with end-to-end system. If the seed stalk is not healthy and internodes are longer, eye-to-eye system of planting may be adopted. As soon as the canes start growing, the furrows are partly filled with soil and inter-row cultivation is carried out. This repeated row cultivation of cane results in levelling of the land by end of May or mid of June, which is known as first earthing-up. Further repetition of inter-row cultivation transforms the furrow into ridges by putting soil around the plants and inter-row space becomes furrow automatically, through which irrigation or drainage is provided for the growth and development of crop. The transformation of furrow into ridges is known as second earthing-up.

Fig-1.Above picture shows Trench method of sowing and after that ridge and furrow method of sowing of sugarcane crop.

SUGARCANE VARIETIES ARE MAINLY CLASSIFIED IN THREE GROUPS

1. Early varieties,
2. Mid-late varieties,
3. Late varieties.

The varieties attend 16.5% sucrose, and 85% purity in 10 months are kept in early category. The varieties accumulate above 16% sucrose level and 85% purity in 12 months are grouped in mid-late category. Those varieties, attend the similar 16% sucrose level and 85% purity in more than12 months and maintain up to 14 months stage are grouped in late maturing varieties. Nowadays early maturing, high sucrose and higher tonnage varieties are also available and are in higher demand by the sugarcane growers as well as sugar mill owners. These varieties are performing well in the country and accounts for higher sugar production.

MATERIALS AND METHODS

Sowing of Sugarcane crop by the trench method resulted into increased germination percent and cane yield. In this method trenches are open at a depth of 30cm with a spacing of 90 cm and setts are sown in these trenches. KVK, Lakhimpur Kheri-I had aware the farmers regarding trench method through training programmesin year 2010 to 2019 with regular visit in the Block-Ramiabehar. During training programme it has been emphasized that lodging of cane will be less and germination % will be improved. Total 115

farmers were respondent for the same. The data collected on the basis of their experiences were presented in Table-1 and Table -2.

Table 1

Parameters	Before KVK intervention (Ridge &Furrow)	After KVK intervention (Trench)
Germination percentage	35-40%	70-80%
Seed rate	30-35 q/acre	15-18q/acre
Weed infestation	Maximum	Minimum
No.of tillers	8-10	18-20
No.of irrigation	7-8	7-8(40% water saved)
Yield	384q/acre	480q/acre
No.ofmilleable cane	5-7	10-12
Lodging	Maximum	No lodging
Spacing	2.5 feet	3 feet
Intercropping	Very less	Easy
Cost	Rs.55000 /acre	Rs.45000/acre

Table-2

S.No.	Operations	No. of person required		Time taken(in hrs)	
		Persons(Trench)	Persons(R&F)	Trench	R&F
1-	Field preparation	1	2	8	8
2-	Sowing	10	10	8	8
3-	Planking	No	2	No	2
4-	Intercultural operation	1	2	1.5(Tractor)	8-10
5-	Irrigation	2	2	5	8

SUMMARY AND DISCUSSION

Trench method resulted increase in germination percentage due to better contact of setts with soil moisture and the lodging reduced with increasing depth of sowing. Tillers were also found maximum in trench method as compared to ridge and furrow method. It was also realized that saving of irrigation water to the tune of 40% at farmer's field. Weed infestation was less due to water applied only in the trenches.The data clearly showed that increased in yield due to better germination percentage as compared to ridge and furrow method(Katiyar,2013) ultimately yield was also recorded maximum in trench method(Singh *et al*.2008). This may be attributed to increase in yield resulted into higher net return and B:C ratio also reported by Singh *et al* ,2012 and at site http://agritech.tnau.ac.in andhttp://iisr.icar.gov.in>aicrp.

Fig.2 Fully grown sugarcane crop by trench method

CONCLUSIONS

1. The germination percentage were found 70-80% as compared to conventional method (35-40%) due to better contact with moist soil surface.
2. Increase in yield (25%) attributed to increase in tillers and malleable cane leads to monetary advantage to farming community.
3. The farmers have got net return of Rs.111000/acre and BCR to tune of 3.46. (Gross Return (Rs/acre) =Yield 480q/acre x Rs. 325/q=Rs.156000.00, Cost of cultivation Rs. 45000/acre).
4. Lodging of Cane is less as compared to R&F method as the better support from ground level.
5. Varieties which are quick growing habit and profuse tillering ability best fitted in trench method.

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Organic Farming and Women

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ABSTRACT

It is much known fact that women are the part and parcel of the agriculture occupation and we have already seen the feminization of agriculture. With the introduction of newer technologies in agriculture, its reach to women is also no matter of question. Although the extent of reach of technologies and its adoption and utilization with special reference to women is a major concern. Involvement of women in organic farming is also not a new concept as it is a proven fact that women are conserver and preserver of the traditional knowledge including agriculture. With the promotion of organic/natural farming, role of women also increased in development of the family, home and economy. The present paper is review based and major focus is on how women are involved in organic or natural farming and where they are lacking. Women can earn a lot with the organic farming and its various products development. Here, it is also important to note that how organic/natural farming is affecting the women, their overall development and most important the sustainability.

Key words: Women, organic farming, natural farming, development and empowerment

INTRODUCTION

Gender relationships are fundamental worldwide to the way farm work is organised, the way assets such as land, labour, seeds and machinery are managed, and to farm decision-making. Given this, the lack of adequate attention to gender issues within the organic and sustainable farming movements is worrying. The revolutionary potential of sustainable approaches to farming to reshape our food systems, and the way humans interact with those systems, will not be realized unless there is a concerted effort by committed sustainable farmers and consumers to work towards gender equality. Although women working in organic sustainable production generally call themselves farmers, unlike women in conventional farming who tend to consider themselves 'farmwives', it is interesting to note that the gender division of labour per se is not being challenged. Women's work on both sustainable and conventional farms is similar. It is labour intensive, largely unmechanised, and rarely involves the application of inorganic chemicals. Organic and sustainable farming has the potential to create new structures that actively work towards achieving women's empowerment and protecting the use of indigenous knowledge. This is a challenge for the organic movement, particularly certified organic, which is predominately driven and supported by political, cultural, economic and social structures that are located within western ideologies and practices. Part of the challenge is to identify behaviour that is impeding women's empowerment in organic agriculture. This may include a dominance of western-

based thinking with regard to women's empowerment and possible interventions. Culturally appropriate solutions need to be created by communities at the local level to address issues of structure.

WHAT IS ORGANIC AGRICULTURE?

- Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects.
- Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. Wettasinha (in Frost 2003) remarks that 'Organic Agriculture is not simply agriculture without chemicals. (It is) an ecologically sound, socially just, economically viable, and therefore sustainable form of agriculture. [It] strives to maintain the ecological balance in the farming system and to utilise the resource base in a sustainable manner, whilst paying keen attention to socio-economic aspects of production. Nutrient recycling, optimal use of available resources, diversification, site specificity are important ecological aspects of organic agriculture. Socio-economic aspects such as food security, fair trade, capacity building etc are no less important.'
- Thus, organic and other forms of sustainable agriculture are the site of multiple values; the realisation of these values is certain to be problematic and conflictual given the fact that trade-offs will have to be made between values, and given the great variety of actors in the process.

WOMEN'S PLAY IN ORGANIC CULTIVATION

The women play a major and important role in organic farming development and allied fields including in the main agricultural production like horticulture, livestock, agro/ social forestry, postharvest operations, fisheries, etc. The environment and extent of women's involvement in organic agriculture, no doubt, differ obviously from region to region. Even within a region, their involvement varies widely among different farming systems, ecological sub-zones, castes, classes and stages in the family cycle. But regardless of these variations, there is hardly any activity in agricultural production, except plowing in which women are not actively involved. Several studies on women in organic farming conducted in India and other developing and underdeveloped countries all point to the conclusion that women contribute far more too agricultural production than has generally been approved

REVIEWS ON WOMEN'S PARTICIPATION IN ORGANIC CULTIVATION

Khana (2007) expressed his views that the principle of organic cultivation is attracting world over farmers due to its various benefits over modern agricultural practices. Sodjinou*et al*., (2015) argued that there are immense challenges like sustaining crop production, productivity without damaging the resources and environment which a farming situation faces but this problem can be overcome by several ways and the first and foremost way is organic farming. We know that organic farming system in India is not new and is being followed from ancient time. It is a way of farming system which principally aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment (Sharma and Kaur, 2013). Nagnur*et al.,* (2012) said that women are the role player in

Indian agriculture which is a well-known fact. In India, agriculture is a joint contribution both of male and female with family members. Women are said to contribute 40 percent of their efforts towards farming and 60 per cent for food preparation. Reddy (2010), wrote that rural farm women are extensively involved in agricultural activities and the extent of their involvement differs with the variations in agro-production systems. In all farm production, women's average contribution is estimated at 55 percent to 66 percent of the total labour. Women are the major stakeholders in organic agriculture, precisely because they are the worst victims of chemical farming.

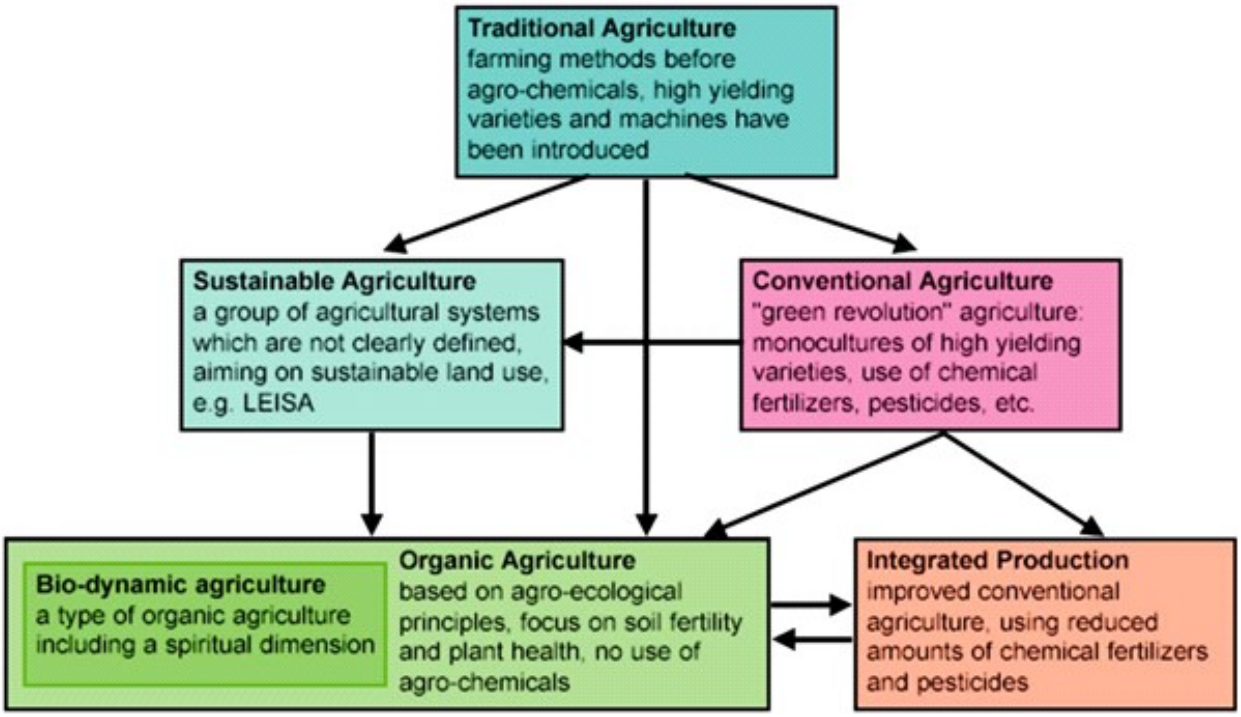

Figure-1 : Definition Of Some Farming Systems :
This Shows An Attempt To Distinguish Between Some Commonly Used Terms Of Agricultural Systems (Arrow Show How They Can Transform From One Type Into Another)

Below is the figure showing the different types of agriculture with its main feature. No doubt, with the advancement and needs, these system arised or modified to support the farming family.

ROLE OF WOMEN IN SUSTAINABLE AGRICULTURE AND ALLIED SECTORS

Women play an important role in allied activities as well; they undertake a wide range of activities related to livestock production, vegetable cultivation, fish processing, and dairy production and maintenance. Beyond the farm, women play a significant role in land and water management6 and are most often the collectors of water, firewood, and fodder. Given the extensive participation of women in all aspects of agricultural and allied activities, the mainstreaming of the gender into the agriculture sector is a key strategy not only for the promotion of equality between men and women but also for sustainable agriculture and rural development.

Providing livelihood and employment to 44 per cent of the workforce in 2018 (World Bank 2019a) and contributing about 17.2 per cent of gross value added in 2017/18 (MoAFW 2018), the agriculture sector remains fundamental for economic growth, poverty alleviation, and environmental sustainability, wherein

rural women contribute significantly in three different ways depending on the socio-economic status of their family. They contribute as paid labourers, unpaid labourers– doing labour on their own/family-owned land, and managers/supervisors in agricultural production and post-harvest operations. Besides they also play an important role in the maintenance of natural processes and ecosystem services and adopt an integrated perspective to farming system that emphasizes on sustainable agricultural practices and resource-use efficiency. This further gets bolstered by their ability to respond to the barriers to farming with innovative strategies that emphasize smaller farm scales, diversified high value and value added products and enterprises, unique marketing strategies, and sustainable practices (Sachs, Barbercheck, Brasier, *et al.* 2016).

The role of women in agriculture and in rural labour markets varies between regions and different agro-climatic zones. The analysis of gender-wise changes in labour-force participation and workforce distribution across sectors shows a disproportionate number of women who are dependent on land: 73 per cent of all rural female workers and 55 per cent of all rural male workers are in agriculture (Table 1). However, in terms of earnings from employment, it is observed that women workers, in both rural and urban areas, continue to receive lower wages than men. Earnings of a male regular wage/salaried employee vis-à-vis a female regular wage/salaried employee are higher by 1.4–1.7 times in rural areas and 1.2–1.3 times in urban areas (MoSPI 2019). Further, in the agriculture sector, the Census of India data reveal that the proportion of women in agriculture declined from 39 per cent in 2001 to 37 per cent in 2011 and the percentage of women cultivators within female agricultural workers has reduced from 46 per cent in 2001 to 37 per cent in 2011 (Table 2).

The pattern of agricultural holdings reflects a predominance of small and marginal farmers in the agriculture sector. Although women play a significant role in agriculture, they own only about 13.9 per cent of the operational holdings, with a large proportion of these (over 27 per cent) in the marginal and small category (Agriculture Census 2015–16). Since small and marginal farmers, in particular women farmers, are more vulnerable to shocks and poverty, it is imperative to focus on resource efficiency in smallholder farming to meet the Sustainable Development Goal (SDG) targets and also to attain sustainability in agriculture (Table 3).

The social and cultural aspects around agriculture have been witnessing changing trends. Women's role has been growing with the 'feminization of agriculture' as the men are migrating to urban areas in search of productive employment, leaving women to manage the farmlands. Other factors include rise of women-headed households and growth in the production of cash crops which are labour intensive and primarily managed by women. While the women are now de-facto playing multiple roles in managing farm and non-farm activities, particularly in the dryland areas, their typical work continues to be limited to less skilled jobs, such as sowing, transplanting, weeding, and harvesting and rearing livestock among other things that fall within the broad framework of domestic life. Participation of women as unpaid subsistence labour in agricultural work is also quite common. Though the number of women's tasks, both in farm and in nonfarm activities, is increasing, it is often treated as an extension of their household work which in turn becomes a dual burden of domestic responsibilities.

SOME FACTS ON AGRICULTURE AND WOMEN

Following are the tables which show some very interesting information on women in agriculture. The data is taken from

Table : 1 Gender wise percentage distribution of workers across sectors in rural areas

Sectors	1999-200*		2004-05*		2011-12*		2017-18**	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
Agriculture	71.4	85..4	66.5	83.3	59.4	74.9	55	73.2
Mining and quarrying	0.6	0.3	0.6	0.3	0.5	0.3	0.5	0.2
Manufacturing	7.3	7.6	7.9	8.4	8.1	9.8	7.7	8.1
Construction	4.5	1.1	6.8	1.5	13	6.6	14.5	5.3
Trade, hotel & restaurant	6.8	2	8.3	2.5	8	3	9.2	4
Other services	9.4	3.6	9.9	4	11	5.4	13.1	9.2
Source: NSS rounds*, MoSPI, 2019**								

Table: 2 Percentage between 2001 and 2011 of cultivators and agriculture labourers (men and women)

Category of workers	2001		2011	
	Male (%)	Female (%)	Male (%)	Female (%)
Cultivators	67.1	32.9	69.7	30.3
Agriculture labourers	53.7	46.3	57.3	42.6
Cultivator's percentage within M/F	6	46	50	37
Source: Census data 2001 and 2011				

Table: 3 Operational land holdings operated by women

Different size groups	2005-06 (%)	2010-11(%)	2015-16*(%)
Marginal(below 1.00 ha)	12.6	13.6	14.6
Small (1-2 ha)	11.1	12.2	13.3
Semi-medium (2-4 ha)	9.6	10.5	11.5
Medium (4-10 ha)	7.8	8.5	9.6
Large (10 ha and above)	6	6.8	7.7
All size groups	11.7	12.8	13.9

Table: 4 The numbers and areas of operational land holdings operated by women in major dryland/rainfed agricultural regions in India (in percentage)

States	Marginal (<1 ha)		Small (1-2 ha)		Semi-medium (2-4 ha)		Medium (4-10 ha)		Large (>10 ha)		All size groups	
	No	Area	No	Area	No	Area	No	No	No	Area	No	Area
Gujarat	39.6	11.6	30.6	24.3	20.4	31	8.8	27.4	0.8	5.7	16.5	15.9
MP	56.2	20.9	26.2	28.9	12.9	27	4.5	19.8	0.3	3.3	11.9	9.6
Rajasthan	49.5	10.7	20.8	13.7	15	19.6	11.7	33.2	3	22.8	10.1	7.9
Chhattisgarh	69.1	27.8	18.4	26	9.2	24.4	2.9	16.5	0.4	5.4	13.8	11.1
UP	86.8	53.6	9.3	23	3.2	15.5	0.7	7	0.1	0.8	7.7	5.8
Tamilnadu	81.3	42.1	12.7	26.4	4.7	18.7	1.2	9.7	0.1	3.1	19.7	17.4
AP	72.3	34.6	18.5	30.6	7.6	22.9	1.5	9.7	0.1	2.2	30.1	27.2
Telangan	65.1	31.3	24.4	34.9	8.7	22.8	1.7	9.3	0.1	1.6	23	22.4
Maharashtra	53.9	20.2	28.8	31.8	13.5	28.4	3.5	15.8	0.3	3.9	15.5	14.1
Source: MoAFW, 2019												

ISSUES AND CHALLENGES AFFECTS WOMEN TO ACCESS OPPORTUNITIES IN ORGANIC FARMING

1. Women farmers Literacy rate
2. Gender Division of Labor in India
3. Property Ownership Rights of Indian Women
4. Women perform all un-mechanized agricultural tasks and perform multiple tasks
5. Lack of market intelligence
6. Women have little control over decision making process
7. Women have limited access to use of productive resources.
8. Rural Credit for agriculture
9. Time allocation for farming

OPPORTUNITIES IN ORGANIC FARMING FOR WOMEN

1. Perceived positive impacts of organic farming
2. Improved health conditions of female farmers and their families
3. Improved food security
4. Facilitated access to seeds
5. Diversified income sources empower female farmers

RECOMMENDATIONS FOR IMPROVING WOMEN'S PARTICIPATION IN ORGANIC FARMING

1. More amenities should be given to poor rural women for land, organic agricultural and livestock extension services.
2. By providing financial powers to women farmers in accessing credit on soft terms from banks and other financial institutions for landholdings, setting up their occupation, for buying properties, and for house building etc.
3. The separate education policy for women may serve the purpose to improve women's literacy rates.
4. The women farmers Skill empowerment training in the area of numerous operations- Organic farming, Vocational training, Field operations, Conservation of biodiversity and Nutritional biosecurity etc.
5. The women farmers must be aware of their existing rights, access to judicial relief and compensation, eliminating discrimination through legal improvements, and providing legal assistance, and counseling
6. The women must be involved in administrative bodies that have the possibility to introduce structural changes.
7. The women farmers' development in technology by designing tools for various field operations, animal husbandry, artificial insemination, veterinary knowledge, and other income activities
8. projection of successful women farmers in organic farming, and representation of their contribution
9. The Creation of self-help groups for women farmers to their financial support, and generation of employment.
10. Minimum and equal wages should be fixed by state government for women agricultural -labors and the rates should be reviewed periodically

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Climate Change Impact Assessment from Drought Perspective for Bundelkhand Region, M.P.

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ABSTRACT

The Bundelkhand region in Madhya Pradesh state poses many issues related to water resource availability and is under grip of frequent drought like situation. The drought condition in the region is continuously worst than before due to climate change which intimate increased drought intensity and magnitude. The region mainly consists of 7 district of Uttar Pradesh and 6 district of Madhya Pradesh. The present study aims to investigate drought characteristics in Bundelkhand region of Madhya Pradesh using departure analysis and prioritization of which is carried out using RDI for planning immediate mitigation strategies. The impact of climate change was assessing using Mann-Kendell test and its magnitude of change using Sen's slope estimator. For assessment of drought characteristics and evaluation of climate change 45 years (1970-2014) monthly rainfall data is analyzed. The average annual rainfall in Bundelkhand region in M.P is computed as 1071.1 mm. In 1970, 1974, 2002, 2006, 2007, and 2010 the region was under grip of widespread drought condition. Prioritization using RDI indicated that Sagar district is at the highest priority and was followed by Chhatarpur and Panna. The trend analysis reveals the decrement of seasonal rainfall patterns except in Damoh and Chhatarpur districts. The annual rainfall trends assessment showed quite similar changing patterns among the districts, except in Chhatarpur and Panna district.

Keywords: Drought area, drought years, trend analysis, Bundelkhand region

INTRODUCTION

Drought is a complex and multivariate phenomenon influenced by diverse physical and biological processes resulting shortage of water over an extended period which badly affects the production of agriculture, livestock, and the environment (Rhee et al. 2018). As per the India Meteorological Department (IMD) if total seasonal rainfall received less than 75% of its normal value than it is considered as drought. The frequency and intensity of drought are exacerbated due to climate change which acts as a driver that causes variability in rainfall patterns. Many studies have shown that greenhouse gas (GHG)-induced global warming may lead to an increase in drought occurrence in the twenty-first century due to decreased precipitation and increased evaporative demand associated with higher vapor pressure deficit under warmer temperatures

(Dai et al. 2018). Climate change has influenced the hydrological processes and renders its performance causing extreme drought conditions and inadequate water availability. The influence of climate change due to its impact on the pattern of precipitation, temperature, and evapotranspiration has diverted the attention of many researchers worldwide to investigate factors that help to render its effects which causes increase drought severity and frequency.

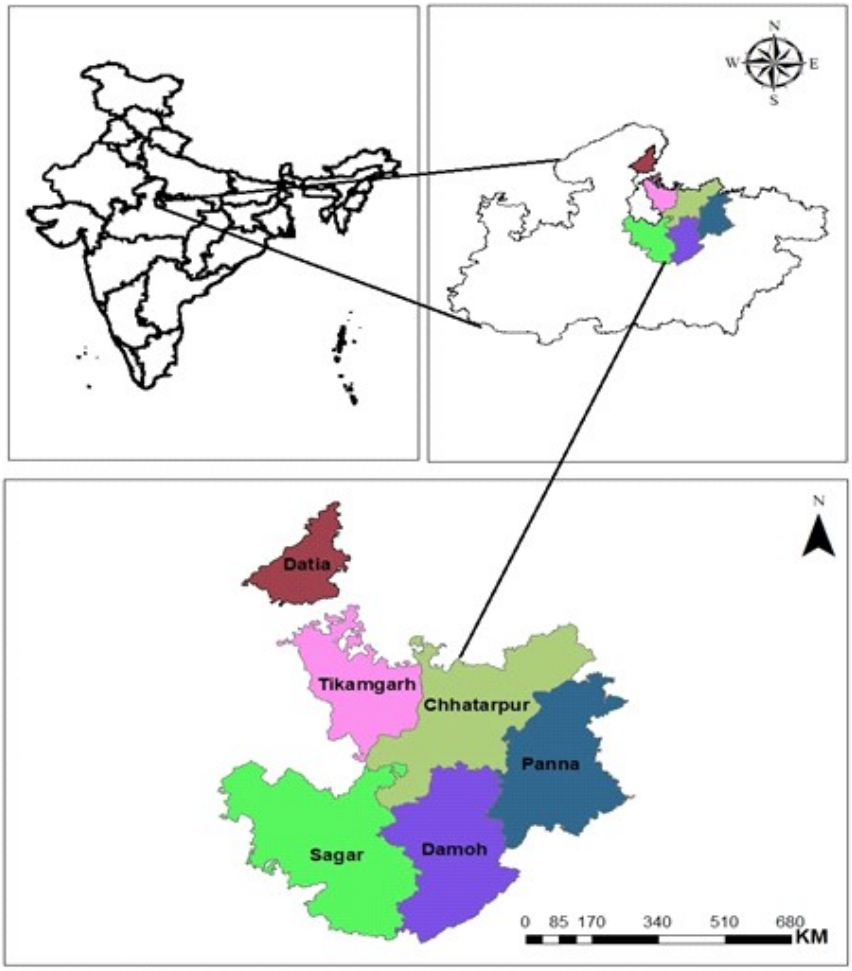
The problem of water shortage attribute to climate change scenario in the long term causes natural variability in the different phenomenon and resulting in incrementing extreme drought conditions imparted as decrease soil moisture, runoff, and streamflow. For water management strategies adaptation the study of effects of climate change on hydrological, ecological, and socioeconomic regimes is necessary. The hydrology of a region i.e. changes in the timing, amount, and form of precipitation, evaporation and transpiration rates, and soil moisture are important to assess the impact of climate change. Though drought is a long-term phenomenon affecting large regions causing significant damages its evaluation coupled with climate change considerably helps in water resources management and socio-economic development in the region. The threat that droughts pose to the different sectors has necessitated the assessment of the potential impacts of climate change at various scales to reduce their vulnerability (Loukas et al. 2007). Few studies on climate change impacts on droughts have employed meteorological drought indices, which require considerably fewer input data when compared to the weather, soil and land use information needed by meteorological, hydrologic, geohydrologic and water management models as the tools for assessing drought responses (i.e.Kothavala, 1999; Blenkinsop and Fowler, 2007; Mavromatis, 2007: Loukas et al.2007).

The present study mainly focuses to evaluate drought characteristics in the Bundelkhand region along with climate change detection. Water stress condition is not new to the Bundelkhand region which is home to 18 million people spread over 7 districts of Uttar Pradesh and 6 districts of Madhya Pradesh. Over 75% of the Bundelkhand population continues to depend on agriculture, while 96% of the total income in the region is raised from agriculture and livestock together. The region experienced drought events in every 16 years during the 18th and 19th centuries. The drought frequency, intensity, and magnitude have further escalated due to climate change over a long period of time. Due to such unprecedented uncertainties associated with drought and climate change scenarios, it is quite critical to examine the drought situations in the region.

MATERIAL AND METHODS

Description of Study Area : The Bundelkhand region lies in a semi-arid plateau which encompasses six districts of Madhya Pradesh (M.P) viz., Chhatarpur, Tikamgarh, Damoh, Sagar, Datia and Panna. The region is located between fertile Gangetic plain stretching across southern UP and the highlands of central MP. The Bundelkhand region lies between 23°082 N and 26°302 N latitude and 78°112 E and 81°302 E longitude. Agriculture is the major occupation in that region and the majority of which is rain-fed. The major rivers in that region include Sindh, Betwa, Ken, Bagahin, Tons, Pahuj, Dhasan, and Chambal. They are the major sources of drinking and irrigation water in the Bundelkhand region and in the neighboring districts of Uttar Pradesh. The major soils include alluvial, medium black, and mixed red and black soils. The base map of the study area is shown in Figure 1.

Data Availability : For the assessment of drought characteristics rainfall data is mainly used and were obtained from the India water portal sites, IMD, Pune. The data pertaining to the Bundelkhand region in Madhya Pradesh consists of monthly rainfall data of 45 years (1970-2014).



IDENTIFICATION OF DROUGHT PRONE AREAS

The drought prone areas were identified using the probability analysis of annual rainfall. The region was considered to be drought affected if the probability of occurrence of 75% of average annual rainfall less than 80% (CWC, 1982; Sharma et al. 2019). The probability of exceedance computed using Weibull's plotting position formula in which annual rainfall series were sorted in the descending order and ranks were assigned from 1, 2, ……N. The computing formula for probability of exceedance is provided in equation 1.

$$P = \frac{m}{N+1} * 100 \quad \text{..... (1)}$$

Where,

P = Probability of Exceedance of annual rainfall,

m = Rank of the particular record,

N = Total number of observation,

IDENTIFICATION OF DROUGHT YEARS

Drought years were identified using departure analysis of seasonal and annual rainfall. For assessing drought year seasonal rainfall was considered as it provides results that are oriented to monsoon and which largely affecting marginal and small farmers. Departure analysis of seasonal rainfall was used to compute drought years using criteria which implies seasonal rainfall departure less than -20%. The criteria used were area-specific because in most of the literature the minimum criteria for drought years were less than -25%. The departure was further classified into different categories for assessing the drought severity and its frequency that prevails in the region (Appa Rao, 1986; Thomas et al. 2014). The seasonal rainfall departure

$$D\ \% = \frac{Di}{Xm} X100 \qquad \ldots\ldots (2)$$

Table 1: classification of drought severity based on the rainfall departure

S.No.	Seasonal rainfall departure (%)	Drought Class
1.	-20 to -25	Mild drought
2.	-25 to -35	Moderate Drought
3.	-35 to -50	Severe Drought
4.	>-50	Extreme Drought

was computed using equation 2. Table 1 enlists the drought classes which were evaluated using departure analysis.

If the value of seasonal departure is less than -20 then no drought condition, if the value of departure lies between -20 to -25% then moderate drought, and if it lies between -35 to -50% then severe drought and less than -50% implies extreme drought condition.

RELATIVE DEPARTURE INDEX

During drought conditions, it is important to identify the most critical area in the drought-affected region. The worst affected area can be prioritized in the region and accordingly mitigation strategies will be implemented. Prioritization of blocks using relative departure index is a simple and most widely used method and is based on assigning weights to different drought severity classes as (1) for mild drought, (2) moderate drought, (3) severe drought, and (4) extreme drought. The weighted are decided by the impact caused by the type of drought, which emphasis that extreme drought which has greater impact will be allotted with a higher weighted number and vice-versa. Summation of weights multiplied with the number of drought events with different severity divided by the total number of years under consideration implies rank or RDI (Kar et al. 2016; Kumar et al. 2020). The computation of RDI was carried out using equation 3.

$$RDI = \frac{\sum_{i=1}^{n} W_i}{N} \qquad \ldots\ldots\ldots\ldots (3)$$

Where,

N= Total number of a year under consideration

W_i= Weight for the i^{th} drought years

MANN-KENDELL (MK) TEST

To detect monotonic trends in a series of rainfall data non-parametric Mann-Kendell (MK) test was used (Thorsten Pohlert, 2018). The MK test involves two sets of hypothesis viz., the null hypothesis (Ho) which implies no trend i.e. the data in a set of series is independent and do not show any realizations and the alternative hypothesis (Ha) that is data follow a monotonic trend. The Mann-Kendall test statistic is calculated using equation 4 (Mann 1945).

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} sign(x_i - x_j) \qquad \text{..... (4)}$$

Where x_i and x_j are the annual values in years i and j, respectively, (i > j) and n is the number of data points. The value of sign(x_i - x_j) is computed as follows:

$$sign(x_i - x_j) = \begin{cases} 1 & \text{if } x_i - x_j > 0 \\ 0 & \text{if } x_i - x_j = 0 \\ -1 & \text{if } x_i - x_j < 0 \end{cases} \qquad \text{.....[5]}$$

This statistic represents the number of positive differences minus the number of negative differences for all the differences considered.

For sample size n > 10, the mean and variance are given by:

$$\sigma^2(S) = \frac{n(n-1)(2n+5) - \sum_{i=1}^{m} t_i(t_i-1)(2t_i+5)}{18} \qquad \text{..... (6)}$$

Where m is the number of tied groups and ti is the number of ties of extent i(Afouda, 2017).

If there are no ties between the observations, the variance is computed as:

$$\sigma^2(S) = \frac{n(n-1)(2n+5)}{18} \qquad \text{..... (7)}$$

The standard normal test statistic Z is computed using equation stated below as per the condition satisfied:

$$Z = \frac{S-1}{\sqrt{Var(S)}} \qquad \text{If, S > 0} \qquad \text{..... (8)}$$

$$Z = \frac{S-1}{\sqrt{Var(S)}} \qquad \text{If, S= 0} \qquad \text{..... (9)}$$

$$Z = \frac{S+1}{\sqrt{Var(S)}} \qquad \text{If, S < 0} \qquad \text{..... (10)}$$

The presence of a statistically significant trend is evaluated using the Z value. A positive value of Z indicates an upward trend and its negative value a downward trend(Adarsh & Reddy, 2015). The Z values were tested at 0.05 level of significance.

SEN'S SLOPE ESTIMATOR

Non-parametric method (Sen, 1968) is used to estimate the magnitude of change in trends in time series data. The slope of 'n' pairs of data can be first estimated by using the following equation 11

$$N = \frac{x_j - x_i}{j - i} \qquad \text{..... (11)}$$

Where *xj*and *xi* are considered as data values at time *j* and *i*(*j*>*i*) correspondingly.

The median of these n values of Q is represented as Sen's estimator of slope (Prayas Rath, 2016)

$$Q = T_{\frac{N+1}{2}} \qquad \text{If N is odd ..... (12)}$$

$$Q = \frac{1}{2}\left(T_{\frac{N}{2}} + T_{\frac{N+1}{2}} \right) \qquad \text{If N is even ..... (13)}$$

Sen's slope is computed using equation 12, if N appears odd, and equation 13, if N appears even. In the end, Q is computed by a two-sided test at 100 (1-á) % confidence interval and then a true slope can be obtained by the non-parametric test. The positive value of Q indicates an upward or increasing trend and a negative value of Q gives a downward or decreasing trend in the time series (Begum, 2006).

RESULT AND DISCUSSION

Statistical Analysis : The statistical approach was mainly considered for assessing the general information for the study area based on which the blocks within the region can be compared. The Bundelkhand region in Madhya Pradesh comprises of 6 districts. The assessment of monthly rainfall data of 45 years (1970 -2014) revealed that the region receives an average annual rainfall of 1071.1 mm. Out of 6 districts; Datia receives the minimum average annual rainfall of 802 mm and a maximum of 1203 mm received by Sagar. The rainfall variability in the region was assessed using the coefficient of variance (CV %). The region shows high variability in annual rainfall and that value correspond to 30%, such high variability in rainfall influence to drought-like situation when substantially low rainfall occurred in any particular years. Almost all districts show high CV% value but were maximum in Sagar with 36% and minimum in Datia with 26 %. Bundelkhand regions have high rainfall variability which acts as a constraint for agricultural activities and thus affecting the livelihood of largely rainfall dependent population. The mean and coefficient of variance for different districts in Bundelkhand region are shown in Table 1. Figure 2 and Figure 3 show the variation in annual rainfall and CV% in the Bundelkhand region.

Table 1: Mean and coefficient of variance in Bundelkhand region of M.P

S.No.	District	Mean	CV (%)
1.	Chhatarpur	935	28.9
2.	Damoh	1174	28.6
3.	Datia	802	26.8
4.	Panna	1179	29.7
5.	Sagar	1203	36.2
6.	Tikamgarh	999	28.1

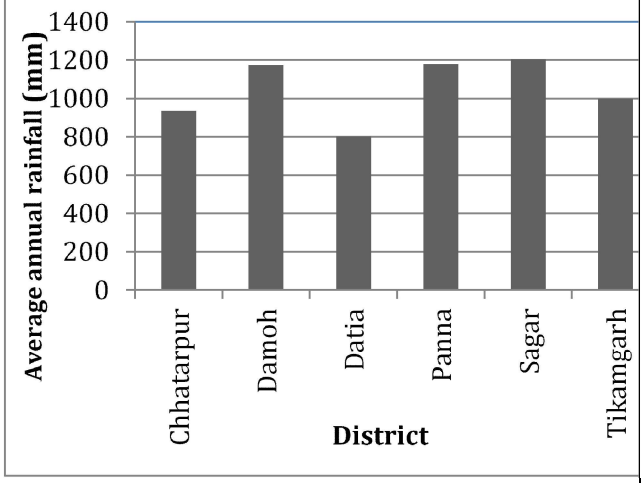


Fig.2. Average annual rainfall in Bundelkhand region (M.P)

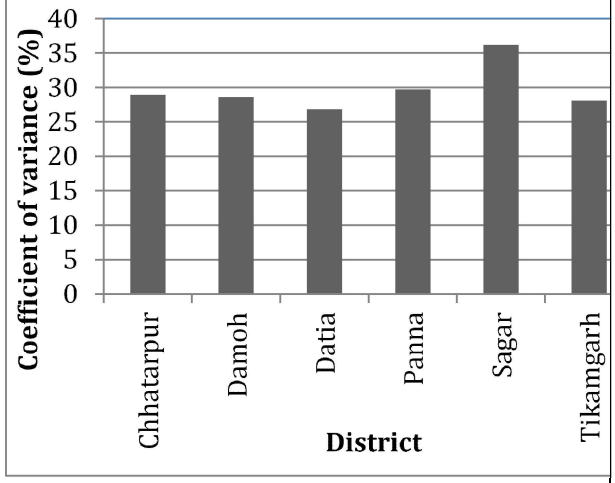


Fig.3. coefficient of variance of annual rainfall

COMPUTATION OF DROUGHT YEARS

Drought years were evaluated using a departure analysis of seasonal rainfall. The seasonal rainfall depicts the drought scenario which prevails during the most critical stage where farmers are highly dependent on monsoon for their crop productivity. The assessment of drought years helps to get the extent as well as the severity of drought in the region. Mainly four types of drought occurred at different years viz. mild, moderate, severe, and extreme. In the present study, the year is considered drought years when rainfall departure is less than -20%. The drought years as computed by departure analysis in the series of 1970-2014 rainfall data are tabulated in 2. Maximum drought severity at various district: Chhatarpur (-44 % in 2014), Damoh (-38 % in 2002), Datia (-44% in 2002), Panna (-47% in 1970), Sagar (-62% in 1972), Tikamgarh (-46% in 1979).

Table 2: Drought year during the span of 1970-2014

District	Drought year
Chhatarpur	1970, 1973, 1974, 1994, 1995, 1998, 2006, 2007, 2010
Damoh	1970, 1972, 1974, 1976, 1989, 2002, 2006, 2007, 2014
Datia	1978, 1979, 1980, 1981, 1989, 2000, 2005, 2006, 2007, 2009, 2010
Panna	1970, 1973, 1977, 1979, 1986, 1998, 2000, 2006, 2007, 2009, 2010
Sagar	1970, 1974, 1981, 1984, 1986, 1988, 1992, 2000, 2002, 2007, 2008, 2010, 2012
Tikamgarh	1977, 1979, 1986, 1988, 1989, 1991, 1995, 2000, 2002, 2004, 2010

The region was under grip of widespread drought condition in 1970, 1974, 2002, 2006, 2007, and 2010. Due to acute water shortage the agriculture sector in region was adversely affected and resulted in loss of livelihood and inadequate crop growth. Figure 4 to 9 depicts seasonal rainfall departure in different districts of Bundelkhand region falling in Madhya Pradesh. The severity of drought was much more intense in Sagar district as compared with other district in Bundelkhand region.

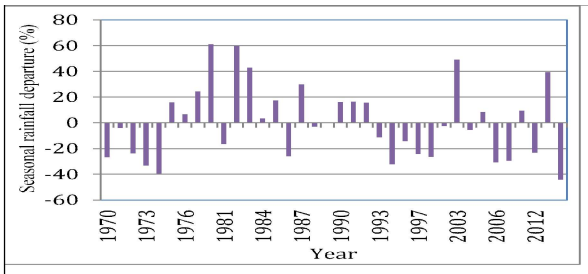


Fig.4: Seasonal rainfall departure at Chhatarpur

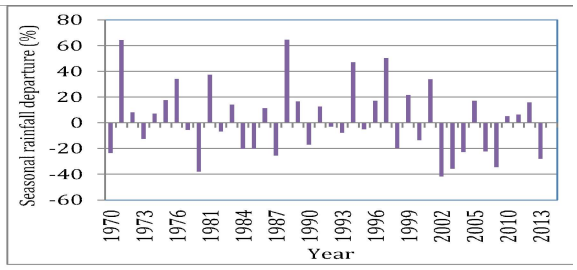


Fig.5: Seasonal rainfall departure at Damoh

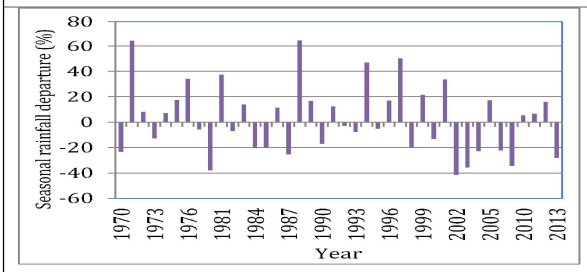


Fig.6: Seasonal rainfall departure at Datia

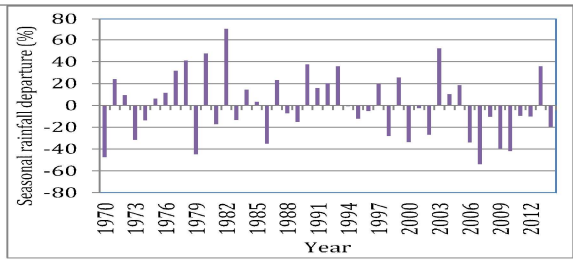


Fig.7: Seasonal rainfall departure at Panna

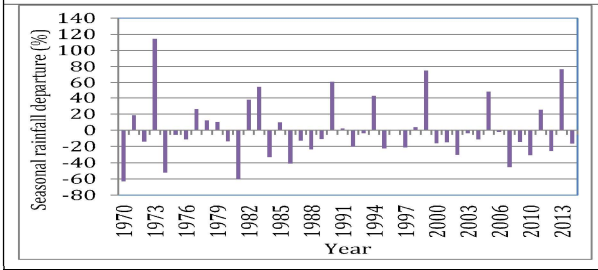


Fig.8: Seasonal rainfall departure at Sagar

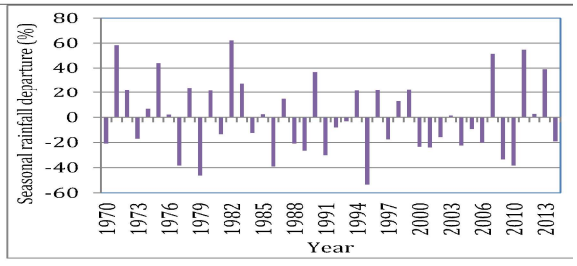


Fig.9: Seasonal rainfall departure at Tikamgarh

EVALUATION OF DROUGHT CHARACTERISTICS

The drought severity and its frequency were assessed using seasonal departure. The region was experiencing a drought of varying severity during the span of 1970-2014 and it is shown in Table 3. The occurrences of extreme drought events were maximum in Sagar district followed by Panna, Chhatarpur, and Damoh. Due to frequent drought occurrences with more widespread aerial extent i.e. 1 in 4 years and inadequate rainfall, the region experiencing poor groundwater availability and even existence of disastrous conditions during the monsoon period. From the analysis, it has been observed that the occurrence of drought is predominant in the region and thus required area-oriented strategies to mitigate and render its impacts. Monitoring of drought and associated agricultural production deficit can be considered as an essential component for drought preparedness in the region.

Table 3 : Drought Characteristics Based on Depature Analyasis

S.No	Stations	Mild	Moderate	Severe	Extreme	Total	Frequency
1	Chhatarpur	1	5	1	2	9	1 in 5
2	Damoh	1	5	1	2	9	1 in 5
3	Datia	3	6	2	0	11	1 in 4
4	Panna	3	3	3	2	11	1 in 4
5	Sagar	2	6	1	4	13	1 in 3
6	Tikamgarh	2	5	3	1	11	1 in 4

COMPUTATION OF DROUGHT PRONE DISTRICTS

Identification of drought prone district involves assessment using the probability analysis of annual rainfall. The probability of occurrence of rainfall equivalent to 75% of normal is obtained from probability distribution graph. From the probability analysis, it is indicated that the district are no drought prone (probability of 75% mean rainfall being less than 80%) but faced regular water shortage and water stress condition due to inadequate water resources management. So efforts should be focused for drought preparedness, mitigation and management measures to cope and render drought impact. The graph depicting the probability distribution of the annual rainfall at Sagar and Tikamgarh district is given in Figure 6 and Figure 7.

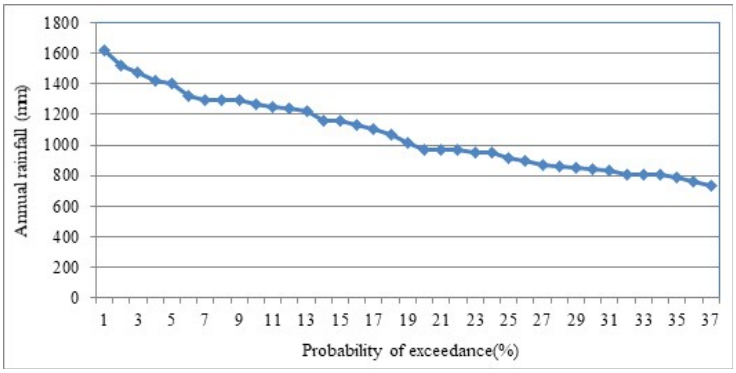


Fig. 6: Probability distribution of annual rainfall at Sagar

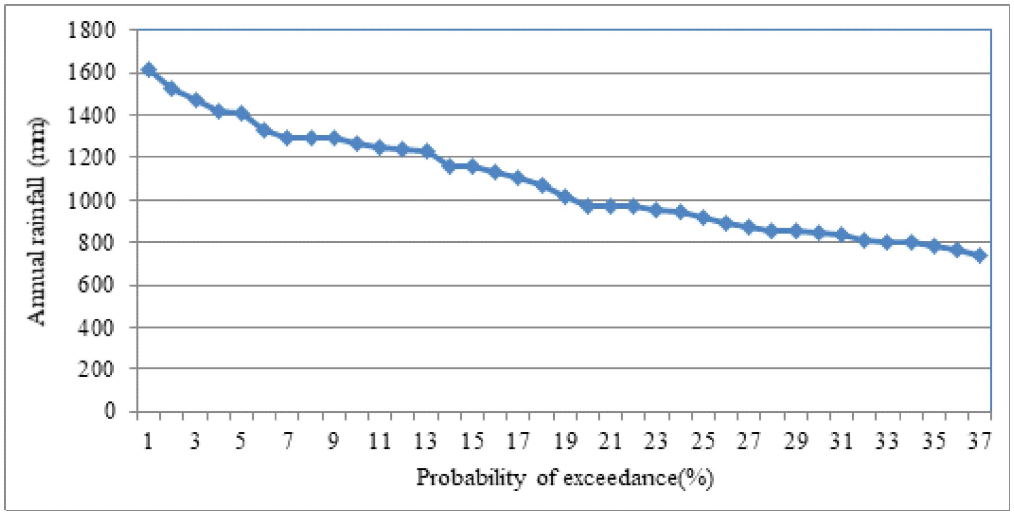


Fig. 7: Probability distribution of annual rainfall at Tikamgarh

RELATIVE DEPARTURE INDEX

Drought in any particular region cannot be avoided but some remedial measures can be pursued before its occurrences based on indices that prioritize district which is most vulnerable to drought. For prioritization, the relative departure index was computed and Table 5 enlists the ranking of different districts of the Bundelkhand region in M.P. Sagar district is at highest priority followed by Chhatarpur and Panna. Thus using prioritization technique drought mitigation strategies and preparedness plans can be implemented as area-oriented and can help best to cope under drought situations.

Table 5: Ranking based on RDI

S.No	Stations	RDI
1	Chhatarpur	0.59
2	Damoh	0.48
3	Datia	0.48
4	Panna	0.58
5	Sagar	0.74
6	Tikamgarh	0.56

TREND ANALYSIS OF SEASONAL AND ANNUAL RAINFALL

Non-parametric Mann-Kendell test was employed to identify the impact of climate change in the region by assessing change in seasonal and annual rainfall patterns. The trend assessment help to interpret the existing rainfall pattern which leads to frequent drought occurrence and thus affecting water availability in the region which causes failure in crop production. The Mann-Kendall test result of seasonal rainfall and annual rainfall has been presented in the Table 6.

Table 6: Trend analysis of seasonal rainfall and annual rainfall

Seasonal rainfall

S.No.	District	Test-Z	Trend	Slope
1	Chhatarpur	0.38	Rising	1.33
2	Damoh	0	No change	0.05
3	Datia	-0.01	Falling	-0.06
4	Panna	-0.09	Falling	-0.34
5	Sagar	-1.11	Falling	-5.17
6	Tikamgarh	-0.28	Falling	-0.81

Annual rainfall

S.No.	District	Test-Z	Trend	Slope
1	Chhatarpur	-1.23	Falling	-4.313
2	Damoh	0.43	Rising	2.235
3	Datia	-0.54	Falling	-1.372
4	Panna	0.85	Rising	4.54
5	Sagar	-1.03	Falling	-4.654
6	Tikamgarh	-0.17	Falling	-0.593

The investigation of seasonal rainfall pattern which is the most critical period for agriculture showed declining trend in most of the district except in Damoh and Chhatarpur district. The assessment of long-term data showed insignificant decreasing trend except in Sagar district (-5.17) at 1% level of significance. Overall, the annual rainfall trends showed quite similar changing patterns among the districts, except in Chhatarpur and Panna district. The insignificance of change in analyzed trend implies high practically significant effects in emerging drought like situation over a long time period. The variability in seasonal and annual rainfall suggesting an urgent need for contingency planning to overcome the disastrous effects caused due to climate change scenario.

CONCLUSION

The statistical analysis for Bundelkhand regions showed high rainfall variability which ranging between 36% at Sagar and 26 % at Datia district whereas the average CV% is 30%. Departure analysis of seasonal rainfall indicated that the area was under widespread drought conditions in 1970, 1974, 2002, 2006, 2007, and 2010 with return period which varying between once in 3 years to once in 4 years. From the probability analysis, it is indicated that the districts are no drought-prone but faced regular water shortage and water stress conditions due to inadequate water resources management. Prioritization of districts using the relative departure index indicates that Sagar district is at the highest priority and was followed by Chhatarpur and Panna. Drought mitigation strategies and preparedness plans must be implemented for districts based on ranking. The trend analysis reveals the decrement of seasonal rainfall patterns except in Damoh and Chhatarpur districts where there is an increasing trend. The change is not significant except at the Sagar district. The annual rainfall trends assessment showed quite similar changing patterns among the districts, except in Chhatarpur and Panna district. The variability in seasonal and annual rainfall signifies the impact of climate change and thus suggesting an urgent need for comprehensive adaptation and mitigation strategies to overcome the effects of extreme weather events.

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Development of Value-Added Cookies Incorporated with Spirulina *Platensis* for The Mitigation of Malnutrition in Children

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ABSTRACT

Child malnutrition is more prevalent in India, manifesting as stunting and underweight problems in children. India is home to roughly one-third of the world's malnourished children. Malnutrition remains a major public health issue in the developing world. As a result, malnutrition is the most important risk factor for disease burden in developing countries. Long-term malnutrition causes "anemia," which affects the general population of developing countries, as well as many other diseases such as goiter, hypokalemia, tooth decay, and vitamin deficiency, which has existed for many years. Thousands of well-executed intervention programs could not even improve the situation a single time. This study focused on incorporating Spirulina as a dietary supplement into cookies to fortify the food product with enriching protein, calcium, iron, vitamin B12, and phosphorus to improve a child's foundation years. Spirulina is a blue-green algae with high nutritional value. In the same area, Spirulina produces 20 times more protein than soya, and Spirulina typically contains about 60 percent protein. It is high in vitamin B12, copper, and iron. Spirulina protein contains few calories.

The researcher added Spirulina in specific quantity to food product recipes of cookies, pasta and noodles. These were then assessed for their nutritive value under normal condition. The results indicated significantly increased values of protein, calcium, phosphorus and iron will not much change in the taste of the food products.

Keywords: *Spirulina, Malnutrition, Anemia, Hemoglobin, Iron*

INTRODUCTION

In recent years, this microscopic organism has attracted individuals and scientists from all over the world. Spirulina is used in a variety of industries, including agriculture, food, pharmaceuticals, perfumery, medicine, and science. It's also utilized as a food supplement and comes in tablet, capsule, and powder form, as well as being incorporated into a variety of foods like cakes, biscuits, noodles, and health beverages (Hayashi *et al*., 1996).Under the microscope, the microorganism known as "Spirulina" is categorised as cyanobacterium and has a spiral filament. Spirulina, or Arthrospira as it is presently known, is a blue-green alga with a long history. The spiral or helical structure of its filaments gives it its name (Belay, 2002).

Spirulina is a photosynthetic prokaryotic or eukaryotic microbe that uses light to generate carbohydrates, proteins, and lipids. Microalgae are cultivated for its polyunsaturated fatty acids, pigments, antioxidants, and therapeutically useful chemicals. *Spirulina platensis* is a plant that is used to treat malnutrition, particularly in children, all over the world. This blue-green cyanobacteria algae is grown in temperate seas all over the world and is regarded a functional food because of its high content of proteins, vitamins, minerals, healthy fatty acids, and other healing phytonutrients like various active plant colours. Because of its high protein content and nutritional value, a blue green microalga has been utilized as a food supplement since ancient times (Burtin P., 2003).Arthrospira (Spirulina), the richest sources of proteins is about 60-70%. Attempting a study on using Spirulina as a protein supplement, it was observed that it can be substituted up to 40% of protein content in diets (Rabelo SF, 2013).

Today's consumers prefer low-calorie, low-fat, and low-cholesterol ready-to-eat goods, i.e. healthy foods, and are aware of the link between diet and illness development. Considering the efforts made to reduce the incidence of diseases such as malnutrition, cancer, cardiovascular, and coronary heart disease, and to enhance health status, the development of food-rich recipes will play a significant role in ensuring consumer health. Cookies are particularly popular among baked goods, as they are viewed as delightful products with unique organoleptic features (Henrikson R. 1989). Cookies are prominent confectionary items because of their organoleptic qualities, adaptability, convenience, texture, and look. The use of natural components with functional qualities that go beyond basic nutrients is an appealing option to create new goods. Microalgal biomass is an important source of fine molecules such as carotenoid pigments, vitamins, proteins, fatty acids, and other physiologically active substances, which may have health advantages (Hoseini SM, 2013) .

Medical scientists are more interested in Spirulina as a nutraceutical and potential pharmaceutical source. Spirulina is a fantastic super food. In its normal state, it contains 65 to 71 percent complete protein. This is greater than in almost any other unprocessed food. Spirulina is a nutrient-dense superfood for optimal health. Superfoods are foods that have health-promoting and disease-preventing characteristics in addition to their nutritional worth. It is nature's most nutrient-dense concentrated whole food source. (Simpore *et al*., 2005).

Iron is essential for the physical and cognitive development of children and teenagers. Anemia is the world's most common nutritional deficiency illness. One-third of the world's population (nearly 2 billion people) is anaemic. Anemia is more prevalent in all age groups in India than in other developing countries.

According to research, iron supplementation improves haemoglobin levels and growth. Since iron supplementation programmes have had little reported success in alleviating anaemia, attention is shifting to food-based approaches that have a larger potential for far-reaching and long-term impact long-term benefits for iron deficient management. (Belay, 2002).

Food-based approaches aim to improve nutrition by increasing the availability and consumption of a nutritionally appropriate and micronutrient-rich diet composed of a variety of readily available foods. Food-based treatments are acknowledged as a vital component of a more comprehensive strategy to combat iron and other micronutrient deficiencies, which is desperately needed. Spirulina has a type of protein that may be beneficial for anaemia and other deficient illnesses (Desai and Sivakami, 2004).

METHODOLOGY

The study was carried out in four phase

1) Procurement of Spirulina: Pure Spirulina powder was procured purchased from a Food Company.

2) Development of value added food products: Most acceptable value added addition level of Spirulina powder i.e. 5% percent was incorporated in cookies

(A) To effectively develop the controlled sample of cookies,

(B) To effectively develop the Spirulina incorporated cookies

3) Organoleptic Evaluation: The develop value added cookies, wasstandardized using composite scoring evaluation with the help of experts. The develop value added product along with their control samples served to the experts for organoleptic evaluation.

4) Nutritional Evaluation: Prepared products were analyzed for moisture, protein, fat, fibre, ash, phosphorus, calcium, iron, alcoholic acidity, pH, peroxide content

Sample preparation- Four samples are taken for experimental in this study, for fortification of cookies.

Table 1: Sample Preparation

Treatment	Sample Ingredients	Ratio Ingredients
A	Flour with Spirulina powder	95 %+5%
B	Flour with Spirulina powder	90%+10%
C	Flour with Spirulina powder	85%+15%
D	Flour without Spirulina powder	100

Table 2: Cookies Preparation

Traditional Indian cookies (as control) were prepared using the following formulation:

Ingredients	Quantity (gm/kg)
Wheat Refined Flour	50 gm
Sugar	12.5gm
Shortening oil	13.75 gm
Baking Powder	1 gm
Baking soda	1 gm

The cookies were baked in an oven at 180°C for 15 min. After cooling, cookies were kept inside sealed cellophane packages (with low permeability to air, oils, greases, bacteria and water) at room temperature for 3 months.

Image2: Controlled Cookies

Image 3: Spirulina Cookies

ORGANOLEPTIC EVALUATION

Organoleptic evaluation of cookies was done by 5 trained panelists, after baking. In individual booths at room temperature, panelists used clean white plastic dishes to serve 40 gram of labeled samples at random on their palates. Cookies were rated in terms of flavour, odour, colour, texture uniformity, non-mouth texture, and mouth texture using a 9-point hedonic test* (9; like extremely and 1; dislike extremely). Finally, total acceptability was determined using the equation.

NUTRITIONAL PARAMETERS-

- ❖ Determination of moisture.
- ❖ Determination of fat.
- ❖ Determination of protein.
- ❖ Determination of total mineral.
- ❖ Determination of carbohydrate
- ❖ Determination of energy.

STATISTICAL ANALYSIS

The data from the 9-point hedonic scale were examined using average score and standard deviation, with the product with the highest average score and lowest standard deviation demonstrating the best acceptability. The chi-square test was used to assess the data. The test was carried out to demonstrate the considerable difference in the values of various nutritional content manufactured products.

Table 3: Results of the Fortified Products

S. No.	Test Parameter	Unit	Control biscuits	5% Spirulina fortified biscuits
1.	Moisture	%	2.76	2.52
2.	Proteins	%	4.50	20.33
3.	Fat	%	17.49	6.24
4	Carbohydrate	%	2.31	23.06
5	Energy	Kcal	554	670
4.	Fibre	%	0.68	1.17
5.	Ash	%	3.08	4.07
6.	Calcium	Mg/100 gm	214.25	288.97
7.	Phosphorus	Mg/100 gm	54.34	115.91
8.	Iron	Mg/100 gm	1.86	3.93
9.	Alcoholic acidity	%	0.23	0.31
10.	Ph	-	7.025	6.025
11.	Peroxide value	Meq/Kg	0.967	0.745

The above table shows the higher value of energy, protein, carbohydrate, fat, moisture and total mineral in experimental sample compare to control.

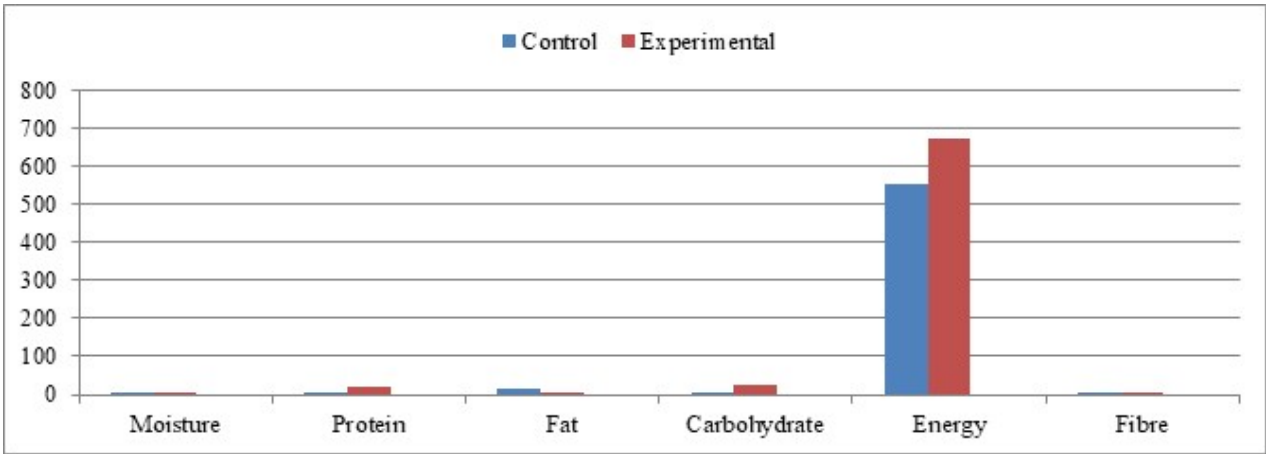
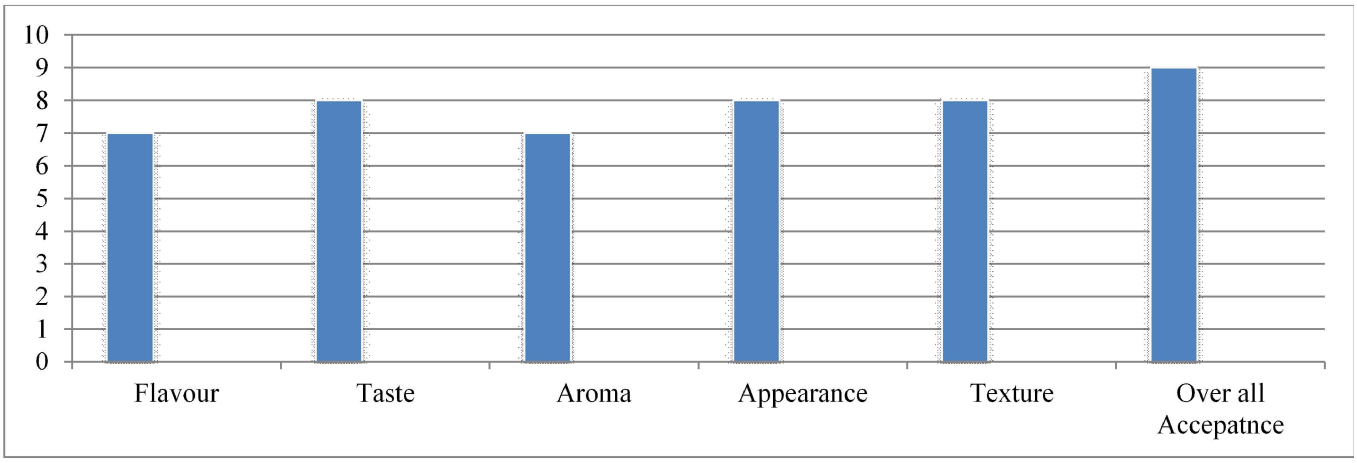


Fig 1: Fat, Protein Carbohydrate, Moisture Energy and Total minerals in control and Experimental product

GRAPH SHOWING SENSORY EVALUATION OF SPIRULINA ENRICHED BISCUITS THROUGH COMPOSITE SCORING:



RESULT AND DISCUSSION

Organoleptic Evaluation: Table 4 reveals that all the food samples were subjected to organoleptic evaluation by the experts and the results were noted. Spirulina fortified food products were falling into the liked, disliked or neither like nor dislike. Study reveals that the study of food products from a total of 50 human experts, who has judge the biscuits. The results are 65% liked

Table 4: Acceptability of Fortified Food Product

Study of Spirulina fortified food products	Fortified Biscuits	
	N%	
Liked	30	65%
Disliked	15	23%
Neither like nor dislike	5	12s%

Nutritional Analysis : Nutritional analysis was carefully evaluated by the researcher under normal conditions. Table 1 show that the nutritional content of fortified food items was significantly higher than that of control samples.

Shelf life study : The researcher assessed the shelf life of all products in the current study based on their organoleptic evaluation over a one-month storage period under normal conditions.

CONCLUSION

The current study found that Spirulina fortified food products prepared from Spirulina at 5% levels were accepted on organoleptic parameters, with the most acceptable products remaining within a satisfactory range during storage. The results show that developed food products are nutritious and have a much higher nutritional value than control samples. As a result, this valuable product has a high extrusion potential and a high acceptability on organoleptic parameters, and better-quality Spirulina fortified food products provide significant benefits to consumers.

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Correlation, Path-Coefficient & Genetic Diversity Patter in Wheat *(Triticum Aestivum L.)* Under Rainfed Conditions

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ABSTRACT

An experiment was carried out at Kisan (PG) College, Simbhaoli during rabi season 2021-22 to access the correlation, path-coefficient and genetic variability in 40 morphological diverse accessions of wheat *(Triticum aestivum L.)* under rainfed condition. The analysis of variance showed highly significant differences among the geno types for all the characters. The highest estimates of the phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for grain yield/plant, tillers/plant andbiological yield/plant.Grain yield/plant, biological yield/plant and harvest index showed high heritability coupled with high genetic advance as percent of mean indicating the influence of additive gene effects. Biological yield/plant, harvest index showed positive and significant correlation with grain yield/plant and exerted positive and high direct effect on grain yield/plant. D^2 analysis grouped the 40 genotypes into six clusters. The maximum inter cluster distance was observed between cluster V and VI. Hence, the genotypes belonging to cluster V and VI can be utilized in crop improvement programmes and for the development of high yielding varieties under rain-fed conditions.

INTRODUCTION

Wheat (*Triticum aestivum* L.) of family Poaceae is agronomically and nutritionally most important cereal crop grown worldwide. It is a self pollinated crop and second most important staple food crop of world after rice. Wheat is considered as king of cereals accounting for 20% of human consumption of calories and is an important source of protein, vitamins and minerals. Three species of wheat *i.e. Triticum aestivum*, *Triticum durum* and *Triticum dicoccum* are presently grown as commercial crop in India. India is the second largest producer of wheat after China. In India wheat occupies an area of 31.05 million hectare with production of about 107.18 million tons during 2019-20 (Anonymous, 2020). Uttar Pradesh is the largest wheat producing state in India and accounts for 33.97% of total area under wheat cultivation in India.

Wheat is widely cultivated in India mainly under irrigated condition; however a large area is covered under rainfed. Out of an estimated 140.3million hectare net cultivated area of the country, 79.44 million hectare (57%) is rainfed, contributing 44% of the total food grain production (Mishra *et al*., 2014). Hence, the productivity in rainfed region can be enhanced by the development of cultivars that are well adapted to dry conditions. The magnitude of genetic variability present in a population is essential for effective genetic improvement.Correlation and path coefficient analysis provide a better understanding of the association of

different characters with grain yield.The grain yield was positively correlated with biomass yield, harvest index, thousand kernel weight, plant height and number of grains/spike (Khanal *et al*., 2020). Khokhar *et al*., (2021) found positive direct effect of days to maturity on grain yield.Singh*et al*., (2021) reported positive direct effect of biological yield per plant on grain yield. Hence, these traits could be used in breeding for grain yield in bread wheat.

Cluster analysis helps to understand the genetic relation between the genotypes and also facilitate the selection of genetically diverse parents in hybridization programme. Hence, the present investigation was carried out to determine the genetic variability, heritability, genetic diversity anddirect and indirect effects of various characters on grain yield in bread wheat under rainfed conditions.

MATERIALS AND METHODS

The experimental material consisted of forty genotypes of wheat (*Triticum aestivum* L.) (Table 1) were obtained from Indian Institute of Wheat and Barley Research Karnal, Haryana.The experiment was laid in a randomized block design with three replications during winter (*rabi*) 2021-22 under rainfed conditions at Experimental Farm of Kisan (PG) College, Simbhaoli, Hapur (UP). In each replication, the genotypes were evaluated in single row of 3m length with row to row and plant spacing of 25cm and 10cm respectively. During experiment only pre- sowing irrigation was applied to ensure proper seed germination. The data were recorded from five randomly selected plants from each genotype on eleven distinct morphological characters viz., days to heading, days to maturity, plant height (cm), number of effective tillers/plant, spike length (cm), number of spikelets/spike, number of grains/spike, 1000-grain weight (g), grain yield/plant(g), biological yield/plant (g) and harvest index (%). Standard statistical procedure were used for the analysis of variance, genotypic and phenotypic coefficient of variation, heritability and genetic advance. The path coefficient analysis was done according to the method by Dewey and Lu (1959). Cluster analysis was done based on Mahalanobis D^2 method (1936).

Table 1. List of genotypes

S. No.		S.No.		S. No.		S. No.	
1.	DBW 88	**11.**	HUW-468	**21.**	Lok 01	**31.**	PBW 1763
2.	DBW-222	**12.**	HUW-234	**22.**	PBW-703	**32.**	PBW-677
3.	DBW-303	**13.**	K-1006	**23.**	PBW-723	**33.**	PBW-34
4.	DBW-187	**14.**	K-1317	**24.**	PBW-780	**34.**	Raj-3765
5.	HD-3059	**15**	K-0307	**25.**	PBW-701	**35.**	Sumai-3
6.	C-306	**16.**	NIAW-1415	**26.**	PBW-712	**36.**	WR-544
7.	HD-3118	**17.**	NI-5439	**27.**	PBW-725	**37.**	DPW-621-50
8.	HD-2824	**18.**	NW-1014	**28.**	PBW-698	**38.**	WH-147
9.	HD-3226	**19.**	NW-5054	**29.**	PBW-702	**39.**	WH-730
10.	HD-3086	**20.**	NW-2036	**30.**	PBW-550	**40.**	WH-1105

RESULTS AND DISCUSSION

Analysis of variance and coefficient of variation : The analysis of variance for different characters is presented in Table 2 indicating significant differences among the geno types for all the characters under study. The estimates of mean, range, genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for various characters studied are presented in Table 3. The PCV values were higher than GCV values for all the characters indicating the influence of environment on the expression of characters. High PCV and GCV values were observed for grain yield/plant (33.92) and (32.80), tillers/plant (32.76) and (29.96), biological yield/plant (30.19) and (29.46), harvest index (27.31) and (26.09) indicating better opportunity for improvement in these traits through selection.

However, moderate PCV and GCV was observed for grains/spike (14.53) and (14.08), 1000 grains weight (11.86) and (11.61), spike length (9.62) and (7.38), plant height (7.65) and (7.05). The magnitude of PCV ranged from 3.58 for days to maturity to 33.92 for grain yield/plant. The characters with high phenotypic coefficient of variation indicated more influence of environmental factors. Similar results on variability for different characters were reported byMohapatra *et al*., (2019), Shah *et al*., (2019), Yadav *et al*., (2021), Olbana *et al*., (2021), Prasad *et al*., (2021), Hassani *et al*., (2022).

Heritability and expected genetic advance : The estimates of heritability and expected genetic advance for various characters studied are shown in Table 3. Heritability estimates were highest for 1000 grains weight (95.85), followed by biological yield/plant (95.22), grains/spike (93.89), grain yield/plant (93.50), harvest index (91.31), days to heading (90.20). High heritability indicated that the characters were least influenced by environmental factors. Fellahi *et al*., (2013), Devesh *et al*., (2018), Thapa *et al*., (2019) and Hayadar *et al*., (2020) also estimated high heritability for important morphological traits. Lowest heritability was observed for spike length (58.85).

Highest value of expected genetic advance expressed as percent of mean was observed for grain yield/plant (65.34), biological yield/plant (59.23), tillers/plant (56.44) and harvest index (51.36). High heritability coupled with high genetic advance (per cent of mean) was observed for grain yield/plant, biological yield/plant and harvest index which suggested that these characters can be considered as favourablefor improvement through selection. Grains/spike and 1000 grain weight showed high heritability coupled with moderate genetic advance while high heritability with low genetic advance was observed for days to heading and days to maturity. Low heritability with low genetic advance values was found for spike length and spikelets/spike indicating slow progress through selection for these characters. Similar findingswere also reported by Arya *et al*., (2017), Vaghela *et al*., (2021) and Lamara *et al*., (2022).

Correlation and path coefficient analysis : Correlation analysis estimates the degree and direction of the relationship between variables and are widely used in breeding selection programs. The phenotypic and genotypic correlation for all the characters is presented in Table 4. Genotypically, the grain yield/plant exhibited highly significant positive correlation with biological yield/plant (0.639), 1000 grain weight (0.467), tillers/plant (0.466), harvest index (0.428), grains/spike (0.328), spike length (0.278) and plant height (0.269). Harvest index showed negative and highly significant relationship with biological yield/plant (-0.384), tillers/plant (-0.301) and number of spikelets/spike (-0.282). Biological yield/plant exhibited positive and highly significant association with tillers/plant while a negative and highly significant correlation with days to heading and days to maturity at both phenotypic and genotypic level.Similar findings were also reported by Kandel *et al*., (2017), Ojha *et al*., (2018), Rathod *et al*., (2019), Maurya *et al*., (2020) and Semahegn *et al*., (2021).

Path coefficient analysis measures the direct influence of one variable upon the other and allow partitioning of correlation coefficient into components of direct and indirect effects. Estimates of direct and indirect effect are presented in Table 5 and 6. Genotypic path analysis (Table 5) revealed that biological yield/plant showed maximum direct effect (1.0014) on grain yield/plant followed by harvest index (0.8242). Days to heading, spike length and spikelets/spike also exhibited positive direct effect while days to maturity, plant height, tillers/plant, grains/spike and 1000 grain weight showed negative direct effect on grain yield/ plant. Tillers/plant showed maximum indirect effect (0.7594) on grain yield/plant via biological yield/plant. Similar results were also observed by Baye *et al*., (2020), Elahi *et al*., (2020), Singh *et al*., (2021) and Ezici *et. al*., (2022).

Phenotypic path analysis (Table 6) showed that biological yield/plant had highest positive direct effect (0.9715) on grain yield/plant. Days to heading, plant height, tillers/plant, grains/spike and 1000 grain weight showed negative direct effect on grain yield/plant. Tillers/plant showed maximum indirect effect (0.6795) on grain yield/plant via biological yield/plant.

Table 2. Mean squares from analysis of variance (ANOVA) of eleven characters in forty genotypes of bread wheat

Source of variation	D.F	Days to Heading	Days to maturity	Plant Height (cm)	Tillers per plant	Spike length (cm)	No of spikelets per spike	Grains per spike	1000 grain weight (g)	Biological yield per plant (g)	Harvest index (%)	Grain yield per plant (g)
Replication	2	1.88	0.78	0.22	0.36	0.01	0.31	6.16	0.82	0.86	6.40	0.06
Treatment	39	67.57**	42.01**	89.08**	2.28**	1.75**	4.24**	139.22**	32.74**	74.28**	179.19**	7.41**
Error	78	2.36	2.32	5.01	0.14	0.33	0.64	2.96	0.47	1.22	5.51	0.17

***, ** significant at 5% and 1% level, respectively**

Table 3. Mean, range, GCV, PCV, Heritability and genetic advance for eleven characters of bread wheat

Genotypes	**Mean**	**Min**	**Max**	**GCV (%)**	**PCV (%)**	**Heritability (%)**	**Genetic advance (GA)**	**GA as % of mean**
Days to Heading	74.13	67.00	86.00	6.29	6.62	90.20	9.12	12.30
Days to maturity	110.13	104.33	121.67	3.30	3.58	85.07	6.91	6.28
Plant Height (cm)	75.13	62.49	94.63	7.05	7.65	84.85	10.05	13.37
Tillers per plant	2.82	1.43	5.30	29.96	32.76	83.62	1.59	56.44
Spike length (cm)	9.33	7.14	10.66	7.38	9.62	58.85	1.09	11.66
No of spikelets per spike	17.17	13.13	19.63	6.38	7.90	65.19	1.82	10.60
Grains per spike	47.85	30.10	58.87	14.08	14.53	93.89	13.45	28.11
1000 grain weight (g)	28.26	19.80	32.78	11.61	11.86	95.85	6.62	23.41
Biological yield per plant (g)	16.75	5.94	30.43	29.46	30.19	95.22	9.92	59.23
Harvest index (%)	29.16	12.25	47.60	26.09	27.31	91.31	14.98	51.36
Grain yield per plant (g)	4.74	2.21	8.10	32.80	33.92	93.50	3.09	65.34

Table 4. Genotypic (G) and Phenotypic (P) Correlation Coefficient for Different Characters in Bread Wheat

Characters		Days to heading	Days to maturity	Plant height (cm)	Tillers per plant	Spike length (cm)	No. of Spikelets per spike	Grains per spike	1000 grain weight (g)	Biological yield/plant (g)	Harvest index (%)	Grain yield per plant (g)
Days to heading	G	**1.000**	0.784**	0.168	-0.076	0.228*	0.271**	0.200*	0.280**	-0.065	0.222*	0.099
	P	**1.000**	0.672**	0.172	-0.075	0.191*	0.200*	0.201*	0.261**	-0.053	0.211*	0.101
Days to maturity	G		**1.000**	-0.189*	-0.105	0.165	0.234*	0.159	0.199*	-0.102	0.246**	0.099
	P		**1.000**	-0.144	-0.072	0.137	0.196*	0.146	0.177	-0.097	0.228*	0.098
Plant height (cm)	G			**1.000**	0.288**	0.298**	0.167	0.087	0.308**	0.427**	-0.112	0.269**
	P			**1.000**	0.305**	0.387**	0.250**	0.127	0.278**	0.423**	-0.097	0.270**
Tillers per plant	G				**1.000**	0.250**	0.269**	0.123	0.287**	0.758**	-0.301**	0.466**
	P				**1.000**	0.266**	0.287**	0.134	0.271**	0.699**	-0.267**	0.427**
Spike length (cm)	G					**1.000**	0.448**	0.397**	0.461**	0.402**	-0.149	0.278**
	P					**1.000**	0.550**	0.395**	0.349**	0.363**	-0.085	0.276**
No. of Spikelets per spike	G						**1.000**	0.449**	0.162	0.440**	-0.282**	0.223*
	P						**1.000**	0.445**	0.148	0.395**	-0.208*	0.220*
Grains per spike	G							**1.000**	0.005	0.433**	-0.117	0.328**
	P							**1.000**	0.013	0.426**	-0.093	0.332**
1000 grain weight (g)	G								**1.000**	0.352**	0.205*	0.467**
	P								**1.000**	0.333**	0.195*	0.440**
Biological yield/ plant (g)	G									**1.000**	-0.384**	0.639**
	P									**1.000**	-0.378**	0.628**

*, ** significant at 5% and 1% level, respectively

Table 5. Direct Effect (Bold Values) and Indirect Effect for Different Characters on Grain Yield at Genotypic Level

Characters	Days to Heading	Days to maturity	Plant Height (cm)	Tillers per plant	Spike length (cm)	No of spikelets per spike	Grains per spike	1000 grain weight (g)	Biological yield per plant (g)	Harvest index (%)	R with Grain yield per plant (g)
Days to Heading	**0.0098**	-0.0213	-0.0112	0.0024	0.0104	0.0110	-0.0067	-0.0137	-0.0650	0.1830	0.099
Days to maturity	0.0077	**-0.0271**	0.0126	0.0033	0.0076	0.0095	-0.0053	-0.0097	-0.1020	0.2025	0.099
Plant Height (cm)	0.0017	0.0051	**-0.0667**	-0.0092	0.0136	0.0068	-0.0029	-0.0151	0.4281	-0.0925	0.269**
Tillers per plant	-0.0008	0.0029	-0.0192	**-0.0319**	0.0114	0.0109	-0.0041	-0.0141	0.7594	-0.2484	0.466**
Spike length (cm)	0.0022	-0.0045	-0.0198	-0.0080	**0.0457**	0.0182	-0.0132	-0.0226	0.4027	-0.1231	0.278**
No of spikelets per spike	0.0027	-0.0063	-0.0111	-0.0086	0.0205	**0.0407**	-0.0150	-0.0079	0.4404	-0.2320	0.223*
Grains per spike	0.0020	-0.0043	-0.0058	-0.0039	0.0181	0.0183	**-0.0333**	-0.0003	0.4335	-0.0963	0.328**
1000 grain weight (g)	0.0028	-0.0054	-0.0206	-0.0092	0.0211	0.0066	-0.0002	**-0.0489**	0.3524	0.1688	0.467**
Biological yield per plant (g)	-0.0006	0.0028	-0.0285	-0.0242	0.0184	0.0179	-0.0144	-0.0172	**1.0014**	-0.3162	0.639**
Harvest index (%)	0.0022	-0.0067	0.0075	0.0096	-0.0068	-0.0115	0.0039	-0.0100	-0.3842	**0.8242**	0.428**

Residual effect = 0.0533

Table 6. Direct Effect (bold values) and Indirect Effect for Different Characters on Grain Yield at Phenotypic Level

Characters	Days to Heading	Days to maturity	Plant Height (cm)	Tillers per plant	Spike length (cm)	No of spikelets per spike	Grains per spike	1000 grain weight (g)	Biological yield per plant (g)	Harvest index (%)	R with Grain yield per plant (g)
Days to Heading	**-0.0137**	0.0035	-0.0099	0.0017	0.0047	0.0051	-0.0028	-0.0076	-0.0515	0.1713	0.101
Days to maturity	-0.0092	**0.0052**	0.0082	0.0017	0.0034	0.0050	-0.0020	-0.0052	-0.0938	0.1854	0.099
Plant Height (cm)	-0.0024	-0.0008	**-0.0573**	-0.0070	0.0095	0.0064	-0.0018	-0.0081	0.4107	-0.0793	0.270**
Tillers per plant	0.0010	-0.0004	-0.0175	**-0.0229**	0.0065	0.0073	-0.0019	-0.0079	0.6795	-0.2172	0.427**
Spike length (cm)	-0.0026	0.0007	-0.0222	-0.0061	**0.0246**	0.0140	-0.0056	-0.0102	0.3524	-0.0692	0.276**
No of spikelets per spike	-0.0027	0.0010	-0.0143	-0.0066	0.0135	**0.0254**	-0.0062	-0.0043	0.3835	-0.1688	0.220*
Grains per spike	-0.0027	0.0008	-0.0073	-0.0031	0.0098	0.0113	**-0.0140**	-0.0004	0.4139	-0.0760	0.332**
1000 grain weight (g)	-0.0036	0.0009	-0.0159	-0.0062	0.0086	0.0038	-0.0002	**-0.0291**	0.3237	0.1583	0.440**
Biological yield per plant (g)	0.0007	-0.0005	-0.0242	-0.0160	0.0089	0.0100	-0.0060	-0.0097	**0.9715**	-0.3072	0.628**
Harvest index (%)	-0.0029	0.0012	0.0056	0.0061	-0.0021	-0.0053	0.0013	-0.0057	-0.3669	**0.8134**	0.445**

Residual effect = 0.0597

GENETIC DIVERGENCE

On the basis of D^2 values, all the 40 genotypes were grouped in 6 clusters (Table 7). Among the six clusters, cluster III was the largest, comprising of 10 genotypes followed by cluster II with 8 genotypes, cluster I with 7 genotypes, cluster IV with 6 genotypes, cluster V with 5 genotypes and cluster VI with 4 genotypes. The clustering pattern revealed that the groups of genotypes which were together in a cluster also indirectly proved their stable performance.

The inter and intra cluster distance among the genotypes is presented in Table 8. The maximum intra-cluster distance was observed in cluster III (2.342) followed by cluster VI (2.197) and cluster V (2.168) indicating differences in genotypes within the cluster. The least intra-cluster distance was found in cluster I (1.939) indicating close resemblance between the genotypes presented in this cluster. The highest inter-cluster distance was observed between cluster Vand VI (6.059) indicating a high degree of genetic diversity. The lowest inter- cluster distance was observed between cluster II and III (2.413) followed by cluster Iand II (2.655) indicating that these clusters were relatively less divergent.

The cluster mean for each character is tabulated in Table 9. Highest mean values for days to heading (82.50) and days to maturity (116.78) was observed in cluster IV while least mean values for these characters was found in cluster V and VI. Cluster VI exhibited the highest mean values fortillers/plant (4.27), spikelets/spike (18.22), 1000 grain weight (30.76), biological yield/plant (24.84) and grain yield/plant (6.91). Highest mean values for grains/spike (51.49) and harvest index (34.68) was recorded in cluster IV. Cluster V exhibited lowest mean values for plant height (67.95), tillers/plant (2.23), spike length (7.82), spikelets/spike (15.40) and grains/spike (38.82). Singh *et al*., (2019), Majid and Dar (2020), Kumar *et al*., (2021),Tanveer *et al*., (2021) and Chaudhary *et al*., (2022) also studied the genetic divergence in bread wheat.

Table 7. Clustering Pattern of 40 Genotypes of Bread Wheat on The Basis of D^2 Statistic

Cluster No.	No. of genotypes	Genotypes in cluster
I	7	DBW 303, HD 3086, HUW 468, NW 1014, NW 2036, PBW 780, WH 147
II	8	K 1317, NIAW 1415, PBW 723, PBW 698, PBW 550, PBW 701, PBW 677, DPW 621-50
III	10	HD 3118, HD 2824, HD 3226, K 1006, K 0307, NI 5439, NW 5054, PBW 34, Sumai 3, WH 730
IV	6	DBW 88, DBW 222, DBW 187, C 306, Lok 01, WH 1105
V	5	HD 3059, HUW 234, PBW 703, PBW 712, WR 544
VI	4	PBW 725, PBW 702, PBW 1763, Raj 3765

Table 8. Inter and Intra-Cluster (Bold Values) Distances Involving Forty Genotypes of Bread Wheat

Clusters	I	II	III	IV	V	VI
I	**1.939**					
II	2.655	**2.080**				
III	2.964	2.413	**2.342**			
IV	4.107	3.693	3.312	**2.167**		
V	3.555	4.948	4.222	5.317	**2.168**	
VI	4.413	2.765	2.953	4.690	6.059	**2.197**

Table 9. Cluster Mean for Eleven Characters in Bread Wheat

Clusters	Days to Heading	Days to maturity	Plant Height (cm)	Tillers per plant	Spike length (cm)	No of spikelets per spike	Grains per spike	1000 grain weight (g)	Biological yield per plant (g)	Harvest index (%)	Grain yield per plant (g)
I	73.19	108.81	74.25	2.45	9.05	17.31	49.02	24.01	15.31	21.97	3.27
II	72.92	109.42	76.06	3.28	10.04	17.85	47.32	30.00	18.72	22.61	4.15
III	73.27	109.00	78.20	2.75	9.57	16.63	49.39	28.56	17.27	34.40	5.86
IV	82.50	116.78	73.77	2.27	9.54	17.81	51.49	30.40	14.84	34.68	5.03
V	70.53	108.73	67.95	2.23	7.82	15.40	38.82	26.26	10.38	33.27	3.38
VI	72.25	108.42	78.15	4.27	9.35	18.22	48.88	30.76	24.84	28.32	6.91

CONCLUSION

From the present study it is concluded that the analysis of variance showed highly significant differences among the genotypes for all the characters studied under rainfed condition. PCV values were higher than GCV values but the difference variability between these two estimates for all the characters was very close. The characters grain yield/plant, biological yield/plant and harvest index were recorded with high heritability and genetic advance values. Correlation analysis showed positive and highly significant association of grain yield with biological yield/ plant followed by thousand grain weight, tillers/plant and harvest index. Cluster analysis revealed highest inter cluster distance between cluster V and VI indicating genetic diversity among the genotypes.

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■■■

Proceedings of National Conference on "Organic & Natural Farming in Context to Indian Agriculture" held on May 13-14, 2022 at CSAUA&T, Kanpur

In our continued endeavor of celebrating Azadi Ka Amrut Mahotsav and on the occasion of the Alumni meet university had organized a National Conference on "Organic & Natural Farming in Context to Indian Agriculture". The premise was that to arrive at suitable strategies and options about the Organic products are grown under a system of agriculture without the use of chemical fertilizers and pesticides with an environmentally and socially responsible approach. This is a method of farming that works at grass root level preserving the reproductive and regenerative capacity of the soil, good plant nutrition, and sound soil management, produces nutritious food rich in vitality which has resistance to diseases. Organic farming in India has been reinvented and getting more popularity with each passing day. Farmers, entrepreneurs, researchers, administrators, policy makers and of course consumers are showing increasingly greater interest in promotion and development of organic farming in the country. Organic food products are considered to be much safer and nutritious than the products produced by the conventional farming. Organic farming also helps to restore the soil health, protect environment, enhance biodiversity, sustain crop productivity and enhance farmers' income. Seeing the long-term benefits of organic farming, the Government of India has taken many important steps for its promotion in the country. With the support of all kinds of stakeholders and the Government, the scope of organic farming movement has widened tremendously in India.

The inaugural programme of the Conference was started by an introductory address from Dr. D.R. Singh, Vice Chancellor, CSA University of Agriculture & Technology, Kanpur. This was followed by a formal welcome address by Dr. Munish Kumar, Professor and Organizing secretary- NCONFIA- 2022. The Chief Guest of the day was Sri Surya Pratap Shahi ji, Hon'ble Minister of Agriculture, Agriculture Education & Research, Govt. of U.P. started his inaugural address, by congratulating the Vice chancellor and his team for organizing the conference on a very important contemporary topic which is crucial at this moment. He addressed the august gathering and explained the importance of natural and organic farming in India and also stresses on organic farming is practiced in 187 countries at about 72.3 million hectares of agricultural land, which is managed by at least 3.1 million farmers. The inauguration was followed by the technical session during which speakers/Scientists presented scientific aspects Organic and Natural farming in India and following recommendations emerged from the deliberations made in the National Conference on "Organic & Natural Farming in Context to Indian Agriculture" held on May 13-14, 2022 at CSAUA&T, Kanpur.

Recommendations

- The enhanced soil fertility leads to stabilization of soil organic matter and in many cases sequestration of carbon dioxide into the soils.
- Increases the soil's water retention capacity, thus contributing to better adaptation of organic agriculture under unpredictable climatic conditions with higher temperatures and uncertain precipitation levels.

- Organic production methods emphasizing soil carbon retention are most likely to withstand climatic challenges particularly in those countries which are most vulnerable to increased climate change.
- Organic agriculture has considerable potential for reducing emissions of greenhouse gases.
- Organic agriculture requires less fossil fuel per hectare and kg of produce due to the avoidance of synthetic fertilizers. Organic agriculture aims at improving soil fertility and nitrogen supply by using leguminous crops, crop residues and cover crops.
- Organic systems are highly adaptive to climate change due to the application of traditional skills and farmers' knowledge, soil fertility-building techniques and a high degree of diversity.
- Gender equality should be encouraged in all facets of agricultural decisions and promote gender specific technologies that are financially affordable. All policy interventions should undergo a gender audit before implementation at the grass root level.
- Policy makers should recognize the role of extensionists (public and private NGOs officially by spelling out a policy to facilitate their participation in national planning.
- Skill development among Indian farmers requires to be operationalized at field level for tapping the vast production potential of agricultural resources.
- Recommendations for improving women's participation in organic farming and More amenities should be given to poor rural women for land, organic agricultural and livestock extension services.
- By providing financial powers to women farmers in accessing credit on soft terms from banks and other financial institutions for landholdings, setting up their occupation, for buying properties, and for house building etc.
- The women farmers Skill empowerment training in the area of numerous operations- Organic farming, Vocational training, Field operations, Conservation of biodiversity and Nutritional biosecurity etc.

■■■


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प्राकृतिक खेती का हब होगा बुंदेलखंड : शाही

- सीएसए विवि में जैविक खेती पर सेमिनार में बोले कृषि मंत्री
- जैविक खेती में उत्पादन देने वाली प्रजाति को करें विकसित

कानपुर. संवाददाता। प्रदेश के कृषि मंत्री सूर्य प्रताप शाही ने कहा कि बुंदेलखंड को प्राकृतिक खेती का हब बनाएंगे। इसके लिए किसानों को प्रेरित किया जाएगा और सभी कृषि विज्ञान केंद्र (केवीके) में एक एकड़ में जैविक खेती का मॉडल विकसित करेंगे। उन्होंने कहा कि वैज्ञानिक जैविक खेती में अधिक उत्पादन देने वाली प्रजाति को विकसित करें, जिससे किसान आकर्षित हों। तकनीक की जरूरत हो तो आईआईटी जैसे संस्थानों से मदद लें। उन्होंने कहा कि यूक्रेन-युद्ध की वजह से आर्थिक स्थिति गंभीर हो रही है, जिसका असर पड़ना तय है। हालांकि भारत कई देशों की मदद कर रहा है।

चंद्रशेखर आजाद कृषि एवं प्रौद्योगिकी विश्वविद्यालय (सीएसए) के कैलाश भवन में दो दिवसीय एलुमनी मीट व प्राकृतिक खेती पर संगोष्ठी का आयोजन किया गया। शुभारंभ कृषि मंत्री सूर्य प्रताप शाही, कुलपति डॉ. डीआर सिंह, एसोसिएशन के अध्यक्ष एसके सिंह ने किया।

कृषि मंत्री सूर्य प्रताप शाही ने उत्कृष्ट कार्य करने वाले किसानों को सम्मानित किया

कुलपति डॉ. डीआर सिंह ने विवि की उपलब्धियों के बारे में जानकारी दी। कहा कि विवि के वैज्ञानिक तीन सौ से अधिक प्रजातियां विकसित कर चुके हैं। कार्यक्रम में शोध पत्र प्रस्तुत किए गए और पुस्तक का विमोचन भी हुआ। संचालन डॉ.श्वेता यादव व डॉ. नौशाद खान ने किया। पूर्व छात्र डॉ. आरसी चौधरी, डॉ. वाईएस शिवाय, डॉ. मसूद अली, डॉ. धर्मराज सिंह, डॉ.एचजी प्रकाश, डॉ.डीपी सिंह, डॉ. राम बदूक सिंह, डॉ. खलील खान आदि मौजूद रहे।

भागलपुर स्थित बिहार कृषि विश्वविद्यालय सबौर के कुलपति प्रो. अरुण कुमार ने कहा कि गंगा किनारे कॉरिडोर विकसित करना जरूरी है। बिहार में यह कॉरिडोर विकसित कर विवि किसानों को जागरूक कर रहा है। लोक सेवा आयोग के पूर्व सदस्य व पूर्व कुलपति डॉ. भारत सिंह ने किसानों को धीरे-धीरे जैविक खेती अपनाने की सलाह दी।

कानपुर जागरण
कानपुर, 15 मई, 2022 दैनिक जागरण 9

प्राकृतिक खेती में लागत शून्य, फसलों की पैदावार होती भरपूर

जासं, कानपुर : चंद्रशेखर आजाद कृषि एवं प्रौद्योगिकी विवि में आयोजित राष्ट्रीय संगोष्ठी के दूसरे व अंतिम दिन विशेषज्ञों ने शोधपत्रों और किसानों ने अनुभवों से प्राकृतिक खेती के फायदे समझाए। भेल कृषक पुरस्कार से सम्मानित हो चुके झांसी के अंबाबाग गांव के किसान व भाजपा किसान मोर्चा के प्रदेश उपाध्यक्ष श्याम बिहारी गुप्ता ने विशेषज्ञों को बताया कि प्राकृतिक खेती में लागत शून्य है और फसलों की भरपूर पैदावार होती है। भारतीय चरागाह एवं चारा अनुसंधान संस्थान झांसी के निदेशक डा. अमरेश चंद्र, डा. श्वेता, डा. मनोज कटियार आदि ने शोधपत्र प्रस्तुत किए।

श्याम बिहारी गुप्ता ने बताया कि वह ढाई एकड़ खेत में वर्ष 2006 से प्राकृतिक खेती कर रहे हैं। ऊसर भूमि को भी उपजाऊ बनाकर वह विभिन्न फसलों चक्र के हिसाब से लगाते हैं। पहले एक गाय थी, अब 30 हैं। डा. अमरेश चंद्र ने विवि के पुराने दिनों की याद ताजा की। किसानों को प्राकृतिक खेती के लिए प्रोत्साहित करने की बात कही। वर्ष 1982 बैच के पूर्व छात्र व कृषि विभाग के संयुक्त निदेशक अभिमन्यु ने भी स्मृतियों से गुरुदायवा। कुछ वैज्ञानिकों अपने पुराने क्लासरूम व हास्टल में भी गए। एलुमिनाई एसोसिएशन के अध्यक्ष डा. एसके सिंह, कार्यक्रम आयोजक डा. मनोज गौतम ने सभी संस्थाओं का आभार जताया।


सीएसए में आयोजित राष्ट्रीय संगोष्ठी में भारतीय चरागाह एवं चारा अनुसंधान संस्थान (आइजीएफआरआई) झांसी के निदेशक डा. अमरेश चंद्र (बाएं) से कृषि के बारे में जानकारी दी। डा. एसजी सिंह (दाएं) व डा.श्याम राज सिंह। बां) मौजूद रहे। जागरण


श्याम बिहारी गुप्ता, झांसी। जागरण

- सीएसए विवि में राष्ट्रीय संगोष्ठी में श्रेष्ठ कृषक पुरस्कार से सम्मानित झांसी के किसान ने दी जानकारी
- विशेषज्ञों ने मोटे अनाज पर प्रस्तुत किए शोधपत्र, साथ में बैठकर विवि के पुराने दिनों की यादें ताजा कीं

केमिकल युक्त फसलों से हो रहीं बीमारियां


डा. रामवेत चौधरी। जागरण

पार्टिसिपेटरी रूरल डेवलपमेंट फाउंडेशन गोरखपुर के वैज्ञानिक डा. रामवेत चौधरी ने रसायनों का इस्तेमाल रोकने की अपील की। उन्होंने कहा कि फसलों में रासायनिक उर्वरकों व कीटनाशकों के प्रयोग से कैंसर, मधुमेह, हृदय व किडनी से भी जुड़ी बीमारियां हो रही हैं।

मधुमेह के रोगी खाएं काला नमक चावल

डा. रामवेत ने बताया कि वह 10 वर्ष तक समुक्त राष्ट्र संघ में वैज्ञानिक रहे और कई पुरस्कार पाए। वर्ष 2006 में सेवानिवृत्ति के बाद गोरखपुर लौटकर 11 बिघे में काला नमक चावल की वह प्रजातियां देशन-तीन, बीना 101, बीना 102 व किरण विकसित की। इस चावल की किस्म प्रजाति 145 दिन में होती है। शुगर की होने के कारण मधुमेह से पीड़ित व्यक्ति भी खा सकता है। इन प्रजातियों की प्राकृतिक विधि से तैयार कराया जा रहा है।

शुरुआती वर्ष में औसत उत्पादन, इसके बाद फायदा


डा. वीरेंद्र सिंह। जागरण

भारतीय कृषि अनुसंधान संस्थान (आइएआरआइ) नई दिल्ली के प्रधान वैज्ञानिक डा. वीरेंद्र सिंह ने बताया कि किसान अपनी भूमि के 20 फीसद हिस्से में प्राकृतिक खेती करें तो उन्हें फायदा दिखेगा। शुरुआत के दो वर्ष में फसलों में औसत पैदावार होती है, लेकिन इसके बाद तेजी से लाभ होता है। इतना फायदा केमिकल व रासायनिक उर्वरकों से भी नहीं होता है। लाभ देखकर किसान अपने पूरे खेत पर प्राकृतिक खेती कर सकते हैं।

4 दैनिक जागरण कानपुर, 14 मई, 2022
कानपुर जागरण

पौष्टिक व गुणवत्ता वाला खाद्यान्न तैयार करें किसान

सीएसए विवि में राष्ट्रीय संगोष्ठी में कृषि मंत्री ने की अपील

जासं, कानपुर : पिछली सदी में खाद्यान्न का संकट था, लेकिन कृषि विश्वविद्यालयों में विकसित तकनीक व हरित क्रांति से देश समृद्ध हुआ। यूक्रेन व रूस के बीच युद्ध के दौरान हम कई देशों को आपूर्ति दे रहे हैं, जो गौरव की बात है। अब किसान प्राकृतिक खेती को बढ़ाकर पौष्टिक व गुणवत्ता वाला खाद्यान्न तैयार करें, क्योंकि फसलों में केमिकल के प्रयोग से बीमारियां हो रही हैं। यह अपील प्रदेश के कृषि मंत्री सूर्य प्रताप शाही ने चंद्रशेखर आजाद कृषि एवं प्रौद्योगिकी विश्वविद्यालय (सीएसएयूविवि) में आठवीं एल्युमिनाइ मीट और दो दिवसीय प्राकृतिक खेती पर राष्ट्रीय संगोष्ठी के दौरान कही। साथ ही प्राकृतिक खेती कर रहे सात किसानों को सम्मानित किया।

कृषि मंत्री ने कहा, सीएसए विश्वविद्यालय देश के प्राचीनतम विश्वविद्यालयों में शामिल है। 115 वर्षों में विवि अपनी आठवीं एल्युमिनाइ मीट कर रहा है। अब प्राकृतिक खेती को बढ़ावा देने का वक्त है। रासायनिक उर्वरकों के प्रयोग से भूमि की जलधारण क्षमता व पोषक तत्वों में कमी हो रही है। प्राकृतिक व गो आधारित खेती एकमात्र समाधान है। सभी कृषि विज्ञान केंद्र एक एकड़ में प्राकृतिक खेती कराएं और किसानों को प्रशिक्षित करें। इससे उनकी आय व रोजगार बढ़ेगा। कुलपति डा. डीआर सिंह ने कहा, दो दिन की संगोष्ठी में प्राकृतिक खेती पर जो सुझाव आएंगे, उसे सरकार को भेजेंगे। विश्वविद्यालय ने दो वर्ष पहले प्राकृतिक खेती शुरू कराई थी। इससे एक हजार से ज्यादा किसान लाभान्वित हो रहे हैं। उनकी आय दो से तीन गुणा बढ़ी है। विश्वविद्यालय फसलों की 300 से अधिक प्रजातियां विकसित कर चुका है। एल्युमिनाइ एसोसिएशन के चेयरमैन डा. एसके सिंह ने बताया, संगठन से 1100 से ज्यादा पूर्व छात्र जुड़े हैं। वि इस दौरान कार्यक्रम संयोजक डा. मुनीष, डा. करम हुसैन, डा. धर्मराज सिंह, डा. श्वेता यादव, पूर्व छात्र डा. आरसी चौधरी, डा. वाईएस शिवाय, डा. भारत सिंह आदि रहे।


सीएसए में कार्यशाला का कृषि मंत्री सूर्य प्रताप सिंह शाही। (बाएं से दूसरे) ने शुभारंभ किया। साथ में कुलपति डा.डीआर सिंह। (बाएं से तीसरे)। निदेशक शोध डा.करम हुसैन। (बाए)। पूर्व छात्र संगठन के चेयरमैन डा.एसके सिंह। (दाएं से तीसरे)। डा.सुनीश गंगवार (दाएं) व डा.धरम राज सिंह। (दाएं से दूसरे)। ● जागरण

कृषि विश्वविद्यालयों से कृषि महाविद्यालयों की संबद्धता पर जल्द होगा निर्णय: कृषि मंत्री ने बताया, कृषि कॉलेज करा रहे महाविद्यालयों को कृषि विश्वविद्यालयों से संबद्ध कराने की तैयारी है। प्रस्ताव पर जल्द फैसला हो सकता है। उन्होंने कुलपति से विवि में शिक्षकों व शिक्षणेत्तर कर्मचारियों के रिक्त पदों पर जल्द नियुक्तियां करने के लिए कहा। उन्होंने बताया, झांसी एफपीओ (किसान उत्पादक संगठन) को प्राकृतिक खेती के रूप में चलाएंगे। चुंदेलखंड में क्लस्टर बनाकर प्राकृतिक खेती का हब तैयार करेंगे। कुलपति ने बताया, विश्वविद्यालय से संबद्ध कृषि विज्ञान केंद्र मैनपुरी में सूंगफली, इटावा में टमाटर, फतेहपुर में बकरी पालन और अलीगढ़ में सरसों व मधुमक्खी पालन का उत्कृष्टता केंद्र बनाया गया है।

नीति आयोग ने किताब में लिखी फर्रुखाबाद के हिमांशु की कहानी

जासं, कानपुर : प्राकृतिक खेती करने वाले किसानों के सम्मान में भारत सरकार के नीति आयोग ने देश भर के 100 किसानों की कहानी को एक किताब में प्रकाशित कराया है। इसमें फर्रुखाबाद कायमगंज रोड स्थित कुइयांधीर गांव के हिमांशु गंगवार की भी कहानी लिखी है। हिमांशु की इस उपलब्धि पर शुक्रवार को सीएसए विवि में कृषि मंत्री ने उन्हें और छह अन्य किसानों को सम्मानित किया।

हिमांशु ने बताया कि उन्होंने नागपुर स्थित आरईसी से मैकेनिकल इंजीनियरिंग में बीटेक किया था। वर्ष 2009 में महाराष्ट्र के सुभाष पालेकर से मुलाकात हुई। इसके बाद उनकी बताई विधि से प्राकृतिक खेती कर रहे हैं। देशी गाय के गोबर, गौमूत्र से जीवामृत, घन जीवामृत तैयार करके खेत में डालते हैं और दलहनी फसलें, आलू आदि उगाते हैं। 25 अप्रैल को नीति आयोग में किताब के विमोचन अवसर पर मुख्यमंत्री योगी आदित्यनाथ, मध्यप्रदेश के मुख्यमंत्री शिवराज सिंह चौहान, उत्तराखंड के मुख्यमंत्री पुष्कर सिंह धामी और तेलंगाना के जी जगनरेड्डी भी मौजूद थे।

फतेहपुर के अँग निवासी किसान सौलेंद्र सिंह के बेटे आनंद सिंह, हसनपुर के रमेश सिंह, सरगनापुर के वीरेंद्र यादव, इटावा के नवली गांव के शिवम तिवारी, रायबरेली के कचनावा गांव के आनंद मिश्रा, अलीगढ़ के मानपुर निवासी यादराम को भी पुरस्कार मिला।

आनंद सिंह ने बताया कि वह वर्मी कंपोस्ट बनाकर और कैंचा की खाद डालकर खेत तैयार करते हैं। फंगस के लिए ट्राइकोडर्मा सीएसए विवि से लेकर आते हैं और गुड़ व 200 लीटर पानी में डालकर रखे कराते हैं। एक बीघे में करीब डेढ़ सौ कुंतल जैविक गन्ना उगा रहे हैं। सिंचाई ड्रिप विधि से करते हैं। हाल ही में ताइवानी अमरूद लगाया है। वीरेंद्र ने बताया कि वह भी प्राकृतिक खेती से गेहूं, धान, मोटे अनाज में रागी, केमोमाइल, तुलसी, लेमन ग्रास उगाते हैं। शिवम टिशू कल्चर विधि से आलू के बीज उगाते हैं।

प्राकृतिक खेती में योगदान के लिए कृषि मंत्री ने हिमांशु के साथ छह किसानों को किया सम्मानित

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अमर उजाला

आलू पर आला काम

बीटेक करने के बाद आलू शोध में मन रमा, इटावा में बनाई टिश्यू कल्चर लैब

21 साल के शिवम आलू से हर साल कमा रहे एक करोड़

खास खबर

दिव्यांश सिंह

कानपुर। बीटेक करने के बाद इटावा के बाघली गांव के 21 वर्षीय शिवम कुमार तिवारी का मन इंजीनियरिंग के बजाय खेती-किसानी की तरफ लग गया। आलू की उन्नत किस्म के बीजों का उत्पादन कर वे साल में करीब एक करोड़ रुपये तक कमा रहे हैं। उनके बीजों से किसानों की कमाई भी बढ़ रही है।

शिवम ने कृषि विश्वविद्यालय (सीएसए) के इटावा स्थित इंजीनियरिंग कॉलेज से मैकेनिकल इंजीनियरिंग से 2019 में बीटेक किया। फिर कहीं नौकरी करने के बजाय उन्होंने 30 एकड़ पर इस एग्री स्टार्टअप की शुरुआत की। अब शिवम 200 एकड़ में आलू बीजों का उत्पादन कर रहे हैं। वह टिश्यू कल्चर लैब में आलू की 17 तरह की प्रजातियों के उन्नत किस्म के बीज तैयार करके किसानों को बेच रहे हैं। शुक्रवार को सीएसए में कृषि, कृषि शिक्षा एवं अनुसंधान मंत्री सूर्य प्रताप शाही ने इस अनूठी उपलब्धि पर शिवम को सम्मानित किया। शिवम ने बताया कि बीटेक की पढ़ाई के दौरान 2017 में सेंट्रल पोटेटो रिसर्च इंस्टीट्यूट (सीपीआरआई) मेरठ में प्रशिक्षण के लिए भेजा गया था। वहां आलू के बीजों की उत्पादन इकाई के कामकाज को देखा तो खेती-किसानी में ही कुछ नया करने की सोची। प्रशिक्षण के बाद इटावा लौटकर किसान पिता राम करन तिवारी से बीज उत्पादन पर बात की। फिर 50 लाख का लोन लेकर टिश्यू कल्चर लैब बनाई। उन्होंने कहा कि इस काम में हर साल 40 लाख खर्च होते हैं और कुल आय 1.40 करोड़ की होती है। (संपादन)

किसान शिवम तिवारी को पुरस्कृत करते कृषि शिक्षा मंत्री सूर्य प्रताप शाही व सीएसए के कुलपति प्रो. डीआर सिंह। संवाद

200 एकड़ में कर रहे आलू के उन्नत बीजों का उत्पादन

चिप्स का प्लांट लगाने की तैयारी

शिवम ने बताया कि अब इटावा में आलू के चिप्स का प्लांट लगाने की तैयारी है। इस प्लांट में किसानों से बाजार के मूल्य से ज्यादा दाम पर आलू खरीदकर उसके चिप्स बनाकर बाजार में उतारेंगे।

टिश्यू कल्चर लैब से ये होते लाभ

टिश्यू कल्चर लैब से विकसित होने वाले पौधे पर बीमारी से रोग नहीं लगता। पहले के बीज या पौधे के विकसित होने की संभावना 95 प्रतिशत तक होती है। इस कारण किसान इनकी ज्यादा मांग करते हैं।

ऐसे बनता है आलू का बीज

शिवम ने बताया कि मार्च में सीपीआरआई मेरठ से पांच हजार रुपये कीमत के आलू की अलग-अलग प्रजाति के माइक्रो प्लांट लाते हैं। लैब में एक पौधे से पांच पौधे बनाते हैं। उसके बाद उन पांच पौधों को वहीं से लगाकर उनसे कई पौधे बनाए जाते हैं। एक माइक्रो प्लांट से 50 हजार पौधे बना सकते हैं। अक्तूबर से पौधों को ग्रीन नेट हाउस में और 10 दिन बाद व्हाइट ग्रीन हाउस में लगाया जाता है। फरवरी से पौधों से कंद (बीज) निकलने लगते हैं, जिसकी बिक्री की जाती है। फिलहाल कुफरी बहार, कुफरी संगम, सुरिखारी और फ्राई होम समेत 17 प्रजातियों के बीजों का उत्पादन किया जा रहा है।

Conference in Print Media

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Kanpur 208 002 (U.P.) India

Nikhil Publishers & Distributors
37, 'Shivram Kripa' Vishnu Colony,
Shahganj, Agra-282010 (U.P.) India
E-mail : nikhilbooks.786@gmail.com

ISBN : 978-93-5552-353-2

₹150.00

9458009531-38 | www.nikhilbooks.com | Nikhil Publishers Agra