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Life Sciences for Sustainable Development

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PREFACE

The title of this book, "Life Sciences for Sustainable Development", speaks to two fundamental components of group interaction: Life Sciences relationships and Sustainable development. An attempt has been made to represent significance and the recognition of the contribution of Science, Technology and Innovation (STI) to sustainable development. This book is compilation of valuable articles of acknowledged experts in the fields of Agricultural and Horticultural sciences, Food science and technology, Biotechnologies, Veterinary Sciences as well as other interdisciplinary fields providing a sufficient depth of the subject to satisfy the need of a level which will be comprehensive and interesting. Life sciences play a specific role in achieving the Sustainable Development Goals.

A number of topics that have been focal points for development throughout their history of research, teaching and societal mission. Furthermore, they traditionally have strong links to stakeholders, such as the food sector, forestry and renewable energies. It is an assemblage of variety of information about advances and developments of Life Sciences for Sustainable Development. With its application oriented and interdisciplinary approach, we hope that the students, teachers, researchers, scientists and policy makers will find this book much more useful.

I would like to thank the management of Seth Kesarimal Porwal College of Arts and Science and Commerce, Kamptee and our principal Dr. M. B. Bagade for their constant motivation and support. Thanks are also due to our publisher Bhumi Publishing, India for compilation of such nice data in the form of this book. Finally, I will always remain in debt to all my well-wishers for their blessings, without which this book would not have come into existence.

- **Dr. Shalini J. Chahande**

CONTENTS

DIVERSIFICATION OF FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE PRODUCTION UNDER MARGINAL HOUSEHOLD CONDITIONS

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Introduction:

Farming system research has been widely recognized as the agricultural production strategy for solving the problems this multidisciplinary farm approach was effective for small and marginal farmers. The main aim under integrated farming system is to integrate various farm enterprises so as to recycle crop waste and byproduct in the farm itself. The small land holding pattern was major concern for profitability and sustainability of farming systems as Indian economy is predominantly based on rural agriculture (Meena *et al.,* 2018). New technology though with potential fails to get desired impact and as a result of complexity of small and marginal farmers resulting with lower profitability, productivity, sustainability and flexible food system. Marginal and small farmer's household being major stake holder (85 % of the farming community) with diversified cropping system dominated mainly by cash crop and herd comprising of only cattle.

Due to heterogeneity in the farmer's community it needs careful approach while transferring the appropriate technology as agro-ecology and resource management varies from one place to another. With the gradual decrease in land holding it is essential to integrate enterprises like dairy, goat rearing, poultry, fishery, horticulture along with field crops etc. to achieve various objectives such as reduction in poverty, secure food availability, sustainability and environmental soundness within the socioeconomic and bio physical environment (Panwar *et al.,* 2018).

As per view of farmers' agriculture had not been a remunerative system due to unsteady fluctuating market prices and constant persisting problems. Increased cultivation cost due to agrochemicals overuse, recycling of less crop residue (as compost) and technical knowledge lack also become a limiting factor for community of farmers. Lack of knowledge about the

complimentary enterprises and also inability to manage self-marketing, farm produce value addition worsens the condition.

With the holding size shrinkage, due to green revolution and economic liberalization, the farmers focus started shifting towards few enterprises because of several factors like fluctuating prices of commodity, labour shortage during peak agriculture season, etc. These factors have imposed a severe impact on resource deprived farm households in such cases income enhancement is only possible by judicious integration of farm resources keeping in view the ecological conditions of the locality (Kaur *et al.,* 2021).

Due to dominance of cereal based cropping system and lack of diversity in the region several problems have cropped up ultimately threatening the farming systems sustainability, economic steadiness and security of the farmer. Now a day for farmer crop production is the major source of subsistence and sustenance, in order to ensure risk coverage and livelihood security farmers should have multiple income sources irrespective of percent contribution in income. Especially integrated farming system (IFS) seems to be propitious solution for economic soundness. Higher adoption of IFS accelerates resource use efficiency, enhanced yield creating chance for production-led impact on rural livelihoods economy (Kaur *et al.,* 2021). The farmers' response to various technologies is influenced by inherent variability that aims at enhancing farms natural resource management, profitability and productivity. However, there are numerous regrettable examples of farming community not accepting the technologies with great prospective especially by small and marginal farmers of the developing countries. The reason being, quite often, these technologies requiring specific solutions and do not fit well into smallholder's heterogeneous systems. Integrated farming system are often less risky and if managed efficiently benefits from synergisms among enterprises, diversity in produce and environmental soundness can be achieved.

Keeping this in view the trials were conducted at farmer's field to study "Diversification of farming systems for sustainable agriculture production under marginal household conditions" in Katol & Narkhed tehsils of Nagpur district for three years during 2017-18 to 2020-21 with the objectives to enhance marginal farmers household's profitability and productivity, through diversification approaches improve the livelihood and nutritional security and in diversification of crop + livestock system estimate the impact of capacity building

Immediate Objectives:

1. To enhance marginal farmers household's profitability and productivity through IFS approach.
2 Through diversification approaches improve the livelihood and nutritional security.
3. In diversification of crop + livestock system estimates the impact of capacity building.

Long Term Objectives:

1. To enhance marginal farmers household's profitability and productivity through IFS approach.
2. Through diversification approaches improve the livelihood and nutritional security.

Methodology:

Field trial entitled "Diversification of farming systems for sustainable agriculture production under marginal household conditions" was carried out during for four years during 2017-18 to 2020-21. Based on recognized constraints multilevel interventions are planned in a systematic perspective on the farmers' field for field crops and allied enterprises (agronomical and horticultural crops, livestock production, goat farming, etc.) different components of farming system, so that it would enable farmer to get multifold increase in net monetary income.

Treatments (Modules):

M_0	**Bench Marks:** Recording bench mark through comprehensive survey, video-graph long with GPS location
M_1	**Cropping system diversification:** The most efficient cropping system to be introduced keeping in view the farmers resources /perception /willingness /market / household requirements and other components of the system.
M_2	**Livestock diversification:** Introduction of region specific low cost livestock components viz. backyard poultry and goat etc. + improvement of livestock health and productivity through improved nutrition (mineral mixture) + de-worming + round the year recommended fodder supply.
M_3	**Product diversification:** On-farm vegetable production/dry land horticulture crops cultivation, preparation of mineral mixture/ value addition in marketable surplus product/ kitchen / roof gardening etc.
M_4	**Capacity building:** Training of farm households on farming systems including post-harvest and value addition (support with critical inputs and assessing its impact.)

Discussion:

Prototype farming systems developed based on characterization of the region comprising the different components like crop, dairy, bullock pair and horticulture in the study region was found to be sustainable and eco-friendly.

Table 1: Farming systems, number of households and mean area

Farming System	No. of households	Mean area (ha)	Mean family size (No's)	Mean benchmark net income from farming (Rs/yr/hh)	Mean benchmark off farm income (Rs/yr/hh)
Crop + Dairy + Horticulture	7	0.89	4	79571	Nil
Crop+ Bullock pair +Horticulture	5	0.88	4	86000	Nil
Crop + Dairy	5	0.83	4	61000	Nil
Crop+ Bullock pair	7	0.77	4	70000	Nil

24 farmers were studied on the basis of bench mark survey of targeted group information was analyzed, and on the basis of various components farming system was classified in four group of farming system. The total net income from Crop + Horticulture +Bullock pair was recorded Rs. 86000 per year from total holding size in bench mark, followed by Field crop +Dairy+ Horticulture i.e. Rs. 79571 per year, Crop+ Bullock pair i.e. Rs 70000 per year and Crop + Dairy i.e. Rs 61000 per year. The farmers have higher proportion of 74-92 percent income generated by crop component of farming system, and only 8-26 income produced from livestock and very less from other sources. Bhoir *et al.* (2020) reported similar findings.

Table 2: Benchmark status of area and net income from various modules

Farming System (s)	Benchmark net income (Rs/yr/hh.)				
	Cropping systems	Livestock diversification	Other components if any	Product diversification	Total
Crop + Dairy +Horticulture	74771	4800	0	0	79571
Crop + Horticulture+ Bullock pair	67500	18500	0	0	86000
Crop +Dairy	51740	9260	0	0	61000
Crop + Bullock pair	51558	18442	0	0	70000

As per scrutiny of the farmers house hold survey data, results reveal that farmers had on an average land holding of 0.77 to 0.89 hectare and number of local cattle (1–2 numbers) in comparison to improved cattle breeds (0–1 numbers).

Table 3: Types of farming systems and components

Farming System (s)	No. of house holds	Mean holding size (ha)	Mean family size (no's)	Cropping systems	Livestock	Other	Mean total net income (Rs/yr/hh)
Crop + Dairy +Horticulture	7	0.89	4	Sole Bt cotton Sole Soybean Soy + Pigeon pea Soy-Chickpea Soy–Wheat	Cow Av. No (2.28)	Nil	79571
Crop + Horticulture + Bullock pair	5	0.88	4	Sole Bt cotton Sole Soybean Soy + Pigeon pea Soy-Chickpea Soy–Wheat	Bullock pair (1)	Nil	86000
Crop +Dairy	5	0.83	4	Sole Bt cotton Sole Soybean Soy + Pigeon pea Soy-Chickpea Sole Chickpea Soy–Wheat	Cows (2.20)	Nil	61000
Crop + Bullock pair	7	0.77	4	Sole Bt cotton Sole Soybean Soy + Pigeon pea Soy-Chickpea Soy–Wheat)	Bullock pair (1)	Nil	70000

Major constraints in farming system across the chosen village locations based on the household survey data were identified. Afterwards consultation with survey and non- survey participants and the concerned local expert potential interventions to address were identified, con- strains were planned and executed to record the change in net returns obtained by farm house holds. In crop production as per farmers view the non-availability of quality seeds of high yielding and improved variety was a very serious hindrance. Also, after a certain peak, the yield get stagnated, For addressing low yield of field crops high yielding varieties, seed treatment with bio fertilizer and bio fungicides, weed management practices, irrigation at crops critical growth stages, insect pest management practices were introduced along with the technical know-how to include those in future also. Recommended fertilizer dose along with micro nutrients for balanced nutrition in crops was also included for higher yield to contribute towards profitability.

Further, for crop component income enhancement intercropping and crop diversification (pulses, oilseed and fiber crops) fetching good prices in market were introduced.

For animal component during lean period non-availability of good quality fodder, due to mineral deficiency low milk production and poor health was responsible for lesser income Also, the farm house hold lacks technical know how about rearing of livestock component, they weren't aware of the scientific approach. To address the concern related to animal health and milk production interventions like inclusion of fodder crop for year-round fodder availability, silage (moor grass preparation) and hay making, mineral mixture supplementation, deworming of animals were considered. Nutritional vegetable and fruit cultivation was incorporated in all farm types. It not only provides balanced food rich in nutrition to the family of farmer but also helps towards self-sufficiency in food, reducing cultivation cost and increase net monetary profit from the same piece of land. For recycling of crop and weed residues composting was also included by providing bio decomposers to hasten the decomposition process and technical knowledge of proper composting methods was given for proper utilization of waste of one enterprise as input for the other enterprise. Self-sustainability of the system depends upon nutrient recycling which enables to reduce reliance on the external input, thus reducing the cultivation cost which leads to augment profit margin.

Mere dependency on crop, horticulture and dairy components was not promising, to make agriculture more lucrative inclusion of improved small ruminants besides improved technology for existing livestock were integrated to improve income. Small ruminants (goat) have played a significant role in the agrarian economy. Inclusion of goat farming is found suitable for landless and marginal group of farmers for productivity enhancement and improving farmers' income. The targeted intervention is done in integrated manner which will provides risk coverage to farm house hold against fluctuations in prices and climatic conditions as farmer can tactically adjust the allocation of input (land, water) across and between enterprises accordingly and choose cropping systems and enterprise based on objectives like profitability, meeting household requirement etc.

After problems identification, a framework of feasible and viable interventions (low-cost) for selected farmers was implemented and evaluated derived from identified constraints for farm types as well as availability of resources at farm. No intervention was considered in existing farming system involving extreme and forceful change rather existing farming system refinement was carried out considering choice of the farmers, his risk bearing capacity, knowledge about the selected enterprise and available resource. The net income obtained after technological intervention was compared with benchmark income and outcome obtained in net monetary returns, rupees per year per household.

Table 4: Salient features of interventions for diversification in each module

Farming System	Diversification module	Interventions in existing	Interventions in diversification
Crop + Dairy +Horticulture	Crop	Application of balanced dose of NPK and foliar application micronutrients containing fertilizers. Seed treatment with bio fertilizers fallowed by soil application of bio pesticides. Introduction of pigeon pea as an intercrop soybean: pigeon pea, intercropping on place of sole cotton. to improve the profitability. Seed treatment with bio control agent fallowed by soil application, supply of pure seed and use of recommended seed rate. Imparting of knowledge and providing seeds	Imparting knowledge sucking pest management. In situ moisture conservation and water management and protective irrigation. Imparting knowledge on package of practices for soybean pigeon pea intercropping. Imparting knowledge on use of bio agents and low cost inputs. Imparting knowledge on use of pure seed and seed rates. Training on intercropping.
	Livestock	Supply forage crops seeds/saplings. Imparting of knowledge and providing kids of goat.	Imparting knowledge about silage and hay makings. Training on goat rearing.
	Horticulture	Supply of disease resistant planting material and phytophthora management kit. Intercropped with high valued vegetable crops.	Training on disease free nursery raising and disease free orange cultivation, phytophthora management. Training high valued vegetable crop production.
	Product Diversification	Making of mineral mixture from soybean, sorghum, and pigeon pea by-products at farm.Methods of Compost making. Introduction to of bio decomposers. Boundary plantation of horticulture plants.	Providing technical knowledge about mineralmineral mixture preparation. Training on different methods of compost compost making preparation Knowledge on management of dry land horticulture crops.

Crop + Horticulture+ Bullock pair	Crop	In situ moisture conservation. soybean cultivation on BBF. Application of balanced dose of NPK and foliar application micronutrients containing fertilizers. Imparting of knowledge and providing seeds of pigeon pea and sorghum. Seed treatment with bio control agent fallowed by soil application. Use of recommended seed rate, balanced nutrient supply and judicious use of irrigation. Imparting of knowledge and providing seeds. Introduction of linseed crop.	Imparting knowledge on. In situ moisture conservation and soybean cultivation on BBF. Imparting knowledge on sucking pest management. Training on intercropping multitier cropping Imparting knowledge on use of bio agents and low cost inputs. Imparting knowledge onuse of recommended seed rate, and judicious use of irrigation. Training on intercropping andpackage of practices of linseed crop.
	Livestock	Imparting of knowledge and providing green fodder saplings. Demonstration on moor grass preparation for off season. Imparting of knowledge and providing kids of goat.	Imparting knowledge on moor grass preparation. Training on goat rearing.
	Horticulture	Supply of disease resistant planting material and phytophthora management kit. Intercropped with high valued vegetable crops.	Training on disease free nursery raising and disease free orange cultivation, phytophthora management. Training high valued vegetable crop production.
	Product Diversification	Making of mineral mixture from soybean, sorghum, and pigeon pea by-products at farm. Methods of Compost making. Introduction of bio- decomposers. Boundary plantation. Kitchen gardening.	Providing technical knowledge about mineral mixture preparation. Training on different methods of compost making. Knowledge on management of dry land horticultural fruit crops. Technical knowledge about how to cultivate vegetable around the year.

Crop +Dairy	Crop	In situ moisture conservation,soybean cultivation on BBF. Application of balanced dose of NPK and foliar application micronutrients containing fertilizers. Imparting of knowledge and providing seeds of pigeon pea and sorghum. Seed treatment with bio control agent fallowed by soil application. Use of recommended seed rate, balanced nutrient supply and judicious use of irrigation. Introduction of linseed crop.	Imparting knowledge on. In situ moisture conservation and soybean cultivation on BBF. Imparting knowledge sucking pest management. Training on intercropping multitier cropping Imparting knowledge on use of bio agents and low cost inputs. Imparting knowledge on use of recommended seed rate, and judicious use of irrigation Training on intercropping package of practices of linseed.
	Livestock	Supply hybrid Napier slips. Imparting of knowledge and providing green fodder saplings. Demonstration on moor grass preparation for off season. Providing 2 kids of Usmanabadi breed goat.	Imparting knowledge about silage and hay making. Imparting knowledge on moor grass preparation Training on goat rearing.
	Product Diversification	Making of mineral mixture from soybean, sorghum, and pigeon pea by-products at farm. Methods of Compost making. Introduction to of bio decomposers. Boundary plantation. Kitchen gardening.	Providing technical knowledge about mineral mixture preparation. Training on different methods of compost preparation. Knowledge on management of dry land horticultural fruit crops. Technical knowledge about how to cultivate vegetable around the year.

Crop + Bullock pair	Crop	In situ moisture conservation. soybean cultivation on BBF. Application of balanced dose of NPK and foliar application micronutrients containing fertilizers. Imparting of knowledge and providing seeds of pigeon pea and sorghum. Seed treatment with bio control agent fallowed by soil application. Use of recommended seed rate, balanced nutrient supply and judicious use of irrigation. Introduction of linseed crop.	Imparting knowledge on. In situ moisture conservation and soybean cultivation on BBF. Imparting knowledge sucking pest management. Training on intercropping multitier cropping. Imparting knowledge on use of bio agents and low cost inputs. Imparting knowledge on. Use of recommended seed rate, and judicious use of irrigation. Training on intercroppingpackage of practices of linseed crop.
	Livestock	Supply hybrid Napier slips. Imparting of knowledge and providing green fodder saplings. Demonstration on moor grass preparation for off season. Providing 2 kids of Usmanabadi breed of goat.	Imparting knowledge about silage and hay makings. Imparting knowledge on moor grass preparation. Training on goat rearing.
	Product Diversification	Making of mineral mixture from soybean, sorghum, and pigeon pea by-products at farm. Methods of compost making. Introduction to of bio decomposers. Boundary plantation. Kitchen gardening.	Providingtechnicalknowledge about mineral mixture preparation. Training on different methods of compost preparation. Knowledge on management of dry land horticultural fruit crops. Technical knowledge about how to cultivate vegetable around the year.

Table 5: Net benefit due to interventions (2020-21) Rs/hh

Farming Systems	Interventional cost (Rs/hh)				Net income due to interventions (Rs/hh)						
	Cropping system	Livestock diversification	Other horticulture plantation	Product diversification	Total	Croppingsystem	Livestock diversification	Horticulture diversification	Product diversification	Total	Income over benchmark
Crop + Dairy +Horticulture	1800	800	0	450	3050	65469	51376	22854	950	140649	61078
Crop + Horticulture+ Bullock pair	1800	600	0	350	2750	88281	9260	18000	739	116280	30280
Crop +Dairy	1800	600	0	350	2750	88208	38111	-	875	127194	66194
Crop + Bullock pair	1800	800	0	450	3050	88281	7614	-	605	96500	26500

Table 6: Improvement of total net income (Rs/yr/hh) and natural resources

Farming Systems	Holding size (ha)	Net income (Rs/yr/hh)							
		Bench mark	After diversification (First year) 2017-18	After diversification (Second year) 2018-19	After diversification (Third year) 2019-20	After diversification (Fourth year) 2020-21	Average	NMR over Benchmark	%Increase over bench mark
Crop + Dairy +Horticulture	0.89	79571	135417	196287	209256	140649	170402	90831	53.30
Crop + Horticulture+ Bullock pair	0.88	86000	107470	162959	178092	116282	141201	55201	39.09
Crop +Dairy	0.83	61000	124733	173752	185147	127194	152707	91707	60.05
Crop + Bullock pair	0.77	70000	111004	138833	155856	96500	125548	55548	44.24

Results:

In present research the interventions consist of crop diversification, improved practices of agronomical and horticulture crops cultivation, better rearing practices for livestock and recycling of farm waste reported increase in income. Net benefit due to interventions showed that the overall net income was increased due to interventions in diversification perspective of all components of farming system. The interventions in existing farming system and diversification of different components of farming system were made on 0.20 ha area for crop module. During forth year (2020-21) the highest net return of Rs. 140649 per annum per house hold was recorded by Field crop +Dairy+ Horticulture farming system after intervention in existing and diversification in different component of farming system followed by Crop +Dairy Rs 127194 per annum per house hold and Crop + Horticulture+ Bullock pair Rs 116280 per annum per house hold. Whereas lowest net return was recorded by Field Crop + Bullock pair farming system i.e. Rs 96500 per annum per house hold same trend was also observed during last three years (2017-2020).

To proceed towards agricultural production farming systems economic viability and sustainability, adoption of these interventions for marginal and small farmers is essential. It is difficult to sustain the farm family from crops income throughout the year, so regular cash flow is required which is only possible when the crop is combined with judicious combination of enterprises feasible in the environmental conditions of the area (Singh *et al.,* 2012; Singh and Ravisankar, 2015).

Conclusion:

The results recommend that rather than blanket application for whole area, recommendations should be case specific to enhance farmer's income. Interventions provide ray of hope if planned through farm types approach identification to enhance the net monetary return, reduce risk, reduce cost of production and increase farm income in a holistic manner for reaping the benefits especially by resource constraint farmers.

It could be concluded that to boost marginal and small farmer's household profitability and productivity by way of integrated farming system approach and to improve through diversification approach, the nutritional along with food security and livelihood, Field crop +Dairy +Horticulture farming system during fourth year (2017-18 to 2020-21) recorded highest average net monetary return of Rs. 170402 per annum per house hold with 53.30% increase over benchmark followed by Crop +Dairy Rs 152707 net monetary return per annum per house hold

with 60.05% increase over benchmark and Crop + Horticulture+ Bullock pair Rs 141201 net monetary return per annum per house hold with 39.09 % increase over benchmark. Whereas lowest average net return was recorded by Field Crop + Bullock pair farming system i.e. Rs 125548 per annum per house hold with 44.24 % increase over benchmark after intervention in existing and diversification in different component of farming system .The results are in line with Shweta *et al.* (2020).

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HALOPRIMING: A KEY STRATEGY TO INCREASE FLAXSEED GERMINATION

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Abstract:

Flaxseeds are a good source of high-quality protein, alpha-linolenic acid, lignans, fibre, soluble and phenolic compounds, and are becoming more popular as a functional food ingredient. Seed dormancy and reduced early crop growth are amongst yield limiting factors of Flaxseed. In many crop species, seed priming has the potential to become a fundamental tool for promoting faster and more uniform seed germination and plant growth. In many vegetables and crop plants, halopriming with $CaCl_2$, $MgCl_2$, NaCl, $NaNO_3$, and KNO_3 has been used to improve germination, minimise seedling emergence time, improve stand establishment, and increase yield. It is concluded that germination improvement in salt-primed seeds could be related to metabolic repair processes that accumulate throughout priming treatments.

Introduction:

Flaxseed *Linum usitatissimum* (Linn.) often known as linseed or Alsi is a medicinal plant species that belongs to the family Linaceae. It is a shallow-rooted annual herbaceous major crop grown in both the tropical and temperate regions of the world. A seed coat or true hull a thin endosperm, two embryos, and an embryo axis make up the entire flaxseed, which is flat and oval with pointy tips (Morris, 2007). Flaxseed is one of the oldest agricultural plants widely grown in India, primarily in Madhya Pradesh, Uttar Pradesh, Maharashtra, Bihar, Rajasthan, for its oil which is high in fatty acids and fiber variants (Millam *et al.*, 2005). India and Canada are the

world's largest flax producers in the world. The total world linseed production is approx. 2.05 million tones, with productivity of 82.6 kilograms per hectare. In India, it covers 296 thousand hectares with a production of 1.55 lakh tones and productivity of 408 kg per hectare. With 0.15 million tones of total flaxseed production, India is ranked fourth (Oomah *et al.,* 1998). Brown flaxseeds and yellow or golden flaxseeds are the two most common types. Both have a comparable nutritional profile and contain the same quantity of short-chain omega-3 fatty acids. Arginine, glutamic acid/glutamine, aromatic amino acids, and branched-chain amino acids (leucine and valine) are abundant in whole flaxseed, flaxseed meals, and isolated proteins.

Its color varies from dark brown to yellow (Oomah *et al.,* 1996). Flax has up to 800 times the amount of lignans as other plant meals (Mazur *et al.,* 1996). Almost every part of the linseed plant is used for a variety of applications. Flax fiber is a biodegradable and natural composite with outstanding mechanical qualities and a low density (Singh *et al.,* 2011). Flax fiber is glossy, silky, and flexible, with bundles of fiber that resemble blonde hair, so the name "flaxen." It's more durable than cotton fiber, but it's less elastic (Singh *et al.,* 2011). Whole flaxseeds, roasted, milled, and flax oil are all edible forms of flax accessible in the food market. Oil, protein, dietary fiber, soluble polysaccharides, lignans, phenolic compounds, vitamins (A, C, F, and E), and minerals (P, Mg, K, Na, Fe, Cu, Mn, and Zn) are all found in flaxseed (Bhatty *et al.,* 1995).

Importance of Flaxseed

Flaxseed has been used in human diets for thousands of years as a beneficial nutritionally rich grain and traditional medicine, and thus more recently as just a source of nutraceuticals and identified as a functional food, whose medical benefits are generally attributed to high concentrations of linolenic acids (Omega 3) and linens, as well as significant amounts of dietary fiber, including soluble and insoluble fibers (Anonymous, 2003). Commercially, every component of the flaxseed plant is used, either directly or after processing.

Nutritional Importance

The human nutrition industry is the most significant for flaxseed because it is a good source of alpha-linolenic acid, high-quality protein, lignans, fiber, soluble, and phenolic compounds, and is emerging as a popular functional food ingredient. Flaxseed has a protein level ranging from 20 to 30 percent, with about 80 % globulins and 20 % gluten (Hall *et al.,* 2006). It has a total nitrogen concentration of 3.25 g/100g of seed (Gopalan *et al.,* 2007). Many vitamins and minerals, such as magnesium, calcium, and phosphorus, are found in flaxseed. Flaxseed's main functional ingredient is alpha-linolenic acid. It can be consumed in a variety of forms, such as oil or in baked goods. It is one of six neutraceuticals that supply dietary fiber and protein (Oomah *et al.,* 1996). Flaxseed is high in Omega-3 fatty acids, Alpha-linolenic acid, short-chain polyunsaturated fatty acids, antioxidants, proteins, soluble and insoluble fibers, and other nutrients (Han *et al.,* 2018). Flaxseed oil has been used in baked goods, milk, and dairy products.

Flaxseed has a crisp texture and a nutty flavor (Rubilar *et al.,* 2010). Its popularity is expanding because of its health benefits, which include lower risk of cardiovascular disease, lower risk of cancer, especially of the breast and prostate glands, laxative impact, anti-inflammatory action, and osteoporosis and relief of menopausal symptoms (Singh *et al.,* 2011).

Medicinal Importance

Alpha-linolenic acid and the antioxidant of flaxseed are good for brain development, lowering blood cholesterol, and platelet aggregation (Oomah *et al.,* 1995). Flaxseed oil may have health benefits such as lowering the risk of cardiovascular disease, diabetes, arthritis, and cancer. People are still uninformed of the exact components, therapeutic, nutritional, and other health benefits of flaxseeds, despite multiple clinical pieces of evidence. Flaxseed is good for blood lipids, baby brain development, and cardiovascular disease prevention. While whole flaxseeds are chemically stable, ground flaxseed can go rancid in as little as one week at room temperature, despite contrary evidence. Flaxseed is gaining traction as a functional food in the global food system. Functional foods are foods or dietary ingredients that have the potential to give physiological advantages and aid in the prevention and treatment of diseases (Al-Okbi, 2005). Flaxseed gas has sparked renewed interest in the field of nutrition and illness research in the last two years, owing to the potential health advantages linked with certain of its biologically active components. Flax lignans have shown promising effects in reducing the growth of cancerous tumors, especially hormone-sensitive ones such as those of the breast, endometrium, and prostate (Tham *et al.,* 1998).

Industrial Importance

Commercially, every portion of the linseed plant is used, either directly or after processing. The shell produces high-quality fiber with low density, while the seed produces oil rich in omega-3 fatty acids, digestible proteins, and linens; it is also used to make paints, varnishes, oilcloths, soaps, printing inks, and a variety of other items. Flaxseed is mostly used in the manufacture of textiles (linen) and papers until the 1990s, while flaxseed oil and its sub-products are employed in the formulation of animal feed (Singh *et al.,* 2011). Flax fiber is derived from the skin of the plant's stem. About 25% of the flax plant is the seed, while the other 75% is stem and leaves (Singh *et al.,* 2011).

Flaxseed Dormancy and Seed Priming

India is an agricultural country, with more than 80% of the rural people relying on agriculture and related activities to generate income. A sufficient crop yield is required to meet the demands of the Indian population. However, several limits on seed germination and agricultural output exist as a result of urbanization, pollution, biotic and abiotic stressors, lack of micronutrient availability, and so on (Singh *et al.,* 2011). Flaxseed is dormant at maturity, which presents a challenge for formers, and seed producers, particularly when the germination

percentage of a seed lot needs to be assessed within a few days of harvest. Farmers that start seed production immediately after harvesting would benefit greatly from knowing how to break seed dormancy. Breaking dormancy and inducing seeds for germination are known as seed priming which comprises several processes. Despite the fact that strategies for breaking dormancy have been presented for a variety of crops. Seed priming is a method of controlled hydration in which seeds are immersed in water or a low osmotic way to solve until germination-related metabolic activities begin although radical emergence does not occur (Harris *et al.,* 1999).

Seed priming is a variety of procedures before planting; it may include halopriming, osmo-priming, hydro-priming, and hardening. All of these approaches start metabolic activity in prepped seeds before planting and terminate them before radical emergence. Priming promotes biological activities and seed vigor during germination in the soil begin, although this. The germination and development process in the field is aided by pre-sowing treatments like priming techniques with various salts and water. Seed priming at a faster rate allows seeds to germinate and emerge even in adverse agro-climatic conditions, enhances uniformity for better harvesting efficiency, and boosts vigor for faster and stronger plants growth, all of which increase crop yield (Sukanya *et al.,* 2018). The primary goal of seed priming should be to identify the effect of priming on germination rate and to determine the mechanism of seed activation. Seed priming could be used as a way to boost the viability of seeds and help them perform better in high saline environments. Seed priming has a key role in improving crop yields in wheat, barley, upland rice, maize, sorghum, pearl millet, and chickpea, with increases of 37%, 40%, 70%, 22%, 31%, 56%, 50% and 20.6% in wheat, barley, upland rice, maize, sorghum, pearl millet, and chickpea, respectively (Harris *et al.,* 2005). The seed germination stage and primary growth phase of the seedling is one of the most important stages in most plants, as it is a response to environmental stress. In this chapter we have focused on impact of halopriming generally which is done with a variety of salts such as $CaCl_2$, $MgCl_2$, NaCl, $NaNO_3$, and KNO_3. Halopriming is a most accepted procedure in which seeds are watered to a specific level to allow for pre-germination metabolic activities (Halmer, 2004). Seeds are exposed to a controlled degree of imbibition during the process due to excess water entering the seed, leading to the formation of reactive oxygen species (ROS) and oxidative stress-induced to cellular components such as proteins, lipid membranes, and nucleic acids. Halopriming decreases ROS generation and so protects the cell from oxidative harm by delaying water access to the seed.

Seed treatment or priming technology is in the early stages of growing faster among resource-constrained farmers. Low-cost techniques can be boosted by appropriate policy intervention, allowing them to be implemented on a larger scale in developing countries and maximizing the benefits of sustainable food production systems. Primed seeds have a high vigor and germination rate, which aids seedling growth and crop stand establishment in stressful

situations. Many countries, including China, Pakistan, and Australia, have used the seed priming approach, and over a thousand trials have been done to assess the effectiveness of priming a range of crops. However, while choosing a halopriming solution, the morphology of the seed should be taken into account, as the partially permeable outer layers of several seeds are extremely sensitive, affecting the priming performance (Pill, 1995). The occurrence of amorphous tissue between the pericarp and seed coat restricts solute exchange, limiting the amount of priming substance and water that may enter the seed (Zhou *et al.,* 2013). If the solution is not adequately selected according to the permeability of the seed, the internal osmotic equilibrium and nutrient balance of the seed will be disrupted due to the entry of ions discharged from the priming solution (salts) (Bradford, 1995). So here in the chapter, the role of various salts such as $CaCl_2$, $NaNO_3$, $MgCl_2$, NaCl, and KNO_3 are described in detail to break the flaxseed dormancy in this chapter.

Halopriming: Some Case Studies

Many agronomic crops and vegetables have benefited from seed priming, which has resulted in faster and more uniform germination and seedling emergence. It can boost vigor in a variety of situations, including low/high temperatures, limited water supply, and salt (Tham *et al.,* 1998). Several case studies are discussed below in table 1.

- Armin *et al.,* (2010) suggested that salt priming improved germinability of watermelon seeds at sub-optimal temperatures. Priming in 2-3% solutions of KNO_3 for 1–5 days significantly increased the germination rate, and synchronization percentage. The enhancement of these effects was greatest at 10-11°C for the watermelon variety “Persia 202” and at 15–16°C for ‘Noy Yizre'el’. Dehydration of seeds following treatments resulted in partial reversion of the positive effects of priming if incubation took place at the lower temperatures.
- Shim *et al.* (2008) reported that priming with KNO_3 solution for 48 to 72 hours in Paspalum improved germination percentage and uniformity. The increased duration of priming with KNO_3 was positively correlated with an improved germination percentage. The effect of increasing concentration was the most apparent at a constant temperature (30^oC) regime with the treatment of 0.2% KNO_3 priming. Germination percentage was increased from 34.3% to 68.0% two weeks after imbibitions as the priming duration was increased from 24 to 72 hours. Therefore, priming with 0.2% or 0.5% solution of KNO_3 for 72 hours is a recommended method that can be practically applied for increasing germination of Peplum under an alternating temperature condition. Halopriming is more technically and financially feasible than hydro-priming since haloprimed seed produces faster germination at a lower cost and with better conserving water, making it a viable option for farmers (Moradi and Younesi, 2009).

- Singh *et al.* (2011) studied the effects of KNO_3 on germination of two and five year's old eggplant seeds. They showed that KNO_3 significantly increased germination percentage and germination rate, seedling length, seedling dry matter in comparison with control.
- Early crop growth and yield performance of flaxseed were evaluated in the field using seed priming treatments of $CaCl_2$ 2.2%, and 50 mmol L-1 salicylic acid. $CaCl_2$ priming shortened emergence time and resulted in the highest seedling fresh and dry weights, as well as chlorophyll content. $CaCl_2$ based priming increased seed weight (9.30%), seed yields (39.49%) and oil contents (13.39 %). Positive relationship between emergence and seed yield, seedling vigor traits, 100-seed weight, with maturity time, were found. The study concluded that seed priming with $CaCl_2$ can play significant role to improve early crop growth and seed yields of linola (Rehman *et al.,* 2014).
- Singh *et al.* (2014) used cowpea to test halopriming; they employed KNO_3 as a priming solution, with three different time intervals (6, 8, and 10 h). Their findings revealed that halopriming was significantly better than unprimed programs in terms of all germination and growth indices.
- Kubala *et al.* (2015) detected improvements in the germination and seedling growth of *Brassica napus* primed with polyethylene glycol (-1.2 MPa) under salinity stress (NaCl: 100 mM). According to the study, the improvement of germination performance and seedling establishment in haloprimed treatments was due to increased P5CSA gene expression and decreased PDH gene expression associated with proline accumulation and H_2O_2 concentrations.
- Tabassum *et al.* (2018) studied halopriming (with 1.5% $CaCl_2$ solution) in the production of wheat (*Triticum aestivum* L.) under drought stress. The results revealed promising crop plant enhancement in comparison with hydropriming treatments regarding osmolyte accumulation, tissue water, leaf area, and yield. The positive plant responses were better with halopriming due to a considerable decrease in lipid peroxidation and acquired drought tolerance.
- In addition to previous reports, we have also demonstrated halopriming using different concentrations (0.5%, 1%, 1.5%, 2%) of various salts like NaCl, KNO_3, and $CaCl_2$ for different priming hour's viz. 6, 12, 18, and 24 hours at room temperature and recorded enhanced germination rate with increasing concentrations of priming solutions and treatment hours in flaxseed (Fig.1).

Table1. Plant wise detail of some salt compounds used in priming and their activity

Sr. No.	Plant	Compound	Priming duration	Activity	Reference
1.	Hot pepper	NaCl	24-48H	Significant increase in germination percentage	Khan *et al.,* 2009
2.	Maize (*Zea mays* L.)	NaCl	3-12 days	The percentage of water intake was greater	Tian *et al.,* 2014
3.	Safflower	NaCl	12H	Primed seeds were greater by about 15-30% than that of plants derived from non primed seeds	Aymen *et al.,* 2014
4.	Common Bean	NaCl	12H	Enhanced germination and seedling performance of common bean	Tufa and Nego, 2016
5.	*Oryza sativa* L.	NaCl	12H	Showed high positive impacts on germination indexes and seedling establishment	Sen and Puthur, 2020
6.	*Oryza sativa* L. (var. Jaya)	ZnO Nanoparticle (25 ppm)	24 H	Improved seed germination and vigor	Aishwarya *et al.,* 2020
7.	Pepper	$CaCl_2$	24-36H	Germination higher in prime seed	Aloui *et al.,* 2014
8.	Linola	$CaCl_2$	24-48H	Improvement in seed vigor	Rehman *et al.,* 2014
9.	Maize (*Zea mays*)	$CaCl_2$	12H	Increase the germination	Gebreegziabher and Chala 2017
10.	Barley	$CaCl_2$	24H	Improve drought tolerance is spring barley	Kaczmarek *et al.,* 2017
11.	Chickpea	$CaCl_2$	8H	Higher physiological and metabolic activities and increased higher plants.	Kumeera *et al.,* 2018

12.	*Salvia miltiorrhiza* Bunge	$CaCl_2$	14 days	Germination and early seedling growth	Lugao *et al.*, 2019
13.	*Faba bean*	$CaCl_2$	7days	Improved the photosynthesis performance	Nouairi *et al.*, 2019
14.	Eggplant seeds	KNO_3	1-6 days	Significantly influenced germination percentage and germination rate	Demir *et al.*, 1994
15.	Paspalum	KNO_3	48-78H	Improved germination percentage	Shim *et al.*, 2008
16.	Tomato	KNO_3	144H	Improved germination rate	Saifi *et al.*, 2010
17.	Canola	KNO_3	24-48H	Seed priming increased the final germination percentage	Farzin *et al.*, 2012
18.	Dill	KNO_3	24H	Germination was significantly higher for non-primed seeds	Espanany *et al.*, 2016
19.	*Brassica rapa* subsp. pekinensis cv. Lainong 50/Chinese cabbage	KNO_3		Increased germination traits at all levels of drought stress as compared to the unprimed treatments	Yan, 2015
20.	*Triticum aestivum* L. var. Chamran/Wheat	K_2O_3Si (0, 1, 1.5 and 2 mM for 6 h)		Enhanced the vitality of seeds, and improved the development of seedlings	Feghhenabi *et al.*, 2020

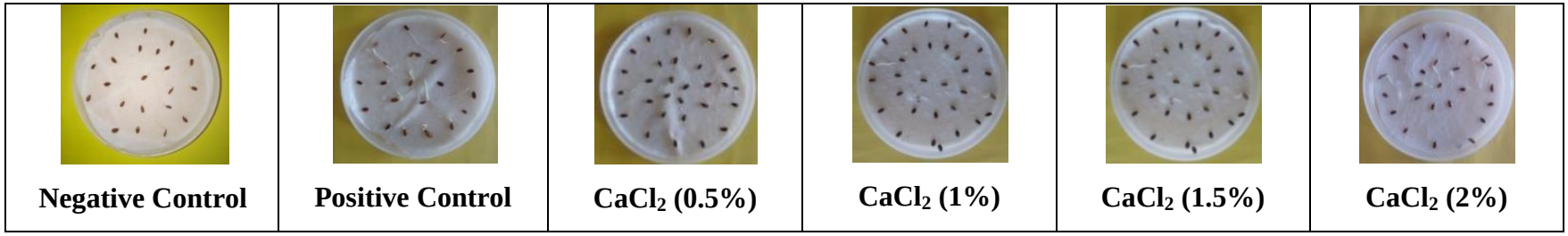

Figure 1: Effect of different concentrations of $CaCl_2$ and treatment durations on percentage seed germination of flaxseed

Conclusion:

Priming is advantageous to a variety of crop species, and halopriming has been implemented to promote seedling germination, seedling emergence time, and yield. According to a literature review and our investigation different concentrations of salts have been shown to increase seed germination rate and percentage of seed growth, which could be due to its ability to influence membrane permeability, which leads to the activation of enzymes responsible for protein synthesis and carbohydrates metabolism. Additionally, germination improvement in salt-primed seeds could be related to metabolic repair processes that accumulate throughout priming treatments. Salt priming also boosted the performance of flaxseeds in our research. Seedling vigor is due to improved starch metabolism, which causes early emergence and strong seedling growth (Farooq *et al.,* 2011). When starch reserve mobilization and radical protrusion are occurring, Ca2+ may be involved in membrane repairs and enzyme activation, resulting in improved performance (Afzal *et al.,* 2008). Therefore as per our investigation and earlier observations, as a result, we may conclude that the salts can be employed to break seed dormancy and improve seed germination. It's a simple, low-cost, low-risk intervention that can help farmers improve their livelihoods by speeding up crop emergence, speeding up crop development, shortening crop duration, and enhancing yield and productivity.

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TECHNOLOGY BENEFITS IN CROP PRODUCTION

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Abstract:

Food Science is basically study of physical, chemical and biological aspect of the food. It also includes the microbiological aspect which can specify the causes of deterioration of the food. Food science also includes the underlying concept of food processing. In todays scenario in this pandemic situation all the food scientist, food technologist, Microbiologist are busy in study of food safety, nutrition and maximum availability of the food to the society. Now if we focus on the broad sense of food technology which is the application of food science for increasing the quantity of food, making safe food available to the society by proper selection of food, adopting different methods of preservation of food, Proper packaging of food to increase the shelf life of food and finally distributing safe food to the mankind. Food technology also make use of related fields like Biotechnology and Genetic engineering for increasing the crop yield, Microbiology and Food safety management systems for Preservation and safety of food.

Introduction:

India is country with many challenges with respect to farming system like Climate change, Labour shortage, soil degradation, increasingly extreme climate. But still we need to increase the food production by 60% by 2050, to feed the total global population of 9 billion. We have to swith over to the technology side to overcome the issue of food production.

If we try to enlighten on traditional system losses caused by different pests are in billions. Use of agrochemicals now a day is great risk. Agrochemicals are toxic and there exposure to environment is have the detrimental effect on living system. In order to cope up with the present scenario of pandemic food scientist, food technologist, Microbiologist are busy in study of food safety, nutrition and maximum availability of the food to the society.

To increase the crop production technologist are working for increase in crop yield we can mix the genes of different organisms we can go for genetically modified food FLAVR

SAVR Tomato is first genetically modified food approved safe by FDA. Similarly different Technologies can be used to increase the crop production.

In developing countries it is imperative to increase the crop production there are various problems which the world is facing out of which main is agriculture land is shrinking and therefore the challenge before the technologist is to produce more food from less land. Increase in food production in many folds can be achieved by Technological interventions.

Technology:

Technology can be defined as the application of organized and scientific knowledge to solve Problems. In agriculture, If we are able to increased crop production than it will lead to the success of a technology. To start with the most vital and critical agricultural input is seed which needs to be focused.

It is estimated that all other factors remaining the same the use of quality seed of high yielding varieties increases crop yield by 15-20% (P K Agrawal).This can be increased to 30-60% in certain conditions.

Increase in productivity:

Crop yield can be increased using various technologies

1) Hybrid Technology

2) Biotechnology particularly CRY genes in cotton

1) Hybrid technology:

Among the crops Rice is an important crop of the world. Hybridization of rice is a significant achievement in production of crop and will lead to successful development. The hybridization of rice was initiated in china in 1970s, but now now most of the rice growing countries are adopting the technology which is leading to high yield near about 20 % crop yield is increased by this technology.

2) **CRY genes in cotton:**

Increase in agriculture production has urged the developing cultivators for high degree of resistance to pest. Many insect species, including cotton bollworm, *Helicoverpa armigera* (Hubner), have developed high levels of resistance to conventional insecticides. To cope up with the above problem it is the need for biotechnologist to achieve the control over insect pest. There for encoding d-endotoxins from *Bacillus thuringiensis* (BT) have been deployed in a number of crops including cotton. Due to use of genetically modified crop the cultivation is increased from

1.97 million ha in 1996 to 160 million ha in 2011 (James, 2011) Cotton cultivars with BT genes for resistance to cotton bollworm, *H. armigera* have resulted in a significant decrease in number of insecticide sprays applied for bollworm control in cotton, and increased cottonseed yield (Sharma *et al.,* 2004; Sharma and Pampapathy, 2006; Dhillon *et al.,* 2012). Though there are promising results of Genetically modified crop but still thee concern related to their impact on non target organism has to be studied

Increase in productivity by new technologies:

Hydroponics and aeroponics:

Nowadays farmers are facing many problems and challenges which include drastic changes in the environmental conditions, labuor problems, Soil degradation etc. If we refer to global population it is about 9 billions and there is need to increase the food production upto 2050 by adopting new technologies. In todays era we need a agricultural revolution which will lead to compete the traditional techniques

Due to use of heavy machineries and different agricultural techniques there is great effect on soil and now the peoples are moving to the new system of farming without soil that is Hydroponics where the nutrient solution is prepared and plant roots are suspended in it which leads to plant growth. At the same time some companies are working in different manner in which is caller aeroponics which means the nutrient media is prepared and sprayed on the plant root and plants are grown. These types of technologies does not require fertilizers for its growth and also the amount of water which is required for growth is also very less and plants grow more rapidly. These techniques like hydroponics and aeroponics require some skill persons but could help a lot to communities affected with disasters.

Use of fungi:

Another such revolution in food science to increase the food production is use of the symbiotic association between plant and the fungi arbuscular mycorrhizal fungi which provides important nutrients for plants like nitrogen and phosphorous in exchange of carbon. But at the same time this research has to be work out by the researchers as arbuscular mycorrhizal fungi has some times have adverse effect on the plant by development of resistant genes and it have parasitic effect on the plant

Another approach to increase resilience is use of Genetically Modified Organism. Organism of our interest can be modifying and editing genes which CRISPR-Cas9 method. In

this method target specific genes can be change by changing the pase pair of DNA. By this method disease resistance or drought tolerance can be increased.

MycoNourish Limited is pioneering the use of customised *Arbuscular Mycorrhizal* Fungi strains to suit individual crops and solve specifi c issues, starting with strawberry and tomato' (Photo credit: Dr Peter Orrell)

Use of technology: To overcome shortage of water

The most important problem nowadays is the shortage of water. This problem is mainly suffered by the farmers and mainly in the summer season which affects the production of crop. There is load shedding for more than 14-18hrs and time is not fixed at what time power will be available and farmer cannot decide when to do the work. Sometimes electricity is present in night and it is necessary for the farmer to start the water pump for irrigation at night but there is a chance that he may be bitten by an animal, like snake. Also sometimes, the soil gets very dry due to lack of sufficient water, which causes the seed to die.

So a device id designed by the engineers that will do all the activities automatically as well as remotely with no human efforts. There objective is to help the farmer produce the best quality of crop and to save the resources (Water and Electricity). They have used the different sensors like

1. Wireless Moisture sensors will sense the amount of water content in the soil.
2. User will just send an SMS with the type of crop and the season, so the irrigation process would be done automatically.
3. Temperature and humidity sensor are used which will also help to decide whether to turn ON/OFF the motor.

3. User can also operate motor by sending an SMS ON/OFF.
4. They have used intrusion sensor which will be placed at the boundaries of the field like a fence and if it breaks user will get SMS that animal has entered into field.
6. User will get SMS if electricity is not available in field.

Making use of such types of product, travelling cost of user as well as human effort will get reduced. User has to wait until the field is properly watered, which makes them to stop doing other activities; this problem is also solved using these type of products. Also Human efforts are reduced, Crops will get proper amount of water and Resources would be saved.

Dairy farm:

Every thing in dairy farm is fully automated Robots can be used for milking of cows as soon as the cows are ready for milking the scanner provides the information to Robot for milking. The walls of the farm automatically maintain the temperature required, and pleasant conditions are maintained for the animals.

Advantage of using technology:

1. Increased Production
2. More friendly to environment
3. Socio-economic benefit to farmers particularly small scale farmers
4. Mitigating some of the challenges associated with climate change

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EFFECT OF DIFFERENT ORGANIC MEDIA ON GROWTH PARAMETERS OF TOMATO SEEDLINGS

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Abstract:

Tomato (*Solanum lycopersicum*) is one of the most important protective food because of its special nutritive value, belongs to the Solanaceae family. It is one of the most versatile vegetable with wide usage in Indian culinary tradition. Potting medium is one of the important factors that can influence the growth and vigour of the seedlings to a greater extent. Seeds grown in a good medium can ensure better establishment and growth. A cheap and successful medium will enable the farmers and nursery men to produce seedlings of vegetables for extensive and commercial cultivation. With this background, the present investigation was carried out to study the effect of different organic media on growth of tomato seedlings. The experiment comprises of using different media *viz*., garden soil, vermicompost, saw dust, sand and farmyard manure. The experiment was carried out in Completely Randomized Design with six treatments and three replications. Tomato variety CO_1 was used for the experiment. The observations on days taken for germination, germination percentage, shoot length, root length and number of leaves was recorded. The result revealed that among the different media used, the media combination of Garden soil + FYM + vermicompost (1:1:1) could be recommended as the best media for the production of tomato seedlings.

Key words: Tomato, media, FYM, vermicompost, sand and saw dust

Introduction:

Tomato (*Solanum lycopersicum*) is one of the most important vegetable crops of India.Tomato was originated from Peruvian and Mexican region. It is an importantvegetable crop grown in almost all parts of tropical and subtropical regions of the world. It belongs to the Solanaceae family. The nutritive value of tomato is excellent, tomatoes are rich in vitamins A, C and K. Tomato is a great source of fibre and potassium.Tomato contains lycopene and beta carotene pigments. It is used in preserved products like ketch-up, sauce, chutney, soup, paste and puree. India is the second largest producer of tomato next to China. Area and production of tomato for India are about 3,50,000 hectares and 53,00,000 tonnes respectively. The average productivity of tomato in India is 158qha^{-1}.

Potting medium is one of the important factors that can influence the growth and vigour of the seedlings to a greater extent, seeds grown in a good medium can ensure better establishment and growth when planted out in the main field. A cheap and successful medium will enable the farmers and nursery men to produce good seedlings of vegetables for extensive and commercial cultivation. The traditional method of raised bed nurseries has certain limitations such as uneven distribution of seed material resulting in poor or uneven germination and growth of the seedlings. In this context, specialized nursery techniques including use of appropriate growing media in poly bags have come to play a major role towards production of good and vigorous seedlings. With this above background in view, the present investigation was carried out to study the effect of different organic media on growth of tomato seedlings.

Materials and Methods:

The experiment was carried out at the Orchard, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Cuddalore District Tamil Nadu, India during May to August 2019. The objective of the study was to find out the effect of different organic media on growth parameters of tomato seedlings. Tomato variety CO_1 was used for the experiment. CO_1variety plants are semi determinate; fruits are round without any grooves and crimson red in colour. It yields about 25 t of fruits ha^{-1} in crop duration of 135 days. The experiment consists of six treatments with three replications in Completely Randomized Design. The experiment was conducted in poly bag of 20 x 15 cm size. The seeds were treated with *Azospirillium* at 200 g per kg of seeds. The seeds were shade dried for half an hour and the pre-treated seeds were sown at three seeds per poly bag. After germination of seeds, one seedling per poly bag was maintained. The seedlings were irrigated regularly and weeds were removed as and when necessary. Observations on growth parameters like days taken for germination, germination percentage, shoot length, number of leaves and root length were recorded. The treatments comprised of using different mixtures of organic inputs as media such as T_1- Garden soil + vermicompost (1:1), T_2- Garden soil + sand (1:1), T_3-Garden soil + saw dust (1:1), T_4-Garden soil + FYM (1:1), T_5 - Garden soil +FYM + vermicompost (1:1:1) and T_6-Garden soil only (control).

Results and Discussion

The growth characters viz., days taken for germination, germination percentage, shoot length, number of leaves and root length were significantly influenced by the different types of media used (Table 1).

Among the treatments tested, it was observed that T_5 [Garden soil + FYM + Vermicompost (1:1:1)] recorded the earliest days taken for germination (7.95 days) followed by

T_1 (8.87 days) and the days taken for germination (12.93 days) was delayed in the control (T_6). The reason could be due to the usage of organic media which improves the soil physical conditions of media and promotes microbial and soil organic matter, which in turn produces organic acids, which inhibits particularly IAA oxidase enzyme, resulted in enhancing the promotive effect on plant growth (Leopold, 1974).

Table 1: Effect of different media on growth of tomato seedlings

Media	Days taken for germination	Germination percentage (%)	Shoot length (cm)	Number of leaves	Root length (cm)
T_1- GS+ VC (1:1)	8.87	78.42	18.16	23.86	5.33
T_2- GS+ S (1:1)	10.74	70.02	14.60	16.30	4.28
T_3- GS + SD (1:1)	11.80	65.50	12.81	13.26	3.63
T_4- GS + FYM (1:1)	9.78	74.10	16.63	20.33	4.81
T_5- GS + FYM+ VC (1:1)	7.95	83.00	20.13	25.93	6.01
T_6- GS alone (Control)	12.93	60.33	10.16	13.26	3.20
S.Ed	**0.42**	**2.01**	**0.57**	**0.83**	**0.20**
CD	**0.88**	**4.20**	**1.18**	**1.73**	**0.45**

GS-Garden soil, VC-Vermicompost, S-Sand, SD-Saw dust, FYM-Farmyard manure

Among the media T_5 [Garden soil + FYM + Vermicompost (1:1:1)] recorded the highest germination percentage (83.00 %) followed T_1 [Garden soil + Vermicompost (1:1)] with 78.42 per cent, whereas least germination percentage (60.33%) was observed in T_6 (control). Vermicompost is having bioactive principles considered to be beneficial for root growth, root initiation, germination and growth of the plant and also having a balanced composition of nutrients. Organic matter present in the vermicompost may also improve nutrient availability and improve phosphorus absorption. All these factors are favourable for seed germination and ultimately, increase seed germination percentage, speed of emergence and seedling vigour. (Karama and Manwan, 1990)

The maximum shoot length (20.13 cm) was noticed in T_5 [Garden soil + FYM + Vermicompost (1:1:1)] which was followed by T_1 [Garden soil +Vermicompost (1:1)] which recorded 18.16 cm. The least value of 10.16 cm was recorded in T_6 (control). Vermicompost present in the media improved the soil pH, increased the availability of plant nutrients, enhanced the water holding capacity of soil and improved the soil aeration and microbial activity of the soil which in turn increased the shoot length (Yogeswar *et al*., 2008).

The number of leaves per plant was found to be the highest (25.93) in the treatment T_5 [Garden soil + FYM + Vermicompost (1:1:1)]. It was followed by the treatment T_1 [Garden soil + Vermicompost (1:1)] recorded 23.86 number of leaves. The lowest number of leaves (13.26) was recorded in the T_6 (control). The maximum vegetative growth obtained may be attributed to the role of organic manures and biofertilizers in better mobilization of plant nutrients that led to vigorous growth of leaves in these treatments. The results are similar to the findings of Charankumar (2009)

The treatment T_5 [Garden soil + FYM + Vermicompost (1:1:1)] registered the highest root length of 6.01 cm. This was followed by the treatment T_1 [Garden soil + Vermicompost (1:1)] which was recorded the root length of 5.33 cm. The least root length of 3.20 cm was recorded in the T_6 (control). The reason for the increase in the growth parameters was due to the beneficial effects of organic ameliorants in improving soil structure thereby facilitating proper drainage and aeration are well established in wide range of crops. Moreover, due to higher nutrient status of FYM and its solubilization effect of plant nutrients, the plants are able to absorb more nutrients as evident from higher nutrient uptake facilitated by deeper penetration of roots and higher nutrient extraction (Subbiah *et al*., 1982).

Conclusion

Based on the present investigation, the result revealed that among the different media used, the media combination of Garden soil + FYM + vermicompost (1:1:1) recorded maximum growth parameters of tomato seedlings, so it could be recommended as the best media for the production of tomato seedlings.

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ETHNO-VETERINARY PRACTICES OF SOME LOCAL PLANTS FOR LIVESTOCK

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Abstract:

The present article explored, some common locally used ethnoveterinary plants from Maharashtra state. Ethno Veterinary Medicine is an age-old traditional practice for the treatment of livestock. They comprise belief, knowledge, practices, and skills about healthcare and the management of livestock. Particularly in Maharashtra number of people depended on farming along with livestock including cattle, Bufelow, sheep, goat, poultry, etc. but due to global warming, pollution, number of diseases affects the livestock. Nowadays hospitals are available everywhere but in some areas such as villages, tribes, remote areas there are no such facilities available. So use of local plants as remedy for diseases like enteritis, maggot wound, fracture, tympani, black quarter, mouth ulcer, foot infection is a common practice. The present article comprises some ethnoveterinary practices from different parts of Maharashtra particularly tribe areas by visiting and collecting all information about plants. Some of them formulated along with the botanical name, local name, families, and their uses.

Keywords: Medicinal uses, ethnoveterinary plants, Maharashtra state, etc.

Introduction:

India has one of the sophisticated medical cultures with a tradition of over 5000 years. Ethno-Veterinary Medicine (EVM) refers to traditional knowledge, skills, methods, practices, and folk beliefs of the people about health care, healthful husbandry, and production of livestock (Mc Corkle, 1986). It includes information on diseases and how to control them, as well as remedies and clinical methods for treatment and prevention, management, feeding, and breeding plans, spiritual aspects, and human resources who hold the knowledge and expertise. In Maharashtra, in agriculture activity bulls were used, for milk production goat, cow, buffaloes were used.

The use of plant-based veterinary medicine is increasing in recent times, because of costly treatment. Several ethnoveterinary studies have been conducted in many parts of India as well as Maharashtra state.Several workers in India have recorded ethnoveterinary practices in

several regions and states (Patil and Patil 2001; Mokat and Doekule, 2004; Harsha *et al.*, 2005; Rothe, 2005; Jain and Kadel, 2006; Deshmukh *et al.*, 2011; Patil and Patil, 2013; Gadpayale *et al.*, 2014; Patil and Deshmukh, 2015; Somkuwar and Chaudhary, 2015)

Methodology:

According to the literature, practically all employees used the approach of documentation, which included surveying and interviewing specialists as well as dairymen using a set questionnaire and observing the animals throughout treatment. The questionnaire includes questions about animal ailments, their causative agents, treatment procedures involving various plant parts, and drug administration methods. Documentation of information carried out by visiting various tribal areas. Collected plants are identified by using some local floras and literature.

Ethnoveterinary practices.

Ethnoveterinary medicine is the study of people's traditional beliefs and trust in the use of plants and plant products to treat animals. This traditional knowledge is valuable and limited to a few individuals, and it must be documented and implemented in society. Plants, their parts, and products, when used in treatment, have numerous advantages, including being inexpensive, readily available, and having no negative side effects.

Following are some plants species which are used in ethno veterinary practices:

Table 1: Details of some plant species along with their family and medicinal uses

Sr. No.	Botanical Name with Family	Local Name	Part used	Uses
1	*Abrus precatorious* L. Fabaceae	Gunja	Seed	Retention of placenta
2	*Ailanthus excels* Roxb. Simaroubaceae,	Maharukh	Leaf	Worm
3	*Caesalpinia bonnducella* (L) Caesalpiniaceae,	Sagargota	Seeds	Timpani
4	*Calotropis gigantia* (L) R.Br. Asclepidaceae	Rui	Latex	Foot and Mouth disease
5	*Cassia fistula* L. Solanaceae	Bahava	Pulp	Worm
6	*Momordica chanantia* L. Cucurbitaceae,	Karla	Leaf	Foot and Mouth disease
7	*Semecarpus anacardium* L.F. Anacardiaceae	Biba	Seed	Foot and Mouth disease
8	*Citrus limon* (L.) Rutaceae	Limbu	Leaf, fruits	Mouth ulcer, Colic, Foot and Mouth Disease
9	*Ficus racemosa* L. Moraceae	Umber	Latex	Bone fracture

10	*Mucuna pruriens* (L.) DC. Fabaceae	Khajkuari	Seeds	Wound itching
11	*Opuntia elatior* Mill. Cactaceae	Naghphani	Leaf	Wound
12	*Pergularia deamia L.* Asclepiadaceae	Utran	Latex, Leaf, Flower	The whiteness of eye, sprain (Lachak), nose bleeding, galactagogue
13	*Tinospora cordifolia* (Willd.) Menispermaceae	Gulwel	Leaf	Fever
14	*Typha angustifolia* L Typhaceae	Pan kanis	Root	Kidney stone
15	*Azadirachta indica*Juss. Meliaceae	Kadu limb	Root	Mastitis
16	*Riccinus communis L.* Euphorbiaceae	Yerandi	Seeds	Indigestion, diarrhea, etc
17	*Tridex procumbens L* Asteraceae	Kambermodi	Whole plants	Wound
18	*Ziziphus xylopyra L.* Rhamnaceae	Ghatbori	Seeds	Digestion trouble
19	*Tribulus terrestris L.* Zygophyllaceae	Gokhru	Leaf	Mouth ulcer
20	*Tamarindus indica L.* Caesalpiniaceae	Chinch	Leaf and fruits	Foot diseases
21	*Jatropha curcas L.* Euphorbiaceae	Chandrajouti	Leaf, seeds	Mouth desease , digestion

Conclusion:

After collecting all data, it was noticed a total of 21 common medicinal plants were used as ethnoveterinary plants. Near about 17 different plants were used to cure mouth ulcers, digestion problems, wounds, foot problems, fever. The families are Euphorbiaceae, Caesalpiniaceae, Zygophyllaceae, Asteraceae, Typhaceae, Meliaceae, Menispermaceae, Asclepiadaceae, Fabaceae, etc. out of *Mucuna pruriens* (L.), *Tridex procumbens L*, *Opuntia elatior* Mill., used as a wound. *Jatropha curcas L.*, *Tribulus Terrestris L.*, *Citrus limon* L. applied for Mouth ulcer.The worm is a common problem in cattle for this Ailanthus excelsaRoxb., Cassia fistula L used. *Tamarindus indica L.*,*Semecarpus anacardium* L, *Momordica chanantia* L.uesd on foot problem which occurs during the rainy season. It found that seed and leaf parts of plants are mostly used because they contain phytoconstituent which cure such type of infection.

Future scope to society:

Documented plants are common and used in various areas and have no other side effects. This can be achieved by creating awareness among villagers through local Government / Social agencies. The multiplication and conservation can easily be done on the field boundaries and barren land in villages. This type of knowledge now day vanished because of illiteracy in society. So need to transfer these practices in the form of books, journals, a newspapers in society.A government-run related program, workshop on ethnoveterinary plants in villages, rural area, tribal, school, colleges to know about the importance of medicinal plants.

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ON FARM CROP RESPONSE TO PLANT NUTRIENTS IN PREDOMINANT CROPPING SYSTEMS

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Introduction:

The greatest challenge is increasing demand for food, fodder, fuel and fiber from limited available land resources under such situation, one of the important strategies will be to increase cop production per unit area through balanced application of nutrients (Aulakh, 2003). Average fertilizer consumption on farmer's field is 45.60 kg N, 16.19 kg P_2O_5, 3.43 kg K_2O ha^{-1} and O kg sulphur. The farmers hesitate to apply recommended dose to the crops because of varied problems and therefore imbalance application of NPK and S is commonly observed leading to lesser yields than expected.

A field experiment entitled On farm crop response to plant nutrients in predominant cropping systems and their impact on crop – livestock – human continuum was carried out at farmer's field intehsils Katol (village Wandali, Hatla and Kukadi panjra) and Narkhed (village Karanjoli, Naygaon dhote and Vivra) of Nagpur district during *Kharif* and *rabi* seasons for four years during 2017-18 to 2020-21to study the response of major nutrients NPK+Swhen applied separately and in different combinations under irrigated conditions on cultivator's fieldson the crops included in the differentprevailing crop sequences (Soybean-Wheat, Soybean-Chickpea and Cotton- Fallow) in Central Vidarbha Zone (Nagpur). The highest yield and the highest total as well as increased benefit were obtained in all the cropping system with application of recommended doses of NPK in combination with sulphur. The experiment was laid out in Randomized Block Design with eight treatments. The highest net return and B: Cratio under Soybean – Wheat, Soybean – Chickpea and Cotton - Fallow system was recorded Rs 51043, 80788 and 57093 ha^{-1} respectively and B;C ratio 2.20,3.16 and 3.12 respectively due to application of NPK with Sulphur.

Keeping this in view the trials were conducted to study the impact of application of recommended fertilizer dose to crops on the cultivator's fieldwith the object to popularize the impact of application of recommended fertilizer dose to increase the productivity of crops.

Objectives:

To find out the response of major nutrients NPKS on the crops included in the different crops sequences on the farmer's fields in Central Vidarbha Zone (Nagpur).

Immediate Objectives*:*

To study the impact of application of recommended fertilizer dose on the cultivator's field in terms of yields and monetary returns as against application of only N, NP, NK, NPK and NPK + micronutrient or these nutrients in imbalance form.

Long Term Objectives*:*

To popularize the impact of application of recommended fertilizer dose to increase the productivity of crops

Materials and Methods:

Field experiment On farm crop response to plant nutrients in predominant cropping systems was carried out during *Kharif* and *rabi* season for four years to study the response of most prevailing cropping systems to NPK+S when applied separately and in different combinations. The soils of experimental sites were medium to heavy in texture, fairly high in clay content, slightly alkaline in reaction with high base saturation of exchange complexes. Well distributed rainfall ranged between 980 to 1150 mm received during the crop growth period.The field experiments was laid out in Randomized Block Design and conducted at six locationsfor Soybean- Wheat and Soybean- Chickpea cropping system and at twelve locations for Cotton-Fallow system during 2017-18 to 2020-21 respectively with eight treatments, treating locations as replications. Treatments consisted of T_1 – No NPK (Control), T_2 – 100 % N ,T_3– 100 % N + 100 % P,T_4– 100 % N + 100 %K, T_5 – 100 % N + 100 % P + 100 % K,T_6 – 100 % N + 100 % P + 100 % K + 100 % Sulphur, T_7-Use of organic manure (Compost @8-10 tons per hectare) / Bio-fertilizers (*Rhizobium*, *Azotobacter* and Phosphate solubilising bacteria) @ 20-25 g per Kg seed) and T_8- Farmers practice. The recommended doses of fertilizer for Soybean (30:75:30:25), Wheat (100:50:50:25), Chickpea (20:40:20:25) and Cotton (100:50:50:25) Kg NPK + S ha^{-1} respectively was applied to crops and plot size was 20mx20m for each treatment, irrigation was given as per the recommended practice. However in farmers practice (T_8) the average doses of fertilizer applicationfor various crops under cropping system for Soybean (22.5:37.02:10.41:00), Wheat (52.50:26.40:22.70:00), Chickpea (20.62:36.25:4.10:00) and Cotton (62.75:30.33:19.62:00) Kg NPK + S ha^{-1} respectively.

Results and Discussion:

Yield and Economics

Soybean – Wheat System:

Table 1: Influence of treatments on Soybean grain yield (kg/ha) inSoybean – Wheat cropping system

Treatments	2017-18	2018-19	2019-20	2020-21	Pooled (2017-2021)
	(Soybean) Kg/ha	(Soybean) Kg/ha	(Soybean) Kg/ha	(Soybean) Kg/ha	(Soybean) Kg/ha
Control	729.12	445.57	510.77	136.55	455.50
N	891.15	596.03	683.89	249.05	605.03
NP	1093.68	891.15	1140.62	535.02	915.12
NK	1018.45	769.63	1003.01	433.64	806.18
NPK	1336.72	1139.97	1217.31	738.97	1108.24
NPK + S	1492.96	1302.00	1340.20	818.45	1238.40
Organic	898.52	758.05	809.11	610.13	791.70
FP	891.15	688.61	998.36	654.85	808.24
CD (P=0.05)	117.73	111.93	112.95	81.67	59.96
CV (%)	9.56	11.64	10.33	13.60	12.09

Table 2: Influence of treatments on Wheat grain yield (kg/ha) in Soybean – Wheat cropping system

Treatments	2017-18	2018-19	2019-20	2020-21	Pooled (2017-2021)
	(Wheat) Kg/ha	(Wheat) Kg/ha	(Wheat) Kg/ha	(Wheat) Kg/ha	(Wheat) Kg/ha
Control	1435.09	896.93	925.85	907.80	982.76
N	1573.97	1070.53	1206.10	1183.14	1204.96
NP	1788.08	1498.75	1627.28	1594.64	1604.94
NK	1562.40	1232.56	1331.41	1302.94	1338.28
NPK	1898.03	1637.63	1921.65	1888.33	1836.44
NPK + S	2077.41	2042.69	2171.62	2079.96	2094.06
Organic	1573.97	1267.28	1290.43	1265.43	1378.02
FP	1307.79	1389.25	1658.59	1632.58	1497.05
CD (P=0.05)	181.19	187.11	169.70	155.44	100.80
CV (%)	9.40	12.05	10.06	9.44	12.29

Table 3: Influence of treatments on economics (Rs/ha) of crops forSoybean – Wheat cropping system

Treatments	GMR	System cost of cultivation	NMR	B:C Ratio
	Rs/ha	Rs/ha	Rs/ha	
Control	39694	31039	8655	1.27
N	50381	33271	17110	1.51
NP	70756	38795	31960	1.82
NK	60134	34141	25993	1.76
NPK	82868	40289	42579	2.05
NPK + S	93525	42482	51043	2.20
Organic	59887	34810	25077	1.72
FP	59350	32542	26808	1.82

The pooled data of four years indicate that the yields of soybean and wheat were increased significantly due to application of all treatments over control. The highest soybean yield (1238.40kg ha^{-1}) and chickpea yield (2094.06 kg ha^{-1}) was obtained by application of recommended dose of NPK + sulphur which was significantly superior over application of all treatments. The highest net return Rs 51043 $ha^{-1}$and B: C ratio 2.20 under soybean - wheat system was recorded due to application of NPK with sulphur. Chaudhari (2019) and Savita *et al.* (2017) also found sameresults.

Soybean-Chickpea System:

The pooled data of four years of experiment on farmer's field indicate that the yield of soybean and chickpea was increased due to application of N, NP, NK, NPK and NPK+S over control. The yields of soybean (1274.84 kg ha^{-1}) and chickpea (1697.63 kg ha^{-1}) was obtained by application of recommended dose of NPK + sulphur which was significantly superior over all treatments. Highest system net return of Rs 80788 ha^{-1} and B: C ratio3.16 in soybean – chick pea system was noticed by application of NPK +S. Muhammad *et al.* (2012) and Prajapati *et al.* (2017) also reported increase in yield due to application of NPK and S.

Table 4: Influence of treatments on Soybean grain yield (kg/ha) inSoybean – Chickpea cropping system

Treatments	2017-18	2018-19	2019-20	2020-21	Pooled (2017-2021)
	(Soybean) Kg/ha	(Soybean) Kg/ha	(Soybean) Kg/ha	(Soybean) Kg/ha	(Soybean) Kg/ha
Control	740.69	567.09	527.22	136.79	492.95
N	868.00	729.12	693.37	261.97	638.11
NP	1116.83	1111.04	1102.48	599.72	982.52
NK	983.73	1111.04	934.78	478.97	877.13
NPK	1174.69	1232.56	1202.45	748.29	1089.50
NPK + S	1464.03	1456.30	1349.57	821.76	1274.84
Organic	949.01	908.51	814.42	644.85	829.20
FP	844.85	792.77	992.83	667.05	824.36
CD (P=0.05)	138.24	153.03	107.82	79.25	60.44
CV (%)	11.64	13.26	9.98	12.64	12.31

Table 5: Influence of treatments on Chickpea grain yield (kg/ha) in Soybean – Chickpea cropping system

Treatments	2017-18	2018-19	2019-20	2020-21	Pooled (2017-2021)
	(Chickpea) Kg/ha	(Chickpea) Kg/ha	(Chickpea) Kg/ha	(Chickpea) Kg/ha	(Chickpea) Kg/ha
Control	977.95	694.40	750.19	740.23	790.69
N	1105.25	908.51	1000.87	966.03	995.16
NP	1371.44	1249.92	1355.69	1288.11	1316.29
NK	1261.49	1058.96	1151.32	1104.91	1144.17
NPK	1521.89	1406.16	1585.79	1532.31	1511.54
NPK + S	1666.56	1654.99	1778.12	1690.86	1697.63
Organic	1047.39	1151.55	1199.69	1106.14	1126.19
FP	1087.89	910.13	1387.85	1380.58	1191.62
CD (P=0.05)	88.65	180.62	158.79	149.46	92.23
CV (%)	6.05	13.86	11.22	11.02	13.73

Table 6: Influence of treatments on economics (Rs/ha) of crops for Soybean – Chickpea cropping system

Treatments	GMR	System cost of cultivation	NMR	B:C Ratio
	Rs/ha	Rs/ha	Rs/ha	
Control	50604	29503	21100	1.71
N	64767	31446	33321	2.05
NP	91202	33900	57302	2.69
NK	79791	32926	46865	2.42
NPK	103889	35391	68496	2.93
NPK + S	118024	37235	80788	3.16
Organic	78073	32301	45772	2.41
FP	81563	30333	51230	2.68

Cotton-Fallow System:

Table 7: Influence of treatments on seed cotton yield (kg/ha) for Cotton-Fallow system

Treatments	2017-18	2018-19	2019-20	2020-21	Pooled (2017-2020)
	(Cotton) Kg/ha	(Cotton) Kg/ha	(Cotton) Kg/ha	(Cotton) Kg/ha	(Cotton) Kg/ha
Control	972.16	717.55	621.13	380.59	672.86
N	1232.56	917.15	808.14	590.15	887.00
NP	1397.48	1571.08	1389.12	1010.45	1342.03
NK	1307.79	1336.72	1228.28	874.28	1186.77
NPK	1504.53	1744.68	1526.83	1140.83	1479.22
NPK + S	1675.24	1889.35	1624.60	1225.60	1603.70
Organic	1241.24	1102.36	912.45	588.45	961.12
FP	988.36	928.76	1145.89	970.79	1008.45
CD (P=0.05)	114.37	156.54	180.94	160.04	63.58
CV (%)	6.80	5.26	6.95	8.69	14.22

Table 8: Influence of treatments on economics (Rs/ha) of crops forCotton- Fallow system

Treatments	GMR	System cost of cultivation	NMR	B:C Ratio
	Rs/ha	Rs/ha	Rs/ha	
Control	34703	19214	15489	1.8
N	45861	20752	25108	2.2
NP	70231	22962	47268	3.05
NK	61987	21080	40907	2.94
NPK	77475	25576	51899	3.02
NPK + S	84023	26930	57093	3.12
Organic	49828	21027	28800	2.36
FP	53023	21567	31456	2.45

The pooled data on four years of experiment on cotton crop indicate that the yield of cotton was increased significantly due to application of N, NP, NK,NPK and NPK+S over control. Application of recommended dose of NPK + sulphur increased the lint yield of cotton i.e. 1603.70kgha^{-1} significantly superior over application of N, NP and NK respectively.Highest system net returnsof Rs 57093 ha^{-1} and B:C ratio3.12 was achieved by application of NPK +S. This result is in line with the findings ofVidyavathi et al. (2012).

Conclusion:

From the pooled data of four years, it could be concluded that by application recommended/balanced dose of NPK fertilizer along with sulphur recorded higher yield in soybean (53.22%) and wheat (39.88%) in soybean-wheat cropping system , higher yield in soybean (54.64%) and chickpea (42.44%) in soybean-chickpea cropping system and higher yield in cotton (59.02%) in cotton-fallow system over farmers practice.

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INDUSTRIAL SCALE PRODUCTION OF ORGANIC WASTE RECYCLER, BLACK SOLDIER FLY, *HERMECIA ILLUCENS* L IN RURAL AND URBAN AREAS OF INDIA

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Abstract:

Organic waste recycling and waste management is rapidly increasing problem in rural and urban areas in all over India. As per studies 40% to 50% of solid waste generated is organic. Organic waste dumped in soil release methane from decomposition of biodegradable waste under anaerobic conditions which contributes to global warming. Open dumping of organic waste, where number of flies sit and can spread diseases. A more sustainable, economically valuable and environment friendly solution for management of such waste is the use of black soldier fly, *Hermecia illucens* L. farming, which helps for any organic waste management as well as can, solve the food problem of aquaculture and poultry. Black soldier fly larvae not only useful as a feed of livestock but can generate other by products like Chitin, biodiesel, biogas, fertilizers etc. This chapter will show light onimportance this fly and how this fly is best suitable for organic waste management, in rural and urban areas of India.

Keywords: Biowaste management, Black soldier fly, *Hermecia illucens*, insect biomass, waste reduction, biomass conversion, feed conversion rate

Introduction:

The management of solid waste generated in a country must be one of the priorities while forming policies at the National level (Abas and Wee, 2014). The framework for solid waste management is still in the development process in India (Akhilesh and Avlokita, 2020). 40 to 50% of solid waste is organic waste which needs to be processed systematically to reduce environmental hazards so development of sustainable waste management solutions is essential. Organic waste management problem is rapidly growing day by day yet difficult to solve, given increased waste production and high costs of disposal (Otles *et al.*, 2015).

Conversion of organic waste into compost by saprophagous such as earthworms and microorganisms are well documented (Suthar and Sing, 2008). In many developing countries, waste collection and disposal are ever-increasing problem and it is believed that one to two thirds

of waste in many countries are not collected (Diener *et al.*, 2009). Insects such as the black soldier fly, *Hermecia illucens* and common housefly *Musca domestica* L. can play a significant role in conversion of organic waste streams into biofertilizer, animal and fish feed and contribute to sustainable management of the environment (Nguyen *et al.*, 2015). Organic wastes releases from animal wastes, household wastes, stores, vegetable market, slaughter houses etc. are usually generated in large quantities and are potential environmental pollutants and cause human health hazards if not handled properly (Li *et al.*, 2011). Food and other organic wastes are a valuable resource that everyone shouldnot waste as it contains a lot of nutrients and energy value that could be beneficial to both humans and the environment if reintegrated into the value chain (Bloukounon-Goubalan *et al.*, 2017).

In India as well as in other developing countries population is continuously increasing, there is a need to produce more and more food rich in protein and fats. This has pushed the livestock sector to increase their yield at the expense of the environment (Nyadjeu *et al.*, 2018). In more populated countries the food production will have to increase by 70% to be able to feed the world in 2050 (Van Huis, 2013). Future shortage for maize, rice, wheat and soybean was estimated approximately 67%, 42%, 38% and 55% respectively (Ray *et al.* 2013). Therefore, it is a need to search for new food and feed source which contain high amount of protein and essential amino acids, fatty acids and micronutrients and it is essential to increase the production of such feed at an industrial level.

The edible insects can fulfil the future food demand at an industrial scale. Edible insects are popular groups of organisms all over the world with potential food source, efficient food conversion rate, short period of breeding, and high protein content (Oonincx *et al.* 2015; Van Der Fels-Klerx *et al.*, 2016). The data revealed that the nutritional quality of edible insects was enough to fight against the human malnutrition (Payne *et al.*, 2016). *Hermecia illucens* (Diptera:Stratiomyidae) commonly known as black soldier fly, the larval stages are voracious feeders on organic wastes, including waste vegetables, fruits, animal excreta and municipal organic waste etc. (Li *et al.*, 2011, Salomane *et al.*, 2016, Rehman, 2017).

Life of Black Soldier Fly:

Hermicia illucens L is widespread in tropical and warmer temperate regions between about 45^0N and 40^0S (McCallan, 1974). The larvae of this fly feed on different organic matter such as rotten, discarded fruits and vegetables, animal manure like poultry and farm manure and human excreta. Larvae are voracious eaters on organic waste and reach upto last larval stage within 15 to 20 days and converts into prepupa. Under ideal conditions with abundant food i.e., waste, larvae can mature in two weeks. However, food shortage and low temperatures can extent the larval period up to four months (Furman *et al.*, 1959) and reach to last larval stage i.e., prepupal stage. BSF larval life cycle shows great flexibility for their development as larval

period depends on temperature and availability of food. This flexibility of life cycle can be very helpful in managing populations during shortage of waste and larvae can be stored for long period for next population.

Prepupal stages are dark brown in colour, come out of trays in search of dry and protected pupation site. At this stage prepupae are at their maximum size, with large amount of protein, 36-48% and fat about 31-33%, which is enough to sustain them through metamorphosis (Hale, 1973). Because of high protein and fat content in prepupae they are the stage to harvest and utilised for livestock feed. Prepupa stage is motile which transform into nonmotile pupa stage, remains for 14 days and emerged as an adult fly.

Pupal stage emerges into Adult Black soldier fly (BSF) which is lethargic and doesnot fly more distance. Adult male and female after emergence attracted towards sunlight or any artificial light and met, after mating female fly finds a suitable place for oviposition. Gravid female gets attracted towards smell of rotton or decaying waste, finds cracks above the waste and lay eggs by inserting its ovipositor in cracks and crevices. A single female can lay nearabout 500 to 800 eggs.

Adult flies donot feed on any food, relies solely on its body fat reserve, but drinks water and can survive upto 10 days. The adult flies do not come into direct contact with any degrading or fresh organic material including foodstuff, and can therefore not be regarded as unsanitary or a vector of diseases (Schremmer, 1986; Leclercq, 1997). House flies are serious vectors of various diseases sit on the garbage and spread number of diseases. Black soldier fly larvae have capacity to repel houseflies from oviposition in the same bin. Sometime even though housefly larvae present in BSFL bins they cannot survive with larvae of BSF (Bradley and Sheppard, 1984).

Once hatching occurs, larvae start to feed on the waste, and reduce the waste from 50 to 80%. Because larval survival percent is high and are voracious feeders, waste or fresh material is processed extremely fast and bacterial growth is suppressed or restrained so reduce the bad odour to minimum.

Bioconversion parameters and nutrient value of Black Soldier Fly (BSF) fed on different organic waste:

Various bioconversion parameters like prepupal weight gain, waste reduction % (WR), bioconversion rate % (BR), Feed conversion ratio studied by Paulin *et al.* (2018) on different organic wastes to evaluate the feasibility of Black Soldier Fly larvae to digest and degrade organic waste in small scale. Organic wastes like pig and chicken manure and Kitchen wastes were fed to 2000 larvae (3-5 day old). His study confirmed the great potential of BSF as a component of waste management in low- and middle-income countries. If applied in organic waste management chain, the process could contribute to generate biofuel energy as well as sustainable protein provision to the animal industries.

The study also done by Andrea Scala *et al.* (2020), demonstrate the ability of the BSF to recycle organic waste at an industrial scale. She used three organic waste streams apples, bananas, and spent grain from brewery. Working at scale of 10,000 BSF larvae, waste valorisation, protein and lipid profiles were measured for each diet treatment. Commonly available organic wastes were successfully used at an industrial scale to produce BSF larvae that have the potential to substitute other sources of protein and lipids in different industrial applications.

The nutritive value of BSF larvae reared on common organic waste streams in Kenya studied by Marwa Shumo *et al.* (2019). The larvae fed on Chicken manure, brewers spent grain and kitchen waste up to prepupal stage. 200gm samples of prepupae from each waste collected for chemical analysis. Samples of BSF larvae analysed for dry matter, crude protein, ether acids, vitamins, flavonoids, minerals and aflatoxins. It is concluded in his study that it is possible to take advantage of readily available organic waste streams in Kenya to produce nutrient rich BSFL derived feed

It was found that fatty acids, amino acids, minerals and vitamins composition in different development stages of BSF. Finding from his study could provide podium to food and feed industry for framing a strategy for specific molecular nutritional component intake into the diets of humans, aquaculture and animals. It is also indicated that BSF is a possible insect which can be applied to combating the food scarcity of countries where micronutrient deficiency is prevalent. Moreover, it contributes to advance exploring for developmental and metabolic biology of this edible insect (Xiu *et al.*, 2017).

Black soldier fly (BSF) farming can be the feed solution for aquaculture and poultry:

Valorisation of organic waste through larval feeding activity of Black Soldier Fly *H. illucens*, constitutes a potential benefit for low- and middle-income countries. BSF larvae feed on organic waste, build their body composition with protein and fat. As there is always a demand for protein and fat in livestock feed, BSF larvae protein and fat can be used to replace fishmeal in monogastric animal's diet (Paulin *et al.*, 2018).

Use of BSF meal in aquafeeds is an emerging concept, where biowaste are converted in to useful biomass efficiently, which in turn results in clean environment and effective utilization of biomass. The nutrient composition of BSF meal (20-25 days old) revealed that it had 40-45% crud protein with 23-27% crude lipid content. An eight-week feeding trial with white leg shrimps shown promising first-hand results. BSF meal can be used as a sustainable alternative to fish meal and it can be included upto 15% in the diet of white shrimp, *P. vannamei* without any deleterious effects (CIBA, 2019).

The study was conducted by Mohammed *et al.* (2016) to evaluate the effect of black soldier fly larvae as a source of protein in layer diets on product performance, egg quality,

hatchability, fertility and sensory characteristics of eggs. The BSFL contained a high percentage of protein (559.9 g kg^{-1}), metabolizable energy (696.3kcal kg^{-1}), crude fat (18.6 g kg^{-1}) and dry matter (178g kg^{-1}) and a good balance of amino acids. This BSFL diet fed to Arabic strain hens at nine months of age. The results showed that feed intake, weight gain, Haugh unit, and hatchability were not affected by this diet; however there was significant improvement in hen day egg production and hen house egg production due to dietary treatments of BSFL. Also feed conversion ratio, egg weight, shell thickness, shell weight, egg yolk colour, fertility, and egg mass were affected by dietary treatments. The odour was not affected by dietary treatments. This study concluded that the Black soldier fly larvae can be good source of protein in layer diets.

Need of industrial use of BSF in India:

Black soldier fly capacity of organic waste treatment with the generation of other valuable products makes the black soldier fly technology a highly promising tool for waste management in low- and middle-income countries like India. It offers small entrepreneurs the possibility of income generation without high investment costs, and reduces environmental impact. Ample research is done by scientists using variable organic wastes fed to BSF larvae but still initiatives for upscaling this technology; proper implementation is less in developing countries (Larde, 1990; Hem *et al.*, 2008).

The latest research report titled “Black Soldier Fly Market by Product (Protein Meals, Biofertilizers (Frass), Chitin/ Chitosan, Others (Cocoons, Pupa), Application (Animal Feed, Agriculture, Pet Food, Pharmaceutical, Cosmetic, Biofuel), and Geography- Global Forecast to 2030”, published by Meticulous Research, the Black Soldier Fly (BSF) Market is expected to reach $3.4 billion by 2030, at a CAGR of 34.7% during the forecast period of 2021 to 2030. The growth of this market is mainly attributed to the growing global demand for animal products, growing aquaculture industry, increasing demand from the animal feed industry for alternative proteins, and increasing government approvals of insect meal in livestock feed (Meticulous research).

In terms of value and volume, the protein meals are expected to witness rapid growth during the forecast period. The growing demand for alternative protein meals from animal feed manufacturers, increased fish meal and soy meal prices, and government support and approval for an insect meal are some if the major drivers for this segment. Moreover, some fish feeding trials have successfully demonstrated the BSF meal as a better substitute for fish meal in aquafeeds.

Based on application, animal feed commanded the largest share of global black soldier fly market in 2020. The largest share of this market is mainly attributed to the growing world population and the rapidly increasing demand for meat products. Also, the adoption of an

alternative source of protein such as insects for animal feed offers a great opportunity during the forecasted period (Meticulous research).

Conclusion:

The study confirms the application potential black soldier fly in solid waste managementlow- and middle-income countries like India. This fly is extremely resistant species capable to deal with demanding environmental conditions, such as drought, food shortage or oxygen deficiency. BSF use in poultry, fish and animal or human diet as green environment friendly sustainable source of protein and fats has recently observed a surge. Black soldier fly larvae have good bioconversion efficiencies than any other insects, has a short life span, feed on any organic waste. Researchers, regional planners and entrepreneurs should form a close network for information exchange to ensure rapid response to emerging new developments and challenges in BSF technology which will lead the country to developing stage ahead.

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A STUDY ON NUTRITIONAL PROPERTIES OF MILLET BASED MUSKMELON KULFI

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Abstract:

The purpose of this study was to establish a technology for making millet-based "musk melon kulfi" and to see if finger millet could be used in kulfi. Minerals such as iron, calcium, phosphorus, fibre, and vitamins are abundant in malted ragi flour. Ragi milk is high in protein and fat. The kulfi samples were made with ragi milk and malted ragi flour in two different ways. Both samples were made with muskmelon and ragi in three different combinations (muskmelon + ragi milk and muskmelon + malted ragi flour) in the ratios of 50:50, 75:25, and 25:75. The 75:25 ratio was found to be the best formulation from both groups. The nutritious value of the muskmelon kulfi was boosted by adding finger millet. The sensory properties (colour, flavour, taste, texture, overall acceptability) as well as the proximate parameters (fat, acidity, sucrose, total solids, protein, and crude fibre) were investigated.

Keywords: Finger millet, musk melon, kulfi

Introduction:

Musk melon is a beautiful, juicy, tasty and delicious fruit popular for its nutritive and medicinal properties. Squash, pumpkins, cucumbers, Musk melons, watermelons, and gourds come under the Cucurbitaceae family. Muskmelon is one of the most important cultivated cucurbits, which is native to India and Africa. Cantaloupes are a source of polyphenol antioxidants, chemicals which were thought to provide certain health benefits to the cardiovascular system and immune system by regulating the formation of nitric oxide, a key chemical in promoting health of the endothelium and prevention of heart attacks.

Musk melon is commonly known as cantaloupe in USA which is among the popular fruits; muskmelon is also a commercial fruit of considerable importance in several parts of India. Muskmelons are valued for their sweet taste, pleasant flavor and attractive appearance (Bhatia *et al*., 1968). The use of muskmelon for juice and its preservation has not received much attention some work has been done in preparation of products like pulp, squash and dry slices (Teotia *et*

al., 1995). Finger millet which is commonly known as ragi in India it is an important part of population's diet and a wonder crop next to wheat. It is also known as dry land crop and is cultivated in both tropical and sub-tropical areas. Finger millet which is commonly known as ragi in India, is valued as staple food and a wonder crop next to wheat. It is also known as dry land crop and is cultivated in both tropical and sub-tropical areas. In India these are mainly cultivated in the southern states which include Andhra Pradesh, Karnataka, Tamil Nadu and Kerala.

According to Patel *et al.* (2015), ragi is found to play a vital role in enhancing the fibre content of ice cream. They also stated that ragi did not have any effect on the sensory quality of ragi ice cream. Interest in finger millet is growing due to its nutritional properties namely the hypoglycemic characteristics (Lakshmi and Sumathi, 2002). The nutritive potential of millets in terms of carbohydrate, protein, and energy valuess are similar to that of cereals like rice, wheat, or barely. Millets are high in healthy dietary fibres and mineral content in comparison to rice and wheat (Hulse *et al.,* 1980; Malleshi *et al.,* 1993).

Ragi is a good source of starch and fibres. Water absorption property, swelling property, swelling power and solubility of starch and fibres are temperature dependent; it also depends on the degree of intermolecular bonding, while starch depolarization is caused by thermal treatment (Alexandar, 1998). Ragi incorporation also reduced the meltdown of ice cream samples.Total carbohydrate content of finger is in the range of 72 to 79.5 percent (Pore and Magar, 1979). Nirmala *et al*. (2000) reported value of 1.5 per cent reducing sugar and 0.03 per cent non-reducing sugar in finger millet. The protein content of finger millet grain varies from 4.9 to 11.3 per cent. The total percentage of lipidin ragi is approximate to be 5.2 per cent, with palmitic, oleic and linoleic acids being the main constituents (McDonough *et al*., 2000).

Finger millet is a rich in minerals, particularly calcium (US National Research Council, 1996). Finger millet also has high in potassium, iron, magnesium, copper, sodium and phosphorus (Obilana and Manyasa, 2002). Finger millet contains both water- soluble and fat-soluble vitamins: thiamine, riboflavin, niacin and apparently vitamin C plus the tocopherols (Vitamin E) (Serna- Saldivar and Rooney, 1995; Obilana and Manyasa, 2002). Serna- Saldivar and Rooney (1995) reported that dried ragi is deficient in Vitamin C and the water-soluble B-vitamins are concentrated in the aleuronic layer and germ, while the liposoluble vitamins are mainly located in the germ.

In a study conducted by Rachie and Peters (2002) patients with diabetes tolerated finger millet better than rice which helped in maintaining their blood sugar levels are comparatively lower. The good thickening and water binding properties of finger millet influenced the

inclusion of finger millet as a functional ingredient in ice cream and thus reducing the amount of stabilizers used and function as fat substitutes in ice cream. The dietary fibre supplementation by finger millet increases the quantity by enhancing the water binding capabilities and benefits both consumers and processors (Grigelmo *et al.*, 1999).

Addition of ragi also improved the texture, sensory characteristics and shelf life of foods due to water binding and gel forming ability, fat mimetic and anti clumping, texturizing and thickening (Thebaudin *et al.*, 1997; Dello *et al*., 2004). Ragi incorporation helps in development of reduced fat ice-cream; and fits into the dietary guideline for person suffering from cardio vascular diseases.

'Ice cream is basically made up of little ice crystals and air bubbles and fat droplets, all sort of glued together by a viscous sugar solution'. The method of creating ice creams remains to be the same with some little differences in flavors, etc. (Chris Clarke, 2015). Kulfi is a famous frozen dairy dessert originated during Mughal India. It is often referred to as 'traditional Indian ice cream. It is popular throughout India, Sri Lanka, Pakistan, Bangladesh, Nepal, Burma (Myanmar), and the Middle East. Kulfi is defined according to PFA standards as the frozen product obtained from buffalo or cow milk or combination thereof or cream or other milk products with or without cane sugar, dextrose, fruit, fruit juices, liquid glucose, eggs, edible flavors and permitted food colours.

The permitted stabilizers and emulsifiers should be not exceeding 0.5 per cent by weight. The product shall contain not less than 3.5 per cent protein 10 per cent milk fat, 30 per cent total solids, except that when any of the forced preparations contains fruits, nuts or both. The content of milk should not be less than 80 per cent by weight. Aneja *et al.* (2002) stated that Kulfi is a popular frozen dairy dessert (Indigenous ice-cream). A mass of partially desiccated milk containing chopped pistachio nuts and the essence of kesar (saffron) is frozen in an ice salt mixture in a metal cone, sealed with plaster of wheat dough. According to Filizy (2016) fortifying ice cream with dietary fibre had major impact on sensory properties overall. Ice cream samples enriched with fibre content received more scores in terms of sensory properties. Samples containing peach peel fibre showed relatively high scores in terms of organoleptic characteristics.

Materials and Methods:

Selection of Raw Materials

Raw materials selected for product development include muskmelon, ragi (ragi milk, malted ragi flour), condensed milk and whipping cream. Muskmelons and ragi used in this experiment were procured from the local market. Fruits of uniform size and shape, maturity without any visible damages were selected and used in this experiment.

Extraction of muskmelon pulp

For preparation of muskmelon pulp, fully matured fresh muskmelon was washed in running water and peeled to remove the skin. The fruits were then cut into small pieces and was pulped by using an electric grinder.

Malting of ragi

For the malting of ragi, the seeds were washed for five minutes and then soaked in water for 5hr. It was drained in order to remove excess water, later the seeds were tied in a muslin cloth. These seeds were then kept for germination for 24hrs. The germinated seeds were dried in hot air oven at 50^0 C for 2hrs. The malted ragi seeds were grounded into flour using an electric grinder.

Extraction of ragi milk

The ragi milk was obtained by washing the ragi seeds with running water and then immersing in water for 24hr. Excess water was drained off; the seed were grounded into paste by using electric grinder. The ragi paste was then tied in a muslin cloth to extract the milk by using hands.

Figure 1: Muskmelon

Figure 2: Muskmelon Pulp

Figure 3: Ragi Milk

Figure 4: Malted Ragi Seeds

Figure 5: Malted Ragi Flour

The muskmelon-ragi kulfi for analysis was prepared in three varying compositions. The control was prepared using only muskmelon (100g). The sample (1) was prepared using muskmelon and ragi milk, and the sample (2) was prepared by using muskmelon and malted ragiflour. The samples were made in three different ratios 50:50, 75:25, 25:75 (muskmelon: ragi milk and muskmelon: malted ragi flour) respectively. The kulfi of best sample i.e, combination in the two sets, 75:25 (muskmelon: ragi milk/malted ragi flour) was accorded to sensory evaluation.

Proximate Analysis

The samples were analysed for the determination of fat, protein, acidity, sucrose, total solids and crude fibre.

Estimation of Fat- Gerber Method

The sample is mixed with sulphuric acid and iso-amyl alcohol in a special Gerber tube, permitting dissolution of the protein and release of fat. The tubes are centrifuged and the fat rising into the calibrated part of the tube is measured as a percentage of the fat content of the kulfi sample. It is an empirical method and reproducible results can be obtained if procedure is followed correctly.

Estimation of Protein

About 5-8 g of the prepared kulfi sample was weighed and transferred to Kjeldahl flask taking care to see that no portion of the sample clings to the neck of the flask and 0.5g of copper sulphate, 15g of potassium sulphate and 40 ml of concentrated sulphuric acid was added. The flask was placed in an inclined position on the stand in the digestion chamber and the sample was digested. The flask gently heated at low flame until the initial frothing ceases and the mixture was boiled steadily at a moderate rate.

$$\text{Nitrogen (\%)} = \frac{T \times 0.1 \times 20 \times 0.014 \times 100}{\text{Weight of sample}}$$

Protein (%) = Nitrogen (%) × 6.38

Where:

T: Titration figure.

0.1: Normality of HCl; 0.014: Atomic weight of nitrogen/ 1000.

20: Dilution factor

Analysis of Acidity

Weigh accurately about 10 g of ice cream sample in a suitable dish or basin. Add 30 ml of warm water. About 1 ml of phenolphthalein indicator was added and then titrated against standard NaOH solution.

Titratable acidity as Lactic acid= 9 AN/ W.

Where,

A = Volume of standard NaOH required for titration

N = Normality of Standard NaOH solution

W = weight of the sample taken for test

Ten grams of kulfi sample were transferred to volumetric flask. Distilled water (100 ml) was added and then neutralized with 1.0N NaOH to a pH 7.5-8.0. About 2 ml of lead acetate were added and the flask was then shaked and left to stand for 10 minutes. Then 2 grams of sodium oxalate were added to remove the excess lead.

Calculation for sucrose :

Total sugar (mg/100 ml) = Factor × 100 / Titre

$$\text{Total sugar (\%)} = \frac{\text{mg / 100g} \times \text{dilution} \times 100}{(1000 \times \text{wt.taken})}$$

Analysis of Crude Fibre

About 2.5-3 gm sample was weighed and transferred to an extraction apparatus (Soxhlet extractor) and extract with petroleum ether. Air dry the extracted sample and transfers to a dry 1L conical flask. If percentage of fat in the product is high (>10%), then treat it with mixture of acetone and petroleum benzene.

$$\text{Crude Fibre (\%)} = \frac{\text{differenceinweightofcrucible}}{\text{weightofsample}} \times 100$$

Determination of Total Solids

The moisture dishes were heated in the oven for one hour. It was cooled and weighed. About 5 g of kulfi sample was added into the dish. Add few drops of water to the sample to assist in spreading the sample with glass rod. The dish was placed on a boiling water bath for 29 - 30 minutes. The bottom of dish was wiped and then transferred to the air oven. It was dried for about 4 hours, and the dish was removed to an efficient desiccator, and allowed to cool. The final weight of the sample was taken.

$$\text{Total solids (\%)} = \frac{W1}{W0} \times 100$$

Where:

W_1: Weight of sample after drying.

W_0: Weight of sample before drying

Results and Discussion:

The millet-based muskmelon ice-cream was prepared in two sets, one by using ragi milk and the other using malted ragi flour. Both sets were prepared in three ratios, 50:50, 75:25, 25:75 (muskmelon: ragi milk/malted ragi flour). The sample in the ratio 75:25 was selected based on sensory evaluation and further nutritional comparison of samples was done.

Both musk melon and ragi are rich in crude fibre. In a study conducted by Punna Ramulu *et al.* (2003) muskmelon (*Cucumis melo)* contains 0.4 g of crude fibre per 100g of muskmelon. Gunashree *et al.* (2014) found that 25 g of milled ragi contains 3.17 ± 0.02 per cent of crude fibre. In the study conducted by Nehasingh*et al.,* (2018), an increase in the crude fibre content from 3.90 to 4.20 per cent was observed in the finger millet sample after roasting when compared to the unroasted sample. 18.6% dietary fibre and 3.6% crude fibre in finger millet (Kamath and Belavady, 1980). Crude fibre in food is of the level of non-digestible carbohydrate and lignin.

The proximate analysis of different samples are given in the Table 1

Table 1: Proximate analysis of different samples

Sr. No.	Quality parameters	Sample1 (T_0)	Sample2 (T_1)	Sample3 (T_2)
A	Fat	8.8%	9.6%	7.6%
B	Acidity	0.15%	0.13%	0.17%
C	Sucrose	19.23%	17.80%	19.24%
D	Total Solids	42.88%	40.79%	47.86%
E	Protein	4.35%	5.25%	5.13%
F	Crude Fibre	Not detected	Not detected	0.5g

As per the results of the chemical analysis T_2 had more nutritive value than T_0. T_2 had low fat percentage, high sucrose and total solid percentage compared to the other samples. It was also rich in crude fibre and protein when compared to control(T_0).

Sensory Analysis

Sensory quality is most closely linked property for of food products. This evaluation technique can be applied from designing a new food product to the final evaluation for the quality of food product. The sensory analysis scores of the samples; (sample1: muskmelon/ ragi milk in the ratios 50:50, 75:25, 25:25) and (sample 2: muskmelon/ malted ragi flour in the ratios 50:50, 75:25, 25:75) based on 9-point hedonic scale are given.

Table 2: Sensory analysis of different samples

Sample	Colour	Texture	Taste	Overall acceptability
T_0	8.2	7.6	7.2	7.8
T_1	8	7.6	7.8	7.6
T_2	8.2	8.6	8.6	8.4
T_3	7.8	7.6	8	7.8

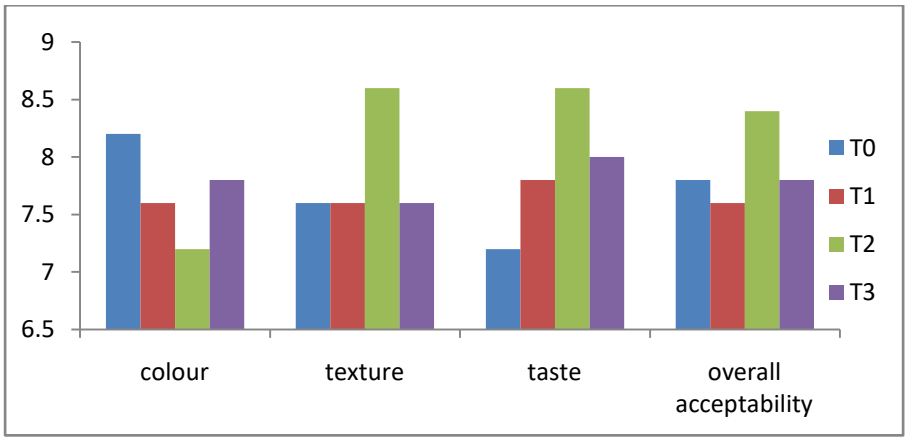

Figure 6: Acceptability of Musk melon Kulfi with Ragi milk

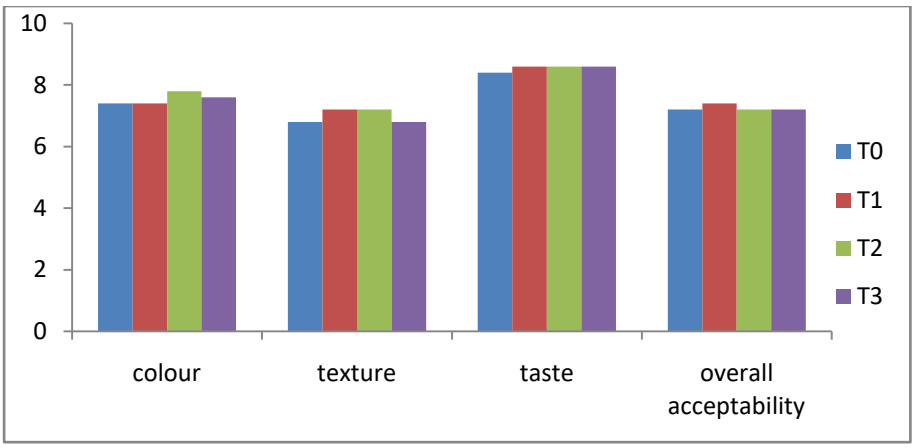

Figure 7: Acceptability of Musk melon Kulfi with Malted Ragi milk

Figure 8: Muskmelon (100g) (T_0)

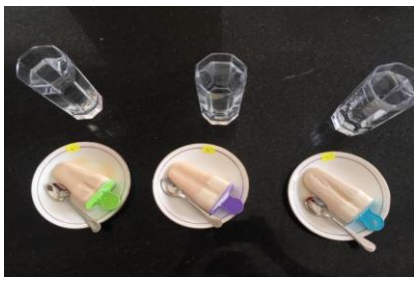

Figure 9: Muskmelon+ragi milk (50:50, 75:25, 25:75)

Figure 10: Muskmelon + malted ragi flour (T_2) (50:50, 75:25, 25:75)

Conclusion:

Millet based muskmelon kulfi was prepared in two methods. One using malted ragi flour and other using ragi milk. Both muskmelon and finger millet are highly nutritious. Muskmelon is rich in anti-oxidants, polyphenols and good source of vitamin A, folate, and vitamin C. Finger millet is rich in mineral nutrients, a goof source of phytochemicals, such as dietary fibre and polyphenols. The combination of musk melon and finger millet in kulfi resulted in nutrionally enriched kulfi. The sensory properties like colour, texture, flavor and taste were also enhanced due to addition of ragi milk as well as malted ragi flour in muskmelon kulfi. Muskmelon kulfi with ragi milk and muskmelon kulfi with malted ragi flour were prepared in three ratios, 50:50, 75:25 and 25:75 (muskmelon: ragi milk and muskmelon: malted ragi flour). The best samples from both the sets were in the ratio 75:25. The chemical analysis of the selected samples and the control was done inorder to evaluate the nutritional characteristics. The muskmelon kulfi with malted ragi flour in the ratio 75:25 was nutritionally more acceptable.

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INDUSTRIAL APPLICATIONS OF MICROBIAL XYLANASES

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Abstract:

Hemicellulose degrading enzymes are hydrolytic, and specifically degrade those glycans that make up the backbone of the hemicelluloses. Typical hemicellulases are therefore endo-1,4-β-D-xylanases (E.C.3.2.1.8), endo-1,4-β-D-mannanases (E.C. 3.2.1.78), and endo-1,4-β-D-galactanases (E.C. 3.2.1.90). Xylanases catalyze the hydrolysis of xylans, which are mainly produced by microorganisms. Microbial xylanases have received a great deal of attention in recent years. Xylanases are widely distributed in both prokaryotes and eukaryotes. A large number of microorganisms, including bacteria, fungi, actinomycetes, and yeast have been reported to produce xylanolytic enzymes.

Keywords: Hemicellulose, xylanases, xylan, xylanolytic enzymes

Introduction:

Microbial hemicellulases, especially xylanases, have important applications in industry due to their enormous potential to modify and transform the lignocelluloses and cell wall materials abundant in vegetable biomass (Lopez *et al.,* 2007) which is used in a wide variety of industrial processes. In recent years, the biotechnological use of xylans and xylanases has grown remarkably (Polizeli *et al.,* 2005) in the preparation of animal feed, and later expanded to the food, textile and paper industries (Viikari *et al.,* 1986). At present, xylanases together with cellulases and pectinases account for 20% of the global industrial enzyme market. At present, the major end products of xylan, which are of considerable importance, are furfural and xylitol. Furfural production is derived mainly from agricultural residues whereas xylitol is obtained from wood residues. The hydrolysis products of xylan (xylose and xylooligosaccharides) have possible applications in the food industry as thickeners or as fat substitutes and as an antifreeze food additive. In the pharmaceutical industry xylan is found suitable as an agent for ‘direct tableting’ and, in combination with other components, it can be used for delayed release tablet construction. The xylan hydrolysis products can be subsequently converted to liquid fuel, single cell proteins, solvents and artificial low calorie sweeteners (Wong and Saddler, 1992).

Paper and pulp technology:

Like any other large-scale industry, the pulp and paper industry exerts its own impact on the environment by releasing unpleasantly smelling sulphur compounds into the air and water (Viikari *et al.,* 1994). Chlorinated phenolic compounds as well as polychlorinated biphenyls, produced during conventional pulp bleaching being toxic and highly resistant to biodegradation, form one of the major sources of environmental pollution. These compounds arise mainly from the reactions between residual lignin present in wood fibres. Xylanases can be used for specific modifications of pulp for the development of environmentally safe processes (Viikari *et al.,* 1994). Xylanases hydrolyze the reprecipitated xylan on the fibers of paper pulp, which allows easier removal of lignin from the fibres.

Animal feed:

Xylanases are used in animal feed along with glucanases, pectinases, cellulases, proteases, amylases, phytases, galactosidases and lipases. These enzymes break down arabinoxylans in the ingredients of the feed, reducing the viscosity of the raw material (Twomey *et al.,* 2003). The arabinoxylan found in the cell walls of grains has an anti-nutrient effect on poultry. In cereals like barley arabinoxylans form the major non-starch polysaccharide. Arabinoxylans constitute 4-8% of barley kernel and they represent 25 and 75% of the cell wall polysaccharides of endosperm and aleurone layer respectively. The arabinoxylanases are partly water soluble and result in a highly viscous aqueous solution. When such components are present in soluble form, they may raise the viscosity of the ingested feed, interfering with the mobility and absorption of other components.

Bread, food and drinks:

Xylanases may be employed in bread-making, together with α-amylases, malting amylase, glucose oxidase and proteases. The xylanases, like the other hemicellulases, break down the hemicelluloses in wheat-flour, helping in the redistribution of water and leaving the dough softer and easier to knead. During the bread-baking process, they delay crumb formation, allowing the dough to grow. With the use of xylanases, there has been an increase in bread volumes, greater absorption of water and improved resistance to fermentation (Camacho and Aguilar, 2003). Nowadays, xylanases, in combination with cellulases, amylases and pectinases, lead to an improved yield of juice by means of liquefaction of fruit and vegetables. The main desirable properties for xylanases for use in the food industry are high stability and optimum activity at an acid pH. Xylanases are used to hydrolyze arabinoxylans to lower oligosaccharides diminishing the beer's viscosity and consequently eliminating its muddy aspect (Dervilly *et al.,* 2002).

Pharmaceuticals and chemicals:

Xylanases are sometimes added in combination with a complex of enzymes such as, hemicellulases, proteases etc., as a dietary supplement or to treat poor digestion. Hydrolytic products of xylan, such as β-D-xylopyranosyl residues, can be converted into combustible liquids (ethanol), solvents and artificial low-calorie sweeteners, material rich in xylan, followed by hydrolysis by xylanases and hemicellulases, to produce sugars such as β-D-xylopyranosyl units. Next, the products are fermented, mainly by yeasts (*Pichia stipitis* and *Candida shehatae*), as outlined in Fig.1 to produce xylitol or ethanol (Sreenath and Jeffreies, 2000). Xylitol is a polyalcohol with a sweetening power comparable to that of sucrose. It is a non-carcinogenic sweetener, suitable for diabetic and obese individuals and respiratory infections, lipid metabolism disorder, kidney and parenteral lesions.

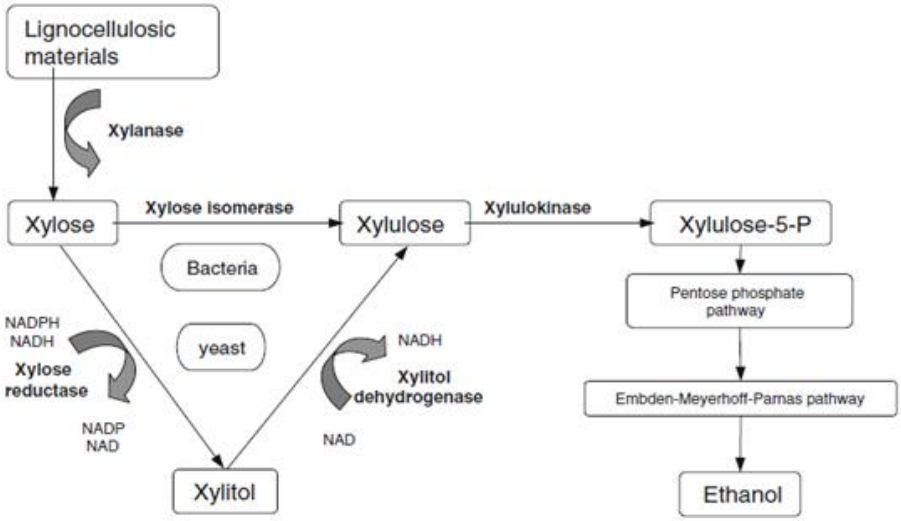

Figure 1: Simplified scheme of xylitol and ethanol production by bacteria and yeasts from lignocellulosic materials

Textiles:

The xylanolytic complex can be used in the textile industry to process plant fibres, such as hessian or linen. For this purpose, the xylanase should be free of cellulolytic enzymes. One process consists of incubating dried ramee (China grass) stem with xylanase to liberate the long cellulose fires intact. After using this method, there is no need to use the strong bleaching step, since the lignin does not undergo oxidation, which would lead to darkening of the fibres (Bruhlmann *et al.*, 2000).

It should be noted that most applications do not require highly purified enzymes. In fact, some applications are enhanced by the presence of other enzymatic activities. The important exception here is certain applications in the paper and pulp industry where the occurrence of cellulases may damage pulp fibers.

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THE EFFECT OF CYMOXANIL 8% + MANCOZEB 64% WP ON THE LIVER OF BROILER (*GALLUUS DOMESTICA)*

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Abstract:

In agriculture the huge use of fungicide may lead to the several health issues. The research was performed to show the effect of cymoxanil 8% + Mancozeb 64% wp on serum and liver of the broiler. 1.5 Kg broiler birds was taken and they divided into four groups that are fed on the contaminated food grains with 2% Cymoaxanil 8% + Mancozeb 64% (w/w) of locally made powder called "Crizol". The control group contains no contamination. After 24 hrs the birds were sacrifice by decapitation and the liver extirpated. Analysis of liver serum reveled that the increase in the lipid concentration. Increase in serum cholesterol and triglyceride, significantly the level of the HDL and LDL.

Keywords: Cymoxanil + Mancozeb, Fungicide, Broiler, Biochemical effect, serum.

Introduction:

There is increase in the use of fungicide in the agriculture because of the several fungus diseases occurs in the crops (Ethelbert *et al.*, 2017). In various agricultural and domestic use of fungicide is the source to introduce in environment. Use of fungicide leads to affect the humans and domestic animals. Biomagnification of the fungicides in the food chain causes several health issues in humans and animals (Ethelbert *et al.*, 2012). Propensity of domestic poultry birds to pick up contaminated food from environment stands for a risk of poisoning (Ezeji *et al.*, 2011). As all the fungicide the cymoxanil and mancozeb is also used to prevent fungal attacks on crops. The contact of these fungicides could be resulting in death due to coronary disease. This study reveled that the toxicological effect of cymoxanil and mancozeb on broiler using some biological biomarkers (Ethelbert *et al.*, 2017).

Material and Method:

Test sample

The fungicide used for this study was locally made powder called 'Crizol' which is indicated by its manufacturer to contain CYMOXANIL 8% + MANCOZEB 64% WP was purchased from an agrochemical shop in Igatpuri.

Formulation of contaminated poultry feeds

Domestically available grains feed was contaminated by weighing out a definite amount of the feed and mix with the graded percentage of the fungicide to give 2% (w/w) contamination respectively. Feed for control contained no 'Crizol' Powder.

Experimental animals

Four Poultry birds (*Gallus domestics)* weighing about 1.5Kg were bought from poultry market in Igatpuri. Then they were fed Cymoxanil + Mancozeb with 2% (w/w) contaminated feeds respectively for a period of 24 hrs. One bird fed with un-contaminated feed served as control. The bird was provided with sufficient water supply.

Extraction of serum from liver

After 24 hrs each bird were taken and sacrifice by decapitation and the liver extirpated. With the help of syringe, the serum was extracted from liver. Then the serum is centrifuge at 3000 rpm for 15 min. The supernatant is collected which is serum and the pallet part is protein.

Determination of lipid profile

Qualitative determination of total serum cholesterol was carried out by the Zak's Method of Cholesterol Estimation. Triglyceride concentration was determined using GPO method while high density lipoprotein (HDL) cholesterol was determined according to precipitating method.

Result and Discussion:

Result of lipid profile shows significant increase in lipid concentration reported a significant increase in serum cholesterol and triglyceride in birds exposed to some fungicide. The level of high-density lipoprotein cholesterol increases significantly in both the cytoplasm and membrane with increase in fungicide concentration. High triglyceride may contribute to hardening of the arteries or thickening of the arteries walls which increase the risk of stroke. High triglycerides can also cause acute inflammation of the pancreas (pancreatitis). Increasing of LDL in blood causes the buildup of fatty deposits (plaques) in arteries which reduces blood flow. These plaques sometimes rupture and can lead to heart attack or stroke.

Table 1: Lipid profile of bird exposed to various doses

Test	Normal	1st Dose	2nd Dose	3rd Dose	Mean
Cholesterol	132.4	276.0	264.3	270.5	270.2
Triglyceride	128.8	398.2	374.4	384.2	385.6
H.D.L.	36.2	69.0	66.1	68.4	67.83
L.D.L.	70	127	124	126	125.6

All doses were in mg/dl

4. Conclusion:

The result of this study shows that Cymoxanil+ Mancozeb affects some hepatic biochemical parameters in the poultry birds and this parameter can serve as useful biomarkers in evaluating the ecological effect of exposed to fungicide. It has shown that the potential risk of fungicide exposure can be assessed by monitoring the levels of Cholesterol, Triglyceride, H.D.L, L.D.L, Total cholesterol. The present study revealed that higher the concentration of fungicide in agriculture higher the risk of coronary diseases and use of bio fungicide may lead to healthy lifestyle.

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ORGANIC NUTRIENT MANAGEMENT PRACTICES FOR LEAFPRODUCTION OF MORINGA (*MORINGA OLEIFERA* LAM.)

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Abstract:

The present study on the effect of organic nutrients management Practices for leafproductionon of moringa (*Moringa oleifera* Lam.) was carried out 2018- 2019 in the vegetable unit, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai nagar. The experiment was carried out with thirteen treatments and three replications under randomized block design. The organic treatments of soil application with vermicompost (5 t ha^{-1}) + azospirillum and phosphobacteria @ 2kg ha^{-1} + foliar spray of panchakavya @ 3 per cent has shown the significant improvement in growth and yield parameters than other treatments.

Keywords: Stem girth, leafstalk weight, leaflet to stalk ratio, herbage yield/ plant, herbage yield/plot.

Introduction:

Drumstick (*Moringa oleifera*), belongs to the family Moringaceae. The moringa tree is nativeto the south of the Himalayan Mountain in northern India and grown around the world. Moringa oleifera is a fast growing, drought resistant tree. Moringa is usually consumed to cure anemia, arthritis and other joint paint (rheumatism), asthma, cancer, constipation, diabetes, diarrhea, seizures, stomach pain, stomach and intestinal ulcers, intestinal spasms, headache, heart problems, high blood pressure, kidney stones, thyroid disorders and infections. It also contains vitamin A, C and iron that support a healthy and active immune system. The Moringa powder is made from naturally dried moringa leaves. It has a delicious spinach green flavour and it contains 25 per cent plant protein which includes all the nine essential amino acids, 24 per cent fiber besides, rich source of vitamin A, vitamin K, vitamin E and calcium. All parts of the tree are considered to possess high medicinal value and are used in the treatment of rheumatism, bites and as cardiac and circulatory stimulant. Stem of the tree exudes a gum, which is used in the paper and pulp industries. Stem bark is used in ayurvedic medicines to cure dry tumor and also to

prevent cough and asthma. This paper highlights the organic method of cultivating moringa leaves without the use of chemical fertilizers.

Materials and Methods:

The study of the effect of organic nutrients management of moringa (*Moringa oleifera* Lam.) for leaf production, was carried out at the vegetable unit of the Department of Horticulture, Faculty of Agriculture, Annamalai University during 2018- 2019. The design followed was randomized block design with thirteen treatments and three replications. The thirteen treatment combinations were T_1-FYM @12.5tha^{-1}+azospirillum and phosphobacteria @ 2kg ha^{-1}, T_2- FYM @ 25t ha + azospirillum and Phosphobacteria @ 2 kg ha^{-1}, T_3 –Vermicompost @ 2.5 t ha^{-1} +azospirillum and phosphobacteria @ 2kg ha^{-1}, T_4- Vermicompost @ 5 t ha +azospirillum and phosphobacteria @ 2kg ha^{-1}, T_5- FYM @ 12.5t ha^{-1}+ azospirillum and phosphobacteria@ 2kg ha^{-1}+ panchakavya @ 3 per cent foliar spray, T_6- FYM `@ 25t ha^{-1}+ azospirillum and phosphobacteria @ 2kg ha^{-1}+ panchakavya@ 3per cent foliar spray, T_7 - Vermicompost @ 2.5t ha^{-1}+ azospirillum and phosphobacteria@ 2kg ha^{-1}panchakavya @ 3per cent foliar spray, T_8- Vermicompost @5t ha^{-1}+ azospirillum and phosphobacteria@ 2kg ha^{-1} + Panchakavya @ 3 per cent foliar spray, T_9- FYM@ 12.5t ha^{-1}+ azospirillum and phosphobacteria@ 2kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray T_{10} - FYM @ 25t ha^{-1}+ azospirillum and phosphobacteria @ 2kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray, T_{11} - Vermicompost @2.5t ha^{-1}+ azospirillum and phosphobacteria@ 2kg ha^{-1}+Neemcake extract @ 10 per cent foliar spray, T_{12} –Vermicompost @5t ha^{-1}+ azospirillum and phosphobacteria @ 2kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray, T_{13} - Absolute control.

Observations on growth parameters were recorded on 35 days intervals starting from 70 days after sowing and totally six harvests were made during the study period. Observations were recorded on plant height, number of branches plant^{-1}, number of leaves plant^{-1} and plant spread. The statistical analysis of data was done by Panse and Sukhatme (1985). The critical difference was worked out for 5 per cent level of significance. The IRRISTAT software was used for the statistical analysis of data.

Results and Discussion:

Stem girth (cm)

The data recorded on stem girth due to the effect of various organic nutrients are furnished in Table 1. The treatment T_8 (Vermicompost @ 5t ha^{-1}+ azospirillum and

phosphobacteria @ 2 kg ha^{-1}+ panchakavya @ 3 per cent foliar spray) recorded the highest stem girth of 7.80, 8.42, 8.98, 9.18, 11.72 and, 12.28 cm on (35, 70, 105, 140, 175 and 210 DAP respectively. It was followed by T_{12} (Vermicompost @5t ha^{-1}+ azospirillum and phosphobacteria @2kgha^{-1}+ neemcake extract @10 per cent foliar spray) which recorded 7.45, 8.21, 8.69, 8.87, 11.35 and 11.97 cm at 35, 70, 105, 140, 175 and 210 DAP. The least stem girth was found at T_{13} (control) which recorded 2.16, 4.58, 4.68, 4.78, 5.95 and 7.02 cm at (35, 70, 105, 140, 175 and 210 DAP respectively. The reasons for the increased stem girth might be due to vermicompost which contains major and minor nutrients in available forms, enzymes, antibiotics, vitamins, beneficial microorganisms and other plant growth hormones and have definite advantage over other organic manures in respect of quality and shelf life of produce as stated by Meerabai *et al.* (2001).

Table 1: Effect of organic nutrients management on stem girth (cm) in moringa cv. PKM-1

Treatment	Stem girth (cm)					
	35 DAP	**70 DAP**	**105 DAP**	**140 DAP**	**175 DAP**	**210 DAP**
T_1	2. 75	5. 01	5. 69	4. 70	6. 55	7. 59
T_2	3. 87	5. 71	6. 65	6. 67	7. 67	8. 63
T_3	3. 32	5. 42	5. 48	5. 58	7. 12	8. 12
T_4	4. 40	6. 18	6. 20	6. 24	8. 2	9. 22
T_5	6. 28	7. 46	7. 70	7. 82	10. 12	10. 88
T_6	7. 08	7. 98	8. 38	8. 54	10. 96	11. 64
T_7	5. 40	6. 76	6. 94	7. 02	9. 20	10. 04
T_8	7. 80	8. 42	8. 98	9. 18	11. 72	12. 28
T_9	5. 85	7. 17	7. 33	7. 43	9. 67	10. 47
T_{10}	6. 69	7. 73	8. 05	8. 19	10. 55	11. 27
T_{11}	4. 91	6. 53	6. 53	6. 59	8. 71	9. 59
T_{12}	7. 45	8. 21	8. 69	8. 87	11. 35	11. 97
T_{13}	2. 16	4. 58	4. 68	4. 78	5. 95	7. 02
Grand mean	**5. 22**	**6. 68**	**6. 80**	**6. 88**	**9. 05**	**9. 21**
S. E_D	**0. 10**	**0. 03**	**0. 13**	**0. 14**	**0. 17**	**0. 05**
CD P =(0. 05)	**0. 21**	**0. 07**	**0. 27**	**0. 28**	**0. 36**	**0. 10**

Panchakavya is fermented organic manure with high microbial load which includes effects of microorganisms and methylotrophs profile bacteria, would have enhanced the production of phytohormones like auxin and giberellins that have inturn stimulated the growth by increasing the stem girth as evidenced from the work of Xu *et al.* (2000).

Leaf stalk weight (g)

The data pertaining to the effect of various organic nutrients on leaf stalk weight is presented in Table 2. The treatment T_8 (Vermicompost @5t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-1} + panchakavya @ 3 per cent foliar spray) recorded the highest leaf stalk weight of 36.17, 43.40, 46.27, 49.44, 50.91 and 45.54 g at 35, 70, 105, 140, 175 and 210 DAP respectively.

Table. 2. Effect of organic nutrients on leaf stalk weight (g) in moringa cv. PKM-1

Treatment	Leaf stalk weight (g)					
	35 DAP	**70 DAP**	**105 DAP**	**140 DAP**	**175 DAP**	**210 DAP**
T_1	20. 38	27. 79	28. 56	31. 73	31. 00	24. 28
T_2	23. 46	30. 83	31. 96	35. 30	34. 80	28. 51
T_3	21. 93	29. 32	30. 27	33. 44	32. 91	26. 41
T_4	24. 97	32. 32	33. 63	36. 80	36. 67	30. 50
T_5	30. 73	38. 04	40. 11	43. 28	43. 95	38. 18
T_6	33. 49	40. 76	43. 23	46. 40	47. 47	41. 90
T_7	27. 89	35. 24	36. 91	40. 08	40. 35	34. 38
T_8	36. 17	43. 40	46. 27	49. 44	50. 91	45. 54
T_9	29. 32	36. 65	38. 52	41. 69	42. 16	36. 29
T_{10}	32. 12	39. 41	41. 68	44. 85	45. 72	40. 05
T_{11}	26. 44	33. 79	35. 28	38. 45	38. 52	32. 45
T_{12}	34. 84	42. 09	44. 76	47. 93	49. 20	43. 73
T_{13}	18. 81	26. 24	26. 83	30. 00	29. 07	22. 13
Grand mean	**27. 97**	**35. 28**	**36. 96**	**39. 95**	**40. 58**	**34. 49**
S. E_D	**0. 35**	**0. 47**	**0. 45**	**0. 49**	**0. 47**	**0. 38**
CD P =(0. 05)	**0. 72**	**0. 97**	**0. 92**	**1. 01**	**0. 98**	**0. 79**

It was followed by T_{12} (Vermicompost @ 5 t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray) which recorded 34.84, 42.09, 44.76, 47.93, 49.20 and 43.73 (g) on (35, 70, 105, 140, 175 and 210 DAP. The lowest leaf stalk weight was noted in T_{13} (control) which recorded 18.81, 26.24, 26.83, 30.00, 29.07 and 22.13 g at (35, 70, 105, 140, 175 and 210 DAP) respectively.

Leaflet to stalk ratio

The data pertaining to the effect of various organic nutrients on leaflet to stalk ratio is presented in Table 3.

Table 3: Effect of organic nutrients on leaflet to stalk ratio in moringa cv. PKM-1

Treatment	Leaflet to stalk ratio					
	35 DAP	**70 DAP**	**105 DAP**	**140 DAP**	**175 DAP**	**210 DAP**
T_1	1. 40	1. 48	1. 44	1. 97	2. 08	2. 64
T_2	2. 00	2. 08	2. 16	2. 65	2. 76	3. 24
T_3	1. 71	1. 79	1. 81	2. 32	2. 43	2. 95
T_4	2. 27	2. 35	2. 49	2. 96	3. 07	3. 51
T_5	3. 15	3. 23	3. 61	4. 00	4. 11	4. 39
T_6	3. 47	3. 71	4. 05	4. 40	4. 51	4. 71
T_7	2. 75	2. 83	3. 09	3. 52	3. 63	3. 99
T_8	3. 71	4. 11	4. 41	4. 72	4. 83	4. 95
T_9	2. 96	3. 04	3. 36	3. 77	3. 88	4. 20
T_{10}	3. 32	3. 48	3. 84	4. 21	4. 32	4. 56
T_{11}	2. 52	2. 60	2. 80	3. 52	3. 36	3. 76
T_{12}	3. 60	3. 92	4. 24	4. 57	4. 68	4. 84
T_{13}	1. 07	1. 15	1. 50	1. 60	2. 03	2. 31
Grand mean	**2. 61**	**2. 74**	**2. 98**	**3. 39**	**3. 48**	**3. 84**
S. E_D	**0. 05**	**0. 05**	**0. 06**	**0. 06**	**0. 06**	**0. 07**
CD P =(0. 05)	**0. 10**	**0. 11**	**0. 12**	**0. 13**	**0. 13**	**0. 15**

The treatment T_8 (Vermicompost @ 5tha^{-1}+ azospirillum and phosphobacteria @ 2 kgha^{-1}+ panchakavya @ 3 per cent foliar spray) recorded the highest leaflet to stalk ratio of 3.71, 4.11, 4.41, 4.72, 4.83 and 4.95 at 35, 70, 105, 140, 175 and 210 DAP respectively. It was followed by

T_{12} (Vermicompost @ 5t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray) which recorded 3.60, 3.92, 4.24, 4.57, 4.68 and 4.84 at 35, 70, 105, 140, 175 and 210 DAP respectively.

The lowest leaflet to stalk ratio of was found in T_{13} (control)which recorded 1.07, 1.15, 1.50, 1.60, 2.03 and 2.31 at 35, 70, 105, 140, 175 and 210 DAP respectively.

Herbage yield $plant^{-1}$ (g)

The data recorded on herbage yield per plant due to the effect of various organic nutrients are furnished in Table 4. The treatment T_8 (Vermicompost @ 5 t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-1} + panchakavya @ 3 per cent foliar spray) recorded the highest herbage yield $plant^{-1}$ of 153.93, 192.73, 216.27, 252.38, 241.92 and 234.19 g at 35, 70, 105, 140, 175 and 210 DAP respectively. It was followed by T_{12} (Vermicompost @ 5 t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray) which recorded 148, 186.15, 207.70, 242.81, 231.62 and 226.55 g at 35, 70, 105, 140, 175 and 210 DAP respectively.

The herbage yield $plant^{-1}$ was the found at T_{13} (control) which recorded 91.05, 113.77, 113.43, 137.54, 118.32 and 142.51 g at 35, 70, 105, 140, 175 and 210 DAP respectively.

Among the various organic treatments the soil application of vermicompost @ 5 t ha^{-1} along with azospirillum and phosphobacteria @ 2kg ha^{-1} and foliar spray of panchakavya @ 3 per cent resulted in increased herbage yield $plant^{-1}$ and yield $plot^{-1}$. The increase in yield attributes might be due to the application of organic source of fertilizers *viz.*, vermicompost, azospirillum, phosphobacteria, which increases the growth and yield resulting in higher photosynthetic rate in plants leading to enhanced yield. This enhanced yield because of vermicompost might be due to the presence of more amount of available nitrogen, which is essential for the synthesis of structural proteins (Edwards, 1998).

The yield and its components in the best treatment might be due to the panchakavya spray. Panchakavya spray had significantly increased the yield parameters due to the fact that panchakavya contains auxins and gibberellins which favored cell elongation. Another reason for increase in number of leaves, fresh and dry weight of leaves and herbage yield could be due to panchakavya resulting in enhanced release of nitrogen from the growth promoting substances produced by the microbes present in panchakavya which might have resulted in the induction of more laterals and high number of leaves and also presence of adequate quantity of enzymes present in cells favoured rapid growth. The nitrogen content in cells due to natural panchakavya spray would have contributed to the buildup of in the cells formation of enzymes needed for rapid growth. This view was supported by the findings of Sivakumar (2004) in *Solanum nigrum*

and Vasumathi (2001) in *Phyllanthus amarus*. Latha and Veena (2013) reported that the application of organics mainly biofertilizers attributed to better growth of plants and higher yields by slow release of nutrients for absorption with additional production of plant growth promoting substances like Giberellin, Cytokinin and Auxins.

Latha and Veena (2013) reported that the application of organics mainly biofertilizers attributed to better growth of plants and higher yields by slow release of nutrients for absorption with additional production of plant growth promoting substances like Giberellin, Cytokinin and Auxins.

Table 4: Effect of organic nutrients on herbage yield plant^{-1} (g) in moringa cv. PKM-1

Treatment	Herbage yield plant^{-1} (g)					
	35 DAP	**70 DAP**	**105 DAP**	**140 DAP**	**175 DAP**	**210 DAP**
T_1	96. 29	120. 35	122. 10	147. 11	128. 62	150. 15
T_2	106. 77	133. 51	139. 14	166. 25	149. 22	165. 43
T_3	101. 53	126. 93	130. 57	156. 68	138. 92	157. 79
T_4	112. 01	140. 09	147. 71	175. 82	159. 52	173. 07
T_5	132. 97	166. 41	181. 99	214. 10	200. 72	203. 63
T_6	143. 45	179. 57	199. 13	233. 24	221. 32	218. 91
T_7	122. 49	153. 25	164. 85	194. 96	180. 12	188. 35
T_8	153. 93	192. 73	216. 27	252. 38	241. 92	234. 19
T_9	127. 73	159. 83	173. 42	204. 53	190. 42	195. 99
T_{10}	138. 21	172. 99	190. 56	223. 67	211. 02	211. 27
T_{11}	117. 25	146. 67	156. 28	185. 39	169. 82	180. 71
T_{12}	148. 69	186. 15	207. 70	242. 81	231. 62	226. 55
T_{13}	91. 05	113. 77	113. 43	137. 54	118. 32	142. 51
Grand mean	**123. 51**	**154. 47**	**166. 37**	**196. 51**	**181. 78**	**189. 58**
S. E_D	**1. 40**	**1. 59**	**1. 75**	**2. 17**	**1. 92**	**1. 99**
CD P =(0. 05)	**2. 91**	**3. 28**	**3. 61**	**4. 48**	**3. 98**	**4. 11**

Dry matter production (g plant^{-1})

The observations recorded on total dry matter production are presented in Table 5. The organic inputs significantly influenced the dry matter production of the plant. Among the different treatments T_8 (Vermicompost @ 5 t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-}

^{1}+ panchakavya @ 3 per cent foliar spray) recorded the highest dry matter production of 53.75 g plant$^{-1.}$

Table 5: Effect of organic nutrients on dry matter production (g plant^{-1}) in moringa cv. PKM-1

Treatment	Dry matter production (g plant^{-1})
T_1	41. 76
T_2	43. 76
T_3	42. 75
T_4	44. 79
T_5	49. 11
T_6	51. 39
T_7	46. 59
T_8	53. 75
T_9	48. 60
T_{10}	50. 24
T_{11}	45. 84
T_{12}	52. 56
T_{13}	40. 79
Grand mean	**47. 26**
S. E_D	**1. 02**
CD p =(0. 05)	**2. 11**

It was followed by T_{12} (Vermicompost @ 5 t ha^{-1}+ azospirillum and phosphobacteria@ 2 kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray) which recorded 52.56 g plant^{-1} of dry matter production and the lowest value recorded was40.79g plant^{-1}in T_{13} (control). Productivity of the crop is primarily is a resultant function of dry matter production. The increased dry matter production was result of better plant growth as reflected by increased plant height, more branching, higher number of leaves and leaf area. The dry matter production was found to be significantly higher in the treatment which received combined application of vermicompost @ 5 t ha^{-1} along with azospirillum and phosphobacteria @ 2kg ha^{-1} and foliar spray of panchakavya @ 3 per cent followed by Vermicompost @5t ha^{-1}+ azospirillum and phosphobacteria@ 2kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray. Higher production of dry matter by the plant could be due to the fact that organic manures have high amounts of humus matter, facilitate N-

fixation by the microbes, regulate the nitrogen supply to the plants and also helps in the production of plant growth promoters. The results are in conformity with reports given by Rao and Ravisankar, (2001)

Dry powder recovery

The data on estimates of dry powder recovery of plants is presented in Table 6. The treatment T_8 (Vermicompost @ 5 t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-1}+ panchakavya @ 3 per cent foliar spray) recorded the highest dry powder recovery of 96.03 per cent. It was followed by treatment T_{12} (Vermicompost @ 5 t ha^{-1}+ azospirillum and phosphobacteria @ 2 kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray) which recorded 94.42 per cent respectively. The lowest value was observed 89.28 per cent in T_{13} (control) respectively.

Table 6: Effect of organic nutrients on dry powder recovery in moringa cv. PKM-1

Treatment	Dry powder recovery (per cent)
T_1	90. 85
T_2	92. 50
T_3	91. 34
T_4	92. 80
T_5	93. 76
T_6	94. 47
T_7	93. 41
T_8	96. 03
T_9	93. 70
T_{10}	93. 84
T_{11}	93. 36
T_{12}	94. 42
T_{13}	89. 28
Grand mean	**93. 19**
S. E_D	**0. 69**
CD p =(0. 05)	**1. 43**

Drying is the most common method of enhancing shelf life of leafy vegetables. The dried green leafy vegetables are mostly used in powder form, which reduces the volume required for storage and easy of handling. Moisture left in the dried foods varies between 2- 30 per cent depending on the type of food. The prime objectives of drying apart from extended storage life

can also be quality enhancement, ease of handling, further processing and sanitation and is probably the oldest method of food preservation practiced by humankind Mujumdar, (2007). The dry powder recovery was found to be significantly higher in the treatment which received combined application of vermicompost @ 5 t ha^{-1} along with azospirillum and phosphobacteria @ 2kg ha^{-1} and foliar spray of panchakavya @ 3 per cent followed by Vermicompost @5t ha^{-1}+ azospirillum and phosphobacteria@ 2kg ha^{-1}+ neemcake extract @ 10 per cent foliar spray.

Conclusion:

It can be concluded that the treatment T_8 (Vermicompost @ 5t ha^{-1}+ azospirillum and phosphobacteria @ 2kg ha^{-1}+ panchakavya @ 3 per cent foliar spray) can be adjudged as the best treatment for enhancing the leaf production ofmoringa cv. PKM-1.

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AWRENESS AND ADVATAGES OF LOW COST REGISTER BASED ON 'UAV' TECHNOLOGY, GIS TECHNIQUES USED IN AGRICULTURE

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Abstract:

The numbers of tasks that nowadays are accomplished by using unmanned aerial vehiclesis rising across many civil applications, including agriculture. Thus, this work aims at providing thereader with an overview of the agronomical use of unmanned aerial vehicles. The work starts with ahistorical analysis of the use of aircrafts in agriculture, as pioneers of their use in modern precisionagriculture techniques, currently applied by a high number of users. Agricultural UAV-based remote sensing tools to facilitate decision-making for increasing productivity in developing countries were developed and tested. Specifically, a high-quality multispectral sensor and sophisticated-yet-user-friendly data processing techniques (software) under an open-access policy were implemented. Also, a set of software tools that included wavelet-based image alignment, image stitching, and crop classification have been implemented and made available to the remote sensing community. The resulting agricultural register provides a true picture of the reality on the ground but also an important volume of descriptive data associated with each entity in the experimental site. Geospatial data obtained through UAV and GIS techniques can be integrated into studies or analyzes together with other environmental data (climatic, pedological, geological, socio-economic data) and can be a support in making management or organization decisions.

Keywords: UAV, GIS, agricultural register, experimental lot, crops

Introduction:

In the past, drones and in general all UAV (Unmanned Aerial Vehicle) technologies were developed and intended especially for the military field, but with the technical and technological progress in other fields of activity, these technologies have a great applicability, with remarkable results and methods of non-destructive work, in other words, offers enormous benefits and opportunities in a wide range of disciplines Remote sensing techniques play an essential role in agricultural applications including crop and soil monitoring, natural resource management, irrigation and fertilization methods, and non-invasive plant diseases detection (Moran *et al.*, 1997; Chavez *et al.*, 2012). Temporal and spatial variability in agricultural areas can be assessed

through multispectral aerial images as spectral properties are associated with physiological responses to crop management and environmental conditions. Depending on the area to be covered and the desired spatial resolution, images can be acquiredNot only drone manufacturers, but also Unmanned Aerial System (UAS) providers, which incorporate application-oriented elements to the UAVs are developing custom made solutions to effectively handle the needs of the end users. Thus, advances in UAV technologies have made it possible for the companies to produce a wide range of models in different sizes, weights and shapes, capable of carrying different sensor payloads. Although smallholding farming contributes about 70% of food globally (Wolfenson, 2013), the diversity of their cropping systems is not accurately captured by national crop statistics. Infact, crop statistical data are important tools for planning, policy-making, and timely intervening to address food insecurity. A data gathering system that cangenerate sufficiently accurate crop statistics right from the farm, rather than from the markets, has the potential to contribute to interested user keen to finalised sound selection, considering their needs and budget by improving crop production and inform decision makers to both commercial and our open-source solutions. A UAV-based on two main remote sensing system components:

(1) To providing support for a given payload by the platform or vehicle which gives the stability needed for the data acquisition, and

(2) For data acquisition from a given target, the sensors are used.

Several options can be found in the market ranging from specialized ready-to-use systems usually associated with high prices. The final user to have technical knowledge in several areas such as electronics, mechanics, and software usage for DIY solutions. Hence, although this section mainly aims to show the implementation of a low-cost multispectral camera, we briefly mention the commercial options for the UAV platforms. The Integrated Multi-spectral Agricultural (IMAGRI -CIP) camera system that we developed was designed to measure high signal-to-noise ratio (SNR) red and NIR images and thus obtains a reliable normalized difference vegetation index (NDVI) estimation. IMAGRI-CIP implementation followed the multiple camera approach given by Yang (2012). Thus, the system is composed of a pcDuino1 embedded computer, two identical monochrome cameras (Chameleon, Point Grey, Canada), two lenses (Edmund Optics, Barrington, NJ), and two filters (Andover Corporation, Salem, NH) (see Fig. 1). The pcDuino1 is a 1-Ghz ARM Cortex A8 processor-based system with the Lubuntu Linux (12.04) operating system. It has two USB 2.0 ports which are used to handle the two cameras

Our analyzation results in a assessment of developed technology through a temporal NDVI study of sugar beet crops against a commercial camera describing the application of this technology to small holding cropping areas. Now we discuss the cost reduction in open-access tools for viability of using hybrid commercial/open-source options, also their respective pros and

cons, as well as theimportent implications of the use of this technology by professionals serving farmer communities. Unlike commercial services that used fix wing solutions for crop dusting, Yamaha developed probably the first Unmanned Aerial Vehicle (UAV) applied to farms in 1997 by using a rotary wing aircraft picture shows. Using helicopters showed big advantages in field spraying due to their high maneuverability, reduced speed and velocity and thepositive impact of the airflow from the rotor in spraying tasks. This was possible due to Prof. M. Sugeno for controlling unstable systems such as helicopters.

Figure 1: Unmanned Aerial Vehicle (UAV)

Location of the study area:

The experimental group considered a case study in this paper is located south of Lovrinlocality, Timiş County (Fig. 2) and belongs to SCDA Lovrin.

Figure 2: Location of the study area (processing after Google Images)

Research methodology:

The working methodology involved several steps, as follows:

1. **Location of the area of interest:** In this stage GPS coordinates purchased from the field were used, depending on which the area was located on the map and in the specialized software;
2. **Acquisition of data with DJI Phantom 4 Pro** UAV equipment, a stage that involved (SIMON *et al.,* 2020)

- Mission planning and setting of flight parameters in the Pix4Dcapture application

- Flying over the area of interest
- Downloading purchased images

-Preprocessing and processing of acquired aerial images, through the Agisoft Photo Scan Professional application: alignment, georeferencing of images, creation of 2D and 3D models and as a final stage, generation of the orthophotoplan;

3. Extraction of information in vector format: The AutoCAD Map 3D 2016 software was used, in which, from the orthophotoplan, the cultivated plots, roads, access roads, were delimited (SIMON *et al.*, 2017);

4. Data processing in the GIS environment: In this stage the descriptive database was created and the cartographic materials were generated.

Aerial image processing in CAD environment

The orthophotoplan in Stereo 70 coordinates, generated in the previous stage was imported in the AutoCAD Map 3D 2016 program. In this program were delimited, by vectorization, the cultivated plots but also the other elements in their vicinity, etc). The result was a georeferenced vector map containing the outline of each entity in the field (Fig.3).

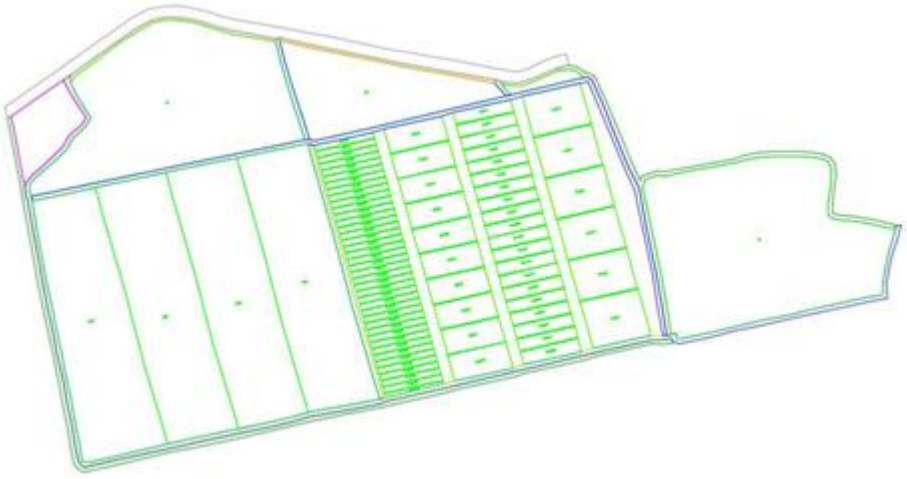

Figure 3: Extraction of information in vector format in the CAD environment

Conclusions:

As previously stated, there are many advantages of using UAVs in agriculture:

By integrating and processing UAV products in the GIS environment, vector data and descriptive databases are obtained that ensure:

- Visualization of the components of the experimental site according to different query criteria (attributes entered in the database according to the needs of the beneficiaries);
- Mapping and signaling of "obstacles" or areas that require "special" works (areas with excess moisture, erosion, unproductive, etc.);

- The creation of a complex agricultural register which, in addition to the graphic representation of the cultivated plots, also contains specific descriptive information, associated to each entity;
- The possibility to easily update the databases, depending on the changes produced from one season to another or from one year to another. Geospatial data obtained through uav and gis techniques can be integrated into studies or analyses together with other environmental data (climatic, pedagogical, geological, socio-economic data) and can be a support in making management or organization decisions

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G- MAPPING: PLANTATION, CONSERVATION, REGULAR MONITORING, AND AWARENESS OF PLANTS

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Abstract:

The article deals with the new innovative idea for Plantation, Conservation, Regular Monitoring, and Awareness of Plants. Conservation with G-Mapping of Endangered Plant Species under this titled project many plants are planted and at the same time information of plants with the actual photo will be published in customized Google Map.

Keywords: G- Mapping, Endangered, Conservation, and Google Map.

Introduction:

Changing forest cover is a major contributor to local climate change around the world, as it impacts both reflectance and evapotranspiration (ET). Deforestation and forestation are expected to have opposing effects on surface reflectance and ET rates, resulting in distinct impacts on local surface temperatures. Relationships between forest change, reflectivity, ET, and local temperatures may vary significantly regionally as the intensities of warming by reflectivity and cooling by ET vary with latitude (Prevedello *et al.*, 2019). Continuous illegal tree cutting has harmed the country's microclimatic conditions, hydrological cycle, soil quality, biodiversity, and so on, making the country more vulnerable to any untoward incident. Sustainable forest management techniques, alternatives to shifting agriculture, encouragement of plantation outside the forest, and use of certified forest products, among other things, are some of the steps that can be used to slow the rate of deforestation (Rima Kumari *et al.*, 2020). In 2010, India had 31.3Mha of natural forest, extending over 11% of its land area. In 2020, it lost 132kha of natural forest, equivalent to 67.3Mt of CO_2 of emissions. In the case of Maharashtra state from 2002 to 2020, the state lost 789ha of humid primary forest, making up 4.5% of its total tree cover loss in the same period. The total area of humid primary forest in the state decreased by 0.94% in this period From 2001 to 2020, the state lost 18.3kha of tree cover, equivalent to a 1.7% decrease in tree cover since 2000, and 8.00Mt of CO_2 emissions. The same scenario is shown by another state also [3].

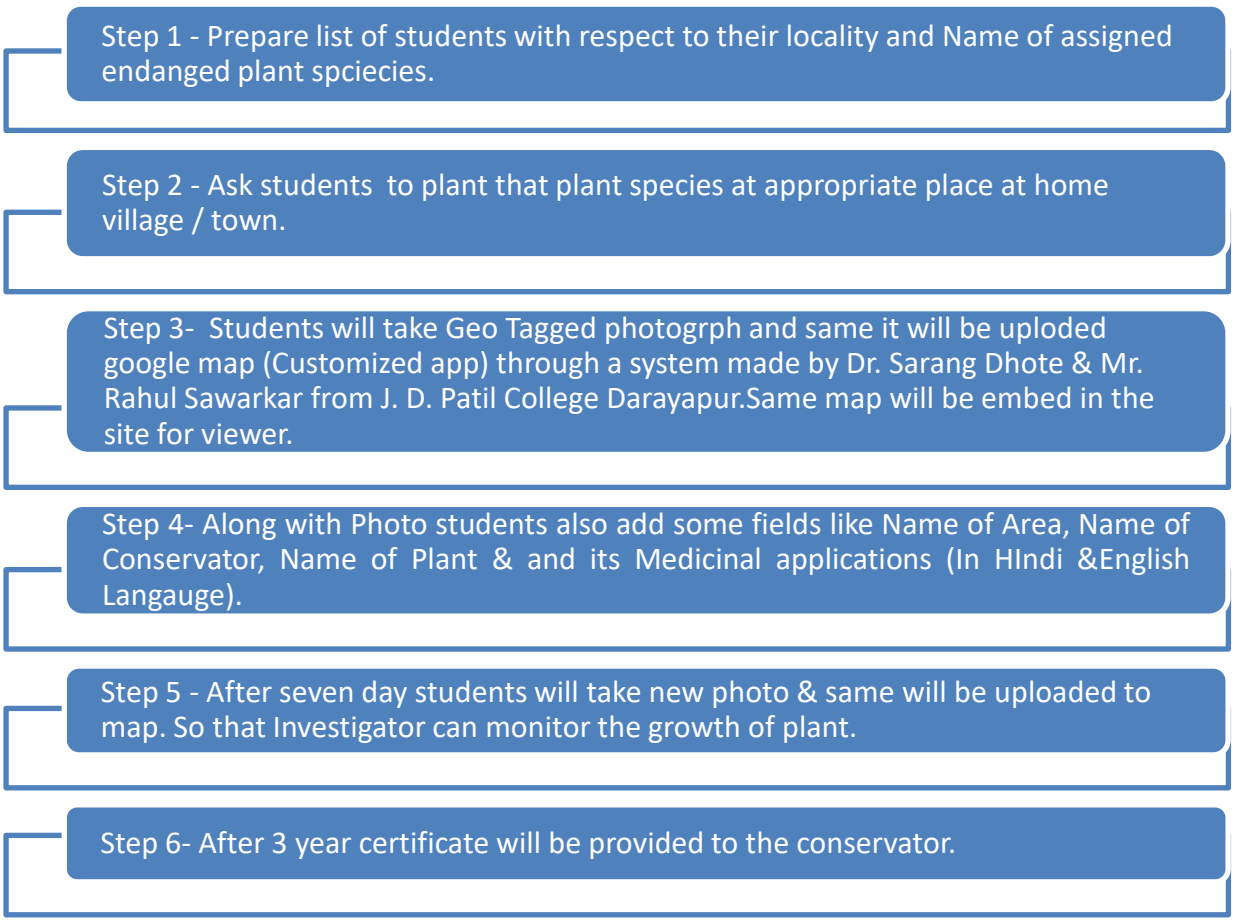
Apart from this Government launched many schemes for plantation and awareness.In 2016-17, the Sub-Mission on Agroforestry (Har Medh Par Ped) Scheme was created to

encourage tree planting on farmland in conjunction with crops/cropping systems to enable farmers to earn additional revenue while also making their agricultural systems more climate-resilient and adaptive. The scheme is being implemented in 20 states, namely Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, M.P., Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Mizoram, Meghalaya, Nagaland, and two union territories, namely JandK and Ladakh, with a 60:40 funding [4]. Maharashtra state came with many schemes like Tree Credit, Vanmohotsav, and Awards for those who take the initiative to plant saplings.

Forthe last 4 to 5 years many sampling is planted in various regions but the main problem is how to monitor the growth of each plant. There is no idea whether all the plants are conserved or not. To overcome this problem, we have developed a system along with our college students where we can monitor the growth of each plantregularly without going into the field. The title of this project is "**Conservation with G-Mapping of Endangered Plant Species**."

Methodology:

Flow Chart of Project



One or two plants are assigned to each student of J. D. Patil Sangludkar Mahavidyalaya concerning their native place. After assigning plant species students will plant a given plant at an appropriate place and will take a geotag photo which will be uploaded to the customized android app which is developed by authors. As soon data is received on the server same will be uploaded to Google Map. After seven days again students will take recent GeoTagphotos and the same will be updated on the map concerning geological marking with this one can monitor the growth of plants after seven days.

Like this various plants will be planted, conserved andtheir Information will be populated on the Google map of the Daryapur region. Users other than students and Investigators can see the information of the tree from the map in the form of Name of Plant, Name of Conservator, its medicinal Applications (In Hindi and English Language) and recent geotag photo.

Result:

Currently, this project is run in the Daryapur region. Nearly 150 plants will be mapped in the Google map. Samajik Wanikaran Department of the Daryapur region is now ready for collaboration work with us.

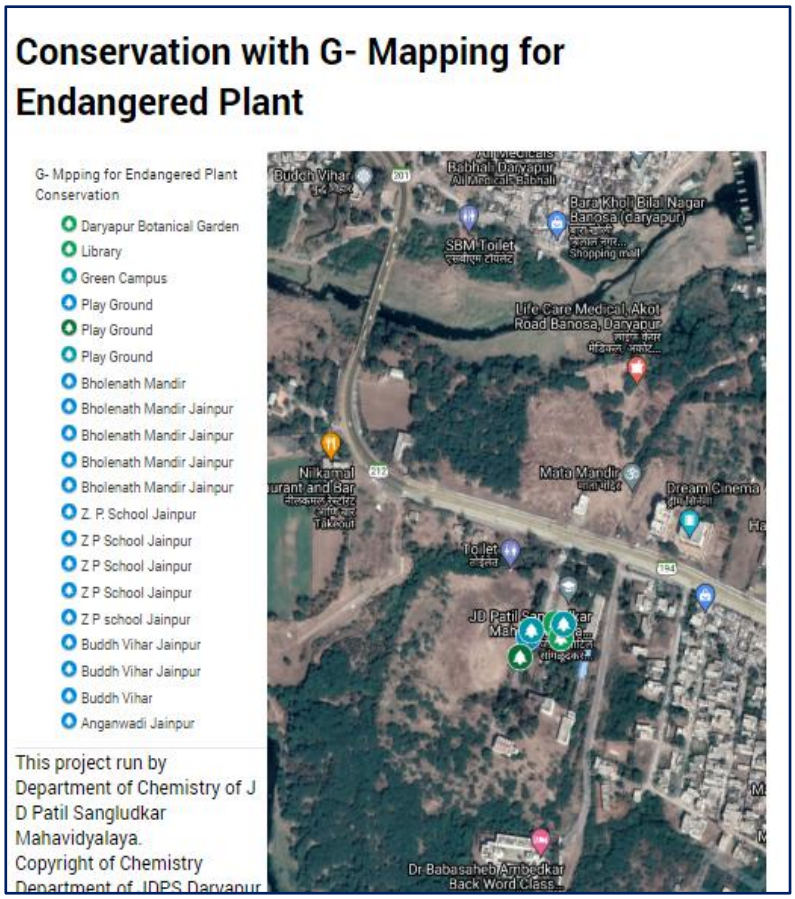


Figure 1: Map showing list of areas mapped under this project

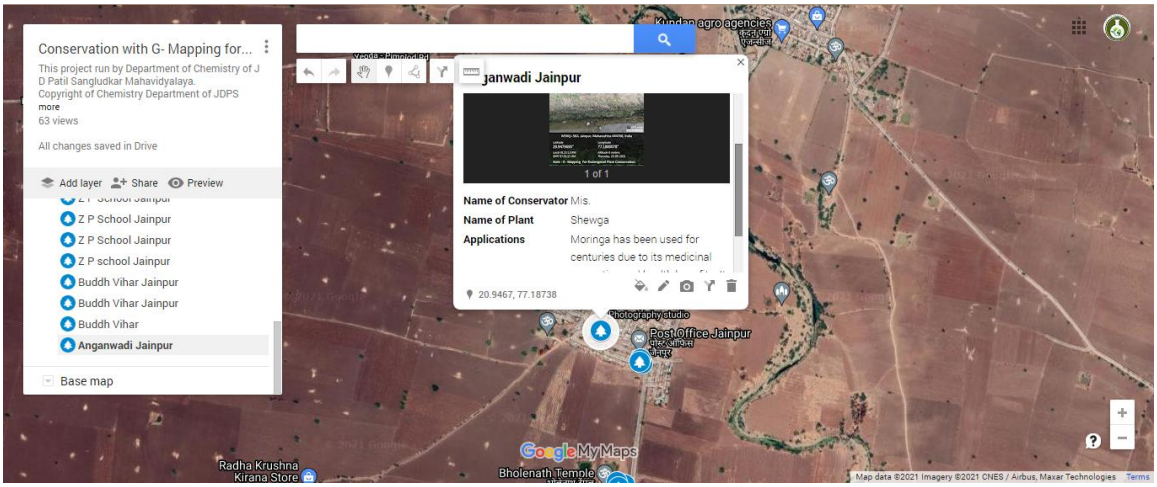


Figure 2: Example of one Plant

Conclusion:

We can conclude that with this system many plants can be only planted but also conserved. Conservators, users, or any person can monitor the growth of plants without field visits.

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HYDROBIOLOGICAL PROFILE AND ITS IMPACT ON AQUATIC LIFE OF RAILWAY STATION POND, GONDIA, MAHARASHTRA

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Abstract:

Railway Station Pond was constructed in 1930 by the Railway Department to supply the water for steam engines and loco sheds. It is located in the heart of Gondia city and is surrounded on three sides by dense habitations and on one side by railway line, near the railway station. It has become highly polluted due to the receipt of untreated sewage, garbage and rubbish from railway station. Studies on the hydrobiology on Railway Station Pond were made on species composition of phytoplanktons, zooplanktons, macrozoobenthos, macroinvertebrates, and macrophytes in relation with physicochemical parametres of water body from June 2006 to May 2007**.** Among phytoplanktons, members of Myxophyceae have shown the dominance over Chlorophyceae and Bacillariophyceae followed by Euglenophyceae. Among the zooplanktons, Rotifers are formed the dominant on copepods, cladocerans and ostracodes. The plankton has shown more abundance during summer season and monsoon while least number was recorded during winter season. The pond water is getting polluted due to inflow of domestic effluents, apart from pollution, resulting from washing of clothes, vehicles, cattle, immersion of Idols during certain festivals etc. All these activities are deteriorating the quality of the water in the lake resulting in the accumulation of the toxic chemicals and other sludge leading to ecological imbalance. However there is an urgent need of an action for conservation to reduce pollution level, to avoid ill effects on human and animal health before it becomes unmanageable.

Introduction:

Water is one of the extremely important ingredient and essential component of life. Fresh water is very essential for the survival of human, animal and plant. Water now a day has a number of hazards such as pollution and reduction in sanitization, which makes it very important for us to focus and reduce consumption and work to develop and maintain sources and resources. Besides survival, water is very essential for irrigation, industries, municipal waste, fisheries,etc.agricultural run off, various chemicals enters in water bodies that changes water

quality and physico-chemical parameters of lakes. Pesticides and heavy metals from agricultural and industrial effluents cause adverse effects on the aquatic animals.

Many nutrients such as Nitrogen and Phosphorus inputs from domestic sewages and fertilizers increase the eutrophication of water bodies (Vass *et al.*, 1989). Lakes are most important ecosystems which plays important role in the life of aquatic animals. They are characterized by distinct biotic and abiotic environment which plays vital role to the maintain ecological balance of flora and fauna and their interrelationship regulate surrounding climate and recharge ground water, but unfortunately they are dying.

Hydrobiological studies on lentic ecosystems are very useful in assessing the deterioration of water quality due to pollution and its importance is highlighted since the time of Applied hydrobiology has a great scope in the healthy existence of inland aquatic ecosystems and in harvesting the natural resources at sustainable level (Goldman and Horne, 1983).

Material and Methods:

Railway Station Pond located at 21. 27' and 39.18" N and 80 11' and 11.67" E and is about 1022 ft. above the mean sea level (MSL) with an area of 0.09 sq. km. Water samples were collected monthly and brought to the laboratory. Physico-chemical parameters like temperature, p^H, dissolved oxygen, free carbon dioxide, chloride, and nutrients like phosphates and nitrates were studied according to (Welch, 1952) and (APHA, 1975). The plankton samples were collected by using standard nylon plankton net made by bolting silk no. 25 planktons were preserved in 4% and identified using (Edmondson, 1959) and other standard manuals. Macro-invertebrates, macrophytes collected and identified by standard methods.

Result and Discussion:

Hydrobiological profile:

Water Temperature:

The temperature plays a very important role in wetland dynamics, affecting other parameters such as salinity, dissolved oxygen, etc. of an aquatic ecosystem and these parameters affects the various chemical and biological reactions. Temperature also affects the speed of chemical changes in water and solubility of gases etc.

Water Temperature in Railway Station Pond ranges between 22^0C to 36^0C with minimum being recorded in December and maximum in the month of May. Similar observations are reported by Shastri *et al.* (2008) in Chingrajpara pond, Bilaspur, that pond water temperature is largely influenced by local climatic condition with minimum temperature in January (20^0C) and

maximum (30.3^0C) in May. Ingole *et al.* (2009) in Majalgaon Dam, Beed, recorded minimum temperature of (23.1^0C) in December and maximum of (31^0C) in May. He further observed that variations in temperature were influenced by metereorological factors such as humidity, winds and solar radiations.

The higher temperature in summer may be due to low water level and shallowness of pond and greater solar radiation with clear atmosphere and winter minima may be due to higher water level, high humidity and lower solar radiations. (Jakher, 2003) showed the winter minima and summer maxima of few manmade lakes in and around Hyderabad (A.P.). Shiddamallaya *et al.* (2008) also reported similar results in Bhalki tank, Bidar.

Table 1: Annual range, Seasonal variations in physicochemical Parameters of Railway Station Pond during 2006-2007

Parameters	Range	Monsoon	Winter	Summer
Water Temperature (°C)	22-36	31.4±1.966	27.9±0.544	34.4±1.556
pH	7.0-8.4	7.5±0.339	8.3±.0.111	7.42±0.227
Dissolved oxygen (mg/l)	2.8-6.0	4.03±0.576	5.4±0.651	3.55±0.763
Free Carbon dioxide (mg/l)	2.7-12.5	7.78±2.002	3.78±0.869	10.13±2.128
Total Alkalinity (mg/l)	180-371	258.25±32.057	240±19.039	336±25.95
Chloride (mg/l)	30.4-79.48	69.95±8.878	55.76±9.983	34.22±3.364
Nitrate (mg/l)	2.90-4.25	3.9± 2.094	3.09±0.128	4.02±0.228
Phosphate (mg/l)	4.70-10.2	7.55 ±.1.433	5.18±0.415	8.64±1.16

pH:

All biologically controlled processes including decomposition of dead organic matter occurs at specific pH values, most of the animal species can survive at narrow range of pH from slightly acidic to slightly alkaline condition.

Seasonally the pH ranged from 7.0 to 8.4, minima recorded during monsoon while maxima recorded during winter in Railway station pond. Vasumathi Reddy et al (2009) in Pakhal lake, Warangal distt, A.P. has reported similar pH value that ranged from 7.2 to 8.2. Jawale *et al.* (2009) in Mangrul Dam, Jalgaon has reported similar observations with the present study.

Dissolved oxygen:

Dissolved oxygen is considered to be lone factor which reveals the nature of the whole aquatic system at a glance, even without the assessment of other physico-chemical and biological parameters. In the water containing large quantity of animals and vegetables decaying matter,

there is great shortage of oxygen, of which the most part is being used up in the process of decomposition (Tonapi, 1980).

Railway Station Pond showed minimum DO in the month of May with 2.8 mg/lit. while maximum in December with 6.0 mg/lit during the study. Ingole *et al.* (2009) reported the DO is essential for growth of algae and fish production. He has recorded higher concentration during winter and early monsoon months and is correlated by its inverse correlation with water temperature. He has observed minimum DO of 3.0 mg/l in summer and maximum of 10.3 mg/l in winter. Shastri (2005) has reported, that is similar results, the minimum DO (4.4 mg/l.) was reported in the summer. Depletion of oxygen in water might be due to addition of sewage. Thirupathaiah *et al.* (2012) reported higher value of dissolved oxygen in winter season while lower value of in summer seasonin lower manair reservoir of Karimnagar district, Andhra Pradesh.

Free Carbon Dioxide:

CO_2 is an end product of both aerobic and anaerobic bacterial oxidation, therefore its concentration is not limited by the amount of dissolved oxygen. Surface water normally contain less than 10 mg/lit free CO_2. The CO_2 content of water depend upon the temperature of water, depth of water, rate of respiration, decomposition of organic matter and chemical nature of the bottom.

In the present study, the minimum free CO_2 was recorded as 2.7 mg/lit in Railway station pond in the month of November and maximum of 12.5 mg/lit during the summer. Bose *et al.* (2008) in two fresh water ponds in Dhanbad, Jharkhand, has also reported minimum value of free CO_2 during winter season.

Total Alkalinity:

A number of bases such as carbonates, bicarbonates, Hydroxide, phosphates, nitrates, silicates, borates etc. contribute to the alkalinity. Thus alkalinity may be expressed as total alkalinity or due to individual bases. Railway station pond showed maximum value of alkalinity during summer season of the study year and minimum during the monsoon. Mukherji *et al.* (2006) reported the maximum total alkalinity in summer with the increase in temperature. Chandrasekhar (2006) in Kondakarla lake, A.P. reported minimum total alkalinity during monsoon and maximum during summer season. Manjare *et al.* (2010) also noted similar results that it was higher in summer and lower in monsoon.

Chloride:

Chloride is universally present in soil and mostly as a soluble ion. The high Chloride concentration is considered to be an indicator of pollution due to organic wastes of animal origin.

The animal excreta contain high quantity of Chloride along with nitrogenous wastes. Most of the lakes and ponds receive Chlorides by leaching through soils and also with runoff from catchment area.

In present study, the minimum Chloride content was recorded in the month of May (2.49 mg/ lit) and the maximum in the month of August (79.48 mg/ lit) in Railway station pond. The maximum chloride content was found in the pond during monsoon season due to high quantity of organic waste of animal origin. Sakhare (2005) in Hingani reservoir, Pangaon reported minimum chloride content during the summer season. Chalkoo (2007) in Wular Lake also reported the maximum chloride content during monsoon season.

Nitrates:

Though nitrogen is a major constituent of atmosphere, it is also found in small amount in the form of ammonia, nitrates, nitrites, organic nitrogen and so on. Maximum value was observed in the Railway station pond in the month of May (4.25 mg/lit) and minimum in the month of December (2.90 mg/lit). In the ponds of Indian deserts, Sharan *et al.* (2007) reported minimum nitrates in December during winter (0.396 mg/l.) and maximum in the month of April during summer (0.960 mg/l.). Dutta *et al.* (2007) also reported maximum nitrates in April (0.45 mg/l.) in ox-bow lakes, Assam. Lower nitrate values were recorded during winter which may be attributed to the abundance of phytoplankton activities of denitrifying bacteria, more quantity of water diluting the pollutants to some extent and decreased activity of microbes at lower temperature. However, higher values in pond recorded during summer season might be due to the presence of higher concentration of nitrogen fixing algae, low water level, more input of nitrogenous effluents.

Phosphates:

Phosphorus bound to rocks is generally insoluble in water so in natural water its content is low. Domestic and industrial effluents and agriculture run off are major sources of Phosphorus in water hence its high concentration indicates the pollution. The value of phosphates ranges from 3.45 to 10.12 mg/l in Railway station pond. The highest value recorded in the pond might be due to high input of domestic sewage, agricultural runoff and anthropogenic activities. Minimum phosphate value during winter may be due to its utilization in macrophytic growth and its sedimentation in the form of ferric complexes in soil due to lower calcium lever and lower temperature, where as higher values during summer can be attributed to high wind speed, decrease in water level due to higher evaporation rate and decomposition of algal population. Maganur, *et al.* (2008) also recorded minimum phosphates during winter in Ranebennur pond,

Haveri district, Karnataka. Ujjainia *et al.* (2007) in different water bodies from S. Rajasthan observed high value of phosphate during summer season.

Phytoplanktons:

Phytoplankton plays a vital role in nutritional cycle of an aquatic ecosystem. The maintenance of a healthy aquatic ecosystem depends on the abiotic properties of water and the biological diversity of the ecosystem. The planktonic study is a very useful tool in understanding the basic nature and general economy of the lake (Pawar *et al.*, 2006).

In the present study, Myxophyceae followed by Chlorophyceae followed by Bacillariophyceae and Euglenophyceae. Myxophyceae Bacillariophyceae have shown the dominance over Chlorophyceae, Bacillariophyceae and followed by Euglenophyceae during the summer season. While during winter Chlorophyceae and Myxophyceae have shown the maximum number and Bacillariophyceae and Euglenophyceae were recorded minimum in number. Seasonal studies on phytoplankton by Kadam *et al.* (2006) in Masoli reservoir, Parbhani have also recorded maximum phytoplankton during summer.

Poor plankton population is due to the utilization of the nutrients by the dense macrophytes. According to Sharma *et al.* (2007) in urban lake system, there is an alarming increase in nitrate and phosphate and phytoplanktons during summer which is mainly due to release of domestic sewage in lake Pichhola.

Zooplanktons:

Water bodies which are rich in phytoplankton are also rich in zooplankton diversity and biomass. Vijaykumar (1992) stated that in an aquatic ecosystem, zooplanktons play an important role not only in converting plant food into animal food but also provide an important food source for other higher organisms including fish.

The Zooplankton was represented Rotifera, Cladocera, Copepoda and Ostracoda in the pond. It was recorded as Rotifera > Copepoda > Cladocera > Ostracoda during study. (Khare, 2005) in Jagat Sagar pond, Chhatarpur, has reported the total zooplankton showed a single peak in the month of April. While lowest during monsoon season. The important zooplankton recorded were- *Brachionus sp., Keratella sp., Daphnia sp., Moina sp., Cyclops sp.*, and *Asplanachna sp.*, etc. He also stated that the population of Rotifers showed a peak in April.

During summer season high density of rotifers might be due to high temperature which is suitable for their growth, reproduction and development and availability of nutrients due to bacterial decomposition. During monsoon season low density of rotifers may be attributed to dilution effect, cloudy weather and low temperature while during winter season, it may coincides with a substantial decrease in temperature in the pond. Jorge *et al.* (2009) reported highest

density and diversity of Rotifers during summer months in Valle de Bravo reservoir, Mexico, due to increase in temperature.

Benthic Macroinvertebrate:

The benthic macroinvertebrate biological communities are most frequently used to evaluate water quality in aquatic environments, and occupy variety of trophic levels, acting on the nutrients, bottom detritus and water column dynamics. It has a great ecological importance because they form the food of fishes and their productivity plays a significant role in sustaining food chain and web.

In the present investigation, the benthic macroinvertebrates consisted of Nematodes, Oligochates, Insects and Gastropodes. Among Nematodes, two species i.e. Helicotylenchus sp. and Rhabtitis sp. were collected from Railway station pond. Number of *Chaetogaster sp., Limnodrillus sp.* and *Brachiura sp.* were collected from the pond. Many workers considered benthic Oligochaetes as indicators of pollution. Among the aquatic insects the indicator species such as Chironomous larvae were recorded in abundance which indicates the polluted status of the pond. The presence of Eristalis species is also an indication of high pollution in the ecosystem.

Lymnea sp. Vivipara sp., Melania sp. abundantly found which indicates the pollutional status of the pond. Among the pelecypods, Lamellidens marginallis were recorded less during the study. Similar results also reported by Arvind Kumar (1999) that Melania *sp.* From Santhal Pargana, Bihar and reported it an indicator of sewage born heavy pollution and hyper eutrophication. Mollusca showed their dominance, this might be due to the adequate availability of Calcium.

Macrophytes:

The macrophytes stimulate the growth of phytoplankton and help in the recycling of organic matter. The macrophytes also provide suitable breeding and sheltering place for macroinvertebrates and fishes (Meshram, 2003).

In the present study, 21 species from four groups were recorded from the pond. Free floating species were abundant in the pond. Submerged and Emergent species were recorded less while marginal species showed their dominance. In the present study, in free floating weeds, *Eichhornia crassipes, Pistia sp.*, Lemna minor were recorded thick distribution and are considered as pollution tolerant species. Among the marginal weeds, *Cyperus sp., Marsilea quadrifolia, Marsilea minuta, Typha sp.* and *Ipomoea aquatica* were recorded. The Railway Station pond showed the thick mat of *Eichhornia crassipes, Pistia sp.*, and *Lemna minor* in summer season which is the result of high nutrient load in the ponds (Table 2). The distribution of different

aquatic macrophytes was correlated with an increase in phosphate and nitrogen content of water bodies. It is probably that these nutrients stimulate the rapid organic production by aquatic macrophytes (Sarkar *et al.*, 2008).

Table 2: Macrophytes Diversity in Railway Station Pond (R.P.) during the study

Sr. No.	Macrophytes	Family	R.P
A	**Free Floating**		
1	*Eichhornia Sp.*		+
2	*Pistia Sp.*	Araceae	+
3	*Lemna minor*	Lemnaceae	+
4	*Wolffia Sp.*	Lemnaceae	+
5	*Salvinia Sp.*	Salviniaceae	+
B	**Submerged**		
7	*Hydrilla Sp.*	Hydrocharitaceae	−
8	*Ceratophyllum Sp.*	Hydrocharitaceae	−
9	*Vallisnaria Sp.*	Hydrocharitaceae	−
10	*Potomogeton Sp.*	Najadaceae	+
12	*Chara vulgaris*		−
C	**Marginal**		
13	*Marsilea quadrifolia*	Marsilaceae	+
14	*Marsilea minuta*	Marsilaceae	+
15	*Ipomoea aquatica*	Convolvulaceae	+
16	*Typha Sp.*	Typhaceae	+
17	*Cyperus Sp.*	Cyperaceae	+
20	*Jussiaea Sp.*	Onagraceae	−
21	*Ludwigia Sp.*	Onagraceae	−

Fish Fauna:

Fishes are very useful indices of the real state of purity of water. Natural waters have more stable conditions which the fish evolve hence enlisting biodiversity and its distribution. In the present investigation, very few species of fishes were recorded from Railway Station pond which is highly polluted. Fish composition and species richness are the biological parameters most affected by anthropogenic activities and domestic pollution.

Summary:

Hydrobiological profile and its impact on aquatic life of Railway Station Pond was investigated. During the study, the results revealed well defined seasonal variations. Physico-chemical parameters such as temperature, dissolved oxygen, total alkalinity and nutrients are very much favourable for flora and fauna. The plankton consisted of phytoplankters and zooplankters. 43 species of phytoplanktons and 24 species of zooplanktons were recorded . Among the phytoplanktons, the order of dominance is Myxophyceae > Chlorophyceae > Bacillariophyceae > Euglenophyceae. While among the zooplankton the order of dominance is Rotifera > Copepoda > Cladocera > Ostracoda.

The benthic macroinvertebrates belonged to Nematoda, Annelida, Insecta and Gastropoda. Among the macrophytes, 21 species were recorded from free floating, submerged, marginal and Emergent types. The ichthyofaunal diversity composed of 27 species belonging to 05 orders and 13 families were identified. On the whole, this pond water is getting polluted due to human activities,discharge of drainage water, agricultural run off and human excreta. The incidence of asthma, dysentry, malaria, respiratory tuberculosis and the skin diseases were observed high in the population in nearby areas.

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EFFECTS OF ENVIRONMENTAL POLLUTANTS ON PUBLIC HEALTH

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Abstract:

Pollutants escape to the environment by a number of natural and/or man-madeactivities and may cause adverse effects on human health and the environment. The human health is adversely affected by environmental pollutants, the pollutants can be air pollutant, water pollutant or soil pollutants.Human health is affected not only by pollutants but various factors like as inadequate nutrition, bad sanitation, collapse of the health care system and pollution. Environmental pollutants have various adverse health effects from early life some of the most important harmful effects are infant mortality, respiratory disorders, allergy, malignancies, cardiovascular disorders and various other harmful effects. Environmental pollutants have both acute and chronic effects on human health, affecting a number of different systems and organs

Keywords: Human health, Environmental pollutants, harmful effects and pollution.

Introduction:

Environmental pollution is reaching major proportions worldwide. The 20th century has seen an extraordinary global transformation on human health. Urbanization as well as industrialization has led to increase energy consumption and lots of waste discharges. Various harmful effects include infant's mortality, mental disorders, cardiovascular disorders, chronic diseases, malignancies, allergy, and increase stress in oxidationetc. Preventive and therapeutive effects have being taken to control natural environmental quality and quantity. Therefore it time to take action and control the pollution. Otherwise, the environmental waste products will degrade environment.

Environmental health is that aspect public health which is Concerned with those forms of life substances, Conditions and forces, present in the surroundings have adverse effects on man's health and well-being, Health may be defined as physical, mental and social well-being of man.In healthy person there is complete absence of disease. There are lots of diseases which are

associated with pollution. Human health is a resulting complex interaction between his internal biological system and external environmental system.

Environmental pollutants have bad concequences on health from early life. Many studies have exposed that environmental pollutants are linked to increased risk of morbidity and mortality from many diseases.

Man is exposed to a variety of environmental hazards. Sometimes, man- made hazards are direct in their impact. The following are environmental hazards:

1) Chemical 2) Sociological 3) psychological 4)Physical

Prior to have first hand information about "Environmental Pollution" is it is necessary to understand "pollution". Environmental pollution is contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected.

Kinds of pollution:

1. Natural Pollution: Environment is affected by natural phenomenon, such as earthquakes, floods, drought, cyclones, etc.

2. Man-made Pollution: Human activities.

The environmental pollution can also be classified further as, Air pollution, water pollution, land pollution, food pollution, noise pollution and radio-active pollution, etc.

Environmental Pollution:

Pollution is defined as the addition of harmful substances in environment.The substances which causes pollution are known as pollutants. Pollutants may be solids, liquids, or gases and their higher concentration affects the quality of environment.

Environmental pollution is the act of introduction by man, or extraneous substances or energy into the environment that induces unfavorable changes. These changes may affect man directly or indirectly by affecting his health, harming his living resources and ecosystem, or by interfering with legitimate uses of the environment.

Environmental pollution causes health problems by affecting human health and lives. Environmental deterioration by man is attributed to three major causative factors.

1) Overpopulation

2) Urbanization

3) Industrialization

Environmental pollution and health problems:

The environment is a combination of the biotic (living organisms) and the abiotic (lithosphere, atmosphere and hydrosphere). The relationship between human health and the environment is a two-way process. Today all have improve their life style but the alterations of the environment may cause harmful effects on health. Environmental pollutants are causing adverse health effects from early life some of the most important harmful effects are perinatal disorders, infant mortality, respiratory disorders, allergy, malignancies, cardiovascular disorders, and increase in stress oxidative, endothelial dysfunction, mental disorders, and various other harmful effects. We all should join hands to control the pollution. Otherwise, the various pollutants from agriculture, mining, manufacturing, transportation, and all other human activities will degrade the environment.

Environment surrounding has very important role on human health. The nature of the air, water, temperature, soil, barometric pressure, cloud, rainfall, humidity and latitude, must all determine man's health. It is rightly said that, if wealth is lost something is lost, but if health is lost than everything is lost. Health and disease are related, for if disease did not exist it would be irrelevant to talk of health. The two states are contrasted in our minds; as if it were the two sides or a coin.

After understanding the interrelationship of health and environment we should understand the magnitude of public health impact. The public awareness should be increased in this regard. Health professionals have an exclusive competency to help for prevention and reduction of the harmful effects of environmental factors, this capacity should be underscored in their usual practice.

- The quality of life is directly dependent on the quality of the environment.
- The concepts of "pure" water, "pure" food, "clean" air, and "clean" neighborhood help to decrease disease rate.
- The quality of the environment help to measure -"a way of life".

Hence, it is important to take an ecological approach to environment with man as part of an ecosystem. Man has the power, but it remains for him to exercise his will and wisdom, to change the environment for thebetterment of his physical, mental, and social well-being healthy environment provides a healthy body and a healthy mind, which is necessary for human happiness.

Various human activities adversely effect the environment by polluting the water we drink, the soil in which plants grow and the air we breathe. Nowadays the use of technology leads to the elimination of various pollutants in the environment, which effects human health and also entire ecosystem. Without any doubt, the global environmental pollution is considered an

international public health issue with multiple facets. Environmental pollution affects Social, economic, legislative concerns and lifestyle habitsof each and every living organism. Urbanization and industrialization causes various types of pollution such as air, water, soil etc.

Developing countries face many problems due to overpopulation and uncontrolled urbanization along with the development of industrialization. This causes poor air quality, especially in countries with social disparities.The use of fuels such as wood fuel or solid fuel for domestic needs due to low incomes exposes people to bad-quality, polluted air at home.

Air pollution has many health effects. The susceptible and sensitive individuals can be affected by air pollution. Short-term exposure to air pollutants is closely related to COPD (Chronic Obstructive Pulmonary Disease), cough, shortness of breath, wheezing, asthma, respiratory disease etc. Air pollution affects all those living in large urban areas, where road emissions contribute to low down the quality of air. Industrial accidents spread toxic fog which can be fatal to the populations of the surrounding areas. The spread of pollutants is determined by many parameters, like atmospheric stability, wind and many more.

Most commonly occurring water pollutants are Domestic Waste, Industrial effluents, Insecticides, pesticides and Detergents and Fertilizers. Some direct sources of water pollution factories, waste management facilities, refineries, etc, and some indirect sources water bodies via groundwater or soil or via the atmosphere as acid rain. In humans, drinking or consuming polluted water may cause various diseases such as typhoid, cholera; hepatitis etc. Water pollution effects the food chain. Polluted water are consumed by aquatic animals (fish, shellfish etc) which are then consumed by humans.

Soil pollution causes many health issues like nausea, headache, fatigue, skin rashes, eye irritation and more serious problems like kidney and liver damage, cancer etc.

Soil pollution:

- Agriculture soil pollution caused due to the excessive use of pesticides and insecticides.
- Soil Pollution by industrial discharges of chemicals from mining and manufacturing of goods.
- Solid wastesoil pollution/ Poor management or inefficient disposal of waste.
- Soil Pollution due to urban activities.

Sources of environmental pollutants exposure:

Environment pollution is one of the most major problem of the 21st century and one that currently poses the greatest threat to humanity and its lifestyle. Environmental exposures refer to the exposures of people to pollutants found in their environment. Although some environments may containenvironmental pollutant agents in amounts that aren’t hazardous to human health and

are technically legal but prolonged and frequent exposure to pollutants may cause severe, chronic and acute health problems.

Exposure refers to the contact with environmental pollutant agents. Since, if we don't make contact with hazardous substances, they are not a threat to our health. But, even if we are in contact with such substances, their level of severity depends on pollutant amount.

While evaluating the dose of a certain dangerous substance, bodyweight is an important factor to take into consideration. For example, when a child is exposed to the same amount of pollutant as an adult, it may harm them more.

The larger the amount of environmental pollutant exposed to, the bigger the chances it will affect our health. So if a environmental pollutant not considered dangerous, in large amounts it can become toxic.

Routes of environmental exposures:

The term "routes of exposure" refers to different ways toxic pollutants can enter body or just come into contact with it.

For example, inhalation of dust, vapors or gases is one of the most common routes. There are different ways pollutants can enter through our nose, go through the air passages and then end up in our lungs. Pollutants are absorbed in the lungs, these chemicals enter the bloodstream and are distributed to the rest of our body.

Direct contact is when environmental pollutants are absorbed through our eyes or skin, after which they enter the bloodstream. When people have cracked or cut skin, these pollutants are more likely to enter the body.

Ingestion is when human absorb pollutants found in food, drinks, cigarettes etc. by swallowing them. Children are more suspectibleto get poisoned this way, as they often put their fingers in their mouths. Just like with the other routes, after they are ingested, the pollutants enter our bloodstream and then spread through the whole body.

Pollutants and Health:

Studies have shown a relationship between environmental pollutants and adverse health effects, focusing on either short-term (acute) or long-term (chronic) exposure. Environmental pollutants is usually formed in the atmosphere as a result of chemical reactions. The penetration of pollutant is closely dependent on their size. Environmental pollutants includes particles with diameters of 10 micrometers (μm) or smaller, called and extremely fine particles with diameters that are generally 2.5 micrometers (μm) and smaller.

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METHOD OF PRESERVATION OF VEGETABLE, FRUITS, GRAINS AND DAIRY FOODS

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Abstract:

Fruits and vegetables are perishable items but having innumerable vitamins minerals proteins etc. hence if we are able to preserve them for being used around the year whenever we need, it will be a fantastic and useful idea. Among all these methods the mainly used methods are salting, pickling, canning, freezing, cooking etc. A seasonal vegetable or fruit will be a blessing if it can be preserved and used throughout the year in all seasons. Many of fruits can be preserved in the form of jam as well as canning and bottling can help us preserve the vitamins like vitamin c in in this fruits. The grains can be preserved without any damage attack by parasites by keeping them dry I and clean for long period. Milk like products can be e reserved with the help of concentration for converting into cheese or cream and the fats also can be preserved herewith. The present paper ore aims at showing the different methods of preservation of vegetables and fruits for the better use of all these ingredients in our diet.

Introduction:

Practiced methods of preservation are to have vegetable available when out of session. Her Methods picking, salting and drying have been followed by modern procedures such as canning, freezing and dehydration. All these, both old and new, are still used.

The different methods used for preservation of fruits are drying, bottling, canning and Jam making. Dried fruits contain no vitamin C currants, sultanas, raisins, prunes, dried bananas may be valuable for their content of mineral salts and sugars but no reliance can be placed on them as sources of vitamins.

Method of preservation of vegetables:

1) **Salting:** This is the oldest method of food preservation that is till in use. The domestic preservation of vegetable like beans by packing them in jars with salt is very destructive to vitamins, little or no vitamin C remains after three months storage and 50-80% of the original carotene is lost.

2) Pickling: Method of pickling differ much and figures available indicate that the effect on vitamin C is also variable. Home made chutney is considered to retain in some instances as much as 94% of the vitamin C in the fresh ingredients other samples contain only 40%. Sauerkralt has a good vitamin C value when freshly made but loses it rapidly on storage.

3) Canning: Carotene is relatively stable to canning but vitamin C losses vary. It may be destroyed by the preliminary balancing of vegetable and is not well retained by non-acid vegetables like beans, peas and spinach, which lose about half their original content. Canned foodare best kept in a cool dry place. Storage of canned vegetables at 50F causes losses of 5-15%of the vitamin C content, while at 80F. This loss in increased to 20-35%.

4) Freezing: In 1929 a quick method of freezing foods was developed and it has proved effective for the preservation of vitamins although preliminary balancing has to be used to destroy oxidative enzymes in vegetables, ultimate losses in vitamin C are only from 20-24% the best temperature for storage seems to be about 0 F. This quick frozen foods do not readily lose vitamins on thawing but do on being allowed to stand at room temperatures. They ought therefore to be used as soon as they have been thawed.

5) Cooking: Whatever the method of harvesting, storage or preservation, most vegetable are eaten cooked, and the vitamin value of the food as it arrives at the table is the figure that is of the greatest interest to those engaged in the planning of diets and the preparation of meals.

Method of preservation of fruits:

1) Jam: This is a useful domestic method of preserving fruit with its vitamin C. The rapid boiling required does not destroy the vitamin C and, although there is progressive loss on storage Jams, kept for reasonable periods still contain measurable quantities, particularly those mad from fruits like black currants, strawberries and gooseberries that have high initial values. Orange peel also contains vitamin C, so that marmalade if made by modern method , is a fairly good source of vitamin C. The old fashioned custom of leaving the cut up orang to stand for twenty four hours before being cooked exposes the fruits to air and to consequents loss of vitamin.

2) Canning and Bottling: Exclusion of air is more efficient in canning than in bottling and this helps in the retention of vitamin C. However home bottling is a useful method and if the bottled fruit is kept away from light the vitamin value is retained moderately well. Losses in canning of bottling fruit Juice and Sliced fruits are about 25%.

The addition of ascorbic acid in weights not more than 0.2% of the weight of the fruit is said to stabilize the colour of canned fruit without affecting its flavour and the vitamin is retained for long periods in 30-60% of sugar as syrup. Little vitamin C is retained in canned fruit. Black currants may contain as much as 26mg/Oz and strawberries, grape fruit and gooseberries from 5-7mg/Oz. Other fruits contain less than 4mg/Oz.

3) Cooking: Fruits cooked in pies stewed of baked contain very little. Vitamin C in most instances less than 1 mg. per ounce. Exceptions are those fruits which have very high initial values, eg. black currants, strawberries raspberries and gooseberries these even with a loss of about so percent, still contain appreciable amounts. On the whole vegetables are better sources of both carotene and vitamin C than fruits. The latter, with one or two notable exceptions, need to be eaten raw and as fresh as possible If they are to contribute an appreciable amount of vitamin C to the daily food intake.

4) Preservation of grains: Grains being hard and dry and not easily damaged grains with stand storage well. Loss of vitamins occurs if they are allowed to become damp of overheated. More over they are liable to be attacked by parasites larvae of moths, weevils and moulds which may cause deterioration. But grain kept dry and clean retains its B vitamins for long period of storage.

Most cereals are used in food as meal or flour, and in this form they provide the staple food to people in many countries, the staple food to people in many countries, the choice depending on climate, soil, custom and economics, the various rye breads of the European countries the polenta and spagnetti of Italy the outecakes and porridge of scotland and the wheaten bread of Australia. The North American continent and great Britain are examples, In India and China whole rice is till eaten to greater extent than bread made from any kind of flour. Ground products of whole grains keep only for limited periods because they contain and moisture. In condition of temperature conductive to enzyme action the fats are split producing fatty acids and the presence of these makes the entire meal rancid.

It was this tendency of whole meal flour to become rancid that made the roller mill such a welcome innovation to millers, because the white flours thereby produced where for the first time free from the oil of the germ and kept for long periods without rancidity. They were also whiter and this pleased public tastes satisfying a desire that can be traced back to the time of the Roman occupation of Britain. At the time when modern white flour first became readily available, i.e. in the latter half of the 19^{th} century nothing was known of the effects the might be produced by a resulting shortage of B vitamin. Thus white flour

becomes popular because it could be stored without deterioration and made a loaf light in colour and in texture.

5) Preservation dairy foods: Milk can be preserved by concentration or by being converted into cheese, cream can be canned and the fats of milk can be made into butler that keeps much longer than liquid milk. Evaporated milk is prepared by subjecting whole milk to heat to destroy any bacteria that are present and then concentrating it to one quarter or one fifth of its. Original bulk It is treated to reduce the size of its fat globules canned and sterilized. Dried milk is a fine powder, produced either by spraying or by passing liquid milk over heated rollers thus reducing its moisture content to under 3% dried milk may be full cream, half cream, or skimmed. Dried skim does not contain the fat soluble vitamins.

Butter: Butter is produced by separating the milk fats form the rest of the milk. The separation is more complete than in the preaparation of cream, butter containing about 85% of the milk fat and only traces of moisture. The natural colour of butter depends on its carotene content; this being divide from green foods, but some pale butter may have high concentration of performed vitamin A.

Cheese: Cheese contains most of the solids of milk, a gallon of milk being required to produce about a pound of cheese of the cheddar type. The milk is soured either by the action of its natural enzymes or by rennet coagulation after which the way is extruded and the cheese is permitted to ripen. Different moulds and yeasts are used to produce cheese of characteristic type and flavour.

Most of the common cheese are made form full cream or partly skimmed. Cow's milk but ships and goats milk are also used and in some countries the milk of the reindeer, buffalo and land.

Cheese contains only small quantities of vitamin D. But are rich sources of vitamin a and contain also some riboflavin. They form the best means of storing the vitamin D. But are rich sources of vitamin a of milk. The riboflavin may even increase in the surface layers during ripening, probably owing to synthesis by micro-organisms.

Conclusion:

To conclude we can say a the diet plans as needed for our betterment and healthy life, in the same way we also should be able to preserve these vitamins, proteins and nutrition's in the fruits as well as vegetables. Having seasonal fruits and vegetables in the same season it's certainly a good idea but not practical one. As we cannot have all the seasonal fruits at our place at the same time in one season, we have to import, transport and bring to our nearest market so

that they can be used by everyone. So the preservation processes shown in this paper by me are very much helpful in all the aspects of our daily life. I wish everyone to follow these methods on large scale and to make use of them for getting more benefits.

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A SHORT REVIEW ON BIOFUEL CELL AND ITS IMPORTANCE IN THE SUSTAINABLE DEVELOPMENT

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Abstract:

Electricity generated from water and coal may make human life easier but on the other hand it causes great harm to the environment. Coal-fired power plants have been linked to different hazardous effect which mayinclude developmental defect in infants. Water power in its various forms is a renewable energy resource and there are no fuel costs, perhaps the largest disadvantage of hydroelectric energy is the impact it can have on the environment. Dams can damage or otherwise impact the environment both upstream and downstream through their construction process during the formation of the dam. Even though it is necessary to do all this for the progress of human beings, but it is the responsibility of all of us to protect the environment.All this can be possible only when we make a good invention by using all the waste things and make them useful to fulfill our need. It is possible today that we can produce electrical energy from chemical energy by using biocatalyst and the device which use in this process called as biofuel cell. In factbiomass utilization is expected to play a crucial role in sustainable development. This review article includes overview of biofuel cell which eludes the balance of environment with the recycling of waste product.

Keywords: Electricity, biomas, biofuel cell, sustainable development.

Introduction:

For speed up the biochemical reaction resides in the living organism a substance plays an important role called as biocatalyst which includes enzyme or hormones (Palmore and Whitesides, 1994). Microorganisms plays important role in both fermentation as well as decomposition. Fermentation is a metabolic process that converts sugar to acids, gases, or alcohol (Chojnacka, 2010). Decomposition includes dead organic substances which are broken down into simpler organic or inorganic matter (Rao and Yanai, 1979). Both processes includes released of electrons during biochemical reaction. These electrons are used to generate electricity. The biological fuel cells are devices competent of directly transforming chemical to electrical energy via electrochemical reactionsby involving biochemical pathways.

The more profitable thing in biofuel is that they have ability to convert chemical energy of biological process into electrical current for generating electricity. The source of energy is organic material like glucose. The most important thing is that the waste product of environment can be recycled properly and became generate electricity from it. For constructing the biofuel cell there is a substance necessary for the activation and speed up biochemical reaction is called as biocatalyst, which is responsible for conversion of chemical energy to electrical current (Chen *et al.,* 2001).

The important approach of biofuel cell is to generate electric current from bounteous organic substance which is useless for human beings but many useful things can be made from it. One of the approaches includes the use of microorganism as well as enforces the fermentation of sketchy material furl product (Tsujimura *et al.,* 2001). Second approach based on the behavior of microorganism which act as a catalyst and able to converts chemical energy to electrical one (Ketz *et al.,* 1999).

It is claimed that the principle is based on authentic enzyme that catalyzes redox reaction for persuading oxidation and reduction of distinct fuel and oxidizing substance on the electrode support and generation of electrical current production is more (Ramanavecius *et al.,* 2004). It is noted that biocatalyst are tempting choice to transient metal catalysts due to following reason:

- These are renewable
- These are found extensively
- They can survive by using cheap fuel cell components (Tayhas *et al.,* 1999).

For the creation of electrical communication an enzyme plays an important role for performing oxidation reaction. These enzymes may be oxidase or dehydrogenase (Habermuller *et al.,* 2000). It is stated that energy source are allotted into three batches i.e., fossil fuel, renewable source and nuclear source (Akdeniz *et al.,* 2002), which have non renewable source energy comprising a large proportion of the energy; these are aligned into two major classification these are nuclear and fossil fuel (Rahimnejad *et al.,* 2009).

Fossil fuel negatively affects nature by releasing carbon dioxide. It surely follows from what has been said that the expenditures of fossil fuels have seriously endangered human life through its drastic consequence such as global warming and pollution (Rahimnejad *et al.,* 2012).

Types of Biofuel cell:

On the basis of use of metal as a catalyst to oxidize the fuel the biofuel cell is of two types i.e. microbial fuel cell and enzymatic biofuel cell.

Microbial fuel cell:

Microbial fuel cell is a bioelectrochemical fuel cell (Logon *et al.,* 2006) that produced electric current by targeting electronsreleased from the oxidation of reduced donor molecules done by microorganism. These electrons are destined to anode to oxidize the compounds which

are electron acceptor located on the cathode through an external electric circuit (Badwal *et al.,* 2014).

A microbial fuel cell is an instrument that transforming chemical energy into electricity via catalytic activities of microorganism. Although microbial fuel cell have a great potential as alternative energy source innovative waste water treatment processes and biosensor for oxygen and pollutant extensive adaptation is needed to harness the maximum microbial potential (Kim et al., 2007).

Recently the microbial fuel cell is the device that makes it come closer to the environment by conserving its ethic. For halting the diversification of environment the microbial fuel cell have started to find the commercial use in waste water treatment. For initiating the process of generating current the substance which neglecting the conflict in between the reactant called as mediator. On the pursuance of mediator the biofuel cell is of two types i.e. mediator microbial cell and mediator less microbial fuel cell.

It is studied that, the majority of microbial cell are electrochemically dormant, hence for shifting the electron from microbial cell to electrode i.e. electrical conductor. It needs the facilitation. The comfortless is produced by mediator like thionine methyl viologon, methyl blue, humic acid (Delney *et al.,* 2008).

Mediator less microbial cell is also known as mediated free microbial fuel cell. This fuel cell can run on wastewater and generates energy diversity from certain plant and oxygen. Hence this assortment is known as plant microbial fuel cell. The possible plant includes cordgrass, rice, algae (Rasierapparte *et al.,* 2021).

Working of Microbial fuel cell:

The method was under the mediator microbial fuel cell. An instrument was contained different component mainly anode chamber, which should be in anaerobic condition in which sewage water can be kept, cathode chamber having fresh water and should be in aerobic condition and proton exchange membrane which allow only H+ ion to cross through it. Anode and cathode were connected with a wire for generating the electric current due to the transformation of electron from anode chamber to cathode chamber. When the waste placed in an anode chamber the microorganism exist in the waste water naturally having a characteristic to consuming organic matter and turn it into CO2, H+ and e- .These electrons flows through circuit from anode to cathode. The H+ ions flow from anode chamber to cathode chamber by the function of exchange membrane. Electrons moves through circuit and CO2 get evolved. The exchange of H+ ions into cathode chamber can also from fresh molecule of water due the reaction takes place in between oxygen present in the cathode chamber and H+ ions coming from anode chamber (Logon *et al.,* 2006).

Enzymatic Biofuel cell:

The biofuel cell which includes the enzymes that acts on the substrate produced electrons by oxidizing it. The approach is based on the energy released during the reaction takes place in between enzyme substrate. It is proven that the most abundant molecules present in the environment are glucose. Due to its low volatility, nontoxic nature it has been widely used as fuel in the biofuel cell. The prospective thing is that the efficient use of a glucose as a substrate is the ability to oxidize glucose to carbon dioxide and convert more efficiently the chemical energy released upon redox reaction to electrical current. It is proven that the enzymatic cascade bioanode containing pyrroloquinoline quinine dependent enzyme oxidized glucose to carbon dioxide through a synthetic minimal metabolic pathway. In the study it is also proven that the bioanode was able to performing direct electron transfer to carbon electrode surfaces and eliminates the need of mediators (Xu *et al.,* 2020).

It is mentioned that enzymatic biofuel cell serves at comprehensive temperature and pH.This cell utilizes vegetables and animal fluids as a biofuel to produces electrical energy. The glucose is the main source of fuel for producing energy. The elemental part of glucose biofuel cell was two bioelectrode by their surface utilizes as an enzyme immobilized site. The enzyme glucose oxidase and dehydrogenase were placed on bioanode and oxidize glucose while oxygen diminished in biocathode using immobilized laccase or billirubin oxidase in order to generate sufficient power (Babadi *et al.,* 2016).

It is studied that the glycerol is used as a fuel, perhaps it is very large scale in our environment but most highlighted thing is that it is a byproduct of biodiesel production. Due to the quality of non toxicity, low vaporpressure low flammability and high energy density mark glycerol is a seductive as an energy stream.It can be used as source fuel for generating the electric current due to the flashy properties. It has described that the use of glycerol for a fuel in the enzymatic biofuel cell that harness three enzymes cascade on the anode that can possess the complete oxidation of glycerol. The bioanode which was developed include PQQ-ADH, PQQ-AldDH, and oxalate oxidase immobilized within tetrabutylammonium improved Nafion membrane With the addition of oxalate oxidase the glycerol/air biofuel cell had yield power densities of up to 1.32 mWcm-1 and able to operate high fuel concentration (Arechederra *et al.,* 2009).

It is reported that grapheme sheets as a feasible probationer can be used for constructing biofuel cell. Preliminary grapheme sheets were chemically synthesized and marked out by surface characterization method. Subsequently, grapheme was used to make the anode and cathode in the biofuel cell. The anode of the bifuel cell containing a gold electrode which was coated by grapheme glucose oxidase by using silica sol-gel matrix. These biofuel cell exhibits a maximum power density of about 24.3 ± 4 μW (Liu *et al.,* 2010).

Importance of biofuel cell in sustainable development:

Growing progress makes human life simple and less complicated. Although human life has been greatly benefited by the development of science and technology but this positive change is on the verge of being negative for the environment. The thermal power station pollutes the atmosphere due to the production of large amount of smoke and fumes. Beside the heated water comes from thermal power plant has adverse effect on the creature lives in the water and disturbs the ecology The transportation of fuel is one of the major difficulties for the plants located away from coal field. The fuel is used in the thermal power station is non renewable resource means producing energy by using it may be limited in future. Sustainable development means the development occurs without damaging the environment. Producing the electric energy by using biofuel cell we can reduce the problem cause to environment to some extent.

Conclusion:

Biofuel cells offer several advantages over conventional batteries, including the use of renewable and non-toxic components, reaction selectivity, fuel flexibility, and the ability to operate at low temperatures and near neutral pH.It creates no harmful emissions, eliminating the costs associated with handling and storing toxic substances such as battery acid or diesel fuel.Biomass energy comes from various raw material sources like waste material of farm, sewage water, and other organic waste material.It can prove to be a very cheap process to generate electricity which does not harm the environment.Keeping in mind the character of microorganisms, it is a very commendable thing to make full use of those things in human life which cannot be used by them in nature

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GOLDEN RICE – GENETICALLY MODIFIED FOOD

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Abstract:

Rice is one of the most consumed grains and leading crops in the world. Globally Rice (*Oriza sativa*) commonly known as Asian Rice (family Poaceae) to have originated from the Graminaceae (grass) family and it's over 40000 varieties in the world and more than 6000 varieties of rice in India. As per the data, rice production is pegged at record 122.27 million tons in 2020-21 crop years as against 118.87 million tons in the previous year. India is heading towards a fourth record wheat harvest and near record rice production for 2020-21 according to a report from the Foreign Agricultural Service of the US department of Agriculture. This crop provides supplementary calories to men more than any other grain, and more than 1 billion people depend on rice crops for their livelihoods. The production of rice will have to boost markedly over the next decades to keep up with population increase and income-induced necessity for food. In Recent years, the development of genetically modified Food (GMO) - a variety of Rice (*Oriza sativa*) i.e. Golden Rice is probably the best-known sustainable green biotechnology product—nutrition value enhanced—transgenic crop for future increasing demand of rice. Golden Rice is the result of an effort to develop rice varities that produce provitamin- A (beta carotene) as a means of alleviating vitamin A (retinol) deficiencies in the diets of poor populations of underdeveloping countries to enhance the sustainable approach.

Keywords: Golden Rice, Green Biotechnology, GMO, Beta –carotene, VAD

Source:https://en.wikipedia.org/wiki/Golden_rice#/media/File:Carotenoidsynthesis.svg; Flickr by IRRI Images at https://www.flickr.com/photos/86712369@N00/5516789000

Biotechnology is well-defined as the research of scientific and engineering values to the processing of material by biological tools to provide goods and services. The history of biotechnology begins with zymotechnology, which commenced with an emphasis on brewing techniques for production of beer. By the end of 19th century large number of industries and group of scientists were involved in the field of biotechnology and developed large scale fermentation were obtained from bacteria. In 1920, Alexander flaming discovered penicillin and large-scale fermentation of penicillin started in 1944.

Principles of Genetic engineering in biotechnology stimulated hopes for both therapeutic proteins,products and biological organisms themselves, such as seeds,pesticides, bioagents, tools, engineered yeasts and modified human cells for treating genetic diseases. Genetic engineering is the procurement of an organism's phenotype by changing its genetic make-up. Genetically modified crops (GM crops) are specially engineered to introduce a new genes and trait into the species. Genetic engineering is initially accomplished by simple pairingor genetic recombination of two or more organism to produce new genetic makeup. GMOs range from micro-organisms like single cell eukaryotes like yeast and unicellular prokaryotes bacteria to insects, plants, fish and mammals like humans.

From Last two decades, Genetically Modified Organisms are being research and developed across the world. Genetic alteration occurs when the DNA of one organism is introduced into the DNA of other organism so that a 'new' trait becomes part of the innovative, modified, organism. These modifications can engineer or induce particular genes in the organism and it will start the debate around the world about possible risks and aids to humans and the environment as a result of Genetically Modified Organisms.Purposes of GM crops generally include, sustainable approach towards likeresistance to certain pests, disease or stress, environmental conditions, or resistance to chemical treatments (e.g., resistance to herbicide). Other purposed of genetic alteration of crops is to increase its nutritional value, in sustainable approach reaches to poor with advance over VAD as seen in the case of golden rice (*Oryza sativa*).

The Discovery:

The generation of the first Golden Rice prototype took a concerted effort of seven years, from 1992 to 1999, by the collaborating institutions. Potrykus' and Beyer's ambitious research was to re-engineer the biosynthetic machinery of the rice grain to produce and accumulate a pigment only found in green tissues and flower petals, against the scepticism of many experts. Golden Rice was developed in the late 1990s by German plant scientists Ingo Potrykus and Peter Beyer of the University of Freiburg in Germany, rice plant was developed containing two

daffodils and one bacterial gene that carry out the four steps required for the production of Beta-carotene in the rice endosperm. Endosperm is the nourishing tissue around the embryo of a seed and makes up the majority of the rice grain that we eat. The resulting plant appear normal expect the after milling (to remove the brown bran), their grain is golden yellow in colour, due to the presence of provitamin- A; This variety of rice is called as Golden rice which is expected to produce beta carotene to combat vitamin A deficiency, was developed to overcome with the deficiency problem of vitamin A-the leading cause of childhood blindness.Vitamin A is important for many functions in the human for examplegrowth and functioning of the visual organ, diversity and maintaining various cells, epithelial membrane connectivity, and production of erythrocytes cells, immune system, reproduction, and iron metabolism. Acalculatedaround 190 million children and 19 million pregnant women have vitamin A deficiency (VAD), and almost a million children go blind every year.

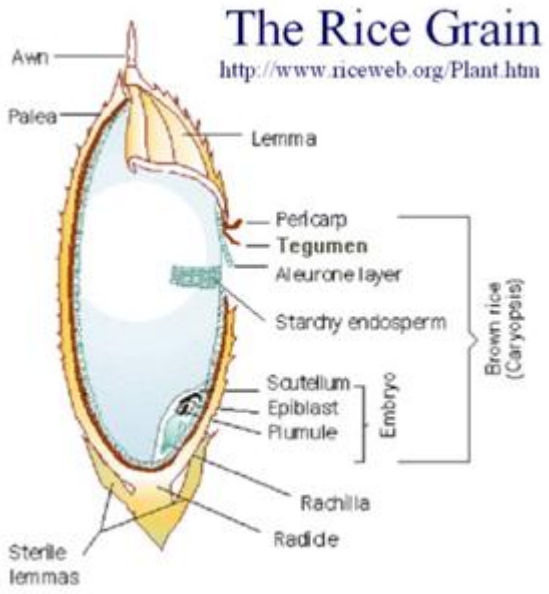

Figure 1: The Rice Grain

(Source -www.isaaa.org/kc/inforesources/biotechcrops/the_golden_rice_technology.htm)

Figure 2: Golden Rice

(Source - https://www.goldenrice.org/Content2-How/how.php)

Mechanism of Golden Rice preparation:

Golden Rice was formed by implanting two genes into rice (*Oryza sativa*). One is from corn (*Zea mays*) is a plant belonging to the family of grasses (Poaceae), while the other is from the bacterium, Erwinia is a genus of Enterobacterales bacteria comprising plant pathogenic verity which was named for the famous plant pathologist, Erwin Frink Smith. The gene from corn (*Zea mays*) causes the rice (*Oryza sativa*) to produce an enzyme called phytoene synthase (PSY) is the enzyme that catalyzes the production of phytoene, the first carotenoid molecule in the pathway, while the gene from Erwinia causes the rice (*Oryza sativa*) to produce an enzyme called phytoene desaturase (CRTI), are enzymes found in archaea, bacteria and fungi that are involved in carotenoid biosynthesis.The Bacterial enzyme phytoene desaturase (CRTI), which, distinct from plant and algae phytoene desaturase (PDS), is not distinctly sensitive to norflurazon, catalyzes the formation of the colourless carotenoid phytoene into lycopene and its use as a selectable marker for insertion of new one. Phytoene desaturase (CRTI) and phytoene synthase (PSY) are needed to convert carotenoid compounds in developing rice grain into beta-caroteneis a pigment found in plants that gives them their colour. The beta-carotene is procuredfrom the Latin name for carrot.Beta-carotene is a pigment generally found in colourful fruits and vegetables like carrots. In rice, the occurrence of this pigment gives it a distinguishing golden colour.They are not normally found in rice grain, but when these two genes are added, the rice develops a yellow (or "golden") colour. The endosperm of Golden Rice (*Oryza sativa*) is yellow due to the accumulation of β-carotene (provitamin A) and xanthophylls. The product of the two carotenoid biosynthesis transgenes used in Golden Rice, phytoene synthase (PSY) and the bacterial carotene desaturase (CRTI), is lycopene, which has a red colour.

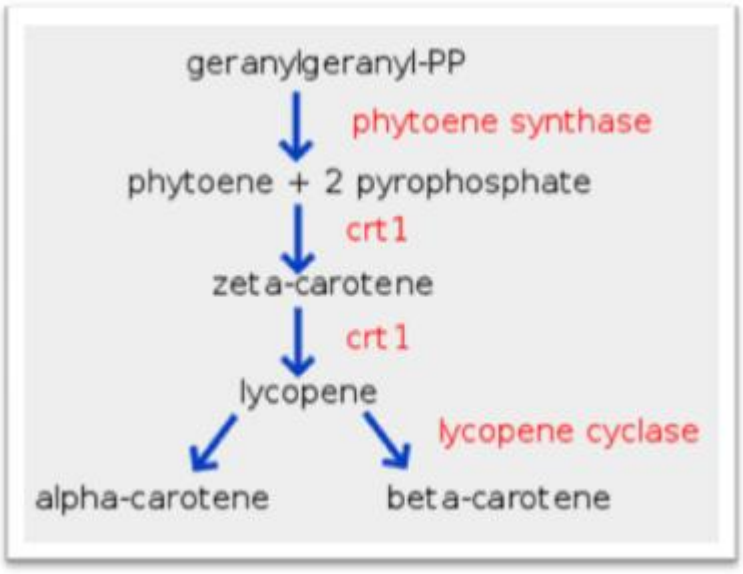

Figure 3: Carotenoid biosynthesis pathway in golden rice

(Source-https://en.wikipedia.org/wiki/Golden_rice#/media/File:Carotenoidsynthesis.svg
File:Carotenoid.jpg: created by en:user: Petaholmes,
modifiedby Benoit.gallet derivativework Smartse)

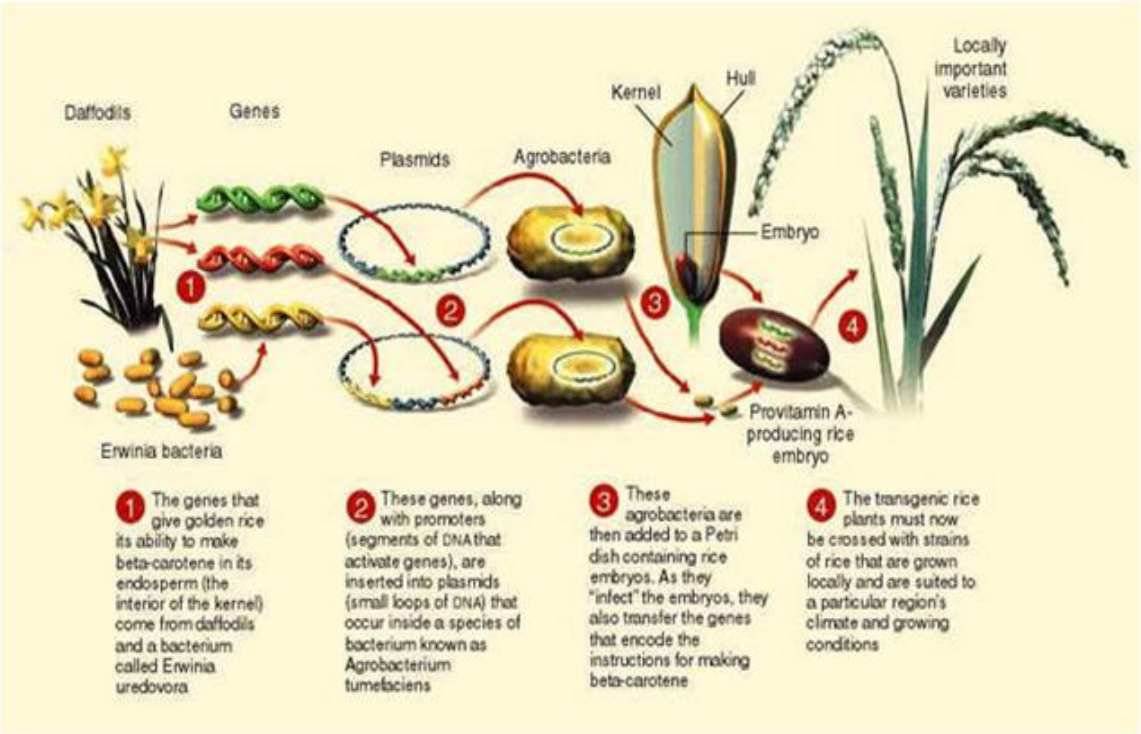

Figure 4: Mechanism of Rice Preparation

(Source:https://www.goldenrice.org/Content3-Why/why3_FAQ.php)

Summary:

Golden Rice was advanced in the hope to overcome a cure for the Vitamin A deficiencies in hunger population of different parts of the world of low developed country. Different versions of Golden rice were research and developed to understand of key genes which limit or assist in the accumulation of β-carotene. GM foods nowgrown on Philippines and available on the marketplace for many countries have passed threattowards the human health and are not likely to present risks for human health. Now, Bangladesh seems to be become the first country to approve Golden Rice for planting. "It is really important to say we got this over the line," says Johnathan Napier, a plant biotechnologist at Rothamsted Research in Harpenden, U.K., who was not involved in the crop's development.

But a series of limitations, most obviously the fact that someGolden Ricespecies fails to produce enough β-carotene to prevent VAD. Therefore, more research must be needed to study other genes which could effectively be limiting the amount of beta-carotene, so that it could overcomedeficiency of vitamin A in low-income population of under-developed countries.

They said that……..!!!!!!!!!

"Greenpeace has identified a weak point in the strategy of using Golden Rice for reducing vitamin A-deficiency" Ingo Potrykus, 10 Feb 2001

"It has not yet been determined whether daily consumption of Golden Rice does improve the vitamin A status of people who are vitamin A deficient and could therefore reduce related conditions such as night blindness." — IRRI, February 2013.

"*No toxicological tests or animal feeding trials have been carried out to assess possible health risks of Golden Rice. IRRI has announced that animal feeding trials are being conducted in the US, but no results have been published so far.*"- Status of Golden Rice, The Print; January, 2014 , Lucy Sharratt, Coordinator, Canadian Biotechnology Action Network;

"GM food scientists have already developed a yellow rice, or "golden" rice, that is rich in vitamin A and iron and helps prevent anemia and blindness, especially in children." -article published on CNN.com "Are biotech crops sowing seeds of dispute?" January 24, 2001, By Troy Goodman.CNN.com Health and Food Writer

"This rice could save a million kids a year" -headline on the cover of Time magazine TIME magazine, July 31, 2000, vol. 156 No 5

"For populations that rely upon rice as their primary or sole food source, this ['Golden Rice'] nutritional enhancement can deliver an enormous improvement in public health."-Dr.

Stanley Wallach of the American College of Nutrition; The Daily Oklahoman, "Biotechnology: Fighting Disease & Malnutrition," October 11, 2000

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HYDROPONICS: IT'S SIGNIFICANCE IN FARM ANIMALS REARING

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Hydroponic technology is not new to the world. In India it is used since time memorable with different names and part of different cultures. However, its use in food chain was never been tried in the past.Recently it is gaining popularity among the farmers.

When the 11th five year plan was coiled by the year 2009, ti has been documented that the prices of livestock feeds and fodders, particularly concentrate feed as well as dry fodder has been increased. This increase in turn influenced the livestock production and livestock industry. This changed scenario created a much greater coordination among the agencies responsible for livestock, crops and allied sector.

Hydroponically grown green grass has been reported from earlier centuries (Cuddeford, 1989). When compared to non-sprouted seeds, sorghum sprout have more nutritive values and enhance level of lysine, methionine and tryptophan. Through the hydroponic growing process, some chemical and structural changes were expressed within the cereal grain (Ikediobi, 1989). The green fodder produced from hydroponic process, grains germinated and forage grown within short period of time inside special growing rooms, provided the appropriate growing conditions.Hydrolysis of proteins, carbohydrates and lipids occurs due to activation of enzymes within the grain and gets converted into their simpler components (Sneath and McIntosh, 2003).

Increased activities of hydrolytic enzymes in sprouting grains causes improvements in the contents of total proteins, fat, certain essential amino acids, total sugars, B-group vitamins, and a decrease in dry matter, starch and anti-nutrients (Chavan and Kadam, 1989). Metabolic role of sprouting might lead to improvements in amino acid composition, B-group vitamins, sugars, protein and starch digestibility and decrease in phytates and protease inhibitors. The metabolic activity of resting seeds increases as soon as they are hydrated during soaking. Complex biochemical changes occur during hydration and subsequent sprouting (Shipard, 2005).

An increase in fresh weight because of sprouting process and besides change in dry matter was noticed by Trubey *et al*. (1969) and Peer and Leeson (1985). This change in dry matter might be due to the enzymatic activities (Sneath and McIntosh, 2003). Plaza *et al*. (2003) attributed that enzymes cause increase in quality of amino acids and concentrations of vitamins.

Dung *et al.* (2010b) attributed the gain in fresh weight to imbibition of water that constitutes 80-90% of the fresh weight of hydroponic barley.

Production potential:

Jawarkarand Chahande, 2018 cultivated hydroponic Jowar for feeding to does and observed that, 1 kg of Jowar seed yield was 7.5 kg of hydroponic fodder within 7 days. These findings is in accordance with previous finding noticed bySaidi and Omar (2015) as they harvested lush green vegetation of hydroponically grown green of 7.5 kg HB/kg barley grains and Chichame and Chahande (2017) who cultivated hydroponic maize weighing 7-10 kg from 1 kg maize seeds. The yield of hydroponics isdepending on the variety of seeds used and variation in methodology adopted.The controlled environment with mechanization and sofastication would lead to achieve higher production of hydroponics. Kruglyakov (1989) reported a production up to 10 kg of fresh green fodder out of 1 kg of barley seeds. The green fodder yield depends on type of grain and the growing conditions. Abd Rahim *et al.* (2015) showed that the green fodder with lush vegetation can be produced in 8 days from planting to harvest using hydroponic technique. The net green product was 7.5 kg HB/kg barley grains.

Chemical compassion/ proximate analysis:

As per AOAC (1990) Proximal Principles (i.e. CP, CF, NFE, EE, and Ash) of hydroponically grown fodder and cultivated fodder samples is analyzed, preferably the samples are processed in duplicate. This gives idea about comparative usefulness of fodders in livestock feeding.

Jawarkar and Chahande (2018) noticed that on dry matter basis CP % of Hydroponic Jowar was higher than that of green cultivated Jowar and gram straw.Percentage of DM in hydroponic Jowar was lower than that of green fodder Jowar. Sneath and McIntosh (2003) was also noticed the similar findings. During soaking and germination, seeds lose dry matter (DM) as they use their own nutrient reserves for growth. The analysis of fodder revealed different changes in composition of proximate analysis. The possible reason for such type of changes in composition might be due to the methodology and artificial beneficial environment of Hydroponics.On feeding hydroponically grown Barley green fodder to interrogates the biological and economical values of hydroponic barley (HB) in Lactating Awassi Ewes, Saidi and Omar (2015) observed that germination of barley resulted in about 18% loss in the DM and 40% increases in CP from day 1 to day 8. Also Helal (2015) reported sprouted barely with increase CP content.

The composition and digestibility studiesduring sprouting process revealed the depletion of many nutrients in both barley and canola, Chung *et al.* (1989). Majority of losses are associated in respect of dry matter, gross energy and triglycerides and Increases in crude fiber and di-glyceride content in barley. Losses in lipid content and increase in phytosterol and phospholipid in sprouted canola and enhancement in digestibility of nutrients in barley but not in canola, implying that sprouting improved nutritional quality of barley but not canola.Estimation of the digestibility of dry matter (DDM), protein (DP) and energy (DE) of raw barley sprouts on 14^{th} day in pigs and poultryrevealed that the 14^{th} day stag of sprout have comparatively lower DDM, DP and DE than ground barley but not to whole barley, Peer and Leeson (1985), and that the increase in sprouting time resulted in decrease in digestibility and the process of drying along with grinding the sprout improves the digestibility. There is gradual increase in protein content of barley sprouts from the time of germination, Morgan *et al.* (1992). The significance of hydroponics in animal feeding by virtue of its nutritional contents (Marsico *et al.,* 2009) is particularly because hydroponics is nutritious feed, rich in vitamins, protein like enzymes, trace elements and ß-carotene. 21.9% DM loss during the process of sprouting in period of 7 days due to process of respiration by germinating seed and loss of solutes however there is no improvement in digestible energy (Dung *et al.,* 2010a) and the nutritive value of grain in original condition is higher than sprouting. The nutritive value of hydroponically grown maize fodder is higher than the conventional maize fodder with respect to organic matter, crude protein, ether extract and nitrogen free extract content (Naik *et al.,* 2012). Helal (2015) conducted the experiment to observe effect of sprouted barley grains (*Hordeum vulgare L.*) on different levels of olive cake (OC) and barley straw as media. Five digestibility trial by using 25 desert male goat with 22.50±2.54 kg average body weight, observed that treatments with sprouted barely increase CP, ash and carbohydrates contents while DM, OM, EE, CF, NDF, ADF and ADL (Acid detergent lignin) contents were decreased. Sprouted barely on olive cake or barley straw recorded the improvement in OM, CP, EE, CF, NFE, NDF, ADF and hemicellulose digestibility. Economical and biological usefulness of feeding hydroponically grown Barley green fodder to interrogate the biological and economical values of hydroponic barley (HB) in lactating Awassi ewes is tested Saidi and Omar (2015) and observed that germination of barley resulted in about 18% loss in the DM and 40% increases in CP from day 1 to day 8. Feed trial conducted by Chichame and Chahande (2017) in Osmanabadi female lactating goats revealed higher CP % in Hydroponic grown maize than that of paragrass and gram straw on dry matter basis.

Ingredient	Harvest stage	Moisture content %	DM %	CP %	CF %	EE %	NFE %	Ash %	Authors
Barley Sprouts	**Original seed**	-	-	10.1	-	-	-	-	Morgan *et al.* (1992)
Barley Sprouts	4 day old	-	-	10.8	-	-	-	-	Morgan *et al.* (1992
Barley Sprouts	6 day old	-	-	13.7	-	-	-	-	Morgan *et al.* (1992
Barley Sprouts	8 day old	-	-	14.9.	-	-	-	-	Morgan *et al.* (1992
Sprouted Barley	-	8.39	-	14.00	11.20	3.61	-	-	Al-Ajmi*et al.* (2009).
Barley Grain	-	-	90.5	12.6	-	-	-	2.0	Dung *et al.* (2010b)
Sprouts	-	-	90.2	15.4	-	-	-	4.3	Dung *et al.* (2010b)
	-	-	85.63	8.07	22.21	1.15	46.02	22.154	Fayed (2011)
Hydroponics Maize	7^{th} day	-	-	13.57	14.07	3.49	66.72	-	Naik *et al.* (2012)
Conventional Green Fodder Maize	-	-	-	10.67	25.92	-	51.78	-	Naik *et al.* (2012)
Maize Seed	-	-	-	-	2.50	-	-	-	Naik *et al.* (2012
Hydroponic Maize Fodder	-	-	18.37	7.30	-	3.50	68.03	2.80	Limba (2015)
Hydroponic Maize Fodder	-	-	08.30	08.87	07.12	04.30	78.71	01.60%	Chichame and Chahande (2017)
Hydroponically Grown Maize	-	-	18.26%	13.25%,	10%	3.89%,	70.56%.	2.3%	Dhawale and Deshmukh (2017)
Hydroponic Jowar Fodder	-	-	09.86	08.75	29.00	04.33	54.30	03.55	Jawarkar and Chahande (2018)
Green Jowar Fodder	-	-	27.87	05.25	32.40	01.76	58.24	02.35	Jawarkar and Chahande (2018)
Concentrate Mix	-	-	96.58	16.13	14.20	03.23	58.44	8.00	Jawarkar and Chahande (2018)
Gram Straw	-	-	95.84	01.75	59.00	01.30	29.45	08.50	Jawarkar and Chahande (2018)
White Kaura Sorghum	7^{th} day	-	-	4.9	-	2.15	-	1.12	Sulesale (2015)

Significance of hydroponics in Body weight and body weight growth:

From a theoretical perspective, performance improvements occur if the supplement supplies the primary limiting nutrients to improve feed use efficiency.In the beef cattle performance from hydroponic sprouts on advantage was found (Sneath and McIntosh 2003). Beef cattle performance on feeding of hydroponic sprouts shows no weight gain when included in the diet instead of grains (Tudor *et al.* 2003). However Dung *et al.* (2010a) stated that the poor quality chaff mixed with hydroponic barley sprouts led to improvement in DM intake, total VFA concentration and total rumen ammonia concentration in sheep. Saadi *et al*. (2013) conducted a study on Awassi male lambs to evaluate the effects of substitution barley by 10%, 30% of sprouted barley with special reference to rumen characters, digestibility and feed efficiency in diet. For the study, eighteen lambs were randomly divided into three groups with each group contain 6 lambs supplemented for 120 days with 10%, 30% sprouted barley and either control (grain barley) in group I, II and III respectively. From the study, dry matter basis substitution of barley grain by 30% sprouted barley in lambs diet gives good improvements particularly in few rumen characters and in most nutrient digestibility and feeding efficiency. Hence, they recommended to substitute barley by sprouted barley formulation in higher percentage mixed with concentrate diet of ruminants.In the experiment conducted with two different feeding groups where control group was fed with regular lactation diet and experimental group was incorporated with hydroponic barley, both the groups had similar and linear increase of weight of ewes (Saidi and Omar, 2015) though the CP content of hydroponic barley ration was lower, and might be due to increased nutrients and the low anti-nutritional factors in hydroponic barley.

Instead of feeding sole hydroponics to the animals if they are fed along with other fodder types are more advantageous. Gebremedhin (2015) studied feeding trail (97 days) of hydroponically grown maize and barley fodder on KonkanKanyal goats for evaluation of nutritional benefit and economic. The experimental groups were T0- Finger millet straw (FMS)100%; T1- FMS + hydroponic maize fodder (HMF) 80:20; T2- FMS + hydroponic barley fodder (HBF) 80:20; T3- FMS + HMF 60:40; T4- FMS + HBF 60:40; T5- FMS + HMF + HBF 60:20:20%. He recorded that feeding of hydroponically grown maize and barley fodder for growing goats improve the total DM intake, feed conversion efficiency, body weight gain and economic.Thegrowth attributes of the goats which were fed on hydroponic maize fodder in an organized intensive goat farm when the kids were ad-lib fed with hydroponic fodder, sorghum, bengal gram and ground nut tops and concentrate feed fed from 16th day onwards Muthuramalingam *et al.* (2015) recorded average daily weight gain as 140.89 ± 0.31 gram. Hydroponic sorghum sprouts arerecommended to farmers to use as good source as feed

supplement. The nutritive value of white kaura sorghum *(Sorghum bicolormoench)* grains and sprouts and their utilization by goats, recorded that the 15% of sprouts in the diet of Red Sokoto goats increases weight gain (Sule sale, 2015), as wellChichame and Chahande (2017) found higher body weight gain in hydroponics supplemented group (50 % and 100 % incorporation) as compared to control in Osmanabadi goat.

Significance of hydroponics in improvement in hematological parameters:

The hematological parameters viz. Hemoglobin, total leukocyte count, total erythrocyte count concentration is influenced by the feeding of hydroponics to the animals.

Methodology generally used for Collection of Blood Sample from animals for estimation of hematological parameters:

The blood samples are collected from experiment animals from jugular vein at 07 to 15 days interval in the morning hours at 06.30 to 08.30 hours, depending on the seasonal variation in ambient temperature. About 5 ml of blood sample is collected from each animal. Out of collected blood sample, 1.5 ml of blood was stored in (K3EDTAV acu Care) vials and remaining 3.5 ml blood was collected for serum separation in clot activator (L- tube) vials. Immediately after collection samples were transferred in ice packs to laboratory for further processing (RBC, WBC, Hb). Serum was separated from blood sample within 3 to 4 hours of collection and stored in deep freeze (-20^{o}C) until utilized for further analysis.Most of the estimations are now a days are carried out using auto-analyzer such as Horiba and the CBC kit used for the estimation of these is ABX Vetpack.The values of Hemoglobin, Total Leukocyte Count (TLC) and Total Erythrocyte Count **(**TEC) are expressed in gram (%), thousand/ µl and million/ µl of blood, respectively.

In the experimental trial where goats were fed with fodder and oat integrated with complement feed as control diet and incorporation of 1.5 kg and 3.0 kg of hydroponically germinating oat Marsico *et al.* (2009) observed that the goats showed a small interest in fresh feed during the trial and further reported that hydroponically germinated oat in partial replacement of the traditional feed in the diet of goat did not affect hematological parameters significantly. In the similar type of experiment Micera *et al.* (2009) who aimed to upgrade of sheep well-being and milk production with diet incorporating hydroponically germinating seeds for 07 days of hydroponic expansion, found that assimilation with hydroponically germinating oat in limited change of the entire feed does not vary hematological parameters. Study by Limba (2015) with Basal Roughage + Concentrate mixture (T1Control), Basal Roughage + Concentrate mixture + 25% CP of concentrate mixture was supplied through Hydroponics maize green fodder

T2, Basal Roughage + Concentrate mixture + 50% CP of concentrate mixture was supplied through Hydroponics maize green fodder T3 and Basal Roughage + Concentrate mixture + 75% CP of concentrate mixture was supplied through Hydroponics maize green fodder T4, given values of hemoglobin were to be 8.83, 8.82, 8.85 and 8.86 g/dl in T1, T2, T3 and T4 treatment groups, respectively and found no effect of feeding hydroponics maize fodder in all treatment groups on hemoglobin percentage. However Chichame and Chahande (2017) in the feeding trial of 90 days on 21 Osmanabadi does by partial and complete replacement of concentrate with hydroponically grown green fodder observed higher blood haemoglobin concentration in hydroponically grown maize fodder supplemented groups T1- (7.39 ±0.86 g/dl),T2- (7.35 ±0.85 g/dl) as compared to non-supplemented group T0 (5.58 ±0.60 g/dl), Higher WBC concentration (thousand/ µl) in hydroponically grown maize fodder supplemented group T1(12.91 ± 0.24) and T2 (13.33 ± 0.20) as compared to non-supplemented group T0 (10.97 ± 0.25) and elevated RBC concentration (million/ µl) in groups T1 (11.84 ± 0.27) and T2 (13.21 ± 0.34) than T0(11.20 ± 0.36).

Significance of hydroponics in improvement in biochemical parameters:

Protocol for determination of total protein in serum samples:

The total protein (gm/dl) from the blood serum is estimated by biuret method by Avantor kit. For investigate the routine, the reagent is taken in the quantity of 1 ml in the test-tube to which the 0.02 ml of the serum sample is added. The test tubes are incubated at the 37°C for ten minutes and the reading is taken after aspiring the mixed sample into the machine at the wavelength of 550 nm.

Protocol for determination of urea in serum samples:

The BUN value (mg/dl) from the blood serum is estimated by Agape kit. The urea in the serum is predicted by using the Agappe urea kit for which Siaca Star 21 machine is used. The reagent R1 was taken in the test tube in the quantity of 800 micro liter to which the reagent R2 was added in quantity of 200 micro liter making the volume up to 1000 micro liter. In this the serum sample was added in the quantity of 100 micro liter. After well mixing the sample, the sample was aspirated in the machine, to the machine was previously set to estimate the urea from the sample. To estimate the BUN the results obtained of the urea was then multiplied by the factor of 0.467

Hydroponically germinated oat in partial replacement of the traditional feed in the diet of goat did not affect biochemical parameters significantly (Marsico *et al.*, 2009). Assimilation with hydroponically germinating oat in limited change of the entire feed does not vary biochemical parameters (Micera *et al.*, 2009). Sprouted barely fed to ewes shows significantly increased level

of total volatile fatty acids (VFA), ruminal ammonia (NH3- N) concentration, serum total proteins, Albumin and urea and insignificantly increase in value of serum globulin but serum creatinine as compared to untreated roughages reported Fayed (2011). Limba (2015) noted that the average mean values for total serum protein were 7.60, 7.73, 7.83 and 7.68 gm/dl in T1, T2, T3 and T4 treatment groups, respectively and stated no effect of replacement of CP of concentrate with hydroponics fodder.Chichame and Chahande (2017) reported higher level of total protein in treatment groups T1 (6.73 ± 0.13) and T2 (6.99 ± 0.13) than control group T0 (6.16 ± 0.12). Research conducted on variety of ruminants, fed with different sprouted grains, at different levels of incorporation, concluded differently. However the numerical differences, though non-significant, may imprint the influence of hydroponics on serum biochemical parameters and indicate its usefulness in animal diet.

Significance of hydroponics in improvement in Body condition score:

As per the protocol of Villaquiran*et al*. (2007) body condition score (BCS) is estimated with scale of 1 of 5. Scale of BCS is considered to be 1.0 for extremely thin goat with no fat reserves and the BCS of 5.0 is a very obese condition goat. The BCS of every animal is studied by palpation of different body parts (Lumbar region, rib cage and sternum) at 15 days interval. The estimation procedure prescribed by Meshram and Chahande (2015) for Osmanabadi goat may be considered. The expression of body condition score in 1 to 5 scales are given below.

1. In body condition score 1:

Seeable condition of the goat is skinny and fragile animal, the backbone is highly clear and forms a continued ridge. The flank is arched. Ribs are apparently palpable. There is no fat canvas and fingers freely enter into intercostal spaces.

2. In body condition score 2:

Seeable condition of the goat is marginally raw-boned, the backbone is still clear with a continuous ridge. Some ribs can be seen and there is a small amount of fat canvas. Ribs are still palpable. Intercostal spaces are smooth but can still be palpable.

3. In body condition score 3:

Seeable condition of the goat is the backbone is not easily seen. Ribs are almost apparent; an equal coat of fat envelope them. Intercostal area is detectable with pressure application by hand.

4. In body condition score 4 :

Seeable condition of the goat is the backbone cannot be detected. Ribs are not visible. The animal appears sleek from side view.

5. In body condition score 5:

Seeable condition of the goat is the backbone is hidden in fat. Ribs are not clear. The rib cage is canvas with enormous fat.

Body condition score of the animals not only gives status of the animal's health but also indicates the corrections in the nutritional status. In adult farm animals only weight does not matter. Body condition of the animal,those suites for the different physiological condition is of paramount importance. Body condition score of goat could be most effectively improve with a balanced and sufficient diet and change in the body weight may not necessarily parallel to body condition scores all the time (Cisse *et al.,* 2002). However Akpa *et al.* (2013) founded that the bucks with BCS 3 are relatively smaller in size than bucks with BCS 4.Seasonal variation in BCS has been reported. Nsoso *et al.* (2003) recorded lower scores in the dry season (2.17±0.10 to 2.65±0.10) as compared to the wet season (3.17±0.10 to 3.79±0.11) in southeast Botswana for Domesticated Tswana goats under extensive and semi-intensive management. These differences may be due to feed sufficiency in one season and /or feed scarcity and /or environmental stress in another season.Market value of the animals has been influenced by the BCS. Girma and Alemu (2012) documented that management decisions with special reference to the quality and quantity of feed needed to optimize performance of goat to be marketed depend on body condition score is simple and useful procedure that could help to the producers while purchasing/ selling stock. Meshram and Chahande (2015) attended 30 males and 161 females of Osmanabadi goat breed that was dispersed into two section, four body weight groups, two sex groups, four age groups and four BCS groups and observe thatthe values of body weight, body condition score and body measurements were higher in male as correlated to the female, the 49% deviation in body weight is attributed to body condition score whereas 64% to 69% variation in body weight is attributed to body measurement and the correlation among the body weight, body measurements and body condition score was highly compellient and clear.Feed trial conducted for evaluation of Body condition score in Osmanabadi goats from Nagpur region (Chichame and Chahande, 2017) observed that Hydroponic maize supplemented groups T1 (2.62 ± 0.04) and T2 (2.67 ± 0.03) recorded significantly higher BCScompared to non-supplemented group T0 (2.39 ± 0.03), clearly indicate the significance of hydroponics in animal diet.

Significance of hydroponics in economics:

Calculation of the economics is the most important part in any business. In animal related businesses 70% of cost off production is due to feed cost, hence feeding of animals influence the economics.

Comparative economics of feeding hydroponically grown green Jowar fodder with field grown Jowar fodder, based on the the cost of electricity charges, irrigation, labor cost, seed cost and land preparation cost for field grown Jowar fodder and the prices of seed, electricity charges and labor charges for hydroponically grown Jowar fodder is calculated (Jawarkar and Chahande, 2018). Lambs fed sprouted barley grains on Tamarix (T4) had better values of economical efficiency than other experimental roughages T5, T3, T2 and T1 in descending order the values were 1.30, 1.26, 1.19 and 1.00, respectively and sprouted barley grains on Tamarix (T4) incurred minimum price for production of one kilogram gain by about 41.5%, 26.3%, 23.9% and 30.4% than T1, T3, T5 and T2 respectively **(**Fayed, 2011). Hydroponic barley as a agricultural byproduct is recommended for arid region as it produce green fodder of more nutritive value for the animals and is environment-friendly as well as decrease the cost of feeding by applying agro-industrial by-products (olive cake) and barley straw by simple methodology using crop sprouts and clarify the complication of feed scarcity, mitigate the pollution dilemma of agro-industrial by-products Helal (2015).Cost of maize seed, cost of nutrient solution, labor cost, and electricity charges are included for calculation of the cost of hydroponics machine green feed for Rathi cows, Limba (2015). The total cost of feeding (Rs./day/animal) varied among T1 , T2, T3 and T4 treatment groups.Hydroponic fodder may have profitable application in intensive large scale goat farming where no land are available to produce green fodder as an alternative feed sources, Muthuramalingam *et al.* (2015). 1 kg hydroponic barley production cost is 0.21 NIS (New Israeli Sheqel). The main economics considered is hydroponic barley cost as it directly related to the farmer money bank (Saidi and Omar, 2015). Comparing hydroponic barleyfodder with traditional roughage fed to local sheep regularly, leads to saving of about 0.79 NIS/kg. Cost per ton of rations was calculated 1510 and 1064 NIS for the control and hydroponic barley rations, respectively.HB can be used as feed for lactating sheep as cost of feed can be reduced by 42%.Higher levels of hydroponic maize in the diet of Osmanabadi goats are beneficial as seen from cost of feeding per unit gain (Chichame and Chahande, 2017).

Picrate paper test for glycoside estimation:

The notion for existence of glycosides in immature crops like Jowar fodder sprouts/ hydroponic Jowar need to be ruled out by undertaking laboratory analysis.For estimation for glycoside which indicates HCN in feed sample was balanced out undertaking of lab analysis of Hydroponic Jowar.These facilities are normally available at the labs dealing withPharmacology and/or Toxicology work. The procedure of estimation is as below:

Recently cut plant is cut into short fragment and arrange in a test tube with 1.5 mL of distilled water and 6 drops of chloroform, pursue by mashing the material by a rod. The tube is

chocked with a seal enclosing a paper strip of picrate-coated paper suspended down from the cork and incubated at normal temperature for 2 hours. A change in colour of the paper, from yellow to dark-red, designated the release of HCN by the plant. If no release of HCN in a period of 2 hours, prove a negative test. Jawarkar and Chahande 2018 carried out Picrate Paper Test in feed sample of Jowar sprout and hydroponic Jowar from 1st day to 7th day of harvest but did not confirm the existence of glycoside in hydroponically grown Jowar. Hence the hydroponics are safe with respect to toxicity.

Hydroponics cultivation procedure:

A germination unit is created and equip with stands and trays. The unit may be computerized to control air conditions, temperatures, ventilations, irrigations and lighting system or operated manually. Each tray is planted with 1 kg of grain sprout, metal trays of 90 x 30 x 4 cm may be used.Chichame and Chahande (2017) and Jagtap and Chahande (2018) cultivated hydroponic maize, later on Jawarkar and Chahande (2018) used the following protocol of cultivation for locally available jowar.

Washing of seed in water by adding 5 drop of Hydrogen Peroxide (H_2O_2)

↓

Soaking of Jowar seed in Gunny bag for 22 hour

↓

Disinfection of metal tray

↓

Loading of 1 kg of Jowar soaked seed into metal tray

↓

Placing of trays on stands

↓

Drip irrigation of the hydroponics Jowar by automatically operated drip irrigation

↓

Harvesting of the hydroponically grown Jowar fodder on 8th day

↓

Evacuation of HGS

↓

Separation of tags

↓

Feeding measured quantity

Hydroponically grown Jowar fodder in fresh condition was harvested from the machine daily for the feeding of does.

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TALKING TREE: AN INTERACTIVE TOOL FOR ENVIRONMENTAL SUSTAINABILITY

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Abstract:

Talking Tree is an Android app that gives information about trees. In this app, the tree itself gives information to users after scanning the QR code or by selecting the number that is assigned to each tree. A tree gives information like its common name, botanical name, habitat, native place, and its medicinal applications. Finally, it gives a message about tree planting. This is currently working in the Marathi, Hindi, and English languages. Users can choose any language from these and the app will work in the selected language. This is the first type of interactive app from India developed by the author, and it is registered for copyright in 2020.Information about 100 species of tree was stored in this app. This app is installed in various organisations in India. By getting knowledge of each tree, people become aware of the plantation and its conservation.

Keywords: Android, QR Code, Common Name, Marathi, Conservation.

Introduction:

According to most estimates, deforestation in tropical rainforests emits more carbon dioxide into the atmosphere than all of the automobiles and trucks on the planet's roadways combined. Cars and trucks account for approximately 14 percent of global carbon emissions, according to the World Carfree Network (WCN), while most researchers attribute up to 15% to deforestation. The reason logging is so detrimental to the environment is that when trees are destroyed, the carbon they store is released into the atmosphere, where it mixes with other greenhouse gases and contributes to global warming [1]. Today, the number of trees on earth is around half of what it was when humans first arose. And the most rapid deforestation has occurred in the last few centuries. Every year, up to 15 billion trees are felled throughout the world. It's just not sustainable or sensible for animals, humans, or the environment. Stopping forest damage is a major priority for us. Years of dedicated work by environmental activists, lawmakers, and corporations are beginning to bear fruit, but there is still much more to be done

[2]. The ugliness of deforestation is primarily considered in terms of emissions; it ignores how deforestation destroys the lives and traditions of forest people, as well as how many species of plants and animals are destroyed, disturbing ecosystems' delicate equilibrium. Indirect repercussions of deforestation and global warming include an increase in mosquito-borne infections and the rapid development of roya, an insidious plant disease that threatens our coffee supply [3].

According to NASA, 17 of the last 18 hottest years on record have happened since 2001, and carbon dioxide levels in the atmosphere have reached their highest level in 650,000 years. These figures are alarming, especially since climate change is increasing year after year. Fortunately, smartphone applications can aid in environmental awareness and the battle against global warming. Whether it's an app to measure air quality, pollution, or water use, smartphone technology empowers everyone to contribute to the planet's preservation. These applications include features such as promoting greener lives, CO_2 emission reduction advice, and other ways to become more eco-friendly [4]. There are several reasons for deforestation, and one of them is that people only know the information about common trees like mango, pipal, etc., but what about other species? And the same thing will be passed on from generation to generation. So it is important to get information about each tree so that future generations can understand the importance of trees in the environment and perhaps work to save our Earth. Many students don’t know the name of the tree or its medicinal applications. Nowadays, the identification of any plant is done by only botanists, especially taxonomists. To overcome this issue, the author came up with the idea of the Talking Tree android application.

In the online market already there are many smartphone applications like PlantNet, iNaturalist, PlantSnap, PictureThis, FlowerChecker, Google Lense, & Garden Compass which identified over 27 million plants through user’s photo submissions and claims up to 99% accuracy. Some applications are free and some are paid. All these applications work only in presence of internet. Biggest advantage of all these applications is they gives information in English Language only.

After literature review it was found that there are many smart phone applications for identifications of plant but limited to only English language. So author decided a novel, & interactive android application for identifications of plants not only with English but also with local languages like Hindi, & Marathi. In Year 2020 author came with new interactive app that is named as Talking Tree which works in English, Hindi, & Marathi Language and also functional without internets also.

Methods:

Data were collected for 11 different plant species which is present in the J. D. Patil Sangludkar Mahavidyalaya, Daryapur campus. After that information of each plant scripted in English, Hindi, and Marathi Language. Some specific number assigned to each plant and with this numbers QR code was made. This QR codes were printed on aluminium sheets and hanged on the respective plants. Android studio is open source software for making various android applications. Author used the same platform for making Talking Tree app. All the information was logically added in the code form in above platform. With the completion of several coding app was ready and it was installed for plant of college premises.

Working of Talking Tree app (J. D. Patil Sangludkar Mahavidyalaya, Daryapur):

- Step One: Go to the play store and search for the Talking Tree app.
- Step 2: Once installed, choose a language (English, Hindi, or Marathi).
- Step Three: After this, the app will ask for your name. You can write your name or you can speak.
- Step Four: Now scan the QR code that is available on Tree. or select the number that is tagged on the tree.
- Now the tree itself talks to us through a mobile app. And the tree also asks us for a selfie.

Features of Talking Tree:

- Very easy to operate.
- Can be installed on any Android Smart Phone.
- Offline also.
- Personal data collection.
- Helpful for students of School & Colleges.
- Complete privacy, not a single data stored or shared to the main server.
- Selfie & Sharing features also.

Information given by Tree:

If the Username is Arnavee

In the English Language

Hello Arnavee, welcome to J. D. Patil Sangludkar Mahavidyalaya, Daryapur, glad to see you today. Arnavee, I am an Almond Tree. My botanical name is Prunus amygdalus. I am belonging to the Rosaceae family. I am native to Iran and surrounding countries. a deciduous tree, growing 4–10 m in height, with a trunk of up to 30 cm (12 in) in diameter. The young twigs are green at first, becoming purplish where exposed to sunlight, then grey in their second year.

My leaves are (3–5 in) long, with a serrated margin and a 2.5 cm (1 in) petiole. The flowers are white to pale pink, 3–5 cm (1–2 in) diameter with five petals, produced singly or in pairs, and appearing before the leaves in early spring. I grow best in Mediterranean climates with warm, dry summers and mild, wet winters. I am a nutritionally dense food, providing a rich source of the B vitamins riboflavin and niacin, vitamin E, and the essential minerals calcium, copper, iron, magnesium, manganese, phosphorus, and zinc. I am susceptible to aflatoxin which is a potentially carcinogenic chemical. Almond oil is a rich source of vitamin E. Arnavee, There is a lot of deforestation going on due to today's increasing urbanization, and you are already bothered by the sudden change in the weather and global warming. There is only one solution and that is planting trees. I'm glad to talk to you today. See you sometime. The other trees in the garden are also waiting to talk to you. Concept of Dr. Sarang Sahebrao Dhote and collaboration of J. D. Patil Sangludkar Mahavidyalaya, Daryapur, India. And I mean, plant a tree and add new friends to your life.

Conclusion:

Such interactive Android applications were not previously available in the Google Playstore, nor were any in its early stages. This type of app creates awareness amongst students and people about conservation and plantation of trees. Many students who do not have a science background also benefited from this app. Melghat Tiger Reserve, Melghat, Forest Training Institute, Chikhaldhara, Balasaheb Thackeray, Gorewada International Zoo, and many school colleges in Nagpur, Amravati, Buldana, and Gadchiroli regions have successfully installed the Talking Tree.

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SUSTAINABLE DEVELOPMENT AND ENVIRONMENT

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Abstract:

Development is the process that improves living standards. According to United Nations Development Programme, "The three essentials of development include the ability to lead a long and healthy life, to acquire knowledge, and to have a decent standard of living". Development is economic and social progress. Man with his innovative genius has constantly made efforts and forced nature to reveal its secrets. Man has brought spectacular breakthrough in the field of science and technology in the hope that they would bring him unmixed blessings by automobiles, electrical appliances, supersonic aircraft, medicines, chemicals, etc. On the other hand, the scientific and technological gifts have a serious problem to face the depletion of natural resources and the problem of pollution a serious ecological imbalance in the life support system. The concept of 'sustainability' has become the current answer to absolving the worldof its environmental and economic crises in the 21st century. The word "sustainability" has become a global buzz word as a potential solution for the many international, regional, and local problems facing society today.

Keywords: Sustainable Development, Natural Resources, Environment

The environment is the combination of external conditions, elements, objects, processes, and forces that affect the lifestyle of individual organisms. Our planet has changed its evolution. Humans have made very impressive economic progress, especially during the past two centuries, in creating material and luxuries of lifestyle. Economic development is necessary for the welfare of people even though it causes damage and destruction to our environment. With economic development increasing use of conventional energy sources is unavoidable. Also, with the increasing population, there is bound to be a tremendous increase in the use of resources. The ever-increasing exploitation of natural resources coupled with environmental degradation has reached a point that now threatens the well-being and future of mankind.

We are using more resources because there are more people and because we want more things. Some resources cannot be replaced and we over-use other things. Over time, we can see

the effect of these actions in degraded lands, polluted waters, and unhealthy living conditions. Some damage takes place so slowly we hardly notice it. It is difficult for all of us to understand all the things that add up to environmental destruction in the real world. Certain destructive changes in ecosystems are irreversible, and once destroyed, the functioning and productivity of ecosystems are difficult to restore.

Sharing and utilization of the benefits of environmental resources in a fair and equitable way is the answer to absolving the world of its environmental and economic crises in the 21st century. Sustainable developments play a key role as a potential solution for the many international, regional, and local problems facing society today. As developing nations struggle with issues of overpopulation, disease, and political conflict, developed countries also have to deal with the creation of pollution and waste that go beyond the capacity of the environment to absorb them, depletion, and degradation of renewable resources due to overexploitation, depletion of non-renewable resources (WECD, 1987).

In 1987, the Bruntland Commission published its report, Our Common Future, to link the issues of economic development and environmental stability. Sustainable use may be defined as" meeting the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations General Assembly, 1987).

One key principle of Sustainable Development is the conservation of the ecosystem. There is a need to conserve the ecosystem and biodiversity because, without these, a living organism will cease to exist. Over-consumption of the resources has negative effects on the environment and, therefore, for development to be sustainable, exploitation of the natural resources must be within the carrying capacity of the earth (Kanie and Biermann, 2017). A prolonged pattern of overconsumption leads to pollution and environmental degradation. Efforts are, therefore, being made to develop non-conventional energy resources which are non-exhaustible or renewable. Energy generated from water, wind, bio-mass, and sun holds out a major promise in this direction. These non-conventional energy resources will provide sustainable energy (Molinoari *et al.,* 2019).

Furthermore, to achieve Sustainable Development, there is a need for population control (Taylor, 2016). The resources of the world are enough for man's need but not for his greed. With proper management and equitable distribution, we can feed every mouth on the earth's surface. Therefore, population control and management are essential for sustainable development.

Wang (2016) opines that human capital is another important principle of Sustainable development. It is people who have the responsibility to utilize and conserve the environment. This makes the role of human resources in the quest for Sustainable development critical. It

implies that human knowledge and skill in caring for the environment, economy, and society need to be developed (Collste *et al.,* 2017).

Sustainable Development is also a normative outlook on the world, meaning that it recommends a set of goals to which the world should aspire. The environmental problems faced by the world are complex and there is uncertainty about the exact nature of causes, the range of impacts, and solutions. Understanding climate change requires the utilization of a wide range of knowledge and skills from different fields such as science, economics, and politics. Notice that sustainable development recommends a holistic framework, in which society aims for economic, social, and environmental goals. Sometimes the following shorthand is used: sustainable development calls for socially inclusive and environmentally sustainable economic growth.

Natural resources are the wealth of the earth. Therefore, it is a sacred duty to preserve it. The relationship of humans with nature and its various components are developed in such a way that the ecological balance should not disturb.

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ROLE OF ROTIFERS AS BIOINDICATORS OF AQUATIC POLLUTION IN SOME FRESHWATER LENTIC ECOSYSTEMS

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Abstract:

The present study is focused on the role of rotifers as bioindicators of aquatic pollution in two freshwater lentic ecosystems named Devtaki pond and Chirebandi pond, Gondia. These two ponds are surrounded by slums of densely populated area of the town and become highly polluted due to the receipt of untreated sewage, garbage and rubbish from nearby areas.Seasonal changes in physico-chemical parameters such as water temperature, P^H, Dissolved Oxygen and inorganic contents were studied month wise from June 2006 to May 2007 in both the ponds. Rotifers were recorded as 1552 ind/lit and contributed 36.10 %. While in Chirebandi pond rotifers recorded with 1180 ind/ltr and contributed 30.88 % among the zooplankton. The Rotifer diversity showed seasonal fluctuations, and was observed during the summer season with very large number and minimum during the winter season and followed by monsoon season. The present study revealed that Brachionus species are more dominant in both the ponds which are followed by Filinia spp., Asplanchna spp., Trichocerca spp.and Lecane spp. These species were exhibiting correlation with the physico-chemical parameters.The study also revealed that there is an indication of pollution in the pond due to anthropogenic activities, rapid encroachments, domestic sewage, the pond water is going to be polluted. Hence preventive measures are needed to control further deterioration of the pond.

Key words: Rotifers, Devtaki Pond, Chirebandi Pond, Bioindicators,Aquatic Pollution.

Introduction:

Certain living organisms serve the purposeof monitoring the envirinmental pollutional conditions. These are termed as bioindicators and are capable of measuring the actual response of organisms or populations to the environmental quality.The physiological and biological diversity of species allow various indicator species for various environmental conditions.

Rotifers occurs almost universally in freshwater habitats, from large lakes and reservoirs, to small ponds.Within a specific freshwater ecosystem, rotifers will be found not just in the open

water, but also in littoral and benthic zones. They make an important group of zooplankton community. They are the best food soursec for fishes in fresh water ponds and play a major role in fish growth and their production, Datta and Bandyopadhay (1985) showed their relationship with tropic status of water bodies. Turner (1927) classified the status of water pollution into various categories on the basis of the presence and absence of typical organisms. A variety of aquatic organisms have been used as biological indicators to ascertain the quality of water (Torzwell, 1965; Saksena and Kulakrni, 1985; Saksena, 1987; Kumar, 1994; Kumar, 1997).

Rotifers form an important group of soft-bodied invertebrates of thr plankton (Wetzel, 2001). The rotifers are microscopic animals mostly living in freshwater and they are characterised by the presence of an anterior wheel like rotating structure called 'Corona' Therefore these organisms are called Wheel animals and globally also known as bioindicators of water quality (Pejler, 1965; Macmets, 1983; Sharma, 1992). In this investigation, emphasis is given on rotifers fauna from different waters to study the rotifers as bioindicators in relation to certain physico-chemical paramertrs.

Materials and Methods:

The present investigations were carried out in two freshwater ponds known as Devtaki pond and Chirebandi pond. The location of Devtaki pond is at 21º 27' and 13.62" N, 80º 12' and 38.51" E. It is about 1032 ft. above the mean sea level (MSL), with net area of 0.06 sq.km. which is surrounded by the densely populated slum of Gondia town. While the location of Chirebandi pond is at 21˚ 25′ and 48.97"N, 80˚ 11′ and 43.41" E. it is about 1041 ft. above the mean sea level with net area of 0.09 sq. km. These two ponds shows an oligosaprobic in nature, but the expansion of urbanization on all sides of town that may engulf this water body in future.
Physico-chemical and biological parameters were studied during June 2006 to May 2007. Water samples were collected monthly and brought to the laboratory for further analysis. Physico-chemical parameters like temperature, transparency (Welch, 1948), p^H, dissolved oxygen, free carbon dioxide, chloride, hardness and nutrients like phosphates and nitrates (APHA, 1975). At the same time the plankton samples were collected by using standard nylon plankton net made by bolting silk no. 25 planktons were preserved in 4% and identified using Edmondson (1959) and other standard manuals.

Observations and Results:

During the present study the physical parameters such as temperature, transparency and chemical parameters namely p^H, dissolved oxygen, free carbon dioxide, chlorine, hardness, alkalinity, phosphate and nitrates. The quantitative analysis of rotifers was done from June 2006 to May 2007. Table no. 1 and 2 shows the seasonal variations of various physico-chemical parameters of Devtaki pond and Chirebandi pond during the study period.

Physico-chemical parameters like water temperature (32.12 ◌̊C), free carbon dioxide (13.72 mg/l), total alkalinity (279.5 mg/l), nitrates (3.46 mg/l) and phosphates (5.99 mg/l) were maximum during summer while transparency (18.25 cm), p^H (7.92), dissolved oxygen (8.48 mg/l) showed its peak in winter while total hardness (699.25 mg/l) and chloride (69.95 mg/l) were recorded maximum during monsoon season in Devtaki pond. While in Chirebandi pond, parameters like water temperature (30.25^0 ◌̊C), free carbon dioxide (6.5 mg/l), total alkalinity (165 mg/l), nitrates (2.88 mg/l) and phosphates (4.99 mg/l) were maximum during summer while transparency (23.63 cm), p^H (7.85), dissolved oxygen (12.05 mg/l) showed its peak in winter and total hardness (557.25 mg/l) and chloride (46.97 mg/l) were recorded maximum during monsoon season.

In the present study total 14 species of rotifera were recorded belonging to 6 genera in both the ponds. The most diversified genera was Brachionus represented by 7 species namely *B. calcyflorus, B. caudatus , B.rubens, B. durgae, B. falcatus, B. bidentata, B. angularis*. The genera which were Filinia species, Asplanchna species, Trichocerca species and Lecane species were recorded. The least dominant genera were represented by a single species of Filinia species, Asplanchna, Lecane species, Trichocerca.

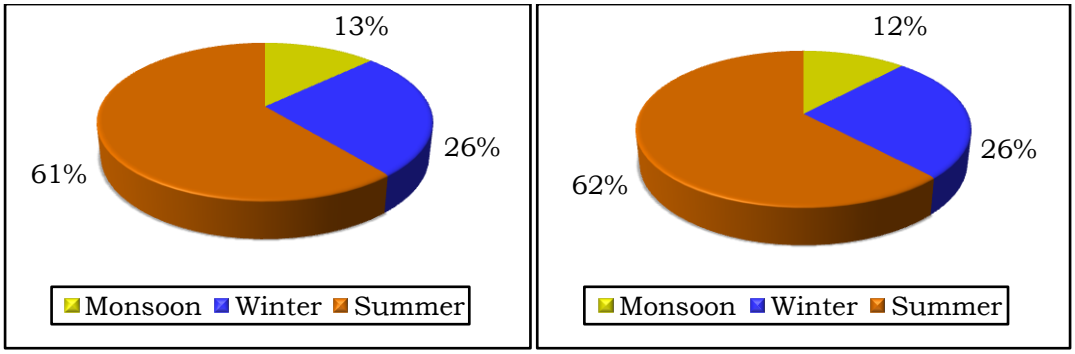
During the study period total population of rotifera in Devtaki pond was recorded as 1552 ind/lit. Seasonal population and density of rotifers recorded its peak during summer (964 ind/lit) followed by winter (399 ind/lit) while least during monsoon (189 ind/lit) and contributed 36.10 % among the zooplankton. The maximum density was in summer with 62% followed in winter by 26% and minimum in monsoon with 12% (Graph no. 1). While in Chirebandi pond rotifers recorded with 1180 ind/ltr and contributed 30.88 % among the zooplankton, B.calcyflorus (153 ind/lit) was recorded highest followed by B.caudatus and least appearance shown by Trichocerca spp.(15 ind/lit). The maximum density was in summer with 61% followed in winter by 26% and minimum in monsoon with 13% (Graph no.2).

Table 1: Annual range, Seasonal variations in Physico-chemical Parameters of Devtaki Pond during 2006-2007

Parameters	Range	Monsoon	Winter	Summer
Water Temperature (^{0}C)	25-35	31.05 ± 2.209	25.88±0.829	32.12±2.236
Transparency (cm)	13-20	15± 0.935	18.25 ± 1.145	14.63 ± 1.92
pH	7.1-8.3	7.43 ± 0.294	7.92 ± 0.238	7.9 ± 0.316
Dissolved oxygen (mg/l)	3.4-10.5	6.25 ± 1.581	8.48 ± 1.645	4.6 ± 0.948
Free Carbon dioxide(mg/l)	6-17.5	12.35 ± 2.546	7.1 ± 0.821	13.72 ± 2.64
Total Alkalinity (mg/l)	103-309	154.5 ± 46.241	192.25 ±35.891	279.5 ± 19.241
Total Hardness (mg/l)	475-830	715.25 ± 100.686	699.25 ± 30.727	541.25 ± 52.227
Chloride (mg/l)	15.6-72.0	56.3 ± 11.091	37.05 ± 7.437	20.85 ± 4.049
Nitrate (mg/l)	2.09-4.06	3.39 ± 0.321	2.26 ± 1.191	3.46 ± 0.458
Phosphate (mg/l)	2.07-7.15	4.42 ± 1.330	3.25 ± 0.803	5.99 ± 0.908

Table 2: Annual range, Seasonal variations in Physico-chemical Parameters of Chirebandi Pond during 2006-2007

Parameters	Range	Monsoon	Winter	Summer
Water Temperature (^{0}C)	23-33	28.5 ± 1.118	23.75±0.829	30.25±2.384
Transparency (cm)	15-24.5	17± 2.031	23.63 ± 0.739	16.7 ± 1.479
pH	7.2-8.2	7.85 ± 0.111	7.85 ± 0.111	7.67 ± 0.311
Dissolved oxygen (mg/l)	4-14.9	11.38 ± 2.211	12.05 ± 2.433	5.7 ± 1.374
Free Carbon dioxide(mg/l)	3.3-7.5	5.13 ± 0.954	3.33± 0.268	6.5 ± 0.845
Total Alkalinity (mg/l)	64-177	89.5 ± 23.921	108.5 ±16.620	165 ± 12.38
Total Hardness (mg/l)	318-710	678.28 ± 146.649	557.25 ± 53.476	403.5 ± 55.554
Chloride (mg/l)	7.92-72.0	46.97 ± 11.064	32.3 ± 7.589	13. 91 ± 4.636
Nitrate (mg/l)	1.70-3.92	2.77 ± 0.507	1.84 ± 0.1	2.88 ± 0.616
Phosphate (mg/l)	1.28-6.05	3.19 ± 1.555	1.78 ± 0.343	4.99 ± 0.889



Graph 1and 2: Seasonal diversity of Rotifers in Devtaki Pond and Chirebandi pond during 2006-2007

Discussion:

Rotifers are considered as valuable bioindicator to depict the trophic status of water quality (Pejler, 1989). Arora (1963) reported that of Brachionus species diverse occurrence and are found from potable water to diluted sewage tanks. Seasonal rotifer study of Devtaki pond and Chirebandi pond showed the peak in density and diversity during summer indicating the influence of various physico-chemical factors. During summer season the favourable range of all above facotrs showing good growth of rotifer population. While in monsoon, increase in total hardness and chlorides have adverse effects on the rotifer population. Similar results are recorded by Gadhikar *et al*. in Shadanoor Dam, Amravati (2016)

In aquatic ecosystem the animals are adapted to average range of water and their tolerance is restricted to some degrees.Thus increase in temperature beyond a certain level as well as fall beyond a certain level would adversely affect the animal population.Temperature range of 26 C to 29 C seems to be the favourable range of temperature for good growth of rotifer population (Salaskar and Yeragi, 2009). Shukla (1991) had also reported that the density of plankton increased in moderate temperature.

Dissolved oxygen play an important role in the increase of rotifer population (Radwan, 1980). He has observed rotifers to reproduce even at poor oxygen concentrations. The observations in the present study of both the ponds indicate low temperature and high dissolved oxygen to favors the reproduction and abundance of rotifers. Generally, the low pH reduces species diversity as well as abundance (Goldman and Horne, 1983). Vasist (1968) noticed genus Brachionus and Keratella to be occuring in the water of pH between 8.0 and 9.00. In the present study it was observed that an increased in the total alkalinity resulted inan increase in the density of plankton.

In the present study, the nutrients such as nitrates and phosphates were recorded higher during summer season which may results into the increased rotifer population during the same

season while lower population recorded during winter and monsoon season. Rotifers utilize these nutrients more rapidly to build up their population. Jorge *et al.* (2009) reported highest density and diversity of Rotifers during summer season in Valle de Bravo reservoir, Mexico, due to increase in temperature. Similar results were also observed by Kedar *et al.* (2007) in Yedshi lake of Maharashtra.

Rotifer population density and diversity were recorded in lower values in both the ponds during the monsoon season which might be due to dilution of water, less nutrients or depletion of factors such as transparency, dissolved oxygen. pH (Chandrashekhar, 1996; Kumar, 2001, Jeelani *et al.,* 2005) in Dal Lake, Kashmir, India. Yadav *et al.* (2003) noticed high density as well as diversity of rotifers both in summer and winter in Fatehpur Sikri Pond, Agra (U.P). Similar pattern of rotifer distribution was also observed by Reeeja Jose and Sonalkumar M.G. (2012) and Bhat *et al.* (2015). In summer less quanity of water in ponds and sufficient food availability due to decomposition of organic matters contribute to increase the density of rotifers. Gadhikar et al in Shadanoor Dam, Amravati,(2016)

The present study showed the Brachionus formed the dominant and diversified genus among the rotifers through out the study period. Sunkad, (2004) and Pawar and Pulley (2005) also recorded the dominance of Brachionus in Rakaskoppa reservoir of Belgaum, North Karnataka, India and Pethwadaj dam of Nanded District (M.S.). Dhanapathi (2000) reported on the distribution of various Brachionus species from different parts of India. Hutchinson (1967) stated that the genus Brachionus is characteristic of hard water.

Summary:

From all above observations on physico-chemical parameters, such as temperature, transparency, pH, dissolved oxygen, free carbon dioxide; total alkalinity, total hardness, nitrates and phosphates have the direct impact on occurrence, density and diversity of rotifers in Devtaki pond and Chirebandi pond. Occurrence of these bioindicator species at higher rate indicates the mesosaprobic nature of these two ponds.

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