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Volume III

Editors

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Dr. Shakun Mishra

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Dr. Dipali L. Barate

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PREFACE

We are delighted to publish our book entitled ***"Agricultural Science: Research and Reviews Volume III"****. This book is the compilation of esteemed articles of acknowledged experts in the fields of basic and applied agricultural science.*

The Indian as well as world population is ever increasing. Hence, it is imperative to boost up agriculture production. This problem can be turned into opportunity by developing skilled manpower to utilize the available resources for food security. Agricultural research can meet this challenge. New technologies have to be evolved and taken from lab to land for sustained yield. The present book on agriculture is to serve as a source of information covering maximum aspects, which can help understand the topics with eagerness to study further research. We developed this digital book with the goal of helping people achieve that feeling of accomplishment.

The articles in the book have been contributed by eminent scientists, academicians. Our special thanks and appreciation goes to experts and research workers whose contributions have enriched this book. We thank our publisher Bhumi Publishing, India for taking pains in bringing out the book.

Finally, we will always remain a debtor to all our well-wishers for their blessings, without which this book would not have come into existence.

- Editorial Team

Agricultural Science: Research and Reviews Volume III

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CONTENTS

DESIGN AND DEVELOPMENT OF BLADES MATERIAL FITTED IN THE REAPER USED FOR HARVESTING FINGER MILLET CROP

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Abstract:

A study was conducted to develop material for cutting blades used in the power tiller front mounted reapers to harvest hard stem crops like finger millet as the existing cutting blades used in the reapers are suitable only for cutting soft stem crops like wheat and paddy. The new blades designed consists of AISI 0-6 Graph-Mo Tool Steel having 1.45 % Carbon, 1.00 % Manganese, 1.25 % Silicon and 0.25 % Molybdenum. The newly designed blades have been incorporated into the existing reapers and its Performance for harvesting finger millet crop was evaluated by adopting RNAM (Regional Network for Agricultural Machinery) test codes and found satisfactorily.

Keywords: Harvester, Reaper blades, Cutter bar, Star wheel, Conveyor

Introduction:

Finger millet (Ragi) is one of the major crops grown in the southern parts of Karnataka. Traditionally this crop is harvested with sickles manually consuming about 150-200 man-h / ha. The reapers developed for harvesting crops like wheat and paddy could not become popular for harvesting finger millet because of various reasons. One of the main reasons was the blades designed for harvesting soft and non fibrous stem portion of the crops like wheat and paddy were not very effective in harvesting crops like finger millet since the stem portion of the finger millet crop is hard and fibrous. Further the height, ear-head size and the size of the stem portion of wheat and paddy crop were small as compared to the height, ear-head size and the size of the stem portion of finger millet. The cutting blades fitted in the existing reapers used for harvesting wheat and paddy becomes wear and tear very frequently when they are used for harvesting finger

millet crop due do hard and fibrous stem and needs frequent replacement. This necessitates the development of suitable blades material which can effectively used for harvesting hard stem cereal crops like finger millet etc. apart from wheat and paddy.

Review of literature:

Devani and Pandey (1985) designed and developed a vertical conveyor belt windrower for harvesting wheat crop. They concluded that, field capacity achieved with 1.6 m wide unit was 0.269 ha/h and for 2.08 m wide unit was 0.337 ha/h. The cost of operation with tractor and power tiller mounted reapers for harvesting crops was low (20 to 30 %.) as compared to manual harvesting and the labor requirement by mechanical harvesting was reduced to 40-42 man-h/ha which is one third of manual harvesting. Singh *et al.* (1988) studied harvesting of wheat crop by power reaper. They found that average field capacity was about 0.4 ha/h with 4 % grain losses. Labor input in mechanical reaping was about 5 man-h/ha compared to 84 man-h/ha in manual harvesting operation. Habib *et al.* (2001) stated that increasing plant diameter needs higher knife velocity for performing the free cutting operation. Whereas, increasing mass of plant stalks need low critical speed. Further, they have stated that critical knife velocity affected by both height of knife from ground and the plant overall length. Also, moisture content of plants materials affecting on the critical knife velocity throwing by the cutting force, where cutting force variation with the moisture content. Habib *et al.* (2002) stated that the parameters affecting cutting process are related to the cutting tool, machine specifications and plant material properties. Further, they have stated that, the cutting energy consumed in harvesting process is much lower than the energy consumed in crushing process due to the effect of moisture content

Methodology:

The working principal of the reaper is shown in Figs:

When the machine (reaper) moves forward into the dense of the crop the crop dividers guide the standing crop towards cutter bar which fitted with blades and fingers. Here the fingers are stationery and the blades (knife) are reciprocating. The crop stems with ear heads are fed into a much narrower gap between the fingers and knifes by means of crop divider and star wheels.

The fingers are much longer, concave in shape and more pointed to feed the stems into the gap gently. When the crop (stem) comes in contact between stationery fingers and the reciprocating blades (knife) it will be cut and hold vertically by means of pressure springs and star wheels against the vertical frame of the reaper. The vertically held crop is then delivered to one side of the machine by two lugged conveyors, one close to the cutter bar and the other at the

upper end and fall on the ground in the form of windrows perpendicular to the direction of the movement. Forming of the windrows of harvested crop helps in easy collection of the crop manually and saves labor.

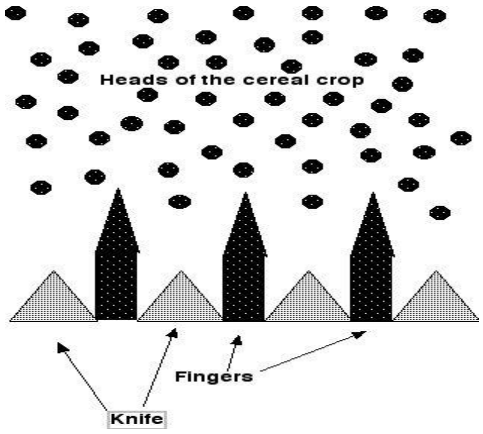

Figure 1: The harvester and the cereal crop

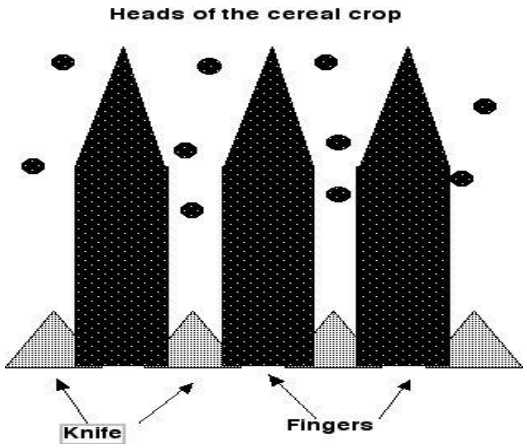

Figure 2: The fingers and knife of the harvester entering in to a dense crop

Problems identified in the existing reapers for harvesting finger millet:

The blades and the frame structure provided in the reaper selected for the study is suitable only for harvesting soft stem and non fibrous crops like paddy, wheat and vegetable crops , and not suitable for harvesting hard stem crops like finger millet etc. The finger millet plant is heavier because of the heavy ear heads at the top, hard and fibrous stem and the crop is dense. Use of the existing reapers for harvesting finger millet crop leads to wear and tear of blades are very frequent and break down of frame structure. When the blades are not sharp and strong enough to withstand cutting force when full of finger millet stems pushed together into the gap, the breakdown of blades are common, and needs a design of blades suitable for harvesting hard stem crops and a strong frame structure to be incorporated into the existing reaper for finger millet harvesting.

Existing Blades:

The blades fitted in the reaper harvester selected for the study was subjected to Microstructure with Photo and chemical analysis.The analysis was done using IS: 881-1998 & Spectro Manual and the test results were compared to that of specified values as per BS: 970-1955 EN-42 J Gr standards.The same reaper bladeswere analyzed for their Microstructure with Photo analysis at Chemical and Metallurgical Laboratories, Bengaluru, using IS: 7739-1975/76 and ASM Hand Book**.**

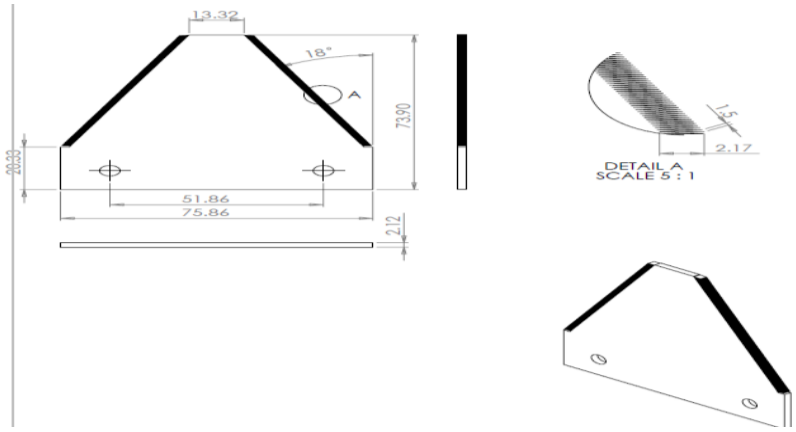

Figure 3: Present Reaper blade

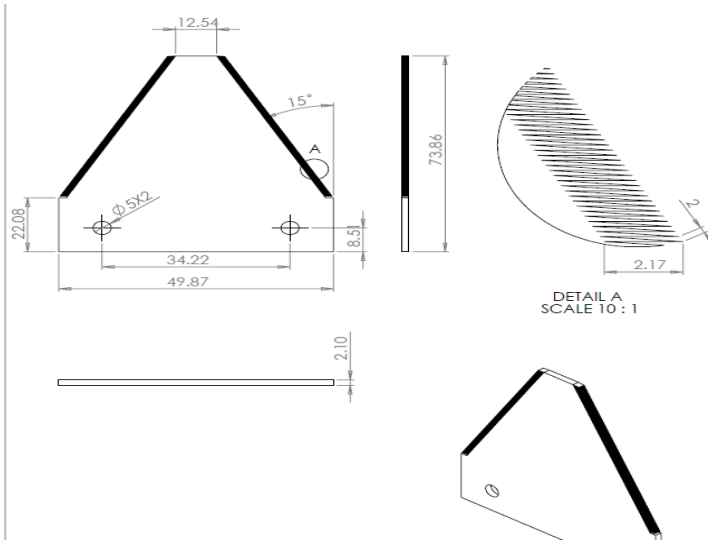

Figure 4: Modified Reaper blade

The data indicates that the combination of alloy material used in the existing blades not sufficient enough to with stand wear resistance strength required to cut hard and fibrous stem crops like finger millets.

Modified chemical composition:

The following combination of alloy material have been designed and developed. This includes the material and the design calculations. Different alloy material combinations and angle of teethes were tried for design of blades suitable for harvesting hard stem crops of finger millet. The blades thus designed was incorporated into the existing reaper and its performance for cutting finger millet stalk was evaluated in the GKVK farm of the University of Agricultural Sciences, Bengaluru, during harvesting season of December 2011. By adopting RNAM (Regional Net Work for Agricultural Machinery) test codes.

Design Calculation:

Design of lugged belts and star wheels:

The lifting and gathering mechanism in case of vertical conveyor windrower are fitted with lugged belt, pressure springs and star wheels. The crop row divider guides the plants towards the cutter bar. The lugged belts guides the plant towards the cutter bar and after the plants are cut the star wheel helps the plants in lifting them up as well as give it a rotation at right angle to the direction of the machine travel. They are conveyed by the vertical conveyor belts. The pressure springs are provided below the star wheels to keep the plants in vertical position with the support from the board of conveyor. In this design the plants are cut in vertical position because they are under control and are not allowed to fall randomly on the conveyor or board, but are conveyed by means of lugged flat belt conveyors in vertical position till they are ejected out of the machine.

The speed of the star wheels and lugged belt depends upon the forward speed of the machine. The star wheels and lugged belts are inclined at an angle with the ground. Therefore the velocity that is responsible for guiding the crop will be less than the peripheral velocity of the star wheels along the plane of rotation. In order to have compact machines the angle of inclination of the star wheel is normally kept at 18°-22°. Higher angle will make it a compact unit but would require higher velocity to have proper gathering action. The speed ratio desired for the lugged belt speed and machine forward speed should 3-5 percent greater than the groundspeed of the machine so that the crop is pushed towards the cutter bar (Fig. 5).

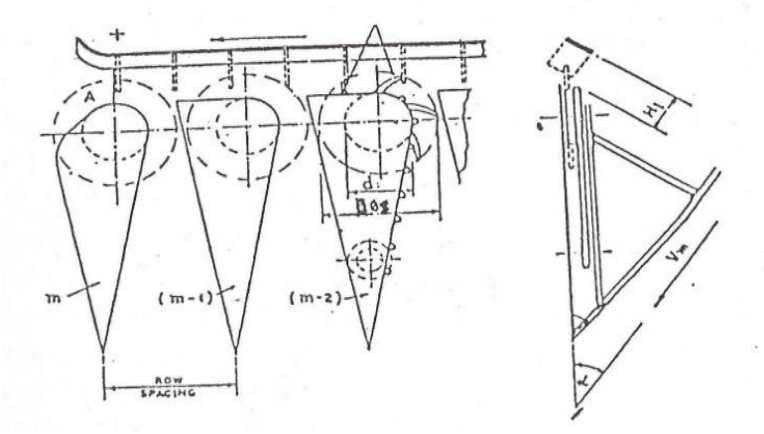

Figure 5: Crop row divider wit star wheel

The higher velocity of the star wheels may increase the shattering losses. Considering the case of power tiller mounted reaper, which is to be operated at a forward velocity of 1 m/sec. Relation, will give the star wheel velocity.

$Vs \cos \alpha / Vm = 1.026$

Putting cos α = cos 18°

The speed ratio of 1.026 between Vs cos α and forward speed is recommended for the proper action

Vs =1.15

The normal value of Vs recommended is 1.1 to 1.2 m/s

Vm = Vs cos α / 1.026

Vm= 1.093 / 1.026

Vm =1.065 m/s

The angular speed of the star wheel

N = Vs *60 / π * Ds

Where,

Ds = average diameter of the star wheel

Inner diameter of star wheel =15cm

Outer diameter of star wheel =26cm

Average diameter of star wheel = 15+26 / 2

Average diameter of star wheel= 20.5cm

N = 1.15 *60 / Π * 20.5

N = 1.071 ~ 107.1rpm

The tip velocity of star wheel

= Π *outer dia * N / 60

The tip velocity of star wheel

=1.45m/s.

Flat belt conveyor design:

The star wheel is driven by the vertical flat belt conveyor with lugs. The speed of conveyor belt for machine speed of 1.0 m/s and normal crop condition should be around 1.5to 1.6 m/s.

Taking speed of vertical conveyor belt as 1.5 m/s. the speed of driven pulley the pitch of lugs and number of arms on the star wheels is given by the simple relationship.

Π Do= P * Ns

Where,

Do = Outer diameter of star wheel

Ns = No of arms on star wheel

P= Pitch of lugs on conveyor, belt

Therefore, P= Π Do/Ns

= 3.142*26/7

P=11.670 ~12 cm

Speed of flat belt pulley is given in relation Vp= ΠDpNp/60

Where ,Np=Speed of flat belt pulley

Dp= Dia of the pulley

Vp = speed of the vertical conveyor belt

Np= 1.5*60 / Π*0.14

Np= 204.60 ~ 205 rpm.

Lug height and clearance:

This method is based on the assumption that the entire cut crop is to be moved out of the machine at the outermost end hence there should not be blockage of the material at this end using the following nomenclature.

P_1 = star wheel annulus lost due to spikes, %

P2= belt length lost due to lugs thickness, %

Ht= Gap needed between belt and pulley to avoid breakage, m

P3= star wheel speed compared to belt speed, %

Reaper total output= W*Vm m^2/s

The total cross sectional area of the plant material to be handled by the reaper at outermost end =W*Vm* Sdm^2/s

The capacity of machine to discharge the cut crop at outermost plant

= $HtVm(1-P_1)(1- P2) *P3$

To avoid blockage

$W*Vm* Sd = HtVm(1-P_1)(1- P2) *P3$

The value of P_1, P2andP3can be easily determined or assumed without causing much deviation in the results, assuming,

P_1=20%, P2=2% and P3=90%

Consider the best crop condition; the maximum number of tillers expected per square meter in the field would be around 500. The tiller diameters will be around 4-5 mm. hence if Sdis $0.02m^2/m^2$ (200 sq.cm)the value will be more than sufficient for all the cases.

The flat belt speedVfis 1.5 m/s

Forward velocity of machineVm=1.065 m/s

W* Vm* Sd = HtVm (1- P1) (1- P2) * P3

230.38 *1.065*0.02= Ht *1.5 (1- 0.20) (1- 0.02) * 0.9

4.907094= Ht *1.5 *0.8*0.98 * 0.9

4.907094= 1.0584 Ht

Ht= 4.907094 /1.0584

Ht= 4.6 cm

Hence taking Ht= 4.6 cm will be sufficient for most of the conditions for the 1.6m width of cut reaper.

Flat belt lugged conveyor drive:

The power for the flat belt drive is transmitted by means of a chain and sprocket drive. The speed of the drive shaft which also drives the cutter bar is kept as 612 rpm.The flat belt speed Vf is to be maintained at 1.5 m/s. assume the diameter of the flat belt pulley as 12 cm.

ΠDNp/ 60= 1.5m

Np= 1.5 ×60×1.5 / Π×0.12=238

i.e. for chain drive the sprocket was taken with 15 teeth i.e. no. of teeth on the driven sprocket = 38.

For chain roller chain of 9.52 mm. pitch above size sprocket were used.

Cutter bar design:

The cutter bar used in the conventional reciprocating type cutter bar with stroke length of 76.2 mm. the cutter bar is driven by the crank mechanism directly from the gear box provided on the reaper.

The recommended speed ratio of average cutter bar, a speed to the forward speed of machine is 1.3-1.4.

Therefore velocity of the cutter bar Vc =1.4 m/s

Nc = Vc* 30 / S

Where,Nc = rpm of crank

S= stroke length

Nc = Vc* 30 / S

Nc = 1.4* 30 / 76.2 =551.18 rpm

Nc = 551.18 rpm ~ 551 rpm.

Absolute velocity of knife Vmax= r * W

Where,

W=angular velocity of crank in rad/sec

r = crank length

Minimum velocity of cutter bar

$V_{min}= W/ (S-bo) b^2$

Angular velocity of crank W = 2ΠN / 60

Where, crank revolution N=2200 rpm

W= 2*Π* 2200 / 60

W= 230.38 rad /sec

Absolute velocity of knife Vmax= r * W

Vmax= 144 * 230.38

Vmax= 33174.72 m/s

Minimum velocity of cutter bar

$V_{min}= W/ (S-bo) b^2$

Therefore bo= b2 +b4 / 2

Where

b2= width of the knife top section

b4= width at the top of ledger plate fixed to knife bar

b0 = average of knife width and knife guard base

bo= b2 +b4 / 2

WKT, b2 = 13 mm and b4=26 mm

bo= 13+26 / 2

bo= 19.5 mm

Minimum velocity of cutter bar

Vmin= W/ (S-bo) b2

Vmin= 230. 38/ (76.2 - 19.5) 39

Vmin= 1.5 m/s

The maximum acceleration and inertia force of knife bar are given by

amax= S W / 2 (l+ Π / (l / r)

$a_{max}= 225 m/s^2$

Where, l = length of connecting rod.

Max. Inertia force= m *amax

Where, m= mass of the cutter bar knife

The mass was approximately 4 kg for 1.6m long cutter bar.

Max. Inertia force= 4 * 225 = 900 kg /m/s²

Max. Inertia force= 900 kg /m/s².

This balancing is done to minimize vibration. The balancing is recommended for about 50% of maximum value i.e., for half the inertia force =450 kg /m/s².

Conclusion:

Based on the earlier field data the newly designed cutter blades were developed for the satisfactory in harvesting of finger millet crops by reducing the wear and tear of blades and frequent breakage as it was done using existing blades.

References:

Devani, R.S. and Pandey, M.M (1985). Design, development and evaluation of vertical conveyor reaper windower. AMA, Vol.15 (a), pp. 41-52,

Fleurdeliz S. Luarez, Bart Duff, AmandeTe and Robert E. Stickney (1989). Socio economic and technical performance of mechanical reapers in the Philippines. Agril. Mechanization in ASIA, AFRICA and LATIN ANERICA, Vol.20, No.1, pp. 49-54.

Garg I.K., Sharma V.K. and Santokh Sing (1984).Agril. Mechanization in ASIA, AFRICA and LATIN ANERICA, Vol.15, No.3, pp. 40-44.

Habib, R.A. Azzam, B.S. Nasr, G.M. and Khattab, A.A (2001). A theoretical analysis of the free cutting force of plant materials. 1st International Conference for Manufacturing Agricultural Equipment and Machinery-9th Conference of Misr Society of Agric. Engg. 9-11 Sept.

Mohammad Raza Alizadeh, Iraj Bagheri and Mir Hussein Payman (2007). Evaluation of a rice reaper used for rapeseed harvesting. American-Eurasian J. Agric. & Environ. Sci., Vol.2 (4), pp. 388-394.

Pndey, M.M. and Devanani, R.S (1987). Analytical determination of an optimum mechanical harvesting pattern for high field efficiency and low cost of operation. J. AgricVol. 36, pp. 261-274.

Ved Prakash Chaudhary and Varshney, B.P (2003). Influence of seedling mat characteristics and machine parameters on performance of self-propelled rice transplanter. In: Agricultural mechanization in Asia, Africa and Latin America, Vol.34, pp.13-38.

ROLE OF REMOTE SENSING AND GIS TECHNOLOGY IN DROUGHT RISK ASSESSMENT

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Abstract:

Drought influences greater human beings than some other herbal catastrophe and consequences in extreme economic, social and environmental costs. Significant strides had been made in latest years to enhance the effectiveness of those structures. Drought is an insidious natural hazard characterized by less than expected or less than normal rainfall that extends over a season or an extended period of time. Droughts are generally classified by type into meteorological, agricultural, hydrological, and socio-economic. There are several natural drought signs that need to be monitored mechanically to decide the onset and give up of drought and its spatial traits.An effective monitoring, early warning and delivery system continuously tracks key drought and water supply indicators and climate-based indices and delivers this information to decision makers. Availability of multiple satellite data sets offers a unique avenue to explore multi-index or multivariate drought indicators.

Introduction:

Drought is an insidious natural hazard characterized by less than expected or less than normal rainfall that extends over a season or an extended period of time. Drought is a temporary anomaly, as opposed to drought, which is a permanent feature of the climate. A precisely defined dry season must also be distinguished from drought, as these terms are often confused or used synonymously. Drought should be viewed as a relative condition rather than an absolute condition. It occurs in both high and low rainfall areas and virtually all climate regimes. Drought is a normal part of the climate, although its spatial extent and severity fluctuates on seasonal and annual timescales. Many countries such as Australia, China, India and the United States of America experience drought in one part of the country every year. The last drought in South Asia (2000-2003) affected more than 100 million people, with serious consequences: Political instability, war and economic isolation have exacerbated the effects of the drought. on

precipitation data, which is limited in the region, is often inaccurate and, more importantly, difficult to obtain in near real time (Thiruvengadachari and Gopalkrishna, 1993). Even crop yields can be predicted 5 to 13 weeks before harvest using remote sensing techniques (Ungani and Kogan, 1998).

A critical component of this strategy is a comprehensive drought monitoring system that can provide early warning of the start and end of a drought, determine its severity and make this information available to a wide range of customers in many climate and climate sensitive sectors. In many cases, the effects of droughts can be reduced or avoided. The drought itself is not a catastrophe. Whether it turns into a disaster depends on its impact on local people, the economy and the environment, as well as their ability to cope with and recover. Therefore, the key to understanding drought understands its natural and social dimensions.

Drought as a threat:

Drought is a slowly evolving natural hazard that is often referred to as a progressive phenomenon.It is a cumulative deviation from normal or expected precipitation, i.e. a long-term mean or average. Due to the progressive nature of the drought, it often takes weeks or months for its effects to show. Rainfall deficits usually first appear as a lack of soil water; Therefore, agriculture is often the first sector affected.

It is often difficult to know when a drought will begin; likewise, it is difficult to determine when a drought has ended and the criteria by which it should occur. Another factor that distinguishes drought from other natural hazards is the lack of a precise and generally accepted definition.There is hundreds of definitions which add to the confusion about the existence of droughts and their severity. The definitions of drought should be specific to the region and the specific application or impact. Droughts have a regional extent and as already mentioned, each region has special climatic conditions.

Temperature, wind, and relative humidity are also important factors to consider when characterizing drought from one location to another. Drought has different meanings for water managers, agricultural producers, hydropower plant operators and wildlife biologists. Even within sectors, there are many different perspectives on drought, as the effects can be very different. For example, the effects of drought on crop yields for corn, wheat, soybeans, and sorghum can vary significantly because they are grown at different times during the growing season and do not require the same amount of water.The effects of droughts are non-structural in nature and are spread over a larger geographic area than damage resulting from other natural hazards such as floods, tropical storms and earthquakes to relieve drought than other natural hazards.

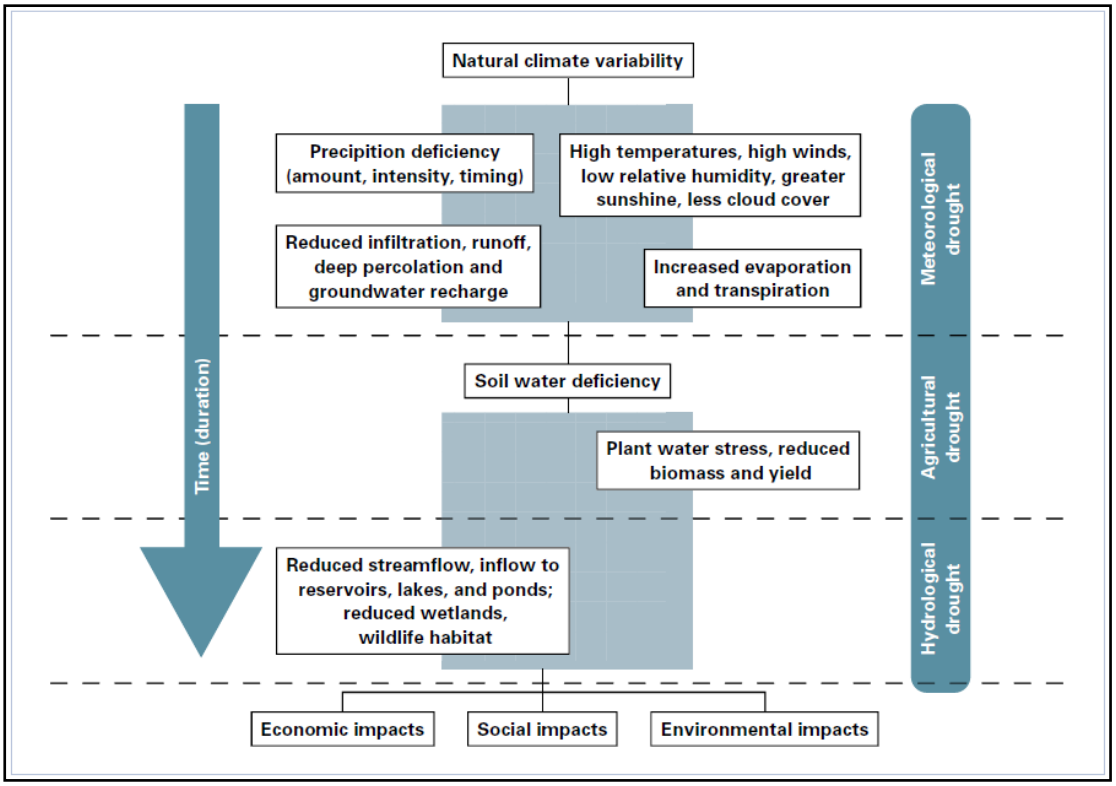

Figure 1: Sequence of drought occurrence and impacts for commonly accepted drought types. All droughts originate from a deficiency of precipitation or meteorological drought but other types of drought and impacts cascade from this deficiency. (Source: National Drought Mitigation Center, University of Nebraska–Lincoln, USA)

Drought Types

Droughts are generally classified by type into meteorological, agricultural, hydrological, and socio-economic.

Meteorological drought is generally defined by a threshold for lack of precipitation over a predetermined period of time. The chosen threshold, e.g. 75 percent of normal precipitation, and the duration (e.g. six months), vary depending on user needs or application. Meteorological droughts are a natural event and the result of several causes that differ from region to region. Agricultural, hydrological and socio-economic drought, however, place greater emphasis on the human or social aspects of drought, highlighting the interaction or interplay between the natural characteristics of meteorological drought and human activities that depend on precipitation to provide adequate water supplies to meet societal and environmental demands.

Agricultural drought is described extranormally via way of means ofthe provision of soil water to guide crop and forage increase than via way of means of the departure of ordinary precipitation over a fewspeciallength of time. There is no direct relationamong precipitation and

infiltration of precipitation into the soil. Infiltration charges vary, relying on antecedent moisture situations, slope, soil kind and the depth of the precipitation event. Soil traits additionally differ: a few soils have excessive water-keeping capability even as others do not. The latter are extraliable to agricultural drought.

Hydrological drought is even similarly eliminated from the precipitation deficiency due to the factit's miles typically described via way of means of the departure of floor and subsurface water materials from a few common situations at diverse factors in time. Like agricultural drought, there may be no direct relation among precipitation quantities and the fame of floor and subsurface water materials in lakes, reservoirs, aquifers and streams due to the factthose hydrological machine additives are used for a couple of and competing purposes, along with irrigation, recreation, tourism, flood control, transportation, hydroelectric energy production, home water deliver, safety of endangered species and environmental and surroundings control and preservation. There is likewise a great time lag among departures of precipitation and the factor at which those deficiencies turn out to beglaring in floor and subsurface additives of the hydrologic system.

Recovery of those additives is gradualdue to lengthy recharge durations for floor and subsurface water materials. In a few drought-susceptible areas, along with the western United States, snow percent gathered for the duration of the wintry weather months is the number onesupply of water for the duration of the summer. Reservoirs boom the resilience of this place to drought due to their potential to save huge quantities of water as a buffer for the duration of single or multiyear drought events.

Socio-economic drought differs markedly from the other types of drought because it reflects the relationship between the supply and demand for some commodity or economic good, such as water, livestock forage or hydroelectric power, which is dependent on precipitation. Supply varies annually as a function of precipitation or water availability.

Demand also fluctuates and is often associated with a positive trend as a result of increasing population, development or other factors. Agricultural, hydrological and socio-economic drought occurs less frequently than meteorological drought because impacts in these sectors are related to the availability of surface and subsurface water supplies. It usually takes several weeks before precipitation deficiencies begin to produce soil moisture deficiencies leading to stress on crops, pastures and rangeland. Continued dry conditions for several months at a time bring about a decline in stream flow and reduced reservoir and lake levels and, potentially, a lowering of the groundwater table. When drought conditions persist for a period, agricultural, hydrological and socio-economic drought occur, producing associated impacts.

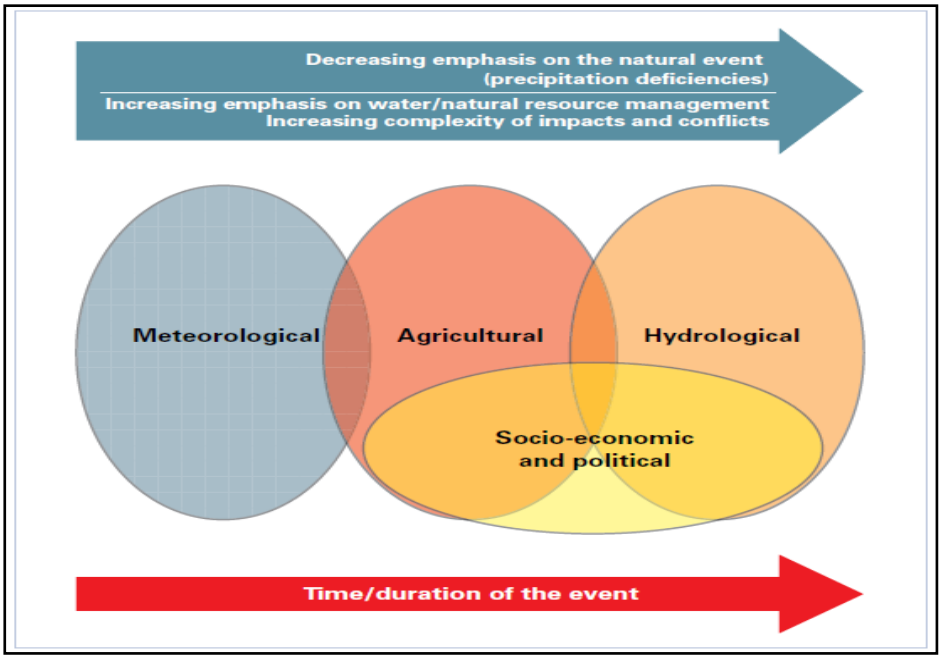

Figure 2: Interrelationships between meteorological, agricultural, hydrological and socio-economic drought.

(Source: National Drought Mitigation Center, University of Nebraska–Lincoln, USA)

Drought monitoring and early warning:

A drought early caution machine is designed to pick out weather and water deliver tendencies and consequently to stumble on the emergence or opportunity of prevalence and the probable severity of drought. These statistics can less enaffects if brought to selection makers in a well-timed and suitable layout and if mitigation measures and preparedness plans are in place.

There are several natural drought signs that need to be monitored mechanically to decide the onset and give up of drought and its spatial traits. Although all styles of droughts originate from a precipitation deficiency, it's miles inadequate to depend entirely in this weather detail to evaluate severity and resultant affects due to elements recognized previously. Effective drought early caution structures need to combine precipitation and different climatic parameters with water statistics along with movement flow, snow percent, groundwater levels, reservoir and lake levels, and soil moisture right into a complete evaluation of present day and destiny drought and water deliver situations. Heyes *et al.* (1999) used the standardized precipitation index (SPI) to screen the 1996 drought withinside the USA, they confirmed that the onset of the drought withinside the USA might have been detected in month earlier of the Palmer Drought Severity Index (PSDI). SPI become utilized in turkey (Komuscu, 1999), Argentina (Seiler et al, 2002) and Europe (Lloyds- Hughes and Saunders, 2002) for actual time tracking of droughts.

Drought monitoring and assessment:

A complete and included techniqueis needed to screen drought extra successfully and offer early caution. The series of climatic and hydrologic facts is fragmented among many businesses or ministries in maximum nations. Often those facts aren't said in a well-timed fashion. Automating the facts series procedure can drastically enhance the timeliness and reliability of drought tracking and early caution structures.

Recent efforts to enhance drought tracking and early caution with inside the United States and differentnations have supplied new early caution and selection- guide equipment and methodologies in guide of drought preparedness making plans and coverage improvement. The training discovered may be use fulfashions for differentnations to comply with as they are attempting to lessen the effects of destiny droughts.

An effective monitoring, early warning and delivery system continuously tracks key drought and water supply indicators and climate-based indices and delivers this information to decision makers.In 1999 the National Oceanic and Atmospheric Administration (NOAA), the USA Department of Agriculture (USDA) and the National Drought Mitigation Center (NDMC) on the University of Nebraska–Lincoln fashioned a partnership geared toward enhancing the coordination and improvement of latest drought tracking equipment. The United States Drought Monitor (USDM) has become an operational product on 18 August 1999. USDM is maintained at the NDMC website (http://www.drought.unl.edu/index.htm), which has become a web-based portal for drought and water supply monitoring.

The system is being advanced by use of drought-associated traits (indices), which might be derived from remote-sensing facts. The indices consist of a deviation from the normalized distinction plants index (NDVI) from its lengthy-time period imply and a plants situation index (VCI). Vegetative situations over the sector are said occasionally via way of means of NOAA National Environmental Satellite Data and Information System (NESDIS) the use of the Advanced Very High-Resolution Radiometer (AVHRR) facts (Kogan, 2000). A latest successor to AVHRR is the Moderate-Resolution Imaging Spectrometer (MODIS), a complicated narrow band- width sensor, from which composited reflectance facts are made to be had for gratis eacheight days via way of means of NASA and USGS, via the Earth Resources Observation Systems (EROS) factscentre (Justice and Townshend, 2002). Thenkabail *et al.* (2004) studied the Use of Remote Sensing Data for Drought Assessment and Monitoring in Southwest Asia and investigated the ancient sample of droughts within side the place the use of month-to-month time-step AVHRR satellite tv for pc facts for 1982–1999. Droughts in latest years have been studied the use ofeight- day time-c program languageperiod MODIS satellite TV for pcsnap

shots to be had from year 2000 onwards. The unique feature of the study is the development of regression relationships between drought-related indices obtained from MODIS and AVHRR data, which have different pixel-resolution and optical characteristics.

These relationships have beenset up for every month of the year separately, in addition to for the pooled facts of all months and defined as much asninety five percentage of variability. The relationships were validated in randomly chosen districts outside the study area. Time series of MODIS imagery provide near real- time, continuous and relatively high-resolution data, on which the assessment of drought development and severity in regions with scarce and inaccurate on-the-ground meteorological observations could be based.

At present, there is no green gadget within the South West Asia region to investigate and supply drought-associated statistics to the stakeholders at the floor. Only the Indian National Remote Sensing Agency (NRSA) has undertaken drought evaluation and reporting seeing that 1986, the use of Indian satellite TV for pc sensors and AVHRR (Thiruvengadachari *et al.,* 1987; Kumar and Panu, 1997; Johnson *et al.,* 1993). The Indian IRS-1C/D hugesubject sensor (WiFS) can be a sturdydevice for nearby drought evaluation with its spatial decision of 188 m and weekly repeat coverage. MODIS statistics continuity from Terra and Aqua satellites is assured over the years with successor satellite TV for pc and sensor structures already deliberate and assured, at least, till 2018, with National Polar-Orbiting Operational Environmental Satellite System (NPOESS) collection of satellites (Justice and Townshend, 2002). Unlike the MODIS, statistics continuity plans aren'tbutintroducedwith the aid of using the Indian Space Research Organization (ISRO). Finally, WiFS has handiest 2 spectral bands, whilst MODIS has 36, of which 7 are taken into considerationmost suitable for land research (Vermote et al. 2002).

Drought-Monitoring Indices:

Recent research display that combining a couple of statistics units improves drought detection (Hao *et al.,* 2014) and tracking (Mu *et al.,* 2013). Several multisensor drought tracking signshad been advanced to enhance description of drought onset, improvement, and termination (Svoboda *et al.,* 2002; Keyantash and Dracup, 2004; Tadesse *et al.,* 2005; Kao and Govindaraju, 2010; Hao and Agha Kouchak, 2013; Rajsekhar *et al.,* 2014). Availability of multiple satellite data sets offers a unique avenue to explore multi-index or multivariate drought indicators. Ground-based observations of many drought-associated variables (e.g., snow, soil moisture, water vapor, and overall water storage) are very confined or erratically dispensed throughout the arena. These can also additionally restrict improvement of multi-index signs in statistics sparse

areas. Given the sort of satellite TV for pc observations, far flung sensing lets inimprovement of an incorporated multi-index composite drought evaluation framework.

Drought-tracking indices are derived from AVHRR and MODIS statistics. They are usually radiometric measures of vegetation situation and dynamics, exploiting the unique spectral signatures of cover elements, especially within side the crimson and near-infrared (NIR) quantities of the spectrum (e.g. Huete *et al.*, 1997, 2002) and are touchy to vegetation type, increase stage, covercowl and structure (Clevers and Verhoef, 1993; Thenkabail 2003). Normalized Difference Vegetation Index (NDVI). NDVI become first counseled with the aid of using Tucker (1979) as an index of vegetation health and density.

$$NDVI = (\lambda NIR - \lambda red) / (\lambda NIR + \lambda red)$$

Where, λNIR nd λred are the reflectance in the NIR and red bands, respectively. NDVI reflects vegetation vigor (Teillet *et al.*, 1997), percent green cover, Leaf Area Index (Baret and Guyot, 1991) and biomass (Thenkabail *et al.*, 2002; Thenkabail *et al.*, 2004).

NDVI itself does not reflect drought or nondrought conditions. But the severity of a drought may be defined as NDVI deviation from its long-term mean (DEVNDVI).

Vegetation condition index (VCI) was first suggested by Kogan (1995, 1997). It shows how close the NDVI of the current month is to the *minimum* NDVI calculated from the long-term record.

$$VCIJ = \frac{(NDVIJ - NDVI_{min})}{(NDVI_{max} - NDVI_{min})} * 100$$

Where, NDVImax and NDVImin are calculated from the long-time period file (e.g., 15 years) for that month and j is the index of the modern month. The situation of the vegetation provided with the aid of using VCI is measured in percentage. The VCI values round 50% replicate truthful vegetation situations. The VCI values among 50 and 100% imply most suitable or above everyday situations. At the VCI fee of 100%, the NDVI fee for this month is identical to NDVImax. The VCI feenear0 percentage display can exceedingly dry month, whilst the NDVI fee is near its long time minimal. Low VCI values over numerous consecutive time durations factor to drought improvement.

Temperature condition index (TCI). TCI was also suggested by Kogan (1995, 1997) and its algorithm is calculated similar to VCI but its formulation was modified to reflect vegetation's response to temperature (the higher the temperature the more extreme the drought). TCI is based

on brightness temperature and represents the deviation of the current month's value from the recorded maximum.

$$TCIJ = \frac{(BT_{max} - BTj)}{(BT_{max} - BT_{min})} * 100 \quad (8)$$

Where, BT is the brightness temperature (e.g., AVHRR band 4). The most and minimal values of BT are calculated from the long-time period (e.g., 15 years) file of far flung-sensing photos for every calendar month j. At the TCI of round 50%, the truthful or everyday temperature situations exist. When TCI values are near 100%, the brightness temperature for this month BTj, is identical to the long-time periodminimal brightness temperature for the pixel. Low TCI values (near 0%) imply particularly warm climate in that month. Consistently low TCI values over numerous consecutive time durations can also additionally factor to drought improvement/presence.

Conclusion:

Drought influences greater human beings than some other herbal catastrophe and consequences in extreme economic, social and environmental costs. Significant strides had been made in latest years to enhance the effectiveness of those structures. With the growing frequency and severity of drought in lots ofareas of the arena and extended societal vulnerability, greater emphasis is now being locatedat the improvement of drought preparedness plans which are proactive in place of reactive and emphasize hazard-primarily based totally control measures. An important implication for a future drought monitoring program is the possibility of combining the estimates of maximum, minimum and long term mean NDVI values derived from the AVHRR data with the actual MODIS data. As the MODIS NDVI data "build up" with time, long-term NDVI characteristics can be determined directly from the MODIS data.

The temporal variations of NDVI are closely linked with precipitation and there is strong linear relationship between NDVI and precipitation in cases where monthly or seasonal precipitation is within a certain range. Rainfall has a positive relation with NDVI and also correlation of rainfall/ NDVI was found to be strong in water limiting areas, which states that the area is more prone to drought. NDVI is a good indicator of vegetation vigour, yet efforts towards a union of different factors to define risk areas is still to be attempted for better describing an

area at risk. Early warning systems can provide decision makers with timely and reliable access to information on which mitigation measures can be based.

References:

Baret, F., and Guyot, G. (1991): Potentials and limits of vegetation indices for LAI and APAR assessment, Remote Sensing of Environment, 35(2): 161–173.

Clevers, J. G.and Verhoef, W. (1993): LAI estimation by means of the WDVI: A sensitivity analysis with a combined PROSPECT-SAIL model, Remote Sensing of Environment 7: 43–64.

Hayes, M., Svoboda, M., Wilhite, D. and Vanyarkho, O. (1999): Monitoring the 1996 drought using the Standardized Precipitation Index, Bull. Am. Meteorol. Soc.80(3): 429–438.

Hao, Z., AghaKouchak, A., Nakhjiri, N. and Farahmand, A. (2014):, Global Integrated Drought Monitoring and Prediction System, Sci. Data, 1: 140001.

Hao, Z., and Agha Kouchak, A. (2013): Multivariate standardized drought index: A parametric multi-index model, Adv. Water Res., 57: 12–18.

Huete, A., Justice, C. and Van Leeuwen, W. (1999): MODIS Vegetation Index (MOD13):, Algorithm Theoretical Basis Document. http://modis.gsfc.nasa.gov/data/atbd/atbd_mod13.pdf

Huete, A., Didan, K., Miura, T., Rodriguez, E. P., Gao, X. and Ferreira, L. G. (2002): Overview of the radiometric and biophysical performance of the MODIS vegetation indices, Remote Sensing of Environment, 83(1): 195–213.

Johnson, G. E., Achutuni, V. R., Thiruvengadachari, S., Kogan, F. N. (1993): The role of NOAA satellite data in drought early warning and monitoring: Selected case studies. Chapter3. In Drought assessment, management, and planning: Theory and case studies, ed. D. A. Wilhite, 31-48. New York, NY: Kluwer Academic Publishers.

Justice, C., Townshend, J., Vermote, E., Masuoka, E., Wolfe, R., Saleous, N., Roy, D. and Morisette, J. (2002): An overview of MODIS Land data processing and product status, Remote Sensing of Environment, 83(1): 3–15.

Keyantash, J., and Dracup, J. (2004): An aggregate drought index: Assessing drought severity based on fluctuations in the hydrologic cycle and surface water storage, Water Resour. Res., 40, W09304.

Kao, S., and Govindaraju, R. (2010): A copula-based joint deficit index for droughts, J. Hydrol., 380(1):, 121–134.

Kogan, F. (1995): Application of vegetation index and brightness temperature for drought detection, Adv. Space Res., 15(11):, 91–100.

Kogan, F. N. (1997): Global drought watch from space, Bull. Am. Meteorol. Soc., 78(4):, 621–636.

Kogan, F. N. (2000): Contribution of remote sensing to drought early warning. In Early warning systems for drought preparedness and drought management, ed. D.A. Wilhite and D.A. Wood. 75–87. Geneva: World Meteorological Organization.

Kumar, V. and Panu, U. (1997): Predictive assessment of severity of agricultural droughts based on agro-climatic factors. Journal of the American Water Resources Association 96062. 33: 1255–1264.

Komuscu, A.U. (1999): Using the SPI to analyze spatial and temporal pattern of drought in Turkey. Drought Network News 11: 7-13

Mu, Q., Zhao, M., Kimball, J. S., McDowell, N. G. and Running, S. W. (2013): A remotely sensed global terrestrial drought severity index, Bull. Am. Meteorol. Soc., 94(1): 83–98.

Rajsekhar, D., Singh, V. P. and Mishra, A. K. (2014): Multivariate drought index: An information theory based approach for integrated drought assessment, J. Hydrol., 526: 164–182.

Svoboda, M. (2002): The drought monitor, Bull. Am. Meteorol. Soc., 83(8): 1181–1190.

Tadesse, T., J. Brown, and M. Hayes (2005): A new approach for predicting drought-related vegetation stress: Integrating satellite, climate, and biophysical data over the US central plains, ISPRS J. Photogramm. Remote Sens., 59(4): 244–253.

Teillet, P. M., Staenz, K. and Willams, D. J. (1997): Effects of spectral, spatial, and radiometric characteristics on remote sensing vegetation indices of forested regions. Remote Sensing of Environment 61: 139–149.

Thenkabail, P. S.; Smith, R. B. and De-Pauw, E. (2002): Evaluation of narrowband and broadband vegetation indices for determining optimal hyperspectral wavebands for agricultural crop characterization. Photogrammetric Engineering and Remote Sensing 68: 607–621.

Thenkabail, P. S. (2003): Biophysical and yield information for precision farming from near-real-time and historical Landsat TM images. International Journal of Remote Sensing 24: 839–877.

Thenkabail, P.S., Enclona, E.A., Ashton, M. S., Legg, C. and Jean De Dieu, M. (2004): Hyperion, IKONOS, ALI, and ETM+ sensors in the study of African rainforests. Remote Sensing of Environment 90: 23–43.

Thiruvengadachari, S.; Prasad, T. S.andHarikishan, J. (1987): Satellite monitoring of agricultural drought in Anantapur district in Andhra Pradesh State. Report No.: RSAM - NRSA - DRM - TR - 03/87. India: Drought Mission Team, Department of Space, Government of India. pp. 35.

Thiruvengadachari, S. and Gopalkrishna, H. R. (1993): An integrated PC environment for assessment of drought. International Journal of Remote Sensing 14: 3201–3208.

Tucker, C. J. (1979): Red and photographic infrared linear combinations for monitoring vegetation, Remote Sensing of Environment, 8(2):, 127–150.

Unganai, L. S., and Kogan, F. N. (1998): Drought monitoring and corn yield estimation in southern Africa from AVHRR data, Remote Sensing of Environment 63(3): 219–232.

Vermote, E. F., Saleous, El and Justice, N.Z. (2002): Atmospheric correction of MODIS data in the visible to middle infrared: first results. Remote Sensing of Environment, 83: 97–111.

ARTIFICIAL INTELLIGENCE TECHNOLOGIES DRIVEN SMART AGRICULTURE

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Abstract:

Agriculture is the primary source of livelihood for about 58% of India's population and more than half of the total population is dependent on it. Gross Value Added by agriculture, forestry, and fishing was estimated at Rs. 19.48 lakh crore (US$ 276.37 billion) in FY20. Artificial Intelligence has become the buzzword nowadays, not only in the agriculture sector, but everywhere we can see the influence AI is having. The main areas where the influence of agriculture can be seen are Policy, governance, advisory and market access, Agricultural Robotics, Early warning system, Food safety & traceability, Financial inclusion and risk management, Augmenting Entire Supply Chain, Capacity building and empowerment, Growth driven by IoT, Image-based insight generation, Identification of optimal mix for agronomic products, Health monitoring of crops and Automation techniques in irrigation and enabling farmers.The increased use of drones and the rising popularity of precision farming are other extended arms of Artificial Intelligence. In agriculture, there may be a tremendous ability for AI machines to offer facts to farmers at the great of soil, while to sow, in which to spray herbicide, and in which to anticipate pest infestations. Thus, if AI structures can propose farmers on quality practices, India should see a farming revolution. To discover the tremendous scope of AI in agriculture, packages want to be greater robust. An open-supply platform could make the answers greater less expensive, ensuing in fast adoption and better penetration of many of the farmers.

Introduction:

The intelligence proven through machines is called Artificial Intelligence. It is the simulation of intelligence in machines that can be programmed to study and mimic the movements of humans. These machines can study with the revel in and carry out human-like tasks (Bagchi, 2018). Artificial Intelligence is helpful in timing planting and making predictions

on the right time to plant, apply fertilizers, harvest etc. based on climate data, historical conditions, market conditions for input and outputs etc. It may helpful for understanding long term soil fertility and the yield on a given piece of land versus as it's subject to multiple treatments over many years, identifying pest and diseases outbreaks before they occur and calculating the probability of outbreaks and helping farmers to manage risk in economic crisis, automating on-farm activities, managing crop quality and assessing quantity i.e. in-field inventory management and then making an economic decision based on these predictions. The primary source of livelihood in India is agriculture and around 58 per cent of India's population depends on it. Gross value added of Rs. 19.48 lakh crore (USD 276.37 billion) in FY20 by agriculture, forestry, and fisheries has been estimated. The share of agriculture and allied sectors in gross value added (GVA) of India is at 17.8 % in FY20 at current prices.Consumer expenditure in India will return to growth by 6.6 per cent in 2021 after the contraction caused by the pandemic. The Indian Economic Survey 2020-21 reported that in FY20 the country recorded full-grain production at 296.65 million tonnes up from 285.21 million tonnes in FY19 by 11.44 million tonnes. In FY21, the Government set a goal to shop from the central pool for 42.74 million tonnes, which is often 10 per cent of the number bought in FY20. For FY22, the government's target has been set to increase the production of food-grain by 2% by 307.31 million tonnes. In FY21, production was recorded at 303.34 million tonnes against a target of 301 million tonnes. India is one of the 15 world's leading agricultural exporters. Agricultural export from India reached US$ 38.54 billion in FY19 and US$ 35.09 billion in FY20.

Artificial Intelligence based on machine learning and advanced computer vision algorithms can continuously analyse the data captured from various sources. Artificial Intelligence and Machine learning are two correlated technologies that are created for intelligent systems. AI is a broader concept to create intelligent machines which can simulate the way human thinks and behave. In simple words, the main objective of AI is to create computer programs smart enough to mimic human intelligence. Knowledge engineering is a vital part of AI systems (Yigit *et al.,* 2019). On the other hand, machine learning is a subset of Artificial Intelligence that allows machines to learn from the data without being programmed explicitly. Machine learning uses complex algorithms that constantly iterate over the huge dataset, and generalizes for the data, giving accurate predictions on unseen data.Computer vision is one evolving and compelling field of Artificial Intelligence through which the complex human vision system is replicated. The core idea behind computer vision is to enable computer systems to identify and locate objects in images and videos in the same way humans identify them. Advanced algorithms like deep learning and the neural network have made a remarkable growth

in computer vision. In-plant phenology studies deep learning algorithms like CNN and its variants are widely used. Convolutional Neural Networks are extensively used for image classification. Convolutional layers are the major building blocks used in CNN and the images are scanned with a window (filter) to look for specific features inside the image to generate a feature map. Followed by convolution, pooling and fully connected layers are also used to build the complete CNN those results in precise detection of features and accurate classification of images. Pooling layers try to reduce the dimensionality of the feature map generated by the convolutional layers without losing much information. With fully connected layers, the features are combined to build the final model. Some of the most widely used CNN architectures are LeNet, AlexNet, GoogleNet, ResNet, VGG16 and so on. Time series data is used for the trend analysis of a particular phenomenon. Box and Jenkins pioneered the time series analysis. The well-known method for time series is Autoregressive Integrated Moving Average Model (ARIMA) for analysing and forecasting the statistical data. (Srinivasa *et al.,* 2021)

Search engine marketing technique provides enormous exposure to the brands which makes use of this strategy, but exposure is not the only benefit that should attract a company to adopt this marketing technique. The importance of Search engine marketing is to:

- **Improves visibility:** In a time-sensitive world the importance of cutting through the wide range of competition to gain the interest of the customers is really important. With the targeted keywords and optimized bidding, a brand can ensure good quality ads and ensure high website visits.
- **Focusses on location-based customer targeting:** Helps a brand to focus on potential customers in their locality, thus prevents wasting time and energy on customers who are far away from the location. This feature can be of great help to small and medium brands with a limited number of branches. This marketing technique is easy to implement and is highly flexible. Brands can make appropriate changes to their website or keywords to increase the traffic to their web pages.
- **Measure the campaign performance:** The investor can easily obtain the data's regarding the performance of the campaign and restructure the advertisement campaign if necessary. This also helps in making appropriate budgeting to prevent unnecessary capital wastage.
- **Pay only per action:** Once the financial settlement for the ad campaign is done, the advertisements appear for free and the investor is expected to pay only if someone takes action when someone clicks on the ads hence visiting the brand website.

- **Establishing brand identity:** If used efficiently Search engine marketing can result in huge revenue generation for business ventures. The high brand value increases the firm position on top of search engine result pages.

Digital marketing technically refers to advertising through digital channels like search engines, websites, social media, and mobile apps. Recent trends have shown a huge hike in companies investing in digital marketing campaigns to endorse their products and services. Google marketing surveys have published the data that 48% of consumers start their queries on search engines, while 33% look to brand websites and 26% search within mobile applications. One such marketing technique that has gained popularity is Search engine marketing or SEM. Search engine marketing is the act of using paid advertisement strategies to improve the visibility of the website or to drive more traffic to the company sites. It can be seen as an umbrella term that comprises techniques such as search engine optimization or SEO and paid searches to improve the firm visibility. Search engine optimization is an organic method to improve visibility by making tactical changes to the website contents and this does not have an ad designation to it and is free of cost. Although the results won't be reflecting in a short period they will certainly contribute to the campaign success in the long run. Whereas many paid strategies are part of the search engine marketing such as keyword bidding, pay per clicks which instantly boosts the search visibility of the sites as per the keywords opted. To buy advertising space on search engines, it is necessary to use platforms such as Google Ads or any such relevant search engine advertising sites. This is a great way to grow brand awareness and increase sales.

Types of Artificial intelligence:

There are three types of Artificial Intelligence (AI).

(i) Artificial Narrow Intelligence (ANI):

This is the most common shape of AI that locates with inside the marketplace now. These Artificial Intelligence structures are designed to remedy one individual trouble and could be capable of executing that challenge well. By definition, they've slim capabilities, like recommending a product for an e-trade consumer or predicting the weather. This is the best type of Artificial Intelligence that exists today. They are capable of coming near human functioning in very precise contexts or even surpass them in lots of instances, however, they best excelling in much managed environments with a confined set of parameters.

(ii) Artificial General Intelligence (AGI):

Artificial General Intelligence (AGI) continues to be a theoretical concept. It’s described as AI which has a human-stage of cognitive function, throughout a huge sort of domain names consisting of language processing and photo processing. We’re nonetheless an

extended manner far from constructing an AGI device. An AGI device could want to contain heaps of Artificial Narrow Intelligence structures running in tandem, speaking with every different to imitate human reasoning.

(iii) Artificial Super Intelligence (ASI):

Artificial Super Intelligence (ASI) is the visible logical development from AGI. An Artificial Super Intelligence (ASI) machine might be capable of surpassing all human abilities. This might consist of selection making, taking rational choices, or even consists of such things as making higher artwork and constructing emotional relationships. The cause of Artificial Intelligence is to resource human abilities and assists to make superior choices with far-achieving consequences.

From a philosophical perspective, Artificial Intelligence can assist people to stay greater significant lives without difficult labour and assist control the complicated net of interconnected individuals, companies, states and international locations to characteristic in a way that's useful to all of humanity.

Importance of Artificial Intelligence in agriculture:

Artificial Intelligence (AI) strategies are extensively used to clear up a one-of-a-kind set of troubles and to optimize the manufacturing and operation techniques inside the fields of agriculture. Artificial intelligence (AI) and Machine Learning (ML) are being rapidly implemented by agriculture in each sentence of agricultural goods and agricultural strategies in the subject matter. In particular, cognitive computing is ready to become the most disruptive generation in farm offerings as it is capable of understanding, learning and responding to one-of-the-kind (mostly based on learning) booming efficiency. Farmers able to learn a lot about their farm's weather, temperature, water use, and soil monitoring with the use of Artificial Intelligence, which will help them enhance their profits. Farmers benefit from AI technologies by learning what crops they can grow, developing high-quality hybrid seeds, and maximising resource efficiency. AI can also help to improve the quality of collected produce as well as the precision with which it is harvested. AI technology aids in the detection of plant illnesses, pest infestations, and nutritional concerns in agricultural fields in precision agriculture. Sensors using AI can readily detect weeds and then inform to use of herbicides. It can reduce cultivation costs by using this strategy since once awareness on herbicides and spray them across the entire field. Farms all across the world are employing AI technology to run more efficiently while still satisfying the world's food needs. AI enables farms of all sizes to run and feed the globe, whether they are little or large. With the help of AI, it can readily learn about forecasting models to

improve accuracy and efficiency. These models will be able to anticipate the weather months in advance with ease. Seasonal forecasting is the most effective way to help small farms.

AI is creating lots of positive changes in Indian agriculture. AI applications in agriculture are valued at $852.2 million in the year 2019 and are estimated to grow up to $8.38 billion by the year 2030, which is nearly a growth of 25 per cent. Technology helps in improving access to markets, inputs, credit and insurance of crops. The use of proper time and accurate data helps in building a demand-driven supply chain. By using sensors, phone photographs, drones and agricultural weather data, soil health data, many AI models become cheap and affordable. Artificial Intelligence (AI) is acting as a catalyst for improving yield by facing various factors like climate changes, population growth, employment issues. Nowadays very few people are interested in farming, that's why many farms are facing the issue of worker's shortage. Traditional farming has needed a lot of workers, to sow the crops and by making farms productive. The solution to cope with the shortage of workers is the use of AI agriculture bots. AI bots are utilized in many forms to augment human labour. Bots can harvest crops at a faster pace than human workers; they also identify and remove the weeds easily, which leads to reducing the costs.

Areas where AI is benefitting in agriculture:

Artificial Intelligence (AI) strategies are extensively used to clear up a one-of-a-kind set of troubles and to optimize the manufacturing and operation techniques inside the fields of agriculture, meals and bio-device engineering. Agriculture is seeing fast adoption of Artificial Intelligence (AI) and Machine Learning (ML) each in phrases of agricultural merchandise and in-subject farming strategies. Cognitive computing, in particular, is prepared to emerge as the maximum disruptive generation in agriculture offerings as it can understand, learn, and reply to one-of-a-kind situations (primarily based totally on learning) to boom efficiency. The Internet of Things (IoT), Cloud Computing, and Big Data have all had a significant impact on current process efficiency. Several farm holdings manage farms with the help of remote sensing technologies, drones, and other devices that collect vital data on soil properties, air, crop health, and weather conditions. Farmers and agribusinesses can use the data to closely monitor crop cultivation, optimise the use of agrochemicals and natural resources, and quickly adapt to changing environmental conditions.The Internet of Things (IoT) has several applications in agriculture, ranging from real-time monitoring of soil, plant, and animal health using in-situ sensors to tracking the origin of a product or Agri-commodity and its environmental impact, as well as its storage environments along the availability chain. It is predicted that by 2030, IoT will have evolved into the 'Internet of Action,' with sensors and

machines capable of self-optimizing and initiating activities on their own, thanks to built-in AI and data analytics capabilities. It may help in the following way:

Augmenting entire supply chain:

AI technologies are assisting in the production of healthier crops, the control of pests, the monitoring of soil and growing conditions, the organisation of data, the reduction of workload, and the improvement of a wide range of agricultural tasks throughout the food supply chain. Indian farmers provide vast data to create AI solutions for the country, and this is the reason which creates the chance for AI in Indian agriculture.

Agricultural Robotics:

Controlling weeds is the top priority of farmers and a challenge as herbicide resistance becomes more common. Agricultural robotics helps to find efficient ways to protect their crops from weeds. The robot sends its vision to a computer and sprays weeds on cotton crops. Herbicide resistance can be prevented by precisely spraying.

Policy, governance, advisory and market access:

The widespread adoption of digital technologies by agriculturists is resulting in an exponential increase in the availability of a wide range of big data that can aid in better policy-making and the transformation of the agriculture sector. Innovative media platforms powered by ICT, bridge the gap between farmers on one end and agricultural researchers and extension agents on the other. It is a less expensive method of increasing smallholders' knowledge of current agricultural practices and markets.Through the transfer of information from traders, market information services help to improve farmers' access to nearby markets and their awareness of current consumer demands.Budget-friendly mobile phones, internet, and other services to disseminate information, as well as improving rural farmers' access to climate-smart solutions and the knowledge to use them.

Early warning system (EWS):

Early warning systems provide governments and communities with real-time information on disaster prevention and management. They also improve the efficiency of emergency response and promote more effective communication by providing people with timely advice on risk-mitigation procedures.

Food safety and traceability:

A combination of simple and sophisticated technologies, such as mobile phones, software solutions, RFID tags, data input websites, and GPS-enabled sensors, assist producers in capturing and analyzing reliable data while also adhering to international traceability standards.

Financial inclusion and risk management:

It improves rural and smallholder farmers' access to financial services, assists them in finding affordable insurance schemes and risk management tools, and provides them with information about financial services that are available to them.

Capacity building and empowerment:

It is an important educational tool for the growth of local communities. They extend the reach of women, youth, and other beneficiaries and pave the way for newer business opportunities to improve livelihoods and incomes.

Growth driven by IoT:

Huge volumes of information get generated each day independent and unstructured formats. These relate to information at the ancient climate pattern, soil reports, new research, rainfall, pest infestation, snapshots from Drones and cameras and so on. Cognitive IoT answers can feel all this information and offer sturdy insights to enhance yield. AI can be used to create intelligent systems which can also be embedded in machines that can work with higher accuracy and speed than humans but with the same responsive as humans (Bhar *et al.,* 2019)

Image-based insight generation:

Precision farming is one of the maximum mentioned regions in farming today. Drone, primarily assist in intensity subject evaluation, crop monitoring, scanning of fields and so on. Computer imaginative and prescient generation, IoT and drone records may be blended to make certain speedy movements with the aid of using farmers. Feeds from drone picture records can generate signals in real-time to boost up precision farming (Baruah, 2018). Some regions in which pc imaginative and prescient generation may be placed to apply are Disease detection, Crop readiness identity and Field management.

Identification of optimal mix for agronomic products:

Based on a couple of parameters like soil condition, climate forecast, a form of seeds, infestation in a sure location and so on, cognitive answers make hints to farmers at the nice desire of plants and hybrid seeds. The advice may be in addition customized primarily based totally on the farm’s requirements, nearby conditions, and facts approximately a hit farming with inside the past. External elements like market trends, charges or customer wishes will also be factored into allowing farmers to make a well-knowledgeable decision.

Monitoring of crops and soil health:

Remote sensing strategies at the side of hyperspectral imaging and 3D laser scanning are crucial to constructing crop metrics throughout hundreds of acres. It can herald a progressive alternate in phrases of ways farmlands are monitored through farmers each from an effort and

time perspective. This generation may also be used to display vegetation alongside their complete lifecycle which includes document era in case of anomalies. Crop Monitoring and Health evaluation continue to be one of the maximum sizable regions in agriculture to offer drone-technology based solutions in collaboration with Artificial Intelligence and web imaginative and prescient technology. (Verma, et al., 2016) Highprecisioncameras drones accumulate precision images which may be handed via a convolution neural network to perceive regions with weeds, which vegetation want water, plant strain degrees with inside the mid boom stage. For diseased and affected vegetation, via way of means of scanning vegetation in each RGB and near-infrared light, its miles feasible to generate multispectral photos with the use of drone devices. With this, its miles feasible to specify which vegetation had been inflamed consisting of their region in a substantial discipline to use remedies, instantly. The multispectral photos integrate hyperspectral photos with 3-D scanning strategies to outline the spatial data gadget this is used for acres of land.

Automation techniques in irrigation and enabling farmers:

In phrases of human-in depth tactics in farming, irrigation is one such process. Machines skilled on historic climate patterns, enrich soil and the sort of plants to be grown, can automate irrigation and growth general yield. With near 70% of the world's freshwater being utilized in irrigation, automation can assist farmers' higher control of their water problems.

Drones- The new buzz in AI-driven agriculture:

Agriculture drone generation has been enhancing over the previous few years, and the use of drones in agriculture has become greater obvious to farmers. Drone programmes in agriculture vary from mapping and surveying to crop-dusting and spraying. Drone-primarily based answers in agriculture have a whole lot of importance in phrases of dealing with negative climate conditions, productiveness gains, precision farming and yield control. Before the crop cycle, the drone may be used to supply a 3-dimensional field map of exact terrain, drainage, soil viability and irrigation. Nitrogen-stage control also can be accomplished through drone technologies.Aerial spraying of pods with seeds and plant vitamins into the soil offers vital dietary supplements for vegetation. Apart from that, Drones may be programmed to spray via way of means of modulating distance from the floor relying on the terrain.

Precision Farming:

Precision farming is summed up by the phrase "Right Place, Right Time, Right Product." This is a greater correct and managed approach that replaces the repetitive and labour-extensive part of farming. It additionally affords to steer approximately crop rotation most excellent

planting and harvesting time, water management, nutrient management, pest assaults and so on. Precision farming's objectives is to: Profitability entails strategically identifying crops and markets as well as predicting ROI based on cost and margin. Efficiency: Investing in a precision algorithm allows for better, faster, and less expensive farming opportunities. This improves overall accuracy and resource efficiency. Sustainability: Improved social, environmental, and economic performance ensures that all performance indicators improve incrementally each season.

AI start-ups in Agriculture in India:

CropIn is an issuer of primarily based farming answers to agribusinesses. Its services are Smart farm; a whole farm control solution, Smart risk; hazard mitigation and forecasting answers, warehouse; traceability and compliance solution, and Smart sales; CRM and enter channel control answers. The business enterprise claims to provide its answers for farming corporations, Agri-enter corporations, crop coverage providers, seed manufacturing corporations, government, and advisories. It additionally claims to provide Acre square answers; a farmer software for corporations to attach their farmers and teach them.

Crofarm affords a virtual delivery chain of the result and veggies from farm to business. It manages the logistics, storage, delivery to customers in retail chains like Big Bazaar, Reliance Retail, and online shops like BigBasket and Grofers. The business enterprise claims to apply AI-enabled proprietary virtual gear for deliver chain control and logistics optimization.

AgNext is a developer of a platform for monitoring and improving agricultural food quality. It offers solutions such as post-harvest procurement assessment & management, inventory monitoring & control, automated quality auditing, food traceability, and much more.

Zentron Labs: Provider of computer vision-based visual inspection systems. Its capabilities consist of the combination of business cameras with pc imaginative and prescient algorithms, dimensioning, offline measurements for pattern inspection, reporting and a web-primarily based AR app. It caters to more than one sector like agriculture, manufacturing, e-commerce, steel forming and the Hi-Tech industries.

Challenges of Artificial Intelligence (AI):

The NITI *Aayog* has recently launched a dialogue paper in which it envisions AI solutions for key sectors which include agriculture. In agriculture, there may be a tremendous ability for AI machines to offer facts to farmers at the soil, while to sow, in which to spray herbicide, and in which to anticipate pest infestations. Thus, if AI structures can propose farmers on quality practices, India should see a farming revolution. However, the sort of futuristic situation has a powerful project of scaling it as much as the complete price chain with elements

like potential enlargement and price discount in mind. Though Artificial Intelligence gives big possibilities for utility in agriculture, there nevertheless exists a loss of familiarity with high-tech gadgets gaining knowledge of answers in farms throughout maximum elements of the world. Exposure of farming to outside elements like climate situations, soil situations and the presence of pests is pretty a lot. So, what may seem like a great answer even as making plans at some point at the beginning of harvesting might not be a most fulfilling one due to adjustments in outside parameters.

Conclusion:

The destiny of farming relies upon in large part the adoption of cognitive answers. While large-scale studies continue to be in development and a few packages are already to be had inside the market, the enterprise continues to be exceptionally underserved. When it involves coping with sensible demanding situations confronted via way of means of farmers and the use of self-sustaining choice-making and predictive answers to clear up them, farming continues to be at a nascent stage. To discover the tremendous scope of AI in agriculture, packages want to be greater robust. Only then will or not it's capable of managing common adjustments in outside conditions, facilitate real-time choice making and employ a suitable framework/platform for efficaciously gathering contextual data. Another essential element is the exorbitant price of various cognitive answers to be had inside the farming market. The answers want to come to be greater less expensive to make sure the generation reaches the masses. An open-supply platform could make the answers greater less expensive, ensuing in fast adoption and better penetration of many of the farmers. AI has yet to reach the small and marginal farmer in Indian agriculture. AI has the potential to exacerbate economic disparities between large and small landholders, as well as landless labourers. As a result, any policy measure on this front must be carefully planned and implemented. The private and public sectors must work together to make AI and other agricultural technologies affordable and well-understood by the end-users – the farmers. Artificial intelligence (AI)-driven technologies are advancing to assist businesses to improve efficiency and address issues including agricultural productivity, soil health, and herbicide resistance. In the agricultural industry, agricultural robots are on the approach of becoming a highly valued AI application. In the dairy business, thousands of milking robots are already in operation, demonstrating widespread adoption. This business is predicted to increase from $1.9 billion to $8 billion by 2023. Agricultural robots may be developed in the next three to five years to perform a wider range of tasks. Crop and soil monitoring technologies will be essential

applications in the future as climate change research and evaluation proceeds. The amount of data that drones and satellites may acquire daily, provide agricultural firms with a new ability to foresee changes and find possibilities. It is believed that satellite machine vision applications (for weather, crop health, agricultural yield prediction, and so on), become increasingly widespread in large industrial facilities. Furthermore, extensive testing and validation of future AI solutions in this sector become crucial because agriculture is influenced by environmental elements that are difficult to control, unlike other industries where risk is easy to model and predict.

References:

Bagchi, Arka (2018): 'Artificial Intelligence in Agriculture. https://www.mindtree.com/sites/default/files/201804/Artificial%20Intelligence%20in%20 Agriculture.pdf

Baruah, Ayushman (2018): Artificial Intelligence in Indian Agriculture – An Indian Industry and Startup Review. www.emerj.comhttps://emerj.com/ai-sector-overviews/artificial-intelligence-in-indian-agriculture-an-industry-and-startup-overview

Bhar L M, S K Ambast, S K Soam and Ch. Srinivasa Rao (2019): Status and prospectus of artificial intelligence in agriculture. Proceedings and recommendations national workshop on artificial intelligence in agriculture held during July 30-31, 2018 at NASC, Complex, New Delhi, pp: 1-92.

Srinivasa Rao, N, Soam S.K., Srinivasa Rao, Ch (2021): Applications of Artificial Intelligence in Precision Agriculture. Gradiva review journal. 7(7): 174-177.

Verma, K, Dinesh P. and Avinash Singh Jat (2016): Agriculture advancement using Artificial Intelligence. 2nd International Conference on Recent Innovations in Science, Technology, Management and Environment, 74-77.

Yigit, Enes, KadirSabanci, AbdurrahimToktas, and Ahmet Kayabasi (2019): A study on visual features of leaves in plant protection using artificial intelligence Techniques. Computers and electronics in agriculture 156: 369-377.

EMERGING TECHNOLOGIES IN AGRICULTURE

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Abstract:

Agriculture is a vital part of the economy of many developing and developed countries, due to its contributions to food production, economic development, and other aspects of development. Innovation in modern agriculture is more important than ever before, as industry faces major challenges due to higher costs of goods and services, shortages of workers. Research and extension systems play a key role in the development and distribution of agricultural technologies. The development of precision agriculture has focused on several aspects, including technology, digitalization, social impacts, skills, environment, and productivity. The digitalization of agriculture has been widely implemented in conjunction with the Information and Communications Technology (ICT) revolution. Digitalisation tools such as Internet of Things (IoT) have helped farmers to conduct efficient and precise data collection that can be easily shared and interpreted. GIS based agriculture, sensor technology, drone technology, indoor vertical farming, satellite and GPS technologies, automation and robotics, modern greenhouse technologies, and blockchain have been among the most significant technological developments in the world. When used in the right manner, these technologies could increase productivity and profitability; their use could also help farmers maintain their livelihoods.

Keywords: Agriculture, Emerging Technology, Innovation, Digitalization.

Introduction:

Most of the country's population is dependent on agriculture as a principal source of income (Dutonde, 2018). It contributes nearly one-sixth of the Indian national income and employs nearly 50% of the workforce (NABARD, 2020; Talaviya *et al.*, 2020). Through its forward and backward links, it is crucial to the nation's food security and contributes to the development of the secondary and tertiary sector of the economy. In modern agriculture, innovation is more important than ever, and the industry as a whole faces major challenges arising from the increased cost of goods and services, a shortage of workers, and changes in

consumer preferences for transparency and sustainability (Ku, 2021). Agricultural corporations recognize that solutions to these challenges are increasingly required. Research and extension systems play a major role in developing and distributing agricultural technologies (Kapur, 2018). Research increases the productivity of farming systems by developing new technologies that, if appropriate for farmers' circumstances, will be rapidly adopted (Talaviya *et al.,* 2020). This approach is usually seen as a top-down approach, with researchers developing the innovation, extension workers spreading the word about its use, and farmers accepting or rejecting the innovation according to the features they find most important. Historically, researchers and extension workers were primarily responsible for identifying and incorporating economic and environmental variables into the development and introduction of agricultural innovations. Krishi Vigyan Kendras, agricultural universities, research institutes have developed many technologies to improve the productivity and profitability of farmers (Shekara *et al.,* 2016). The development of the agricultural sector will speed up rural development, further contributing to rural transformation and finally supporting structural transformation. To transfer the technologies from laboratory to field, the extension system uses a range of extension methods, including training, demonstration, and exposure visit, in which the majority of research is focused on location and crop specific technologies and primarily on a problem-solving approach. Nevertheless, farmers should be given basic knowledge of agriculture in order to build a better knowledge base at the farmer level to make better farm management decisions and to adopt modern technologies. Thus, innovations in research should be accompanied by training for farmers on new developments and how they should respond. Technological change has been major driving force for increasing agricultural productivity as well as promoting agricultural development in worldwide. Future agriculture will rely on sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology, mainly because of advances in technology, such as sensors, devices, and computers (Clercq *et al.,* 2018). These advanced devices, precision agriculture and robotic systems will make farms more profitable, efficient, safe, and environmentally friendly (Pothireddygari, 2020). Therefore, the following emerging technologies will change the agricultural landscape in the years ahead.

GIS based agriculture:

A Geographic Information System (GIS) is a technology that allows the collection and use of geographical data to help in the development of Agriculture. GIS software allows for a greater integration of large amounts of different data and the combination of various layers of information to better manage and retrieve the data (Acharya *et al.*, 2018). It allows tabular soil information to be geo referenced and converted to geographic and interpretive maps, giving the

user a visual representation of the tabular data (Coleman and Galbraith, 2000). By using a simple mouse click, users can view tabular information for any feature on any map. GIS is a dynamic product rather than a static one, which makes it easy to update, modify, and reproduce maps. Multiple layers of maps can be displayed in a variety of patterns, sizes, and combinations to meet the needs of the user. It provides agricultural scientists with powerful tools to provide better service to farmers and the agricultural community by answering their questions and helping them to make better decisions when undertaking planning activities for the development of agriculture. GIS determines how to irrigate crops based on local water resources and weather patterns. They are different types of GIS mapping that are useful in agriculture: Soil type mapping, crop coverage, rivers and distributaries mapping, land use mapping, contour mapping, irrigation system mapping, and meteorological mapping (Pothireddygari, 2020).

Sensor Technology:

In most of the developed countries sensor technology become very popular as remotely sensed data also plays an important role in data collection, and it is recorded by sensors attached to a platform, which may include cameras, digital scanners, and LIDAR, while platforms typically consist of aircraft and satellites (Pajares *et al.,* 2013). Sensor-based technologies also provide the appropriate tools to decrease the use of agrochemicals and promote environmentally friendly agronomical practices (Acharya *et al.,* 2018). Precision agriculture is an emerging industry in which sensor-based technologies can play a significant role (Pajares *et al.,* 2013). Sensors are selected or designed according to the problems to be solved or needs identified by farmers. Soil and water sensors, which are durable, unobtrusive, and relatively inexpensive, are most likely to have the greatest impact (Ayoka, 2015). Even family farms find it affordable to spread them over their fields, and they provide many benefits. For example, these sensors can detect moisture and nitrogen levels, and the farm can use this information to determine when to water and fertilize, instead of relying on a predetermined schedule (Ayoka, 2015). On the basis of regression trees, a spectroradiometer is used for hyperspectral analysis of soil while frequency-domain reflectometry is employed for soil salinity assessment of sandy mineral and bulk electrical conductivity as a part of soil analysis and characterization (Pajares *et al.,* 2013). An ultrasonic sensor and a camera are used together to detect weeds in cereals; the ultrasonic recognizes plant height, while the camera measures weed and crop coverage. After crops are harvested, RFID sensors can be used to trace food products from the field to the supermarket (Sadiku *et al.,* 2020). Radio Frequency Identification (RFID) is a technology that assists in improving information flow within the supply chain and security in the agri-food sector.

Drone Technology:

In almost every sector of the economy, the use of drones is booming, but the use of drones in agriculture is steadily expanding as part of a practical approach to sustainable agricultural management (Pinguet, 2021). In the agricultural sector drones are often used to make better agronomic decisions, and are part of a system called precision agriculture. In many areas, drone use is already an integral part of large scale precision farming operations (Pinguet, 2021). Drones can provide precise field mapping, including elevation information that allows growers to spot any irregularities in the field. Drones can capture 3D imagery that can be used to predict soil quality (Sadiku *et al.,* 2020). Drone data can be used to accurately plan and make ongoing improvements in crop monitoring, such as ditches, soil health and changing fertilizer applications, and help farmers to streamline their operations. Instead of more traditional time and labour-intensive data collection, products can be tracked accurately from farm to fork by using GPS locations for every point along the journey (Pinguet, 2021). It is also very much effective to help farmers after the natural disasters when damage across terrains may not be readily accessible on foot.

Vertical Farming:

The idea of a vertical farm was developed to remedy this crisis as the world's population grows along with the land needed to produce the food required. Vertical farming has the potential to become the future of sustainable agriculture and replace traditional farming as the primary source of food for society. By replacing traditional farms with vertical farms, society would help protect the environment while also generating social and economic benefits. Vertical farming involves growing crops in vertically stacked layers or embedded in other structures (such as a skyscraper) with comparatively less water and no soil (Royston and Pavithra, 2018). Actually, vertical farming is the urban farming of fruits, vegetables, and grains in a building in a city or urban centre, in which floors are designed to accommodate certain crops. Vertical farming uses indoor farming techniques and controlled environment agriculture (CEA) technology, which means that all environmental factors, such as artificial control of light, humidity, and temperature, can be controlled (Royston and Pavithra, 2018). One of the most evident advantages is the ability to grow in urban settings, becoming more efficient at bringing fresher food to market quicker and at lower prices. Vertical farming advocates hope to replace traditional farms with vertical farms directly in urban areas to reduce land, water, and energy used to produce a more sustainable form of food production. Vertical farming will not be restricted to urban areas, as initially hoped. Farmers in all regions can use it to make better use of existing land and to grow crops that might not be viable in those areas (Ayoka, 2015). Vertical farming is not only

scientifically viable, but it could become financially viable within the next decade as vertical farms are designed to reduce the overall amount of resources used and reduce agricultural carbon emissions (Sadiku *et al.,* 2020).

Satellite and GPS Technologies:

Stakeholders from across the agricultural sector are interested in knowing where and how much of each crop is grown. Satellite EO is a form of remote sensing that employs platforms located up to 36,000 kilometers from earth to gather information about its surface and atmosphere (Jarman, 2018). There are a wide variety of commercial and open-source satellite data sources with different spatial/temporal resolutions and associated costs. Analysis of EOS (Earth observation satellites) data can provide accurate geospatial information about cropped areas that is different from the statistical information that is usually gleaned from census returns and other sampling methods (Jarman, 2018). Using free EOS data, such as Landsat and Sentinel, many countries around the world are collaborating on national and regional crop-type mapping. Precision farming will be judged by the type of information provided to the farmer, and how quickly the farmers were convinced. The Global Positioning System (GPS) is a widely used precision agriculture tool that transmits signals that allow GPS receivers to calculate their position (Shanwad *et al.,* 2002). In addition to its convenience and all-weather operation, GPS is known for its high resolution and consistent accuracy.

Automation and Robotic Technology:

Automation in agriculture has become a trend, where agricultural tasks such as cultivation, inspection, spraying, pruning, and harvesting are automated to reduce the human involvement in agriculture (Mahmud *et al.,* 2020). The term automated agriculture is used to refer to any parts of equipment or machinery which are designed to eliminate human involvement in agriculture. The automation of certain operations in agriculture has enabled farmers to operate with less energy and cost, and factors such as the shortage of agricultural workers, aging farmer's population, and rising agricultural wage have motivated farmers and researchers to develop automation system in agriculture. Computational contributions to the automation of agriculture robotic and other computer-based advances could be crucial to the future of agriculture. Agricultural robotics seems like a promising field for producing more food at a sustainable rate and at a lower cost (Kulkarni *et al.,* 2020, Sreekantha, 2016). Self-driving technology is one of the greatest robotic advances that could have a broader application in agriculture. Machinery that can autonomously move through fields is indispensable to the full automation of farming tasks (Nagel, 2019). The health of plants is also enhanced by automating

weed control. Similarly, an automated and precise method of watering a crop is essential to its growth. Some research has also been conducted on fully automating the harvesting process.

Internet of Things (IoT):

The Internet of Things (IoT) is a network of physical objects, vehicles, buildings, and other items that have electronics, software, sensors, and network connectivity that enable these objects to collect and exchange data (Bamigboye and Ademola, 2016). The IoT can be used to sense and control objects from anywhere across existing network infrastructure, providing opportunities for a more direct link between physical and computer-based systems, which in turn result in greater efficiency, accuracy, and economic value. Smart cities are generally built on software and cyber physical networks. The IoT can be applied to other areas, such as intelligent greenhouses and agricultural drones (Gómez-Chabla *et al.*, 2019). These are relatively cheap drones with advanced sensors that, among other things, offer farmers new ways to increase yields and reduce crop damage.

Conclusion:

Agriculture remains one of India's most important and successful sectors, with 58% of the population relying on it for its existence. Agriculture contributes almost 10% of the world's exports earning but it needs to play a more central role in creating value, productivity, high-quality products, and skilled labour force to handle these challenges successfully. Therefore, technology based agriculture becomes very popular in recent years. Farmers around the world are adapting to technical aids to improve their production and yields. Farmers, researchers, and technical manufacturers are working together to find more efficient solutions, increase production, and reduce costs. A large number of people in rural areas live in poverty and backwardness. Agriculture is the main occupation of the rural population, therefore the application of technology and new and innovative techniques and methods will be highly effective in improving their living conditions and alleviating their poverty problems. Emerging technologies such as GIS based agriculture, sensor technology, drone technology, indoor vertical farming, satellite and GPS technologies, automation and robotics will make the world more sustainable.

References:

Acharya S. M, Pawar S. S, Wable N. B. (2018): Application of remote sensing and GIS in agriculture, International Journal of Advanced Engineering Research and Science, 5(4): 63-65.

Ayoka (2015): 7 Emerging agriculture technologies, available at: https://ayokasystems.com/news/emerging-agriculture-technologies/.

Bamigboye, F. O., Ademola, E. O. (2016): Internet of Things (Iot): It's Application for sustainable agricultural productivity in Nigeria, Proceedings of the iSTEAMS Multidisciplinary Cross-Border Conference University of Professional Studies, Accra Ghana, 309-312.

Clercq, M. D., Vats, A., Biel, A. (2018): Agriculture 4.0: The future of farming technology, published by the World Government Summit.

Coleman, A. L., Galbraith, J. M. (2000): Using GIS as an agricultural land-Use planning tool, Virginia Agricultural Experiment Station, Bulletin 00-2, 1-86.

Dutonde, S. R. (2018): Modern agriculture: concept and it's benefits, International journal of current engineering and scientific research, 5(1): 222-227.

Gómez-Chabla, R., Real-Avilés, K., C. Morán, Grijalva, P. Recalde, T. (2019): IoT Applications in agriculture: A systematic literature review, (Eds.): CITAMA 2019, AISC 901, 68–76.

Jarman, M. (2018): Satellites for agriculture, published by AHDB,Stoneleigh Park, Kenilworth.

Kapur, R. (2018): Usage of technology in the agricultural sector, Acta Scientific Agriculture 2(6):78-84.

Ku, L. (2021): New agriculture technology in modern farming, available at: https://www.plugandplaytechcenter.com/resources/new-agriculture-technology-modern-farming/

Kulkarni, A. A., Dhanush, P., Chetan, B. S., Thamme Gowda, C. S., Shrivastava, P. K. (2020): Applications of automation and robotics in agriculture industries; A review, international conference on mechanical and energy technologies, IOP conf. series: Materials Science and Engineering 748, 012002, doi:10.1088/1757-899X/748/1/012002.

Mahmud, M. S. A., Abidin, M. S. Z., Emmanuel, A. A., Hasan, H. S. (2020): Robotics and automation in agriculture: Present and future applications, Applications of modelling and simulation, 4, 130-140.

NABARD (2020): Impact assessment of COVID-19 on Indian agriculture and rural Economy, online survey, Department of Economic Analysis and Research, National Bank for Agriculture and Rural Development, Mumbai.

Nagel, M. (2019): Computational Contributions to the automation of agriculture, Thesis, Liberty University.

Pajares, G., Peruzzi, A., Gonzalez-de-Santos, P. (2013): Sensors in agriculture and forestry, Sensors, 2013, 13, 12132-12139.

Pinguet, B. (2021): The role of drone technology in sustainable agriculture, available at: https://www.precisionag.com/in-field-technologies/drones-uavs/the-role-of-drone technology-in-sustainable-agriculture/.

Pothireddygari, A. (2020): Editorial note for advanced technologies used in agricultural sciences, Journal of Agricultural Sciences and Food Research, 11(3): 274.

Royston, R. M., Pavithra, M. P. (2018): Vertical farming: A concept, International Journal of Engineering and Techniques, 4(3): 500-506.

Sadiku, M. N. O., Ashaolu, T. J., Musa, S. M. (2020): Emerging technologies in agriculture, International Journal of Scientific Advances, 1(1), 31-34.

Shanwad, U. K., Patil, V. C. , Dasog, G. S., Mansur, C. P., Shashidhar, K. C. (2002): Global positioning system (GPS) in precision agriculture, Asian GPS Conference Proceedings.

Shekara, P. C., Balasubramani, N., Sharma, R., Shukla, C., Kumar, A., Chaudhary, B. C., Baumann, M. (2016): Farmer's handbook on basic agriculture, published by Desai Fruits and Vegetables Pvt. Ltd. Navsar, Gujarat, India.

Sreekantha, D. K. (2016): Automation in agriculture : A study, International Journal of Engineering Science Invention Research and Development, 2(12): 823-833.

Talaviya, T., Shah, D., Patel, N., Yagnik, H., Shah, M. (2020): Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides, Artificial Intelligence in Agriculture, 4, 58–73.

NANOTECHNOLOGY FOR AGRICULTURE

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Introduction:

Traditionally, agriculture preceded the economic revolution with the aid of around 90 centuries. However, studies in nanotechnology began growing for commercial packages nearly half a century in the past, the momentum for use of nanotechnology in agriculture came handiest recently with the reviews posted using Roco, (Roco *et al.*, 1999). An informal google pupil seeks on nanotechnology in agriculture identified about 1,100 entries till 1999, which elevated regularly to 13,900 inside the ultimate 4 years. Even now, the share of guides on nanotechnology in agriculture remains minuscule i.e. much less than 5% of every one of the kindred fields of energy, energy, and materials, and one-seventh that of nanomedicines. But, the accelerating tempo displays the developing popularity of the several capability agricultural applications of nanotechnology. It has been anticipated that the novel homes of nano-scale biomaterials mixed with imaginative engineering could have innovative applications for agriculture and food structures; and as nanotechnology advances, crops may result in the layout of recent materials and devices (Scott *et al.*, 2013).

Nanotechnology has gained extreme attention in latest years because of its wide applications in numerous regions like medicine, medical pills, catalysis, power, and materials. Those nanoparticles with a small size to the huge surface region (1–100 nm) have potential scientific, industrial, and agricultural programs. Scientists have carried out significant efforts closer to the synthesis of nanoparticles utilizing unique methods, including physical, chemical, and biological methods (Ghidan *et al.,* 2017). These strategies have many disadvantages due to the problem of scale-up of the procedure, separation, and purification of nanoparticles from the micro-emulsion (oil, surfactant, co-surfactant, and aqueous phase) and consuming a large number of surfactants (Pilarska *et al.,* 2013). Green strategies for synthesizing nanoparticles with plant extracts are positive because it is simple, convenient, green and require less response time. Nanomaterials organized by eco-friendly and inexperienced methods should boom agriculture ability for enhancing the fertilization process, plant boom regulators, and insecticides (Ghidan *et*

al., 2017). Further, they minimize the number of harmful chemicals that pollute the environment. Consequently, this technology helps in reducing environmental pollutants (Huang *et al.,* 2015), and nanotechnology has recently gained attention due to its wide programs in different fields which include medicine, environment, and agriculture (Kah *et al.,* 2014)

Nanotechnology in pesticides and fertilizers:

In recent times, sustainable agriculture is wanted. It can be understood to give a very good technique of environment for long term. Practices that could reason lengthy-time period harm to soil include immoderate tilling of the soil which ends up in erosion and irrigation without wished drainage. This can cause salinization. That is to satisfy individual food, animal feed, and fiber wishes. Lengthy-term experiments are required to expose the effect of various practices on soil properties which can be critical to sustainability and to provide vital statistics on this goal. In the US, a federal enterprise, the development of nano-chemical substances has seemed like promising marketers for plant increase and pest control. The fertilizers are required in plant life increase. The nanomaterials act as fertilizers that might have the homes consisting of crop improvement and with much less eco-toxicity. Vegetation can deliver a crucial manner for their bioaccumulation into the meals chain. The recent developments in agriculture cover the packages of NPs for more effective and secure use of chemical compounds for flora. The consequences of different NPs on plant increase and phytotoxicity were stated by using numerous employees together with magnetite (Fe_3O_4) nanoparticles and plant increase (Shankramma *et al.,* 2016), alumina, zinc, and zinc oxide on seed germination and root growth of 5 better plant species; radish, rape, lettuce, corn, and cucumber, silver nanoparticles and seedling growth in wheat (Lin *et al.,* 2007), sulfur nanoparticles on tomato (Salem *et al.,* 2016), zinc oxide in mung bean, nanoparticles of Alo, Cuo, Feo, Mno, Nio, and ZnO (Ghidan *et al.,* 2018.,). Silver nanoparticles can stimulate wheat boom and yield. Soil carried out 25 ppm NPs had relatively favorable growth selling outcomes on wheat increase and yield. Zinc has been taken into consideration as a vital micronutrient for metabolic activities in vegetation even though it is required in hint amounts in vegetation. It was discovered that zinc has an important position in the management of reactive oxygen species and the protection of plant cells against oxidative stresses. Zinc has crucial functions within the synthesis of auxin or indoleacetic acid (IAA) from tryptophan as well as in biochemical reactions required for the formation of chlorophyll and carbohydrates. The crop yield and exceptional of produce may be affected by deficiency of Zn. The development of insecticide resistance in pest bugs has been an increasing problem for agriculture and public health. Magnesium oxide (MgO) is a crucial inorganic substance with many makes use of such as adsorbents, fire retardants; advanced ceramics, poisonous waste remediation, and photograph digital materials. Consequently, various strategies and routes for the synthesis of MgO NPs had been said (Ghidan *et al.,* 2017) MgOH became synthesized by using

green strategies the use of riskless neem leaves extract (Moorthy *et al.,* 2015), citrus lemon leaves extract, acacia gum (Awwad *et al.,* 2014)

Manipulation of plant pests *fusarium* wilt is a destructive sickness of tomato and lettuce in numerous nations due to its excessive manufacturing loss, prolonged survival of fungus in the soil, and technology of resistant races. The disorder can be decreased to some extent with the use of resistant cultivars and chemical substances. However, the incidence and improvement of the latest pathogenic races are persevering with the problem, and the use of chemical substances is steeply-priced and now not constantly effective. In current years, the usage of nanomaterials has been considered as an opportunity answer to governing plant pathogens. (Ghidan *et al.,* 2018) has synthesized nanoparticles of magnesium oxide (MgO) and examined the effect of various concentrations on the green peach aphid (GPA) beneath the greenhouse conditions(Al-antary *et al.*,2013, al- Momany *et al.,* 2008, al- Momany*et al.,* 2013, Al-January *et al.*,2014) the synthesis of nanomaterials of copper oxide (Cuo), zinc oxide (ZnO), magnesium hydroxide (MH) and magnesium oxide (MgO) has been executed successfully via using aqueous extracts of *Punica granatum* peels, *Olea europaea* leaves, and *Chamaemelum nobile* flowers (Ghidan *et al.,* 2017). The screening of synthesized bio-nano particles discovered that these nanoparticles had been powerful in growing the mortality percentage of inexperienced peach aphids. After the glasshouse experiments, the metallic oxide nanoparticle accumulations have been analyzed inside the fruits and leaves of inexpert candy pepper. The consequences showed that there has been no steel accumulation in any of the plant fruits. Foliar spray through synthesized of MgOH nanoparticles for inexperienced pepper leaves discovered that the foliar spraying leaves with a hundred–800 ppm metal nanoparticles are very beneficial to plant boom and produced healthy flora with greener leaves and high fruit high-quality compared to the manage. Researchers made giant efforts toward the synthesis of nanoparticles through numerous methods, which include physical, chemical, and organic techniques (Ghidan *et al.,* 2017). Inexpert methods for synthesizing nanoparticles with plant extracts are advantageous as it is straight forward, handy, environment pleasant and require less response time. Nanomaterials organized with the aid of green and green techniques may boom agriculture's ability for improving the fertilization process, plant increase, and pesticides. Similarly, this technology minimizes the number of dangerous chemicals that pollute the environment (Huang *et al.,* 2015). The inexperienced peach aphid is considered a key pest on peach and a globally critical pest of a huge range of arable and horticultural vegetation. The pest is classified as the most vital agricultural pest in the world. This devastating pest combats organophosphorus and carbamate insecticides by using overproducing insecticide-degrading carboxylesterases. Moreover, managing this kind of pest is becoming increasingly difficult, due to the fact the overproduction of resistance for aphid people

while the use of chemical pesticides including carbamates, organophosphates, and pyrethroids (Madanat *et al.,* 2016). Nanomaterials together with copper oxide (CuO NPs), zinc oxide (ZnoNPs), magnesium hydroxide (MgOH NPs), and magnesium oxide (MgO NPs) were synthesized utilizing specific physical and chemical methods (Jiang *et al.,* 2015). With the developing wishes to limit the use of environmental-danger substances, which includes insecticides, the biosynthesis of nanoparticles as an emerging spotlight of the intersection of nanotechnology and biotechnology has received increasing attention.

Nano insecticidal potential copper oxide nanoparticles (CuONPs) are synthesized thru specific strategies (Ghidan *et al.,* 2016) which includes precipitation (Sahooli *et al.,* 2012) and chemical reduction (Karthik *et al.,* 2013) many plants aqueous extracts have been mentioned which include citrus lemon juice (Mohan *et al.,* 2015) and carob leaves (Awwad *et al.,* 2015). Programs led many researchers to broaden distinctive methods to synthesis ZnONPs including chemical direction (Singh *et al.,* 2008), hydrolyzed in polar natural solvents (Ehlert *et al.,* 2014), and microwave synthesis (Sutradhar *et al.,* 2016). Exclusive plant extracts were pronounced inside the open literature for the inexperienced synthesis of ZnONPs consisting of *Olea europaea*, *Solanum nigrum* leaves (Ramesh *et al.,* 2015), and *Azadirachta indica* (Madanat *et al.,* 2016). Distinctive techniques for synthesis MgOHNPs and MgONPs have been said which include hydrothermal route, water-in-oil microemulsion, and microwave reaction (Yousefi *et al.,* 2014). MeOH became synthesized with the aid of inexperienced techniques the use of trustworthy and eco-friendly such as neem leaves extract, citrus lemon leaves extract, acacia gum, *Brassica oleracea*, and *Punica granatum* peels (Ghidan *et al.,* 2017, Madanat *et al.,* 2016). In agriculture quarter, there are several uses to be had like nanotech primarily based insecticides and fertilizers with effective impact on plant increase and molecular farming with the help of nano vectors which is hoping to take the place of viral vectors (Chinnamuthu *et al.,* 2009)

In Antimicrobial Processes, numerous nanomaterials are used as antimicrobial retailers in meal packing in which silver nanoparticles are of exquisite interest. That is due to its prolonged use. Some different nanoparticles presently used are titanium dioxide (TiO2), zinc oxide (ZnO), silicon oxide (SiO2), magnesium oxide (MgO), gold, and silver. They all have specific traits and features, for instance, zinc nanocrystal shows antimicrobial and antifungal interest (Duncan *et al.,* 2011). Silver changed into a disinfectant and sterilizing agent used by NASA and Russian area stations for water (Vermeiren *et al.,* 2002), silver zeolite, and silver. Gold has a high-temperature balance and coffee volatility and accurate antifungal and antimicrobial consequences against 150 unique microorganisms (Necula *et al.,* 2005). FDA in 2009 approves the direct use of silver as a disinfectant in industrial water; in view that with effective results towards microorganisms. The antimicrobial effect of those is *E. coli*, Monocyte genes and *Staphylococcus aureus* (Necula *et al.,* 2010), and nano silver particles lined with cellulose

acetate phthalate also supplied similar results (Kumar *et al.,* 2010). Some nanoparticles have proven their antifungal pastime. These fungi encompass *Candida albicans, Aspergillus niger* (Sánchez *et al.,* 2009) and yeast (Kim *et al.,* 2003). Other nanoparticles besides silver also are located to have antimicrobial characteristics like titanium oxide (TiO2). Its antimicrobial pastime in UV light changed into obvious. Zinc oxide is pronounced to have an antimicrobial pastime in packaging fabric (Kim *et al.,* 2003). Zinc oxide nanoparticles synthesized by the use of *Punica granatum* peel aqueous extract have shown effectiveness as antibacterial dealers in opposition to well-known strains of gram-positive *Staphylococcus aureus* and gram-negative *Escherichia coli*. (Ghidan *et al.,* 2017, Mariadoss *et al.,* 2019)

Nanotechnology application as nano fungicides:

The usage of nano silver has been studied these days in opposition to phytopathogen *Colletotrichum gloeosporioides* (Aguilar *et al.,*2016) other nanoparticles (Fe, Cu, Si, Al, Zn, ZnO, TiO_2, CeO_2, Al_2O_3, and carbon nanotubes) had been suggested to have a few destructive effects on plant boom other than the antimicrobial homes (Rico *et al.,* 2010). On occasion, nanoparticles also have an impact on the boom of useful soil microorganisms, together with *pseudomonas* (Gajjar *et al.,* 2003). Numerous research companies focused their hobby on the use of eco-friendly insecticides. Similar to chemical insecticides, nanoparticles-based insecticides and herbicides are being explored for the application of antimicrobial agents to shield plants from numerous diseases. Giant studies on nanoparticle-based structures might also put off the intensive use of pesticides within the agricultural zone (Baruah *et al.,*2009) the antifungal residences of nanoparticles can assist to formulate nanoparticle-based totally insecticides (Aguilar *et al.,*2016). Some of the one-of-a-kind inorganic nano particle-primarily based antimicrobial agents, silver has been considerably studied with the aid of many researchers because of its several benefits over other nanoparticles together with copper, Zinc, Gold, ZnO, Al_2O_3, and TiO_2.

Nanotechnology for controlling plant virus in the particular spherical virus is taken into consideration to be the going on nanomaterials. The smallest plant viruses known until date are satellite TV for PC tobacco necrosis virus measuring best 18 nm in diameter (Hoglund *et al.,* 1968). Plant viruses are made up of single or double-stranded RNA/DNA as a genome that is encapsulated by way of a protein coat. Their ability to contaminate, supply nucleic acid genome to a particular site in host cellular, mirror, package deal nucleic acid and come out of host cell exactly in an orderly way have necessitated them to be used in nanotechnology. A whole evaluation on the use of plant viruses as bio templates for nanomaterials and their makes use has been completed lately via young et al. (Young *et al.,* 2008)

References:

Aguilar-Méndez MA,Martín-Martínez ES, Ortega-Madan L,Sharma SC, Udayabhanu HR,Suresh D, et al. Facile green fabricationof nanostructure ZnO plates, bullets,flower, prismatic tip, closed pinecone: Their antibacterial, antioxidant, photoluminescent and photocatalytic properties. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy. 2016; 152:404-416

Al- Momany A, Al-Antary T. Pests of Garden and Home. 2nd ed. Amman: Publications of the University of Jordan;2008. p. 518

Al-Antary T, Al-Dabbas M, Shaderma A. Effect of UV-radiation on methomyl, oxamyl, and carbosulfan residues in lettuce juice. Fresenius Environmental Bulletin.2014;23(3a):924928

Al-Antary T, Khader B. Toxicity of four insecticides on longevity and fecundity of three populations of the green peach aphid Myzuspersicae (Aphididae: Homoptera) for three generations. Jordan Journal of Agricultural Sciences. 2013;9(1):52-62

Awwad A, Ahmad A. Biosynthesis, characterization, and optical properties of magnesium hydroxide and oxide nanoflakes using *Citrus limon* leaf extract. Arab Journal of Physical Chemistry. 2014; 1:65-70

Awwad A, Ibrahim Q. Optical and X-ray diffraction characterization of biosynthesis copper oxide nanoparticles using carob leaf extract. Arab Journal of Physical Chemistry. 2015; 2:20-24

Baruah S, Dutta J. Nanotechnology applications in pollution sensing and degradation in agriculture: A review. Environmental Chemistry Letters. 2009; 7:191-204

Chinnamuthu CR, Murugesa BP. Nanotechnology and agroecosystem. The Madras Agricultural Journal. 2009;96(1-6):17-31

Duncan TV. Applications of nanotechnology in food packaging and food safety: barrier materials, antimicrobials, and sensors. Journal of Colloid and Interface Science.2011;363(1):1-24. DOI: 10.1016/j.jcis.2011.07.017

Ehlert S, Lunkenbein T, Breu J,Forster S. Facile large-scale synthetic route to monodisperse ZnO nanocrystals. Colloids and Surfaces A: Physicochemical and Engineering Aspects. 2014; 444:76-80

Ghidan AY, Al Antary TM,Awwad AM. Aphidicidal potential of green synthesized magnesium hydroxide nanoparticles using *Olea europaea* leaves extract. ARPN Journal of Agricultural and Biological Science.2017b;12(10):293-301

Ghidan AY, Al-Antary TM, Awwad AM, Ghidan OY, Al Araj SE, Ateyyat MA. Comparison of different green synthesized nanomaterials on green peach aphid as aphicidal potential. Fresenius Environmental Bulletin.2018a, 2018a;27(10):7009-7016

Ghidan AY, Al-Antary TM, Awwad AM. Green synthesis of copper oxide nanoparticles using *Punica granatum* peels extract: Effect on green peach Aphid. Environmental Nanotechnology, Monitoring, and Management. 2016; 6:95-98

Ghidan AY, Al-Antary TM,Salem NM, Awwad AM. Facile green synthetic route to the zinc oxide(ZnONPs) nanoparticles: Effect on green peach aphid and antibacterial activity. Journal of Agricultural Science.2017a;9(2):131-138

Hoglund S. Some electron microscopic studies on the satellite tobacco necrosis virus and its IgG antibody. The Journal of General Virology. 1968; 2:427-436

Huang S, Wang L, Liu L, Hou Y, Li L. Nanotechnology in agriculture, livestock, and aquaculture in China. A review. Agronomy for Sustainable Development. 2015; 35:369-400

Jiang T, Wang Y, Meng D, Yu M.Facile synthesis and photocatalytic performance of self-assembly CuO microspheres. Superlattices and Microstructures. 2015; 85:1-6

Kah M, Hofmann T. Nanopesticide research: Current trends and future priorities. Environment International. 2014; 63:224-235

Karthik AD, Geetha K. Synthesis of copper precursor, copper and its oxide nanoparticles by green chemical reduction method and its antimicrobial activity. Journal of Applied Pharmaceutical Science. 2013; 3:16-21

Kim B, Kim D, Cho D, Cho S. Bactericidal effect of TiO2 photocatalyst on selected food-borne pathogenic bacteria. Chemosphere.2003;52(1):277-281

Kumar R, Munsted H. Silver ion release from antimicrobial polyamide/silver composites. Biomaterials.2005;26(14):2081-2088

Lin D, Xing B. Phytotoxicity of nanoparticles: Inhibition of seed germination and root growth Environmental pollution.2007;150(2):243-250DOI:10.1016/j.envpol.2007.01.016

Madanat H, Al Antary T, Zarqa M. Toxicity of six ethanol plant extracts against the green peach aphid Myzuspersicae Sulzer (Homoptera: Aphididae). Fresenius Environmental Bulletin. 2016; 25:706-718

Mariadoss AVA, Ramachandran V, Vijayakumar S, Balupillai A, Herbert FJ, Kumar S, et al. green synthesis, characterization and antibacterial activity of silver nanoparticles by *Malus domestica* and its cytotoxic effect on (MCF-7) cell line. Microbial Pathogenesis. 2019; 135:1-9

Mohan S, Singh Y, Verna DK, Hassan SH. Synthesis of CuO nanoparticles through a green route using citrus Limon juice and its application as nano sorbent for Cr (VI)remediation: Process optimization with RSM and ANN-GA based model. process safety and Environmental Protection. 2015; 96:156-166

Necula AM, Duncan S, Stoica I, Olaru N, Olaru L, Ioan S. Morphological properties and antibacterial activity of nano-silver containing cellulose acetate phthalate films. International Journal of Polymer Analysis and Characterization. 2010;15(6):341-350. DOI: 10.1080/1023666X.2010.500524

Pilarska A, Wysokowski M, Markiewicz E, Jesionowski T. Synthesis of magnesium hydroxide and its calcinated by a precipitation method with the use of magnesium sulphate and poly (ethylene glycols). Powder Technology. 2013; 235:148-157

Ramesh M, Anbuvannan M, Viruthagiri G. Green synthesis of ZnO nanoparticles using *Solanum nigrum* leaf extract and their antibacterial activity. Spectrochemical Acta, Part A: Molecular and Biomolecular Spectroscopy.2015;136(Part B):864-870

Rico CM, Majumdar S,Duarte-Gardea M, Peralta-Catalina JR,Marambio-Jones E, Hoek MV. A review of the antibacterial effects of silver nanomaterials and potential implications for human health and the environment. Journal of nanoparticle research. 2010;12(5):1531-1551. DOI:10.1007/ s11051-010-9900-y

Roco MC. Towards a US national nanotechnology initiative. J Nano art Res. 1999; 1:435–438.

Sahooli M, Sabbagh S, Saboori R.Synthesis and characterization of man-sized CuO nanoparticles. Materials Letters. 2012; 81:169-172

Salem NM, Albanna LS,Abdeen A, Ibrahim OQ , Awwad AI.Sulfur nanoparticles improve the root and shoot growth of tomatoes. Journal of Agricultural Science. 2016;8(4): 179-185.DOI: 10.5539/jas. v8n4p179

Scott N, Chen H. Nanoscale science and engineering for agriculture and food systems. Industrial Biotechnology. 2013; 9:17–18.

Shankramma K, Yallappa S, Shivanna MB, Manjanna J. Fe2O3magnetic nanoparticles to enhance *S.lycopersicum* (tomato) plant growth and their biomineralization. Applied Nanoscience. 2016; 6:983-990. DOI:10.1007/s13204-015-0510-y

Sutradhar P, Debbarma M, Saha M. Microwave synthesis of zinc oxide nanoparticles using coffee powder extract and its application for solar cell. Synthesis and Reactivity in Inorganic, Metal-Organic, and Nano-Metal Chemistry. 2016; 46:1622-1627

Vermeiren L, Devlieghere F, Debevere J. Effectiveness of some recent antimicrobial packaging concepts. Food Additives and Contaminants Part A.2002;19(Suppl):163-171

Young M, Willits D, Uchida M, Dougla T. Plant viruses as bio templates for materials and their use in nanotechnology. Annual Review of Phytopathology. 2008; 46:361-384

Yousefi M. Fast method for synthesizing magnesium hydroxide nanoparticles, thermally stable and flame retardant polyvinyl alcohol nanocomposite. Journal of Nanotechnology Studies.2014;4:383-388

"BIOFERTILIZERS" AN ALTERNATIVE TO CHEMICAL FERTILIZER: A NASCENT TOOL

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Introduction:

Biofertilizers are organic by-product that inset living microorganisms such as bacteria, fungi and actinomycetes that are found in plant roots or soil. The utilization of bio-fertilizer becoming increasingly popular day by day in the substitution of chemical fertilizer in order to detract the cost of crop production, enhance the yield and growth of crop by increasing the availability of nitrogen and other plant nutrients to plant and also produce some substances, like as auxin, cytokinin, and gibberellins that are auxiliary for the growth and maintenance of plants. Biofertilizers are eco-friendly organic based agro-product that provides so many benefits. Biofertilizer is a fertilizer that contains living microorganism, which when applied to plant surfaces it promotes plant growth by enhancing the supply of nutrients to the host plant. Biofertilizers add nutrients via natural processes like as nitrogen fixation, solubilizing phosphorus, and stimulate plant growth by synthesis the growth-promoting substances. Technically Bio-fertilizer are lived it can be beneficial when association with plant roots. The microbes presents in biofertilizers easily converts complex organic material into simple form which will be easily absorb by the plants and thus it keeps the natural habitat of the soil. Microbial activity practise chief role in agriculture because these microbes are very valuable in the availability and movements of minerals necessary for plant growth and ultimately reduces the utilization of chemical fertilizers [Devi and Sumathy, 2017]. Agriculture makes a basic role in the growth and survival of any nations and maintaining its quality and quantity is essential to feed the population. In neoteric years the agriculture has undergone different scientific upstart in order to make it more accomplished [Ajmal *et al*., 2018]. Mainly chemical fertilizers serve as a fast food for plants because chemical fertilizers cause plants to grow more rapidly and efficiently.

Figure 1: Commercially available biofertilizers (Source: The News Skill)

Nonstop use of chemical fertilizers to soils leads to the relapse of soil fertility and quality and heavy metals are able to accumulate in plant tissue which affects the fruit's nutritional value and edibility [Farnia and Hasanpoor (2015)]. Although chemical fertilizers contains nutrient supplement such as nitrogen (N), phosphorous (P) and potassium (K) to plants, but these nutrient supplement cause various health hazards. Biofertilizer is best choice over chemical fertilizers because biofertilizers gives nutrients to plant by the action of nitrogen fixation, solubilising phosphorus. Because of varied health risks, people prefer to use organic foods that are grown without the help of any chemical fertilizers. There are different microbes that are generally used to make bio-fertilizer such as nitrogen fixing bacteria, phosphorus and potassium solubilizers, growth promoting rhizobacteria (PGPRs), mycorrhizal fungi, cyanobacteria and other advantageous microbes.

Benefits of biofertilizers:

Biofertilizer have various help benefits to soils and plants and thus to human. Here below various health benefits of biofertilizers are discussed.

1. The application of bio-fertilizers leads to raise the plant growth, nutrients, and water uptake and also increase plant tolerance to abiotic and biotic factors.
2. These biofertilizers also play a chief role in sustainability and productivity of soil, these biofertilizers are ecofriendly and also have cost effective inputs to farmers.
3. These biofertilizers are used to increase the fixation of nutrients in the rhizosphere, emphatic in soil stability, produce growth stimulants of plant, allow biological control, recycle nutrients, biodegrade the substances, support mycorrhiza symbiosis, and develop bioremediation processes in soils that is contaminated with toxic, recalcitrant substances and xenobiotic.

4. Biofertilizers reachability endows lots of benefits from social, environmental and an economic point of view [Carvajal- Munoz and Carmona- Garcia (2012)].
5. Biofertilizers also develop bioremediation processes to the soils that are contaminated with different types of toxic, xenobiotic, recalcitrant substances and also offer biological control and biodegrade the substances.
6. Biofertilizers are much cost-effective than chemical fertilizers, they enhances nitrogen content of soil therefore increase the utility of nitrogen to leguminous plants.
7. They also secrete certain types of plant growth promoting substances and demonstrate anti-fungal activities to protect the plants from pathogenic fungi.
8. Fruitful micro organisms present in biofertilizers helps plant to grow and also protect the plant from pests and diseases.
9. Biofertilizers when used as seed or soil inoculants then these biofertilizers multiply and take part in nutrient cycle and increase crop productivity [Adesemoye and Kloepper, (2009)].
10. . The microorganisms involved in it could easily convert complex organic material into simple one compound, which is easily absorbed by the plants,

Chemical fertilizers singly cannot confer all the necessary nutrients demanded by the plants which results in decrease of soil's organic content which in turn, contrarily affects the physical and biological characters of soil. Generally all these factors collectively led to increase in interest towards the exploitage of organic manures.

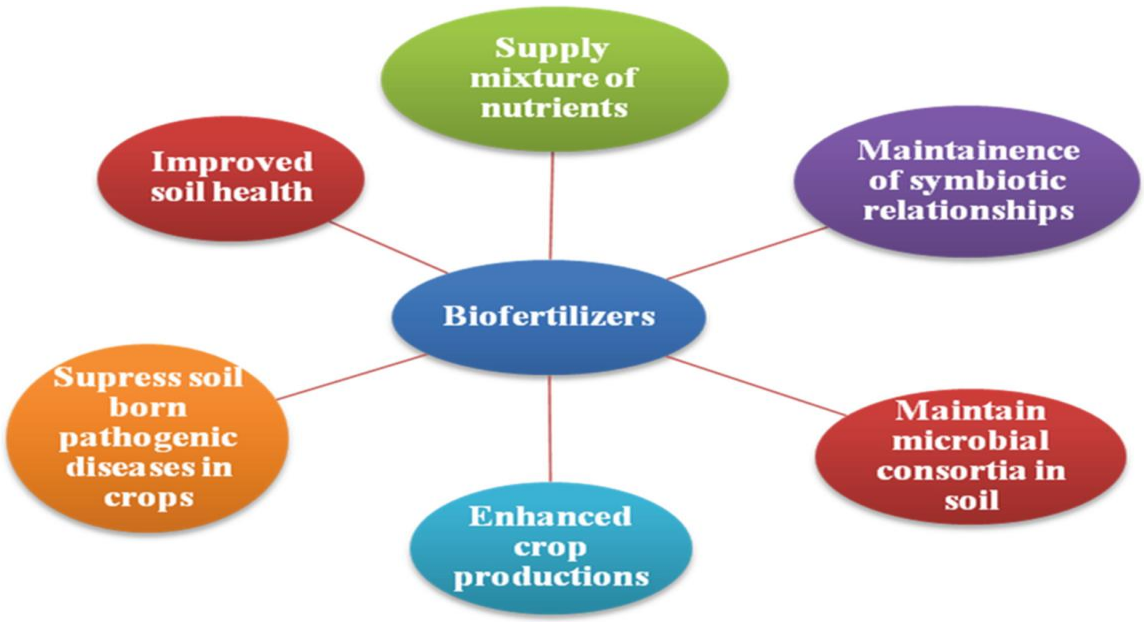

Figure 2: Benefits of biofertilizers over chemical fertilizers (Source: Springerlink)

The application of organic manure not only comprise the management of crop yields, but also plays a crucial role to demonstrate both direct as well as indirect impact on the nutrient reachability in soil by repairing the physical, biological and chemical properties of soil and likewise increases the impact of used fertilizers [Verma (2017)]. Increasing weightage of bio-fertilizers decreases the need of chemical fertilizers and thus it will be useful in the renovation of environment. All the micro and macronutrients minerals that promote plant growth should be present in fertile soil. Good fertility is ultimate for prosperous plant growth, and the accessibility of fertilizes is an essential graining activity. For healthy plant growth the maintenance of sufficient levels of nutrients in soil is important [Patel (2014).

Types of biofertilizers:

Different types of biofertilizers used in agricultural crops, on the bases of different types of microbes present in biofertilizers, the biofertilizers are classified into various types.

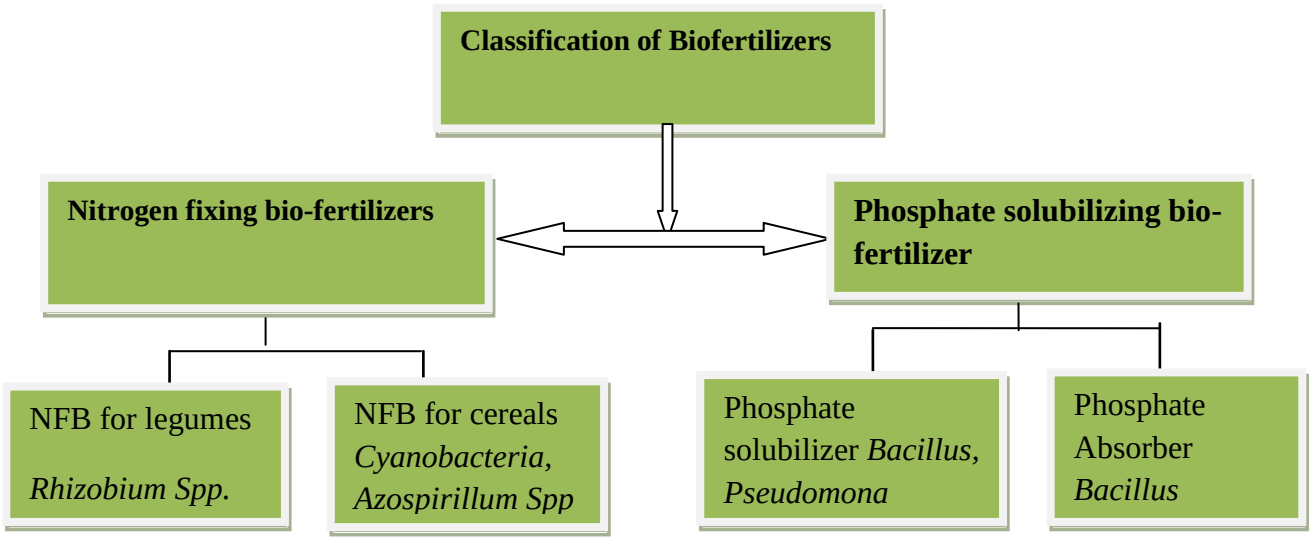

Figure 3: Classifications of biofertilizers on the bases of microorganisms used

The various kinds of bio-fertilizers listed below:

1. **Nitrogen fixing bio-fertilizers (NFB**): These biofertilizers fixes atmospheric nitrogen and convert it to usable organic forms which can be easily absorbed by the plants. Basically nitrogen fixing bio-fertilizers are crop specific bio-fertilizers [Ghany *et al.* (2013)]. The Examples of nitrogen fixing biofertilizer microorganisms are *Cyanobacteria*, *Rhizobium Spp*. and *Azospirillum Spp.* Utilization of 'Nitrogen' is an important target in crop management.
2. **Phosphate solubilizing bio-fertilizer (PSB):** In land phosphorus mostly occurs as insoluble phosphate form that is not absorbed by plants [Gupta (2004)]. Some fungus and bacteria have ability to convert insoluble phosphates to its soluble forms in soil.

Phosphate solubilizing biofertilizers are group of beneficial bacteria that are able to hydrolyzing complex insoluble inorganic and organic phosphorus compounds into its simple solubilizing form. Some example of PSB are *Bacillus Spp., Pseudomoona Spp.* and *Aspergillus Spp*.

3. **Plant growth promoting Rhizobacteria (PGPR**:- Bacteria which promotes plant growth are called plant growth promoting rhizobacteria [Satyaprakash (2017)]. Basically PGPR are crop exclusive bio-fertilizers. PGRP function by producing anti-metabolites and hormones that stimulate root growth, decomposing organic material and aid in mineralization of the soil, thus nutrients availability in soil increase and so crop production increase. Plant growths promoting rhizobacteria gather the atmospheric nitrogen into its usable form and these bacteria also produce certain metabolites such as auxin, cytokinin, hydrogen cyanide (HCN), gibberellins and phytohormones. The example of PGPR is *Pseudomonas Spp., Azotobacter* etc *Azotobacter.*
4. **Phosphate mobilizing bio-fertilizers (PMB)** Phosphorus solubilize biofertilizer infrequently act as phosphate mobilizing biofertilizers [Chang and Yang (2009)]. The examples of phosphate mobilizing biofertilizers are *Mycorrhiza, Vesicular Arbuscular Mycorrhiza* fungi (VAM) etc.
5. **Potassium solubilizing bio-fertilizer (KSB):** The example of KSB comprises *Aspergillus niger* and *Bacillus Spp*. Potassium mainly found as silicate minerals forms in the soil that are unachievable to plants. Potassium solubilizing microbes solubilize silicates, these microorganisms produce organic acids that decompose silicates and help to remove metal ions, so make them available to plants.
6. **Potassium mobilizing bio-fertilizer (KMB):** The Example of potassium mobilizing bio-fertilizer is *Bacillus mucilaginosus*, that is able to regiment the inaccessible form of potassium in the soil. So, the application of these type of microorganisms to enhance the availability of potash to plant is the optimum.

Conclusion:

Biofertilizers aid to resolve the problem of feeding an increasing global population at a time when agriculture is facing diverse environmental stresses. It is important to be aware the helpful aspects of biofertilizers and implement its utility to modern agricultural practices. The achievement of the science related to biofertilizers fall under on inventions of innovative

strategies related to the functions of PGPRs and their suitable application to the field of agriculture.

References:

Adesemoye, A.O. and Kloepper, J.W. (2009): Plant–microbes interactions in enhanced fertilizer-use efficiency. Applied microbiology and biotechnology, 85(1), pp.1-12.

Ajmal, M., Ali, H.I., Saeed, R., Akhtar, A., Tahir, M., Mehboob, M.Z. and Ayub, A. (2018): Biofertilizer as an alternative for chemical fertilizers. Journal of Agriculture and Allied Sciences, 7(1), pp.1-7.

Carvajal-Muñoz, J.S. and Carmona-Garcia, C.E., (2012): Benefits and limitations of biofertilization in agricultural practices. Livestock Research for Rural Development, 24(3), pp.1-8.

Chang, C.H. and Yang, S.S. (2009): Thermo-tolerant phosphate-solubilizing microbes for multi-functional biofertilizer preparation. Bioresource Technology, 100(4), pp.1648-1658.

Devi, V. and Sumathy, V.J.H. (2017): Production of biofertilizer from fruit waste. European journal of pharmaceutical and medical research, 4(9), pp.436-443.

Farnia, A. and Hassanpour, K. (2015): Comparison between effect of chemical and biological fertilizers on yield and yield components of wheat (Triticum aestivum L.) Pishtaz cultivar. Ind. J. Nat. Sci, 5, pp.7792-7808.

Ghany, T.M.A., Alawlaqi, M.M. and Al-Abboud, M.A. (2013): Role of biofertilizers in agriculture: a brief review. Mycopath, 11(2), pp.95-101.

Gupta, A.K., 2004. The complete technology book on biofertilizers and organic farming. National Institute of industrial research press. India, p.168.

Patel, N. (2014): Bio fertilizer: A promising tool for sustainable farming. International Journal of Innovative Science Engineering and Technology. 3 (9), 15838-15842.

Satyaprakash, M. (2017): Phosphorous and phosphate solubilising bacteria and their role in plant nutrition. International journal of Current Microbiology and Applied Sciences, 6 (4): 2133-2144.

Verma, S. (2017): Bio-efficacy of organic formulations on crop production. A review International Journal of Current Microbiology and Applied Sciences, 6(5): 648-665.

BENEFITS OF MEGACHIROPTERAN AND MICROCHIROPTERAN BATS IN ENVIRONMENT

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Abstract:

Bats are very vulnerable and most crucial creature of ecosystem. Bats are playing the critical economic and ecological roles in ecosystems. Evidence shows that bat perform a leading role in the complex web of life. They are essential allies among in delicate nature system of checks and balances. Without them, entire system of life may die with them. Bats provide value to ecosystem as primary, secondary and tertiary consumers that support and sustain both natural and human dominated ecosystem.Economic value of ecosystem service provided by Insectivorous and Frugivorous bats in insect-suppression as well as in seed disperser and pollination. The papillary morphology of tongue of Megachiropteran and Microchiropteran bats was adapted according to its dietary habits. Size and shape of mechanical filiform papillae and numbers of gustatory fungiform as well as circumvallate papillae with keratinization process shows their adaptation into frugivorous and insectivorous behaviour. But due to destruction of hibernacula, maternity sites and foraging areas may loss out several hundreads or thousands species at one time. In recent years, bats have increasingly subjected to a variety of disturbances i.e. industrial chemical, water pollution, air pollution, light pollution, habitat alteration, deforestation and other human activities increasing the growing risk of extinction. All these factors decrease the ability of bats to successfully feed, reproduce and hibernate. So need of little attention towards the protection of bat habitat. Bat Conservation International (BCI), the World's leading bat conservation organization has sponsored various research projects worldwide and from which they educate people at all levels about the importance and benefits of bats and the need to protect them.

Introduction:

Bats have evolved an incredibly rich diversity of behavioural, roosting and feeding habits. Bats are second largest order of mammals. They're valuable natural beneficial resources sleep in almost every habitat. Stable and healthy environment are providing various ecosystem services like pure water, fresh unpolluted air, rich fertile soil, greater binding capacity of toxic substances, decomposition of waste, recycling of nutrients, continue process of soil formation, reduction of insect-pest numbering, Pollination and seed dispersal etc. All above ecosystem services are provides the advantages to human for his or her well-being. Bats contribute its effective and major role for ecosystem stability like insect-pest suppression, Pollinating flowers and dispersing seeds. Bats are playing central roles in maintain the balance and regeneration of forest ecosystem, (Ramteke, 2016a). It also protects the agroforestry crop yield from insect-pest disturbance and provided crucial benefits to the farmers.

Varied feeding habits of bats like insectivorous, frugivorous, nectarivorous, omnivorous and carnivorous providing its beneficial role. The tongue and papillae structure of megachiropteran and microchiropteran bats supports their role in several ecosystem services. Megachiropteran bat, *Rousettus leschenaultia* belong to the order of Chiroptera and family Pteropodidae. They're diversely roost in fruit trees, roof of old houses and underground dilapidated mines. Flying foxes of the Pteropus (Pterpodidae) are important pollinators and seed dispersers in oceanic-island ecosystem, (Cox *et al.*, 1991, 1992). Singh and Bhatti, (1993) and Jackowiak *et al.* (2009), noticed Pteropus giganteus giganteus had longer and well muscular tongue for rasping. Insectivorous bats especially play crucial roles in many ecosystems by suppressing insect population in both natural and human-altered landscapes. Bats play key ecological roles as primary predators and are the foremost important natural controllers of night flying insects (Bat Conservation International, 1989).

The structural arrangement of lingual papillae of those Microchiropteran and Megachiropteran bats gives their greater support in suppression of insect-pest and disperser of seeds. So, the structural characteristics of papillae of tongue of bats are exactly appropriate for their function. The tongue of *Rousettus leschenaultia* (Megachiropteran bat), shows that, the anterior tip of tongue surrounded by scale-like filiform papillae which directed laterally towards the posterior region. The massive sized mechanical tricuspid papillae covered the acute antero-dorsal surface of tongue. The characteristic inverted cup-shaped circumvallate papillae are present at the bottom of the tongue with well developed taste buds within the lateral epithelium. This kind of structural arrangement of papillae of tongue of Megachiropteran bats are appropriate during feeding of tremendous range and

variety of food. Insectivorous bat, *Hipposideros speoris* (Microchiropteran) has a small tongue covered by a mixture of scale like tricuspid and hook-like filiform papillae, fungiform and circumvallate papillae. Scale like filiform papillae is the main characteristic feature of insectivorous bats. With the assistance of scale-like papillae, bats are easily catching the insect during flight, (Ramteke *et al.,* 2012d).

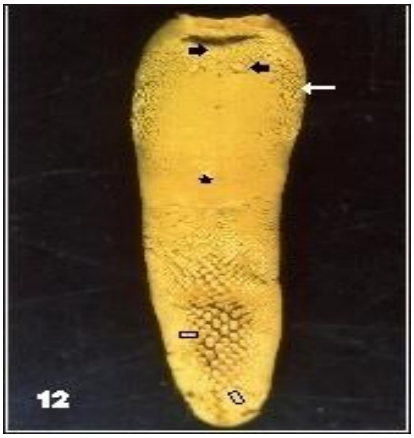

Figure 1: Dorsal view of the tongue of *R. leschenaulti*

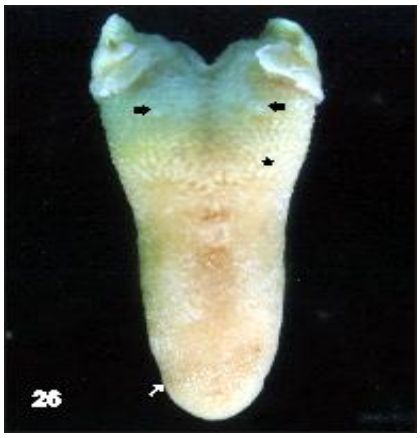

Figure 2: Dorsal view of the tongue of *H. speoris*

Figure 1 showing the dorsal view of the tongue (Fig.1) of *R. leschenaulti* (with a body mass 120 gms). The tongue measures 28mm in length, 9mm in breadth and 0.64 gms in weight. Dorsal surface of tongue consist three types of foliate papilla, viz. filiform, fungiform and vallate papillae. Anterior tip of tongue possesses a cluster of large tricuspid papillae (arrow head) encircled by smaller tricuspid papillae. Scale like papillae (small arrow) was observed surrounding the anterior tip, directed towards the posterior surface. Large conical papillae (long arrow) were noticed on the lateral parts of posterior region; smaller conical papillae are present around three circumvallate papillae (thick arrows). Round shaped fungiform papillae were distributed most part of the dorsum.

Figure 2 is the tongue of *H. speoris* to show dorsal. The insectivorous bat had a small anterior blunt tip with a cluster of filiform papillae on the dorsal part of the tongue. The filiform papillae are smaller (small arrow) at the anterior portion and larger (star) towards the posterior region. Fungiform papillae are embedded between the filiform papillae. Two circumvallate papillae (thick arrows) are present at the posterior region.

Figure 3 shows the T. S. of tongue of *Rousettus leschenaulti* at adult stage to show the anterior tip surrounded by scale-like filiform papillae (arrow heads) directed towards the posterior region. The scale-like papillae are flat and lie close to the surface of the tongue. Figure 4 shows the enlarged part of the section showing large sized mechanical papilla; which covers

the extreme antero-dorsal surface of the tongue. Histologically the papillae composed a thick orthokeratotic core (small arrow) of central prickle cell layer covered by thin parakeratotic layer (arrow head). Figure 5 shows the part of the section to show the scale-like papillae (thick arrows) which are present around the tricuspid papillae at the anterior surface.

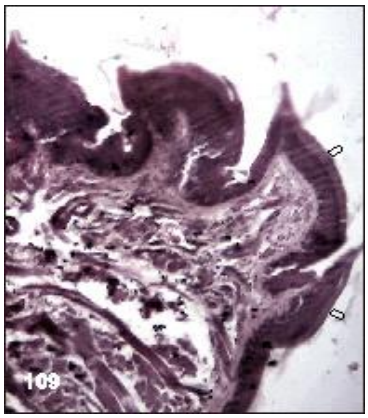

Figure 3: T. S. of tongue of *Rousettus leschenaulti* at adult stage (x 150)

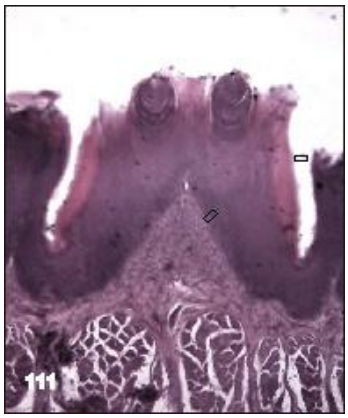

Figure 4: Enlarged section showing large sized mechanical papilla (x 150)

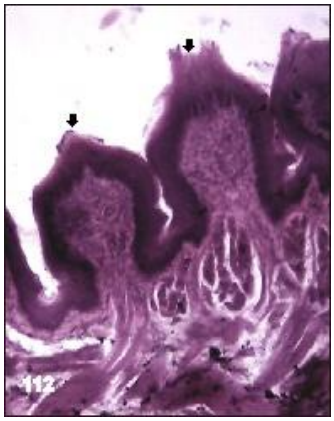

Figure 5: Part of the section to show the scale-like papillae (x 150)

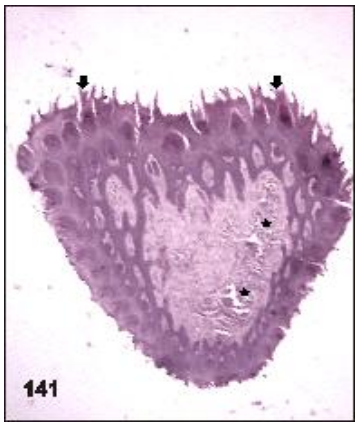

Figure 6: T. S. of tongue of adult *H. speoris* showing the anterior region (x 80)

Figure 7: T. S. of tongue showing anterior two thirds of the upper surface (x 100)

Figure 8: Section to show the circumvallate papilla (x40)

Figure 6 shows the T. S. of tongue of adult *Hipposideros speoris* showing the anterior region of the tongue. Anterior triangular blunt tip had a cluster of tricuspid papillae (thick arrows) surrounded by scaly filiform papillae, which are more keratinized. Beneath the surface epithelium, the mucous membrane consists of the striated muscles (stars). Figure 7 shows the part of the section to show the anterior two thirds of the upper surface was roughened by many fine projections (thick arrows) i.e. the papillary area gives plushlike appearance to the dorsal surface. Under the surface epithelium the striated muscles running in a 3 different planes i.e.

vertical, longitudinal and transverse (arrow heads). Figure 8 shows the section to show the circumvallate papilla (thick arrow) at the posterior region. The papillae lie in a V shaped line and consists the taste buds in the lateral wall of stratified epithelium.

Discussion:

The structure and arrangement of gustatory fungiform papillae on the tongue of Megachiropteran as well as Microchiropteran bats plays an effective role in reception of gustatory sensation and on the other hand an important factor affecting the structure of lingual papillae is the ingestion of food, it's grinding in the oral cavity which is then forwarded towards the alimentary tract. Most important feature of the mammalian tongue is taste bud only present in gustatory papillae i.e. circumvallate and fungiform papillae and their special contribution in taste reception. The numbers of fungiform papillae in Megachiropteran and Microchiropteran bats are affected by the different varieties of food consumed by bats and so it's greater impact seen on the morphological structure of lingual papillae with increasing and decreasing number of gustatory fungiform papillae. Distribution, microstructure, location and numbers of gustatory papillae in mammalian tongue are specific according to their specific adapted feeding habits. Close relationship found between microstructure of tongue with varieties of food as well as specific type of food consumed by Megachiropteran and Microchiropteran bats (Iwasaki, 1986; Kulzer 1982).

Megachiropteran bats *Rousettus leschenaultia* and *Cynopterus sphinx* belong the order Chiroptera and Family Pteropodidae and commonly called as Indian Fruit Bat (*Rousettus leschenaultia*) and Indian Short Nosed Fruit Bat (*Cynopterus sphinx*). Both of the Megachiropteran bats, *Rousettus leschenaultia* and *Cynopterus sphinx* are adapted for frugivorous feeding habits showing numerous fungiform papillae for the sensitive secretory function. Number of fungiform papillae is more in frugivorous bats because of these Megachiropteran bats consumed different varieties of food when their choisable food is in shortage and so the feeding apparatus needs more fungiform papillae for the sensation of taste of different types of food. Availability of food specially changed according to the seasonal changes and the migration of bats takes place from one place to another. Frugivorous bats species in general are not as selective as much wider variety of food items typically consumed by the bats due to the food availability and competition for resources. Availability of fruit changes according seasonal change (Bonaccorso, 1984). Food preferences have been change with variation in the food requirement of the frugivorous bats according to the physiological condition, food quality and enviormental features.

In whole process i.e. Seed dispersal and Pollination, the lingual papillae of bats tongue plays very important role. Mechanical tricuspid filiform papillae are very common in frugivorous bats for grasping structure. The fruit pulp is fleshy, soft, edible nutritive tissue surrounding the seeds. The rasping tongue of frugivorous bats helped to grind the fruit pulp and squeeze every drop of juice from the fruit. Seeds are separated from the fruit pulp when they are passed through the bats gut and they had a higher germination rate. Thus the bats are responsible for dispersing enormous number of seeds throughout the forest, in which some seeds could not germinate immediately or they might be destroyed by seed predator. Only one tenth of one percent of the seeds was to germinate.

Bat pollination occurs in approximately 250 genera. Bat pollination is comparatively common in certain angiosperm subfamilies, a little but ecologically and economically important group of plants are classified in 28 orders, 67 families and about 528 species of angiosperms are pollinated by nectar-feeding bats, (von Helversen, 2003). These plants, successively contribute to the assembly of 448 bat-dependent products during a sort of categories, including timber and other wood products (23%), food drinks and fresh fruit (19%), medicine (15%), dyes, fiber, animal fodder, fuel wood, ornamental plants. However, bat-provided services represents one input within a multi-input production process, therefore the expansive role plays by bats within the production of products that contribute to human well-being. Of all the bats around the World, approximately seventy percent are insectivorous, nearly thirty percent eat nectar or fruit, ten species are carnivorous, two-species are fish-eaters and only three species the common vampire (ALtringham, 1996). They are among nature's most beneficial animal and without them, thousands of flora and fauna affected by their absence and threatening entire ecosystem from rainforests to deserts.

Two families of bat i.e. Phyllostomidae (New World bats) and Pteropodidae (Old World bats) contain over 100 species of fruit eaters responsible for dispersing seeds from hundreds of species of tropical trees and shrubs. By virtue of their abundance and highly mobile lifestyle, these animals play an essential role in the seed dispersal ecology of tropical forests. Bats are well-equiped to disperse tree seeds far and wide through a forest. Fruit and nectar-eating bats play a vital role for the survival and preservation of these rain-forests and maintaining the stability of World climates. More than 100 species of fruit eaters are responsible for dispersing seeds from hundreads of species of tropical trees and shrubs. For example, In West Africa, bats carry 90-98% of the seeds of "Pioneer Plants". Due to seed dispersion by bats, the trees and shrubs grows rapidly and attract other mammals and birds for seed dispersion of different plants. Such cycle of rainforest regeneration might never take place without bats (Allen, 1996).

The tropical almond tree, *Terminalia catappa* is an example of a bat-dispersed tree with many human uses. This tree is dispersed by Cynopterus bats throughout Asia. Old World Fruit-bat, *Cynopterus sphinx* is highly mobile and potentially more reliable for visitation, because of their endothermic metabolism can carry large pollen loads to long distance, (Ramteke A.V. 2012b).They also disperse small seeds upto hundreads of kilometer and perform an important role in transporting zoochorous seeds to remote areas in both mainland as well as islands, (Emura *et.al*.,2001). In India, it is important in coastal communities where it provides shades, fuel-wood and edible nuts. The timber derived from almond trees makes a decorative general-purpose hardwood and making furniture. Tannin id extracted from the bark, leaves, roots and the fruit-shell. The large leaves are also used as wrapping material and have many medicinal uses including anti indigestion and anti dysentery. Young leaves are used to cure headaches and colic. A black dye is obtained from the bark, fruit and foliage. Its leaves and bark have a wide range of other medicinal uses. In India, the Mahwa tree (*Madhuca indica*), also called the Honey tree, Sugar tree or Indian butter tree is pollinated by *Pterpus giganteus, Rousettus leschenaultia and Cynopterus sphinx.*

Bats along with many other flower-visiting and fruit-eating animals provide important mobility for plant gametes. One of the most important ecological services that bats provide for their food plants is long-distance dispersal of pollen and seeds. In most seed dispersal system, the seeds are dispersed close to parent plants with only a few meters away i.e. 100 to 1000s meters. But seed dispersed by frugivorous bats undoubtedly provide relatively long seed-dispersal distances. For example, in Central Panama, the Jamaican fruit bat *Artibeus jamaicensis* carries single fig fruits 100-250 m away from fruiting plants. Bat-dispersed palms and figs are very common in most of the tropical forest. Figs are important bat-fruit throughout the tropics. Bat dispersed, soft-fruited species of *Cecropia, Piper Solanum* and *Vismig* are critically important pioneer species. Fruit-eating Phyllostomid bats thus play an extremely important role in forests regeneration in the New-World.

Due to both process i.e. seed disperse and pollination, the newly plant regenerate, which grow and become mature and attract hungry bats and so the process of reforestation is continued. In the absence of fruit-eating bats reforestation of cleared areas will become much more difficult and most valuable plants may be seriously jeopardized and tropical important trees and shrubs will loss.

The tongue of *Taphozous melanopogan* and *Taphozous longimanus* bats are extremely keratinized because of the insectivorous feeding habits. Keratinization or mucous outer epithelium surface covering which was closely correlated with their diet. Anterio-dorsal surface

of tongue mainly bears the tricuspid and scale like filiform papillae which are specially modified for catching the insect during the flight in insectivorous bat. The filiform papillae were observed throughout the whole tongue and their shapes varied according to their location within the tongue.

Figure 9: Bat feeding habit

The shapes of the filiform papillae same throughout the anterior half portion of the tongue, but their directions changed, some directed towards the anterior rounded tip and some towards the posterior side. Filiform papillae of the anterior side are smaller and thinner as compared to the filiform of the posterior side. Large group of filiform papillae was visible at the middle section of tongue. The function of filiform papillae at the anterior surface has specially participated in touch and attachment to the food, so making the anterior surface of tongue rough and fractious. Bristle-like filiform papillae helps to increase the friction between the tongue and food substances, which facilitating the movement of the particles by the tongue within the oral cavity, whereas the conical and crown-like filiform papillae performed the function that to retain food in the mouth during flight, (Okon, 1974).

Insectivorous bats is the natural predators, which provided the advantages to the agroforestry by the consumption of millions crop-insects. So, the value of the pest suppression services is provided by insectivorous bats. Successively migration of insectivorous bats, *Hipposideros speoris* towards the open land space and increased the cultivation rate of yield. So, the bat provided pest-control services i.e. reduced the pesticide application and avoid crop from damage by insect-pest. The share of the appliance of synthetic pesticide become minimized from farmers and safer the human health risks from harmful toxicity.

Insectivorous bats are generalist predators, feeding on a wide diversity of taxonomic group. They are opportunistically consuming appropriately sized prey according to it's availability within a preferred habitat. Most insectivorous bats eat large quantities of Lepidopterans (moths), Coleopterans (Beetles), Dipterans (flies), Homopterans (cicadas leaf

hopper) and Hemipterans (true bugs). Some species also eat unusual prey items such as scorpions and spiders. Various species of prominent agricultural insect pest have been found in the diets of bats. These insect include June beetles, Click beetles, Leaf hoppers, plant hoppers, the spotted cucumber beetle and the green stinkbug. In the Mid western United States, annually consumes approximately 600,000 Cucumber beetle, 194,000 June beetles, 158,000 Leaf-hopper and 335,000 Stinkbugs. Average-sized bat colony could prevent the production of 33, 000,000 Cucumber beetle larvae.

Figure 10: Insectivorous feeding habits

Highly adapted insectivorous bats such *Miniopterus scheribersi fuliginosus* and *Pipistrellus savii* (Park and Lee, 200), *Rhinopoma kinneari* and *Scotophilus heathi* (Agarwal and Gupta, 1982), *Pipistrellus pipistrellus* (Pastor *et al*., 2004) and *Myotis macrodactylus* (Hwang and Lee, 2007) studied by different zoologist. They were specially noticed that all of these insectivorous bats are very important for agricultural as well as coffee plantation (Environment, 1994). In agricultural systems, many insectivorous bats are specially habitat, e.g. Organic farms in the United Kingdom, shade cacao plantation in Brazil, Olive orchards in Greece, Mid-western agricultural land,cereal crops in England, Arboreal crops in Mexico, agricultural riparian areas and still relatively common in rural-areas of South-eastern Australia. The lesser long-eared bat (*Nyctophilus geoffroyi*) and Gould's Wattled bat (*Chalinolobus gouldii*) were highly selective in the location of their roosts in the landscape, in roost-site selection in roosting behavior and responded differently to different level of roost availability, (Gregorin, 2003). Gould's Wattled bats mainly lives on trees for roosting sites such as under bark (Lumsden *et al.,* 2002). The insectivorous bats use high-volume echolocation calls to locate and capture prey, (Schnitzler, 2001). Since, insectivorous bats are maintaining insect population in agro ecosystem and supports to the biodiversity conservation. Insectivorous bats is the natural predators, which provided the benefits to the agroforestry by the consumption of millions crop-insects, so, the economic value of the pest-suppression service is provided by insectivorous bats. Thus the

benefits provided to the agroforestry by the consumption of millions insects by bats and shows high activity levels in several agricultural forestry, (Cleveland, 2006). A single bat eats thousands of insect each night ranging from 1,000 to 3,000). One colony of 20 millions Mexican free- tailed bats in Central Texas consumes nearly a half million pounds of insect each night (BCI, 1989). Northern Long-eared bat (*Myotis septentrionalis*) suppresses mosquito population through direct predation. A little brown bat, one of the North Americas most abundant species is capable for capturing 600 mosquitoes in just an hour. A colony of 150 large brown bats can eat approximately 38,000 cucumber beetle in a single summer, which are potentially destroy Corn spinach and Vine plants. So, (Pimentel *et al.,* 1997) concluded that 50% reduction in pesticides use and provided that biological, cultural and environmental pest control technologies in replacement of pesticides. Pesticide application rate reduced due to high bat predation rate and bats provides a direct contribution of regulating service on pest-control for the great agricultural productions. Due to the biodiversity of insectivorous bat from forest to open space land e.g. Coffee-plantation and agricultural field, they perform their greater role to control the insect-pest numbers in agricultural areas. They are also maintaining their population and provide an important ecosystem service to the farmers (Estrada and Coates-Estrada, 2002). This bats save the thousands of rupees of farmers, which are specially utilized for the applications of pesticides needed to control of a variety of crop-insect. The ecological and economic impact of insectivorous bats on ecosystem is that abundant quantity of insects eaten by insectivorous bats.

So, that the various sorts of feeding habits of bats i.e. insectivorous, frugivorous and nectarivorous are beneficial for human-being. Today, these valuable mammals often go unnoticed because they are small, largely silent and minimum their roost sites. Land-holders and land-managers are frequently unaware of the diversity of bats on their properties, their beneficial nature and the habitat requirements for their continued survival. It is very essential to providing the habitat protection, Conservation and monitoring of roosts as well as providing all the essential information to local localities. So highlighting on the importance of trees in the rural landscape is foraging habitat for bats, protect the bat populations and improve public perception of bats, (Lumsden, 2005). Some of the nectar and fruit-eaters bats play especially important roles in the pollination and dispersal biology of trees, vines and shrubs in oceanic islands where reduced biodiversity and unbalanced faunas are available. Means the greatest conservation of islands faunas are takes place by bat species. Regional economy is affected, when the service of animal-pollinator is being completely lost and the productivity of pollinator-dependent crop declining. Once again, a greater economical value of pollination services is provided by bats. Due to the loss of insectivorous bats, the insect-pest enormously multiplied because of the unchecked control by their natural predator. So, farmers are totally dependent on pesticides for

controlling crop-pest, which already suffered our environment and personal health. In United State, 850 million pounds of pesticides applied on crop, which not only contaminated the ground water but its runoff is further damaging Wildlife habitat.

Only increased effort are needed to educate government agencies, industries, International Corporations and the general public about the ecological and economical value of plant-visiting bats and other native flowering and fruit-eating trees as well as insectivorous bats.

References:

Agarwal KA and Gupta BB (1982): The structure and histology of the tongue in 2 Indian bats. *Rhinopoma kinneari* (Rhinopomatidae) and *Scotophilus heathi* (Vespertilionidae): Folia. Morphol. (Prague): 30(1): 26-41.

Allen W.H. (1996): The varied bats of Barro Colorado Island. Bioscience, October, 46: 639-642.

Altringham JD (1996): Bats Biology and Behaviour. Oxf. Uni. Press, New York.

Bat Conservation International (1989): Bats: Gentle friends, Essential Allies, BCI, Austin, Texas.

Bonaccorso F.J. and Humphrey S.R.(1984): Fruit bat nivhe dynamics: their role in maintaining tropical forest diversity. Tropical Rainforest (eds A.C. Chadwick and S.L. Sutton): Phil. Lit Soc, Leeds. Pp: 169-183.

Cox P.A; Elmqvist T, Pierson E.D. and Rainey W.E. (1992): Flying foxes as pollinators and seed dispersers in Pacific Island ecosystem. In "Pacific Island flying foxes". Proceed of International Conservation Conference. (Wilson, D.E and Graham, G.I; Edls): USFWS. Biological Report. 90: (23): United States and Wildlife Services, Washigton, D.C; USA. Pp: 18-23.

Emura S, Hayakawa D, Chen H. Shoumura S, Atoji Y and Agungpriyono S (2001): SEM study on the dorsal lingual surface of the lesser dog-faced fruit bat, *Cynopterus brachyotis*. Okajimas Folia. Anat. Jpn. 78: 123-128.

Environment (1994): Batty Friends, 36(8): 24.

Estrada A and Coates-Estrada R (2002): Bats in continuous forest, forest fragments and in an agricultural mosaic habitat. Island at LOS. Tuxtlas. Mexico. Bio, Cons. 103: 237-245.

Gregorin R (2003): Comparative morphology of the tongue in the free-tailed bats (Chiroptera Molossidae): Iheringia, Serie. Zool. Porto. Alegre. 93: 213-221.

Hwang H and Lee J (2007): Morphological study on the dorsal lingual papillae of *Myotis macrodactylus*. Korean. J. Electron. Microscopy 37: 147-156.

Iwasaki S, Miyata K, Wakasugi C and Kobayashi K (1986): Scanning electron microscopic observations of the dorsal tongue surface in the Japanese house bat, *Pipistrellus abramus*. J. Mamm. Soc. 11: 155-164.

Jackowiak H, Trzciellinska-Lorych J and Godynicki S (2009): The microstructure of lingual papillae in the Egyptian fruit bat (*Rousettus aegyptiacus*) as observed by light microscopy and scanning electron microscopy. Arch. Histol. Cyto. 72: 13-21.

Kulzer, E. (1982): Nector licking in the African long tongued fruit bat, *Megaloglossus woermanni*. Bonn. Zoon Beitr. 33(24): 151-164.

Lumsden L.F., Bennett A.F. and Silins J.E. (2002): Location of roosts of the lesser long-eared bat *Nyctophilus geoffroyi* and Gould's wattled bat, *Chalinolobus gouldii* in a fragmented landscapes in South-eastern, Australia. Journal of Zoology, London, 257: 207-218.

Lumsden L.F. and Bennett A.F (2005): Scattered trees in rural landscapes: Foraging habit for insectivorous bats in South-eastern Australia. Bio.Cons.122(2): 205-222.

Okon E.E.(1974): Fruit bats at Ife: their roosting and food preferences.(Ife fruit bat project no. 2): Nigeri. 39: 33-40.

Park J and Lee J.H (2009): Comparative morphology of the tongue of *Miniopterus schereibersi fuliginosus* and *Pipistrellus savii*. Korean J. Micro 39(3): 267-276.

Pastor J F, Moro J.A, Verona J.A.G, Gato A, Represa JiJ and Barbosa E.!1993): Morphological study by scanning electron microscopy of the common European bat (*Pipistrellus pipistrellus*): Arch. Oral Bio. 38: 597-599.

Pimentel D (1997): Techniques for reducing pesticide use: Economic and Environmental Benefits. John. Wiley and Sons, Chichester. U.K.

Ramteke A.V., Zade S.B and Patil K.G (2012a): Insect-pest suppression and Ecosystem Services of Insectivorous Bat, *Taphozous longimanus* (Emballonuridae): Proceedings of National Congress-Stepping up with Bioscientific Technologies-INNERVATE-2012. Pp: 193-197.

Ramteke A.V, Zade S.B and Patil K.G (2012b): Crucial role of lingual papillae of Fruit Bat, *Cynopterus sphinx* in seed dispersal and pollination. J. Science Information, Special Issue 3: 81-84.

Ramteke A.V, Zade S.B and Patil K.G (2012d): Small Rhinolophid Bat *Hipposideros speoris* in agroforestry system. Bionano, Frontier, ISSN No. 0974-0678. Vol: 5(2-1):

Singh R.V and Bhatti U.S (1993): Functional morphology of the Bucco-pharynx and oesophagus of *Pteropus giganteus giganteus*. Bat. Res. News. 34:1.

Von Helversen O and Winter Y (2003): Glossophaginae bats and their flowers: Costs and benefits for plants and pollinators. In. kunz, T.H. Fenton M.B. eds. Bat ecology, Chicago: University of Chicago Press, 346-397.

AVIFAUNAL CONSERVATION STRATEGY – A SURVEY REPORT

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Introduction:

Bird biodiversity is the variety of species which play important role in the nature. Birds are vertebrate warm blooded animals, whose temperature remains more or less constant and independent of the surrounding temperature (Ali, 2002). As we know that the birds are most useful scientifically, socially and economically hence there is need of the study of the birds for their conservation point of view.Gondia is called as the 'district of lakes' as there are more than thousands of water bodies including dams, lakes and ponds. As there is large vegetation near the water bodies which provides food to the birds, hence many migratory bird species attracts these water bodies in Gondia district of Maharashtra.

Different researchers and bird watchers explored some of the lakes in the district; like Chitampalli (1976) have recorded 209 species from Navegaonbandh, 126 species by Chinchkhede and Kedar (2013) from Navegaon National Park, 52 species by Bhandarkar and Paliwal (2014) from Shrungarbandh lake, 27 species by Puri (2015) from Zaliya lake, 52 species by Gorghate *et al.* (2015) from Khajri lake, 30 species by Roy and Jha (2017) from *Nav Talav* Amgaon, 103 species by Puri and Virani (2017) from Bodalkasa, Chorkhamara and Khairbandha lakes, 76 species by Puri (2021) from Kawalewada dam of Gondia district, Maharashtra State. With reference to these research articles, theauthor observed the birds directly or by visual encounter method using a binocular with effect from February 2014 to January 2021 by weekly and fortnightly visits from Zaliya *talav* (21^{o}36'46"N latitude and 80^{o}43'73" E longitude), Bodalkasa lake (21^{o}21'15"N latitude and 80^{o}01'00"E longitude), Chorkhamara lake (21^{o}18'00"N latitude and 79^{o}57'00"E longitude), Khairbandha lake (21^{o}28'30"N latitude and 80^{o}03'45"E longitude) and Kawalewada dam (21^{o}44'13" N and 79^{o}88'30" E) from Gondia district of Maharashtra State during this survey.

The selected study lakes were under tremendous pressure on account of many threats including anthropogenic activities which disturbs the avifaunal diversity.

Threats encountered during the survey:

The anthropogenic activities and other impacting factors influence the bird diversity (Nalavade, 2013; Ramamurthy and Rajakumar, 2014). During present survey the main following enlisted threats to the avifauna were noticed.

1. **Washing activities:**

The surrounding village people and dairy farmers are using the lakes traditionally for washing their clothes, milk cans, livestock and for bathing purposes. These activities polluted the water and acted as a deterrent for the birds.

2. **Recreational activities and tourism:**

As the Bodalkasa and Chorkhamara lakes lie in the area of Nagzira Wild Life Sanctuary in the district, hence many tourists visit to these lakes. Some smaller parties were celebrated inside the area of the lakes and there is celebration of many festivals near the edge of the lakeslike *Pola* and *Mahashivratri* which disturbs the birds.

3. **MFP (Minor Forest Products) collection:**

The villagers of surrounding area depend on the forest sources and water bodies for their daily livelihood. The MFP includes collection of firewood, *Mahua* flowers, fruits, nuts, seeds, leaves including *Tendupatta*, bark, gum, medicinal plants, etc. especially at early morning hence the birds become disturbed due to this anthropogenic pressure.

4. Agricultural practices:

In present study area, the neighbouring land owners of the lake are awere found to have encroached the lakes for farming. Use of chemical fertilizers and pesticides for agricultural purposes in the catchment area of the lakes disturb the avifauna.

5. Cattlegrazing:

Daily thousands of cattle including cows, buffaloes, goats, etc. graze on the grassy area near the edges of these lakes which is responsible for degradation of the bird habitat. This intensive cattle grazing could results in breaking the nutrient cycle of the lake.

6. Fishing Practices:

The rich prawn and fish resources of the lakes attract powerful business interests. Intensive fishing activities and use of boats through a whole day in the lakes affect the avifauna.

7. Forest fires:

Artificially the ground fires were applied for the roasting of the lobsters, prawns and smaller fishes by the fishermen near the lakes. Some times fire in the field goes out of control and is responsible for large forest fires which degrade the habitat and affects the avifauna.

8. Loss and degradation of habitats:

The illegal quarrying, dumping of ash, cattle grazing, agricultural practices as encroachment, forest fires, unpleasant disturbance by visitors, cutting trees and other many factors are responsible for the loss and degradation of the habitats of the birds. The habitat degradation was the main cause for destroying the eggs and breeding places of the birds.

9. Poaching:

As the birds are good sources of food for the people, they trap and poach them. There is an illegal hunting of some birds such aspigeons, sandpipers and ducks by professional bird-trappers in and around the lakes which affects the bird diversity.

10. Dogs menace:

Some dogs were seen at study area whicheat the eggs and chicks of some birds and affect their population. Disturbance by dogs to juveniles of storks in the shallow area of the lakes and the nesting birds like pipits, larks, Indian robin and red-wattled lapwings affects their population.

11. Pollution:

The dumping of unwanted bottles, plastic covers and *nirmalya visarjan* into the lakes was noticed during the study period. Also during festivals like *Ganesha* and *Durga puja*, the immersion of massive idols made of clay and plaster of paris in the lakes causes the siltation and pollution which adversely affects the birds.

To overcome these threats, in this chapter a conservative strategy was suggested with reference to this survey.

Recommended Conservation Strategy:

There is a slight pressure of various threats and some impacting factors on the water bodies, forests and bird biodiversity. Hence it is necessary to find out the solution for this problem. Only legislative measures are not complete remedy to manage the bird biodiversity. Some following recommendations are suggested here to conserve the bird biodiversity and natural resources.

1. Local Environment Awareness Campaign (LEAC) must be made so that the local public realizes the significance of the lakes in terms of their life values and need to utilize them sustainably for mutual benefits.
2. Regulation of detrimental activities associated with lake is needed. Suitable relocation of washing activities like cloth washing, cattle washing, bathing separately at particular area by making partition in the lake and stream out that water in a particular direction.
3. Eco-tourism should been courage by employing scientific preventive measures in the area, since the lakes are situated nearer to other famous tourist places such as Nagzira wildlife Sanctuary and Navegaon National Park in the district. But the tourists and visitors should allow upto certain boundary line around the lakes and not inside of the lakes. Maintain visitor dairy at each lake to avoid unwanted anthropogenic disturbances and for further action regarding wildlife.
4. Fuel wood collectors should be prohibited in the forest area, if necessary for their livelihood they should allowed only at noon time. Also there must be supply of gas cylinders on subsidy basis and awareness should be created in tribal people about using gas cylinders.

5. *Mahwa* flower collectors (tribal people) must use the long clothes by keeping below the tree before one day and collect these flowers within a short time without disturbing bird activities at morning time.
6. Encroachment of the lakes must be prevented from agricultural practices; this can be effectively and easily achieved with strict enforcement of laws and constant vigil by concerning departments. Steps must be taken by agricultural department to reduce the use of chemical fertilizers and pesticides in the catchment area of the lakes; they must do organic farming in lake area if necessary.
7. A Water bodies Protection Cell may be created at state level as per the directions of the Supreme Court regarding protection of water bodies from encroachment to receive complaints and effectively monitor the disposal of complaints.
8. Integrated grazing policy like alternative grazing, and based on the recommendations of advisory and expert committee must follow to help in the preservation of forest resources and biodiversity. Direct cattle grazingnear the edges of the lake should be totally prohibited. Thelocal people must be educated in this aspect.
9. Stocking lakes through fishermen cooperative societies with a particular guideline manual. Fishermen only allowed at noon time and after a particular gap of days and not continuously in the lakes to catch fishes. The fisheries department should initiate immediate steps for the sustainable use of these lakes in this regarded.
10. Ground fires for the roasting of the prawns and smaller fishes by fishermen should be prohibited near the lakes. Instead of it, they may use any particular large utensil for the roasting purposes.
11. Dumping and flying of ash from Adani power plant in Gondia district must be properly managed by following the rules of environmental pollution and industrial acts. Also that ash should be used for making the bricks.
12. Regular checking ofthe poaching and illegal hunting by appointing more staff from concerning departments, Lake protection committees (LPCs) and NGOs to prevent further population loss of the birds.
13. Pollution and siltation may be avoided by maintaining special water tanks beside to the lakes separately for the immersion of the idols. After the immersion of idols, the lakes may be desilted by the department if necessary.
14. Measurements of water chemistry by concerning departments should be taken on a regular basis to allowing term monitoring of changes in nutrient levels and other parameters.
15. The water level and water quality of the lake should be properly maintained by irrigation department to cater to the needs of both irrigation and wild life.

16. Promote cooperation with government and non-government organizations to share their research experiences.
17. Organisation of Lake Protection Committees (LPCs) by involving retired and local environment loving people to prevent the lakes and bird biodiversity from adverse situations.
18. Establish and implementation of a Bird Information Cell at the office of the DFO together the information on the status of the bird species and it must be linked with internet.
19. Conduct more analytical research on the biology and ecology of important migratory birds. Intensive studies should be carried out on the vegetation, water quality and land use changes at the study sites. Regular and sustained monitoring of the birds at the present study area need to be ensured.
20. Establish environmental education centres to create environmental awareness by developing locally based education programmes for students and the general public about birds and other wildlife. The general public should appreciate and realize the importance of the birds.
21. Encourage the local people by giving awards those helps in the conservation of the birds and other wildlife.
22. Declare the all lakes as lake reserve on the line of forest reserve.
23. Setting up of Bird-clubs in schools and colleges to impart environment education, to encourage and mobilise participation of the students in various bird conservation activities in their localities. The curriculum should include chapters on the importance of birds in nature and to humans, and the need to conserve them.
24. Good quality scientific bird books should be published in simple local language to extend the reach of knowledge about birds to the general public.
25. Bird conservation rallies and other birds related competitions should be organized to create awareness among the students and local people.

As there are Sarus Conservation Committees and organisation of Sarus-Vulture Conservation Rally in Gondia district (Dhurve *et al.,* 2010); that should be follow for all other birds by modifying as Bird Conservation Committees. Every people at local level must participate with their own interest for the prevention of the forests, water bodies, and bird diversity.

References:

Ali, S. (2002): The Book of Indian Birds (13 th Ed.): Mumbai: Bombay Natural History Society, pp. 326.

Bhandarkar, S. V. and Paliwal, G. T. (2014): Biodiversity and conservation status of water birds in Shrungarbandh lake district Gondia, Maharashtra, India. Int. J. of Life Sciences, 2(3): 239-243.

Chinchkhede, K. and Kedar, G. T. (2013): Habitat Niche and status of the birds of Navegaon National Park, Maharashtra. Int. J. of Scientific Research, 2(9): 430-436.

Chitampalli, M. (1976): Checklist of birds of Navegaon National Park. Deputy Conservator of Forest (Wildlife), Nagpur.

Dhurve, M., Gautam, I, Akare, S. and Kasambe, R. (2010): Status of Sarus Crane (*Grus Antigone*) in Maharashtra. Newsletter of Birdwatchers, 50(6): 81-82. Available at http://www.researchgate.net/publication/247161304

Gorghate, N., Raut, M., Khune, C. and Nagpurkar, L. (2015): Status of wetland avifauna at Khajri Lake, District Gondia, Maharashtra, India. IJRBAT, Special Issue (6): 123-127.

Grimmett, R., Inskipp, C. and Inskipp, T. (2011): Birds of the Indian Subcontinent (2nd Ed.): London WCIB 3DP: Christopher Helm, Oxford University Press, pp. 528.

Nalavade, S. B. (2013): Conservation and sustainable management of Avifaunal diversity in Northern Western Ghats, India: A geographical perspective. Ph. D. thesis, Tilak Maharashtra Vidyapeeth, Pune.

Puri, S. D. (2015): Avifaunal diversity of Malguzari lake at Zaliya near Amgaon in Gondia district (MS), India. Int. J. of Life Sciences, 3(3): 219-224.

Puri, S. D. and Virani, R. S. (2017): Impact assessment of avifauna from the selected lakes around Adani thermal power station in Gondia district, MS, India. Int. J. of Life Sciences, Special Issue 8: 85-96.

Puri, S. D. (2021): Bird species account near kawalewada dam from Gondia District of Maharashtra, India. Int. J. for Innovative Research in Multidisciplinary Field, Special Issue 23: 184-189.

Ramamurthy, V. and Rajakumar, R (2014): A study of avifaunal diversity and influences of water quality in the Udhayamarthandapuram bird sanctuary, Tiruvarur district, Tamil Nadu, India. Int. J. of Innovative Research in Science, Engineering and Technology, 3(1): 8851-8858.

Roy, J. and Jha, A. (2017): The waterbird community of a village wetland system – A case study of Amgaon tehsil in Gondia district of Maharashtra. IJRBAT, Special Issue 2 (V): 1018-1024.

BIOINDICATORS AND THEIR ROLE FOR OUR ENVIRONMENT

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Abstract:

In our environment, bioindicators are living organisms such as plants, plankton, animals and microbes that indicate the health of the natural ecosystem in the environment. They are used to assess environmental changes in the environment as tools used to assess environmental status. Bioindicator organisms such as lichens, birds and organisms may indicate a problem in your ecosystem. The changes can be of a chemical, physiological or behavioral nature. Ecological health can be extended too many aspects of human health and well-being. Bioindicators are species that are used to assess the state of health of the environment or the ecosystem and that are able to determine environmental integrity based on their functions and populations (Hamza, 2017). They prove scientifically that every organism within an ecosystem is able to report on the state of its environment. Used to detect changes in the natural environment and monitor the presence of pollution and its effects on ecosystems. This review article clarifies the importance of bioindicators for our environment and determines the health of the ecosystem.

Keywords: Environment, Pollution, Organisms

Introduction:

As global climate change affects the temperature associate degreed weather patterns, it'll additionally impact plant and animal life. Globally, scientists expect the quantity and vary of species that outline diversity, will decline greatly as temperature continues to rise. Our world undergoes speedy changes and is visaged with an increasing number of celebrated and unknown pollutants which mix with climate change and losses of biodiversity to threaten most ecosystems (Markert *et al.,* 2004). In nature bioindicators and biomonitors have proved to be wonderful tools in several environmental cases and will offer data which can't be derived from technical measure alone. Bioindicators are the living organisms admire plants, planktons, animals and microbes. They're used for assessing settingal health and biological science changes going down within the environment (Trishala *et al.,* 2016). In nature every organic entity is capable of detection

indications concerning the health of its surroundings. Through the appliance of bioindicators we will predict the wild of a particular region or the level/degree of contamination (Khatri and Tyapgi, 2015). Qualitative standing of the environment is signaled by a bunch of indicators, called bioindicators, many of that are accountable for showing progressive impacts of various styles of pollutants (Asif *et al.*, 2017). Complete watching of the realm is feasible by bioindication that indicates varied living systems with easy knowledge (Muller, 1980). The result of external factors on ecosystems is assessed by a reliable procedure of bioindication (Markert, 2008). Bioindicators perform to find changes within the natural ecosystems yet as indicate negative or positive impacts. They will also detect changes in the setting because of the presence of pollutants which may have an effect on the diversity of the environment, as well as species gift in it (Holt and Miller, 2010).

Discussions:

Environmental dimension is one in every of the key influences on the standard of life. The teams of bioindicators are chargeable for the positive impact of environmental quality and results in bigger consumption of services. They will be used for assessment of system and environmental quality and for analysis of management measures. In Australia, the taxonomy, biology and ecology of nonsymbiotic mesostigmatic mites are studied and presently utilized in biological management and bioindication activities (Beaulieu andWeeks, 2007).

Types of bioindicators:

The bioindicators are the living organisms such as plants, planktons, animals, and microbes, which are utilized to screen the health of the natural ecosystem in the environment. Naturally occurring bioindicators are used to assess the health of the environment and act as a tool for detecting environmental changes.

Plant as indicators:

Plants are the important thing species indicating the terrific alarm device for detecting the presence of immoderate concentrations of air pollution and regularly offer first proof that the air is polluted. Plant responses were used as signs of air pollution. Research research have proven that numerous forms of plant biomonitors, inclusive of mosses, lichens, tree bark, tree rings, and leaves. Marine flora offer treasured statistics to expect the fame of marine environments, as they're immovable and swiftly reap equilibrium with their herbal surroundings (Jain *et al.*, 2010). It changed into additionally cited that presence or absence of a few precise flora or different flowers presents adequate statistics approximately environmental health. Lichens that are discovered at the trunk vicinity of timber and rocks are composed of algae and fungi. They react

to ecological adjustments in forests, inclusive of the adjustments withinside the shape of the forest, air quality, and climate. The disappearance of lichen in forests, due to adjustments which includes growth within side the degree of sulphur dioxide (SO_2), positive pollution and nitrogen (Gerhardt, 2002). Hamza (2017) cited that a few plant species are exceedingly touchy to unique air pollution and display precise responses to pollution outcomes with the aid of using displaying precise harm symptoms. These species may be used to discover and screen the presence or absence of air pollution. Monitoring of air pollutants the use of flora is a value powerful and environmentally pleasant technique.

Animal as indicators:

Changes in animal population, either increases or decreases, can indicate pollution. Pollution and other stress agents were monitored by measuring the concentration of toxins in animal tissues, behaviour in the field, and individual physiology. Frogs are also bioindicators, detecting the changes that take place in their freshwater and terrestrial habitats. Invertebrate species such as protozoan, earthworms, Acari and other groups seem to respond to chemical residues and other environmental stresses in many different ways. Indicator species are used to monitor environmental changes, assess the efficacy of management, and provide warning signals for impending ecological shifts. The practice is widely adopted in recent years by ecologists, conservation biologists, and environmental practitioners (Ahmed *et al.,* 2015).

Fish:

Fish had been broadly recorded as beneficial signs of environmental water best because of their differential sensitivity to pollution. Certain studies research documented the fish network when it comes to water best. Due to complicated habitat necessities the fish fauna is a important indicator of the ecological integrity of aquatic structures at special scales. Fishes act as a organic indicator of water best, due to their affinity to build up the metals of their muscles (Zhao *et al.,* 2012) that reasons changes in physiological, biochemical and genetic parameters of their body (Javed& Usman, 2017). The health of fish species each on the person degree and at populace degree is decided with the aid of using the connectivity of various habitat factors in a vast spatial-temporal context. Thus, bioindication the usage of fish represents a terrific tracking device in particular with pollution (Andreas *et al.,* 2003).Urbanization in South Africa has resulted withinside the degradation of aquatic ecosystems and impacting the supply of smooth water. Biological organisms, they have got used such as fish assemblages as signs of environmental change (Jonathan *et al.,* 2019).

Birds:

Studies have shown that birds are good bioindicators for many reasons including their known ecology, plant communities and they cover different levels of the ecological pyramid. Bird species are highly sensitive to known environmental stressors and are generally able to assess the effect of their stressors on biota and the reaction of a subgroup of other taxa occurring in the habitat (Hess, 2002). Birds have the ability to directly and quickly change the properties of ecosystems. Over time, birds have been widely used as biomonitors for pollution with persistent organic pollutants, and the response of systems to climate change (Andrea, 2014) can be used at the regional spatial level. A classic example is the response of some water birds to wetland eutrophication (Juan and Andy, 2012).

Mammals:

Mammals are an extraordinary group with an amazing variety of species, shapes, ecologies, physiology, life histories and behaviors. Compared to large mammals, small mammals represent one of the best groups as ecological indicators in terrestrial ecosystems as monitors of pollution (Talmage and Walto, 1991). According to Jennie and Lisa, small mammals such as mice and voles have potential as indicators of sustainable forest management. They have an important functional role in forests, they are economically important as prey animals. The potential role of bats as bioindicators was discussed by Jones *et al.* (2009) highlighted that it describes a number of properties that may make bats suitable for bio-indicator species, including their position at high trophic levels, widespread distribution, and relative taxonomic stability Bats' wealth and activity could make these mammals useful bioindicators in agro-ecosystems (Olimpi, 2018).

Planktons (indicator of water pollution):

Plankton species are the numerous series of organisms discovered in water which are not able to propel themselves in opposition to water current. In the aquatic environment they offer a critical supply of meals to many small and massive aquatic organisms. According to Uday *et al.* (2013), planktons reply hastily to environmental modifications and were very beneficial withinside the identity of assessing water quality. The capacity for freshwater organisms to mirror modifications in environmental situations changed into referred to through Kolenati (1848) and Cohn (1853), who determined that biota in polluted waters had been exceptional from the ones in non-polluted situations. Planktons function early-caution indicators that mirror the fitness popularity of an aquatic environment. Nygaard (1949) referred to that phytoplankton affiliation may be used as an index of pollution. The productiveness of aquatic surroundings is without delay correlated, with the density of phytoplankton (Narsimha, 2013). Their increase and

variety may, except different factors, be managed through seasonal temperature modifications and growing water temperatures.

Phytoplankton indicators:

Phytoplanktons are microscopic plant species; they have their important role in the marine food web. In an aquatic environment phytoplankton perform photosynthesis to convert the sun's rays into energy to support them, and consume carbon dioxide and produce oxygen. Phytoplankton species give more evidence regarding alterations in water quality than nutrient or chlorophyll-a concentration (Zaharddeen, 2020). Phytoplankton demonstrates water quality through changes in its community composition, and distribution, and proportion of sensitive species (Gharib *et al.,* 2011). Some species of phytoplankton thrive in highly eutrophic waters, whereas some species are very sensitive to environmental changes. Rivers with weak currents always contain phytoplankton communities.

Zooplankton indicators:

Zooplanktons are the small floating or weakly swimming organisms that drift with water currents, they make up the planktonic food supply. Almost all the oceanic organisms are dependent on this planktonic food. They also play an important role as bioindicators and help to evaluate the level of water pollution. In freshwater communities, along with fish, they are the main food supplement to many marine water species (Walsh, 1978). Zooplankton is assumed to be a vital part which indicates water quality, eutrophication, and the productivity of a freshwater body. In order to determine the status of a freshwater body it is necessary to measure seasonal variations and presence of zooplanktons (Zannatul and Muktadir, 2009).

Conclusion:

The role of bioindicator species is to appraise the health conditions of our environment and to determine the environmental integrity by using their functions and populations. Like all management tools, we must be conscious of its weakness. However, bioindicators have limitations that are clearly overshadowed by their benefits for our environment. They bring together information from the biological, physical and chemical components of our world that manifest themselves as changes in ecosystem processes. Like plankton, fish, birds, mammal species work as bioindicators for habitat modification and provide an opportunity for the ecosystem health assessments for its sustainability. The conclusion drawn is that bioindication and biomonitoring have become promising methods to studying the actual impacts of external factors on an ecosystem, and differentiate the polluted and unpolluted areas.

References:

Ahmed A.H. Siddiga, Aaron M. Ellisonb, Alison Ochs, Claudia Villar-Leemand, Matthew K. Laub (2015): How do ecologists select and use indicator species to monitor ecological chang? Insights from 14 years of publication in Ecological Indicator, Ecological Indicators, 60(2016): 223-230.

Andreas Chovanec, Rudolf Hofer, Fritz Schiemer (2003): Fish as bioindicators, Trace Metal & other contaminants in the environ. (ELSEVIER), 6:639-676.

Andrea B (2014): Avian genetic ecotoxicology, DNA of the canary in a coalmine, Current Zoology, 60(2): 285-298.

Asif N, Malik M.F. and Chaudhry F.N. (2017): A Review of on Environmental Pollution Bioindicators, Pollution, 4(1): 111-118.

Cury P.M., Boyd I.L (2011): Global seabird response to forage fish depletion: One-third for the birds, Science, 334(6063): 1703-17068.

Beaulieu F and Weeks A.R (2007): Free-living mesostigmatic mites in Australia: their roles in biological control and bioindication, Australian Jour. of Experimental Agricult., 47(4): 460-478.

Egwumah F.A., Egwaumah P.O (2017): Paramount roles of wild birds as bioindicators of contamination, Int. J. Avian & Wildlife Biol., 2(6): 194-199.

Emily A. Holt and Scott W. Miller (2010): Bioindicators: Using organisms to measure environmental impacts, Nature Education Knowledge, 3(10): 8.

EqwumahAttah Francis and Egwumah P.O (2017): Paramount roles of wild birds as bioindicators of contamination, Int. Jour. Avian & Wildlife Bio., 2(6):

Gerhardt A (2002): Bioindicator species and their use in biomonitoring, Environ. Monitoring I, Encyclopedia of life support systems. UNESCO ed. Oxford (UK), Eolss Pub.

Hamza Badamasi (2017): Biomonitoring of air pollution using plants, MAYFEB Jour. of Environ. Sci., 2: 27-39.

Hess G, King (2002): Planning open space for wildlife 1, selecting focal species using a Delphi survey approach, Landscape & Urban Planning, 58: 25-40.

Holt E.A. and Miller S.W. (2010): Bioindicators: using organisms to measure environmental impacts. Nature, 3(10): 8-10.

Jain A, Singh B.N., Singh S.P., Singh H.B., Singh S (2010): Exploring biodiversity as bioindicators for water pollution, National Conference on Biodiversity, Development and Poverty Allevation, Lucknow, U.P. (India):

Jennie Pearce, Lisa Venier (2005): Small mammals as bioindicators of sustainable boreal forest management, Forest Eco. & Management, 208(1): 153-175.

Jonathan C Levin, Darragh J Woodford, Gavin C Snow (2019): Evaluating the effectiveness of freshwater fishes as bio-indicators for urban impacts in the Crocodile (West) cathment, South Africa, Water SA, 45(3):

Jones G, Jacobs D, Kunz T, Willing M, Racey P (2009): Carpe noctem: the importance of bats as bioindicators, Endanger Species, 8: 93-115.

Khatri N and Tyagi S (2015): Influences of natural and anthropogenic factors on surface and groundwater quality in rural and urban areas, Front Life Sci. vol. 8(1): 23-39.

Markert B.A., Breure A.M., and Zechmeister (2004): Bioindicators and Biomonitors: Principles, Concepts and Applications, ELSEVIER Sci. Ltd. Vol. 6.

Markert B. (2008): From biomonitoring to integrated observation of the environment – the multi-markered bioindication concept, Ecological Chem. & Engineering, 15(3): 315-330.

Mueller P. (1980): Biogeographie. URB, Ulmer Verlag. Stuttgart.

Naigaga I., Kaiser H., Muller W.J., Ojok L., Mbabazi D., Muhumuza E (2011): Fish as bioindicators in aquatic environmental pollution assessment: A case study in Lake Victoria wetlands, Uganda, Phy. & Chem. of the Earth (ELESEVIER), 36(14-15): 918-928.

Nygaaed G (1949): Hydrobiological studies of some Danish ponds and lakes, Bio Skr., 7: 1-293.

Olimpi E.M., Philpott S.M (2018): Agroecological farming practices promote bats, Agric. Ecosyst. Environ, 265: 282-291.

Trishala K. Parmar, Deepak Rawtani and Agrawal Y.K (2016): Bioindicators: the natural indicators of environmental pollution, Frontiers in Life Science, vol. 9(2): 110-118.

Uday Bhan Sing, Amrik Singh Ahluwalia, Sharma C, Jindal R, Thakur R.K (2013): Planktonic indicators: A promising tool for monitoring water quality (early-warning signals), Ecology Envir. & Conser., 19(3): 793-800.

Walsh G.E (1978): Toxic effects of pollutants on plankton, Principles of ecotoxicology, New York, Wiley.

Zahraddeen Hassan Yusuf (2020): Phytoplankton as bioindicators of water quality in Nasarawa reservoir, Katsina State, Nigeria, Acta Limnologica Brasiliensia, 32(4):

Zannatual F, Mukadir A.K.M (2009): A review: potentiality of zooplankton as bioindicator, Am J Appl Sci., 6(10): 1815-1819.

CASE STUDY OF TOXIC EFFECT OF PESTICIDES AND THEIR ALTERNATIVES

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Pesticides:

"**Pesticides are chemicals that we use to kill undesirable organisms".**

When we say undesirable organisms, we are referring to organisms (plants, animals, insects, etc.) that are harm full to us. Some of these organisms, or "pests", eat our crops, while others spread diseases. And it doesn't always have to be this serious. Weeds can be considered a pest for just growing in the wrong places (our yards). The point is, if we are us some type of chemical would be considered as pesticide.

The Need for Pesticides:

Many of the pesticide that we use make our lives easier. For instance, (using some of our earlier examples) the pesticides in wool and our wood makes our clothes and furniture last longer. You wouldn't want to have buy a new wool sweater every year, would you? (Roy *et al.*, 1998). The fact that pesticides consumption more in daily life breakfast, lunch, dinner are probably what makes people the most uncomfortable. Do we really need that? Why can't all the farmers just grow food organically?

The answer, unfortunately, is that with current agricultural methods and technologies it is not possible to provide the enough quantities of food currently needed for the living organisms. Pesticides allow us to increase our harvests and feed more people. In addition to applications in agriculture, pesticides have many other important uses. Many pests transmit diseases, which are very dangerous to us.

For example, in the past, malaria was once a serious disease that killed millions of people globally (Senthiselvan *et al.*, 1992). To fight this problem, we used the pesticide DDT, to kill the mosquitoes which transmitted the disease. It was successful, with most of the human beings who died from malaria shrank drastically.

Here's another example they many of us can relate to : million of people in the US have allergic reaction to the cockroaches in our homes the pesticides in insect sprays and bites help reduce this problem.

Danger of pesticides:

Presently we are using more pesticides than ever. Here in the US, we use almost 4 pounds of it annually per person! Although most modern pesticide are much safer than their predecessors are, few of our commonly used pesticides considered toxic (voccia, *et, al.* 1999).

Genetic damage, reproductive problems etc. are just some of the risks associative with pesticides.

History of pesticides:

Most of us have little sense of neither when pesticides use started nor the forms that have impact the earth and these are following as-

- Ancient time: Ashes, common salts, and bitters are used as herbicides
- First century AD: Roman naturalist Pliny the Elder, his historia naturalise, advocates the use of arsenic as an insecticide: suggests soda and olive oil for treatment of legumes
- 16^{th} century: Chinese farmers use arsenicals and nicotine in the form of tobacco extracts as insecticides
- 1850s: Pyrethrum and soap see wide use in the west as insecticides: Wash off tobacco, sulfur, and lime used to come back insects and fungi.
- 1867: The pigments paris green, an impure form of copper arsenate, is introduced into united states to control outbreaks of Colorado potato beetle, within a decayed paris green and kerosene oil emulsion are used against a wide variety of chewing and sucking insect
- 1896: French grap grower applies Bordeaux mixture Cu sulfate & calcium hydroxide, observes nearby weeds turning black and the idea of selective chemicals herbicides is born.
- 1900: Sulphuric acid, copper nitrates, potassium salts are used.
- 1900 – 1950: Sodium arsenates solutions become the standard herbicides and are used in larger quantities.
- 1913: Organic mercury seed dressing
- 1913 – 1939: First of several dither carbonates fungicides used in US.
- 1939: Insecticidal potential of DDT discovered in Switzerland, leading to synthesis of thousands of chemicals. Chlorinated hydrocarbons such as DDT, BHC, & chlordane, and others, all powerful contact and stomach poisons, see enthusiastic use against malaria and other insect borne diseases.
- 1950s: Fungicides appear ; organic phosphorus insecticide is introduced.

- 1961 DDT registered for use on 34 different crops as pesticide usage dramatically increases
- 1962 Rachel Carson publishes silent spring on environmentalist's rallying cry against pesticide use. The potential of pesticides for bioaccumulation andlong term toxicity became widely recognized, and pest resistance became increasingly evident. Farmers stopped using DDT and carbonates, which although more acutely toxic, do not persist in the environment.
- In 1972, EPA revoked the use of DDT on all food sources in the United States. The World Health Organization, however, still reserves the right to use DDT on particularly virulent outbreaks of malaria.
- 1970s-1980s: Herbicidal sulfur urea, synthetic fungicides, and light- stable parathyroid pesticides introduced.
- 1990 Renewed interest in integrated pest management; intensified research on biological pest control methods and other alternatives to pesticides. The emergence of pest management programs, a result of improved knowledge in host pest interactions, has helped decrease insecticide use on major crop commodities such as corn, soyabeans, cotton and wheat since the 1960s.

Today, there is great interest is genetically engineered microbial agents, including development of pest – resistance transgenic crops and other biological pest control methods (Gray *et al.*, 1999).

Characterstics of pesticides:

Pesticides prevent, destroy, repel or mitigate any pest ranging from insects ranging from insects animals and weeds to, animals and weeds, to microorganisms such as fungi, moulds, bacteria and viruses.

- Insect killer (insecticides)
- Mould and fungi killers (Fungicides)
- Weed killers (herbicides)
- Slug pellets (molluses)
- Plant growth regulators
- Bird and animal repllents
- Rat and mouse killers
- Antimicrobials
- Inert ingredients

Pesticides help to manage and prevent pests that spread disease, that damage crops, buildings and other property, and that are public nuisance.

Types of Pesticides:

1. Heavy metals or inorganic pesticides
2. Natural organics
3. Chlorinated hydrocarbon pesticides(DDT)
4. Organophosphate pesticides
5. Carbonates
6. Herbicides

Pesticides classes – Fungicides –

- Aliolidi cylalanines and oxazolidinones
- Benzimidazoles and thiophanates
- Carboxamides
- Methoxyacrylate Methoxyacrylate and oximinoacetate (Strobilurins) and oximinoacetate(Strobilurins)
- Organotin compounds
- Anilinopyrimidines
- Phenylpyrroles
- Dicarboximides
- Demethylase inhibitors
- Inorganic Fungicides
- Phthalimides
- Chloronitriles
- Dithiocarbamates and Ethylenebisdithiocarbamates

Pesticides classes – Insecticides –

- Carbamates:AChE Inhibitors
- Organophosphorous :AChE Inhibitors
- Cldiohli GABA iyclodiene organochlorines:GABA Antagonists
- Organochlorines: Sodium channel modulators
- Pyrethroids: Sodium channel modulators
- Nicotine, Nicotine and neonicotinoids: Acetylcholine receptor agonists and Neonictinoids: Acetylcholine Receptor Agonists
- Avermectins and Milbemycin: Chloride Channel Activators
- Juvenile Juvenile Hormone mimics and Selective Feeding Blocker Hormone Mimics and Selective Feeding Blocker
- Phenyltrazins/Aminotriazines: Larvacides /Molt Disruptors.

- Delta -Endotoxins Derived from Bacillus thuringiensis
- Benzoylureas:Chitin Synthesis Inhibitors
- Diachydrazine
- Octopaminergic Agonists and Monoamine Oxidase Inhibitors
- Respiratory Inhibitors and Uncouples

Pheromones Pesticides Classes – Herbicides-

- Acetyl Co -A Carboxylase Inhibitors
- AryloxyphenoxypropPionates
- Diphenyl Ethers
- N-Phenylphthalimides, Thiadiazoles, dtili
- Aryloxyphenoxypropionates

Widely used pesticides:

1. DDT

The insecticide DDT has been banned in the developed world for many years though is in widespread use in the developing world. Various DDT metabolities have endocrine effects.

2. Lindane

It is an organic chlorine pesticide, which is under a great deal of regulatory pressure around the world. On the 13th July 2000, an EU regulatory committee voted to ban agricultural uses of Lindane in Europe – though it can still used in some other products, such as ant killer. The oestrogenic properties of lindane have been demonstrated in severa; systems, including the production of egg yolk protein and zona radiate (Lim *et al.,* 1997). .

3. Carbendazim

Carbendazim is a fungicide, probably partly through disrupting of cells in tissues which is the same way as it works as a fungicide. In addition, carbendazim is also a testrogen damaging development of mammals in the womb.

4. Benomyl

Benomyl is a fungicide that is metabolised into carbendazim, see above (Lim and Miler, 1997).

5. Procymidone

Procymidoneis an anti-androgen, with anti-maleness properties similar to vinclozolin.

6. Chlorpyrifos

Chlorpyrifos is a neurotoxin, and exposure to low concentrations can afeect brain development in rats (Roy *et al.,* 1998).

7. Deltamethrin

Deltamethrin is a pyrethroid insecticide and been listed as a potential endocrine disrupter by the German Federal Environment Agency, who report that it can affect sperm and the placenta. Research has shown that chronic exposure of adult rats to deltamethrin causes the death of some testicular cells (El Gohary *et al.,* 1999).

8. Carbofuran

Carbofuran caused sperm and reproductive system damage.

Route of exposure:

People exposed to pesticides by a number of different routes including occupation, in the home, at school and in their food. There are concerns that pesticides used to control pests on food crops are dangerous to people who consume those foods. These concerns are one reason for the organic food movement.

A study published by the United States National Research Council in 1993 determined that for infants and children, the mayor source of exposure to pesticides is through diet.

Strawberries and tomatoes are the two crops with the most intensive use of soil fumigants. They are particularly vulnerable to several type of diseases, insects, mites, and parasite worms (Plant *et al.,* 1998). In 2003, in Canada alone, 3.7 million pounds (1, 700 metric tons) of metal sodium were use on tomatoes. In recent years, other farmers have have demonstrated that it is possible to produce strawberries and tomatoes without the use of harmful chemicals and in a cost effective way. Exposure routes other than consuming food that contains residues, in particular pesticides drift are potentially significant to the public.

Shocking facts:

Chemical pesticides usages will threat the habitat of bees. The systemic application of pesticides in flowers has killed scores of bees. More than 25% of the bee colonies died in winter 2006/07. That translates to a loss of tens of billions of bees. In addition, it is estimated that this loss will negatively affect the agricultural economy to the tune of $8 to $12 billion (*et al.,* 1998).

Farmers and their families and other persons who use chemical pesticides regularly are at greatest risk for achieving toxic levels in their bodies. The danger spread through wind, residues, byproducts, run off etc.

What are the dangers from pesticide exposure?

The plant accidently released 40 tons of an intermediate chemical gas, methyl isocyanides, used to produce some pesticides. In that disaster, nearly 3, 000 people were kill immediately, overall approximately 15, 000 deaths occurred. Today nearly 100, 000 people suffer from mild to severe permanent damage because of that disaster (Plant *et al.,* 1998).

The Natural Resource Defence Council has collected data, which recorded higher incidence of childhood leukemia, brain cancer and birth defects. These results correlated with early exposure to pesticides.

Environmental effects of pesticides:

In Soil:

Uncontrolled application of pesticides can contaminate soil and may kill other nontarget organisms. Pesticides can damage soil biomass and microorganism such as bacteria, fungi, and earthworms. Microbial biomass is a labile component of soil organic matter and has an important role in soil nutrient element cycle. Soil pH is also of some importance. Adsorption increases with decreasing soil pH for ionizable pesticides (e. g. 2, 4-D, 2, 4, 5-T, picloram, and atrazine). Heavy treatment of soil with pesticides can cause populations of beneficial soil microorganisms to decline. According to the soil scientist Dr. Elaine Ingham, "If we lose both bacteria and fungi, then the soil degrades. Overuse of chemical fertilizers and pesticides have effects on the soil organisms that are similar to human overuse of antibiotics.

In Air:

Many pesticides have been detected in air at more than half the sites sampled nationwide. Herbicides are designed to kill plants, so it is not surprising that they can injure or kill desirable species if they are applied directly to such plants, or if they drift or volatilise onto them.

In Marine animals:

Chlorpyrifos, a common contaminant of urban streams (U. S. Geological Survey, 1999), is highly toxic to fish, and has caused fish, kills in waterways near treated fields or buildings (US EPA, 2000). Herbicides can also be toxic to fish. According to the EPA, studies show that trifluralin, an active ingredient in the weed-killer Snapshot, "is highly to very highly toxic to both cold and warm water fish" (U. S. EPA, 1996).

Several cases of pesticide poisoning of dolphins have been reported worldwide. Because of their high trophic level in the food chain and relatively low activities of drug-metabolising enzymes, aquatic mammals such as dolphins accumulate increased concentrations of persistent organic pollutants

Dolphins inhabiting riverine and estuarine ecosystems are particularly vulnerable to the activities of humans because of the restricted confines of their habitat, which is in close proximity to point sources of pollution. River dolphins are among the world's most seriously endangered species. Populations of river dolphins have been dwindling and face the threat of extinction; the Yangtze river dolphin (Lipotes vexillifer) in China and the Indus river dolphin (Platanista minor) in Pakistan are already close to extinction

In Bees:

The herbicide oxadiazon is also toxic to bees, which are pollinators (Washington State Department of Transportation, 1993). Herbicides may hurt insects or spiders also indirectly when they destroy the foliage that these animals need for food and shelter. For example spider and carabid beetle populations declined when 2, 4-D applications destroyed their natural habitat

In Birds:

Herbicides can also be toxic to birds. Although Trifluralin was considered "practically nontoxic to birds" in studies of acute toxicity, birds exposed multiple times to the herbicide experienced diminished reproductive success in the form of cracked eggs. Exposure of eggs to 2, 4-D reduced successful hatching of chicken eggs and caused feminization or sterility in pheasant chicks. Herbicides can also adversely affect birds by destroying their habitat. Glyphosate treatment in clear cuts caused dramatic decreases in the populations of birds that lived there. Effects of some organochlorines (OCs) on fish-eating water birds and marine mammals have been documented in North America and Europe

In Plants:

In addition to killing non-target plants outright, pesticide exposure can cause sub lethal effects on plants. Phenoxy herbicides, including 2, 4-D, can injure nearby trees and shrubs if they drift or volatilize onto leaves.

Exposure to the herbicide glyphosate can severely reduce seed quality.

Exposure to the herbicide clopyralid can reduce yields in potato plants

In Humans:

A study on those affected in the Seveso diaster of 1976 in Italy during the production of 2,4,5T, a herbicide, concluded that chloracne (nearly 200 cases with a definite exposure dependence) was the only effect established with certainty as a result of dioxin formation. Early health investigations including liver function, immune function, neurologic impairment, and reproductive effects yielded inconclusive results. An excess mortality from cardiovascular and respiratory diseases was uncovered, possibly related to the psychosocial consequences of the accident in addition to the chemical contamination. An excess of diabetes cases was also found. Results of cancer incidence and mortality follow-up showed an increased occurrence of cancer of the gastrointestinal sites and of the lymphatic and haematopoietic tissue. Results cannot be viewed as conclusive, however, because of various limitations: few individual exposure data, short latency period, and small population size for certain cancer types. A similar study in 2001 observed no increase in all-cause and all-cancer mortality. However, the results support the notion that dioxin is carcinogenic to humans and corroborate the hypotheses of its association with cardiovascular- and endocrine-related effects.

How do you know if you are going to be ill? You do not; you just have to hope for the best. How will you be affected? Well, you do not really know how your body will react to the toxins until it happens. Several factors determine how your body will react including your level of exposure, the nature of inorganic you ingest, and your individual resistance to the chemicals. Some people are unaffected or are mildly affected, while others become severely ill from similar levels of exposure. Some possible reactions are:

- Fatigue
- Skin Irritations
- Nausea
- Vomiting
- Breathing Problems
- Brain Disorders
- Blood Disorders
- Liver & Kidney Damage
- Reproductive Damage
- Cancer
- Death

How to Eliminate Toxin from Pesticides?

It is a best way to grow your own produce. Cultivation of crops in our surrounding area means that you can use healthful methods to control any pests.

These are all-natural remedies for controlling pests and enriching soil or you can use organic pesticides. Visit your near by organic market for the freshest grown foods. At your local store, look for organic food products. Since awareness is being raised, more people are paying attention to what they are eating, as are the store managers. More and more stores are working to accommodate this new healthier appetite by providing consumers with organically grown products they want. There are certain produce items, which contain the huge amount of pesticides. Avoiding these crops can reduce your pesticides consumption levels by as much as 90%. Some of these items are fruit like cherries, apples, peaches, pears and grapes. Vegetables you could avoid are celery, spinach and sweet bell peppers. Remember, if they are organically grown, then these are safe to eat.

References:

Afifi, N, A., Ramadan, A., Abd-El-Aziz, M, I, and Saki, E.E. (1991): Influence of dimethoate on testicular and epididymal organs, testosterone plasma level and their tissue residues in rats. Deutsche Tieraerztliche Wochenschrift 23(3) : 234-236.

Cooper, R. L., Goldman, J. M. and Stoker, T. E.(1999): Neuroendocrine and reproductive effects of contemporary- use pesticides. Toxicology and Industrial Health 12(6) : 213-216.

Czeizel, A. E.(1996): Human germinal mutagenic effects in realtion to intentional and accidental exposure to toxic agents. Environmental Health Perspectives104 Suppl 24(5) : 432-435.

Celius, T., Haugen, T, B., Grotmol, T. and Walther, B. T. (1999): A sensitive zonagenetic assay for rapid in vitro assessment of estrogenic potency of xenobiotics and mycotoxins. Environmental Health Perspectives 21(3) :435-436.

Cooper, R. L., Goldman, J. M. and Stoker, T. E. (1999): Neuroendocrine and reproductive effects of contemporary-use pesticides. Toxicology and Industrial Health 11(4) :213-215.

ENDS (1999): Industry glimpses new challenges as endocrine science advances. ENDS Report 21(4) 245-265.

El-Gohary, M., Awara, W. M., Nassar, S. and Hawas, S. (1999): Deltamethrin-induced testicular apoptosis in rats: the productive effect of nitric oxide synthase inhibitor. Toxicology 3(4): 32-34.

Gray, L. E, Ostby, J., Monosson, E, and Kelce, W, R. (1999): Environmental antiandrogens : low doses of the fungicides vinclozolin alter sexual differentiation of male rat. Toxicology and Industrial Health 23(1) : 34-36.

Gray, L, E, (1998): Xenoendocrine disrupters: laboratory studies on male reproductive effects. Toxicology Letters 21(2) : 42-45.

Gray, l, E., Wolf, C., Lambright, C., Mann, P., Price, M., Cooper, R. L. and Ostby, J. (1999): Adminidtration of potentially antiandrogenic pesticides (procymidone, linuron, iprodione, chlozolinate, p,p'-DDE, and ketonazole) and toxic substances (dibutyl- and diethylhexyl phthalate, PCB 169, and ethane dimethan sulphonate) during sexual differentiation produces diverse profiles of reproductive malformations in the male rat. Toxicology and Industrial Health 42(4): 45-46.

Go, V., Garey, J., Wolff, M. S. and Pogo, B.G. T.Johnson, D. E., Seidler, F. J. and Slotkin, T. A. (1998): Early biochemical detection of delayed neurotoxicity resulting from developmental exposure to chlorpyrifos. Brain Research Bulletin 24(8) : 24-26.

Lim, J. and Miller, M.G.(1997): The role of benomyl metabolite carbendazim in benomyl-induced testicular toxicity. Toxicology and Applied Pharmacology. Lyons, G (for WWF) 1999. Chemicals Tresspass: A Toxic Legacy. WWF, July (1999) 23(5) : 35-36.

Monosson, E., Kelce, W. R., Lambright, C., Ostby, J and Gray, L. E. J. (1999): Peripubertal exposure to the antiandrogenic fungicide, vinclozolin, delays puberty, inhibits the development of androgen-dependent tissues, and alters androgen receptor function in the male rat. Toxicology and Industrial Health 34(5) : 35-36.

Maiti, P. K. and Kar, A.(1997): Dimethoate inhibits extrathyroidal 5'-monodeiodination of thyroxine to 3, 3', 5-triiodothronine in mice : the possible involvement of the lipid peroxidative process. Toxicological Letters**91**: 1-6.

Nakai, M., Toshimori, K., Yoshinaga, K., Nasu, T. and Hess, R. A. (1998): Carbendazim-induced abnormal development of the acrosome during early phases of spermiogenesis in rat testes. Cell and Tissue Research 14 (6) : 24-26.

Ostby, J, Kelce, W. R., Lambright, C., Wolf, C.J., Mann, P. and Gray, L. E.J.(1999): The fungicide procymidone alters sexual differentiation in the male rat by acting as an androgen-receptor antagonist in vivo and in in vitro. Toxicology and Industrial Health 24(6) : 35-37.

Pant, N., Prasad, A. K., Srivatava, S. C., Shankar, R. and Srivastava, S. P.(1995): Effect of oral administration of carbofuran on male reproductive system of rat. Human & Experimental Toxicology 46(6) : 46- 58.

Pant, N., Shankar, R. and Srivastava, S. P (1997): In utero and lactational exposure of carbofuran to rats : Effect on testes and sperm. Human & Experimental Toxicology 24 (4) : 24-26.

Paul, R., Silve, S., De Nys, N., Dupuy, P.H., Bouteiller, C.L., Rosenfeld, J., Ferrara, P., Le Fur, G., Casella, P. and Loison, G. (1998): Both the immunosuppressant SR31747 and the antiestrogen tamoxifen bind to an emopamil-insensitive site of mammalian Delta8-Delta7 sterol isomerase. Journal of Pharmacology and Experimental Therapeutics 48 (4): 35-39.

Roy, T. S., Andrews, J. E., Seilder, F. J. and Slotkin, T. A. (1998): Chlorpyrifos elicits miotic abnormalities and apoptosis in neuroepithelium of cultured rat embryos. Teratology 24(4): 45-47.

Rawlings, N.C., Cook, S. J and Waldbillig, D. (1998): Effects of the pesticides carbofuran, chlorpyrifos, dimethoate, lindane, triallate, trifluralin, 2,4-D and pentachlorophenol on the metabolic endocrine and reproductive endocrine system in ewes. Journal of Toxic and Environmental Health 47(6): 47-58.

Silvestroni, L. and Palleschi, S. (1999): Effects of organochlorine xenobiotics on human spermatozoa, Chemosphere. Vinggaard, A. M., Joergensen, E. C. and Larsen, J. C. (1999): Rapid and sensitive reporter gene assays for detection of antiandrogenic and estrogenic effects of environmental chemicals. Toxicology and Applied Pharmacology 74 (6) : 68-69.

Voccia, I., Blakley, B., Brousseau, p. and Fournier, M. (1999): Immunotoxicity of pesticides : a review. Toxicology and Industrial Health 35(3) : 46-48.

Yousef, M.I., Salem, M.H., Ibrahim, H. Z., Helmi, S., Seehy, M. A. and Bertheussen, K.(1995): Toxic effects of carbofuran and glyphosate on semen characteristics in rabbits. Journal of Environmental Science and Health 36(5) :65-66

FORMULATION AND EVALUATION OF TRADITIONAL HERBAL COSMETICS

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Abstract:

Herbs are gifts to mankind in several ways. Which possess adequate amount of different phytochemicals are embedded in many herbs. Plants not only used as medicine, it also play a major role in preparing cosmetics. The word herbal refers to safety, which has no adverse effects. Herbal cosmetics are also known as "natural cosmetics". Herbal cosmetics are classified as skin care and hair care products. Skin care products are sensitive, without harmless mostly used by people. According to that different combination herbs were analysed tests such as physical appearance and organoleptic properties. Natural products were safe to human as well as environment. This present study will helps to protect environment from air, water, soil and land pollution. Traditional medicine and cosmetics were used since pre–vedic period to sustain people long duration of period in earth.

Introduction:

Nature have abundant source of plant materials. Most of the herbs are used as herbal medicine. In Latin Herbal Cosmetics term is derived as "the art of beautifying or decorating the human body". Herbal cosmetics are safe, economically less cost, and their utilization trendy in the modernized world. These products improve the functioning or texture of the skin by boosting collagen growth by eradicating harmful effects of free radicals, maintain keratin structure in good condition, and making the skin healthier. Herbal cosmetics are formulated, using different cosmetic ingredients to form the base in which one or more herbal ingredients are used to cure various skin ailments. Cosmetics include skincare creams, lotions, powders, perfumes, lipsticks, face wash, hair colors, bath oils and soaps, etc., these products are used in greater amounts. The demand for herbal cosmetics is increasing rapidly due to their lack of side effects.

Natural products:

Herbal cosmetics are mostly beautifying the skin, hair care. Skin and hair maintenance was based on the day-to-day activities such as healthy food habits, designation, residing area temperature. Herbal plants possess different phytochemicals, which can cure the properties like antimicrobial, antioxidant, anti-allergic, anti-skin rashes, skin cancer, anti- dermatophytes, etc., According to the climatic condition skin may get damaged, due to lacking water content in their body. It will cause "Crack, sunburns, pigmentation, wrinkles".

Benefits of herbal products:

(i) Cleanser:

The natural products are used to clear "dust, dead cells, and dirt" from the holes in the skin. Few purifiers like plant-based oils received from seeds and fruits, etc.

(ii) Safe guarder:

Skin is the largest sense organ, which is enclosed our body and it is protected through various herbs, avoid sunburns and winter conditions. Do not affect any skin allergy, when we use herbal cosmetics.

(iii) Skin tonner:

The herbal cosmetics are suitable for any kind of skin texture. All cosmetics are purely made from herbs. Hence, it is women friendly product and it protects men too.

(iv) No side effects:

Herbal cosmetic products are made from phytochemicals, and it is totally away from synthetic chemicals. Synthetic chemicals are causes Skin allergy, hair fall, change skin tones, and affect hair condition.

Materials and Methods:

Herbal cosmetics are playing prime role in past few decades, since pre – historic periods herbal products are using in our country, in-between due to modernization and civilization chemical-based cosmetics are increased. Now a days herbal product usage awareness created among people. Some of the herbal cosmetics of hair care and skin care products are we have chosen for this present study.

Face pack:

The following tests were evaluated for the quality of this product.

Materials required:

Bowl, Spoon, mixer – grinder, Knife, few herbs as follows:

Sr. No.	Name of the herbs	Vernacular Name	Parts used	Quantity	Uses	Illustration of herbs
1.	*Curcuma longa*L	Manjal	Rhizome	50g	Skin allergy and Inflammation	
2.	*Vigna radiata* L	Pachaipayaru	Seeds	50 g	Skin conditioner	
3.	*Cicer arietinum* L	Kadalaimavu	Seeds	50 g	Improves the skin complexion	
4.	*Senna auriculata* L	Avaram poo	Flowers	100g	Maintains body odour and cures itching	
5.	*Citrus limon* L	Elumichai	Fruit	20 ml	Remove dirt and cures acne.	
6.	*Rosa species* L	Rose	Petals (Rose water)	50 ml	Moisturize *skin*	

Herbal facepack preparation:

***Curcuma longa* L powder**

***Vigna radiata* L powder**

***Cicer arietinum* L powder**

***Senna auriculata* L powder**

***Citrus lemon* L juice**

Squeezing *Citrus lemon* L

Rose water

Mixing all ingredients

Herbal Face pack

Physical evaluation:

Different physical appearance such as colour, odour and texture were tested by visually (Bhutkar and Shah, 2019).

Physicochemical evaluation:

i. Irritancy Test:

An upper surface of the skin of 1cm^2 chosen for irritancy test. Prepared face pack applied on the skin, irritation, redness, and swelling were tested and reported for regular intervals up to 24 hours (Pal, 2017).

ii. Stability Test:

The prepared sample were kept at room temperature 35℃ and stored at different temperature for one month. Morphological Parameters Evaluated parameters like colour, odor and texture, pH and smoothness (Pal, 2017).

Washability Test:

It is a common phenomenon applies the prepared face pack on the skin and after 5 minutes rinse with 1 litre water to remove the dirt and face pack. This face pack is easy to use and washable (Bhutkar and Shah, 2019).

Fairness cream:

Materials required:

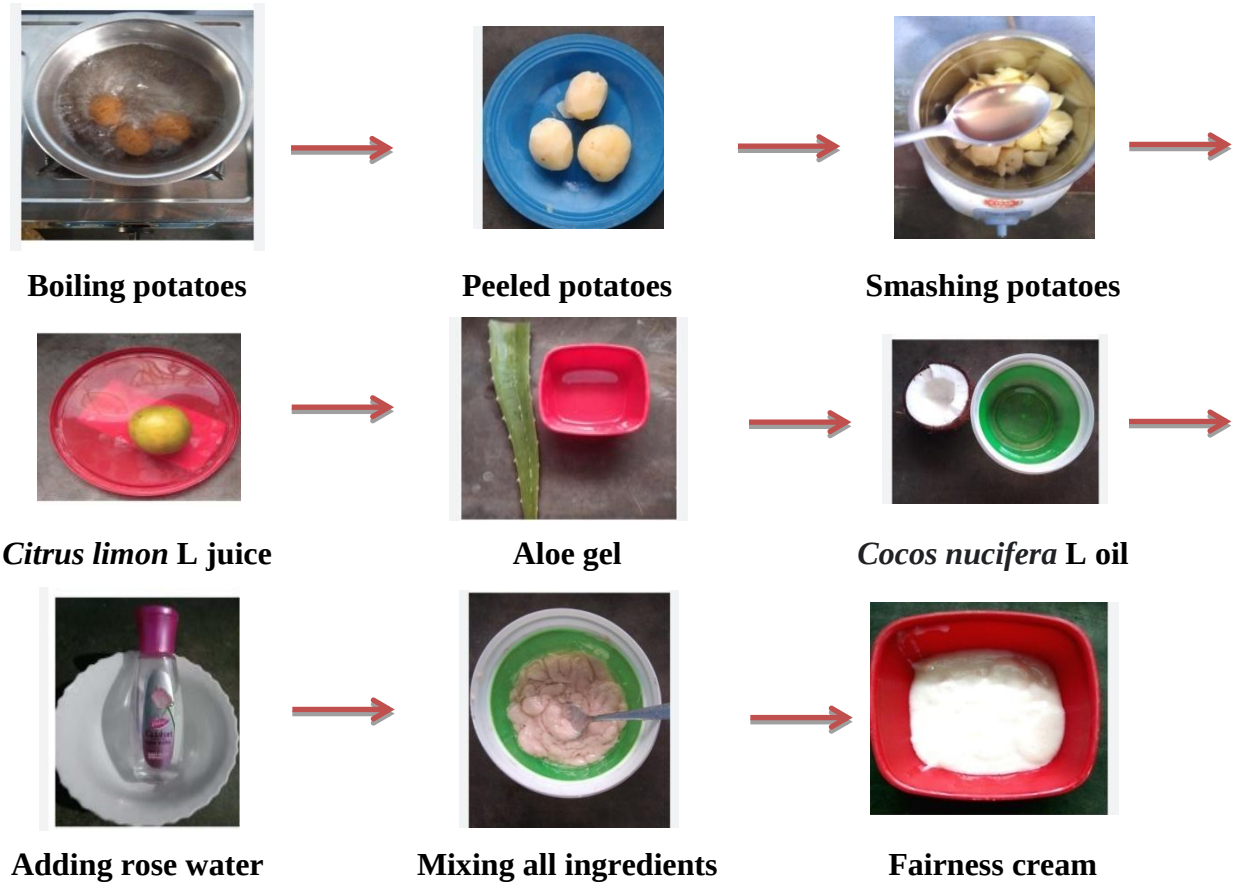
Bowl spoon, spoon, Knife, few herbs and vegetables as follows:

Sr. No.	Name of the herbs	Vernacular Name	Parts used	Quantity	Uses	Illustration of herbs
1.	*Solanum tuberosum* L	Potato	Tuber	3	Cure sunspots and burns	
2.	*Cocos nucifera* L	Thengai	Dried Kernel oil	30 ml	Cures acene and moisturize *skin*	
3.	*Aloe barbadensis* L	Katralai	Leaf (Gel)	100g	Rich in anti – oxidants and minerals	
4.	*Citrus limon* L	Elumichai	Fruit juice	20 ml	Remove dirt and cures acne	
5.	*Rosa specis* L	Rose	Petals (Rose water)	50 ml	Moisturize *skin*	

Methodology:

The following ingredients such as boiled and smashed *Solanum tuberosum* L, oil of *Cocos nucifera* L, gel of *Aloe barbadensis* L, fruit juice of *Citrus limon* L and flower petals essence of *Rosa species* L are mixed and made as fairness cream.

Herbal fairness cream preparation:



Boiling potatoes **Peeled potatoes** **Smashing potatoes**

***Citrus limon* L juice** **Aloe gel** ***Cocos nucifera* L oil**

Adding rose water **Mixing all ingredients** **Fairness cream**

Homogeneity:

The prepared face cream examined by visual appearance and by touch (Gupta, 2015).

Appearance:

The appearance of the cream was analysed by its color, Pearlscence and roughness are graded (Aswal *et al.*, 2013).

After feel:

Emolliency, slipperiness and amount of residue left after the application of fixed amount of cream was checked (Aswal *et al.*, 2013).

Types of smears:

After application of cream, the type of film or smear formed on the skin was checked (Dhyani *et al.*, 2019).

Removal:

The ease of removal of the cream applied was examined by washing the applied part with tap water (Sahu *et al.*, 2012).

Irritancy test:

An upper surface of the skin chosen 1 Sq. cm for irritancy test. Within 24 hours checked and reported (Sahu *et al.*, 2012).

Herbal soap:

Materials required:

Bowl, spoon, mixer – grinder, knife, pH strip, Gas stove, Lighter, hot water, some other ingredients as follows:

Sr. No.	Name of the herbs	Vernacular Name	Parts used	Quantity	Uses	Illustration of ingredients
1.	*Beta vulgaris* L	Beetroot	Root	2	Protect from aging and wrinkles	
2.	Honey comb	Then mezhlugu	Wax of beehieve	50 g	Skin firm, anti-allergenic and anti-inflammatory	
3.	*Aloe barbadensis* L	Katralai	Leaf (Gel)	50 g	Rich in anti – oxidants and minerals	
4.	*Rosa species* L	Rose	Petals (Rose water)	50 ml	Moisturize skin	

Methodology:

The *Beta vulgaris* L cut into pieces, grinded and filtered juice mixed with melted bee wax. After mixing *Aloe barbadensis* L gel and finally *Rosa species* L essence added for fragrance to made herbal soap.

Beet root soap preparation:

Different Physicochemical Parameters are discussed below:

Determination of clarity, odour and colour:

Colour and clarity were checked against white background by naked eyes and odor was checked by smelling (Haneefa *et al.*, 2019).

pH:

The pH of the prepared soap was assessed by touching a pH strip to the freshly formulated soap and conjointly by dissolving 1 gm in 10 ml water with the help of digital pH meter (Manjusha, 2019).

Cubes of *Beta vulgaris* L

Grinded *Beta vulgaris* L

***Aloe barbadensis* L gel**

Bee hive wax

Melted bee wax

Mixing of *Aloe barbadensis*

Adding rose water

Ingredients solidifying

Beet root soap

Foaming ability and foam stability:

Cylinder shake method was used to test for the foaming ability. 50 ml of the 1% formulated products solution was placed into a 250 ml graduated cylinder, covered with one hand, and shaken for 10 times. After 1 min of shaking, the total volume of the foam content was recorded. Foam stability was valued by recording the foam volume after 1 min and 4 min of shake test (Joshi, 2019).

Skin irritation test:

An upper surface of the 1 cm^2 skin chosen for irritancy test. Prepared face pack applied on the skin, irritation, redness, and swelling were tested and reported for regular intervals up to 24 hours.

Herbal lipbalm:

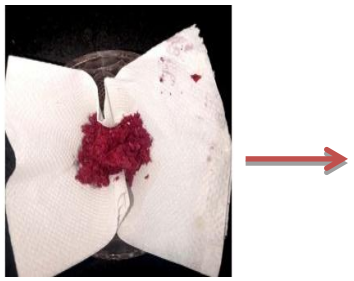
Materials required:

Bowl, spoon, pH strip, knife, Gas stove, Lighter, hot water, Thermometer, tissue paper, some other ingredients as follows:

Sr. No.	Name of the herbs	Vernacular Name	Parts used	Quantity	Uses	Illustration of ingredients
1.	*Beta vulgaris* L	Beetroot	Root	2	Protect from aging and wrinkles	
2.	Honey comb	Then mezhlugu	Wax of beehieve	50 g	Skin firm, anti-allergenic and anti-inflammatory	

Methodology:

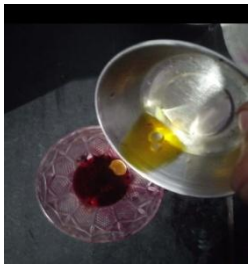
The *Beta vulgaris* L crush with tissue paper and melted bee wax added to form lipbalm.



Beet root

Honey comb

Melting of Honey comb



Mixing of honey comb

Turned semisolid content

Lipbalm

Organoleptic properties:

The lip balm was studied for organoleptic characters such as colour, odour, taste and appearance (Jadhav, 2019).

Physicochemical evaluation:

Determination of melting point:

Determination of melting point is an important parameter for lipstick formulation as it is an indication of the limit of safe storage. It was determined by capillary tube method. Melt

approximately 50mg sample of lipstick and filled into glass capillary tube opened at both ends. Capillary was cooled with ice for 2h and fastened with thermometer. Thermometer with capillary was deep in the beaker containing full of water which was placed on heating plate with magnetic stirrer. Heating and stirring was started slowly at fixed speed. The temperature at which material moves along the capillary tube was considered as melting point (Pandit *et al.,* 2020).

Breaking point:

This test was carried out to find out the value of maximum load that lipstick can withstand before it breaks. This test gives strength of lipstick. It was checked by held lipstick horizontally in a socket inch away from the edge of support. Gradually the weight increases by a specific value 10gm at specific interval of 30 secs. The weight at which breaks was considered as the breaking (Pandit *et al.,* 2020).

Softening point:

Lipstick should be able to withstand range of conditions to which it will be subjected in the consumer's handbag. It should be resistant to varying temperature conditions and be just as easy to apply in hot and as in cold weather. Softening point of lipstick was determined by Ring and Ball method (Pandit *et al.,* 2020).

Aging stability:

The products were stored in 40℃ for 1 hrs. Various parameters such as bleeding, crystallization of on surface and ease of application were observed **(**Mali *et al.,* 2019).

pH parameter:

The pH of formulated herbal lipsticks was determined using pH meter **(**Mali *et al.,* 2019).

Skin irritation test:

It is carried out by applying product on the skin for 10 minutes **(**Mali *et al.*, 2019).

Perfume stability:

The formulated herbal lipsticks were tested after 30 days, to record fragrance **(**Mali *et al.,* 2019).

Results:

The results of evaluation are displayed in Table for organoleptic and physico-chemical evaluation. The study of nature, color, odor taste, texture, pH of different products is combined form under various Ingredients. Different herbal cosmetics results were as follow as:

Face pack:

Physical evaluation:

Sr. No.	Evaluation parameters	Observation
1.	Nature	Powder
2.	Odour	Pleasant
3.	Colour	Yellow
4.	Texture	Smooth

Physicochemical evaluation:

Irritancy test:

Sr. No.	Evaluation parameters	Observation
1.	Irritation	Nil
2.	Redness	Nil
3.	Swelling	Nil

Stability Test:

Sr. No.	Evaluation parameters	Room Temperature	35^0C
1.	Colour	No change	No change
2.	Odor	No change	No change
3.	P^H	5.8	5.8
4.	Texture	Fine	Fine
5.	Smoothness	Smooth	Smooth

Fairness cream:

Physicochemical evaluation:

Irritancy Test:

Sr. No.	Evaluation parameters	Observation
1.	Irritation	Nil
2.	Redness	Nil
3.	Swelling	Nil

Stability test:

Sr. No.	Evaluation parameters	Observation
1.	Physical appearance	No change in colour
2.	After feel	No change in fixed amount of cream base found
3.	Types of smear	Non – greasy
4.	Texture	Fine
5.	Smoothness	Smooth

Herbal soap:

Physical evaluation:

Sr. No.	Evaluation parameters	Observation
1.	Nature	Solid
2.	Odour	Pleasant
3.	Colour	Red
4.	Texture	Fine

Physicochemical evaluation:

Sr. No.	Evaluation parameters	Observation
1.	Colour	No change
2.	Odor	No change
3.	P^H	7.6
4.	Transperancy	Transparent
5.	Foam ability	yes
6.	Foam type	Small, compact, dense and uniform
7.	Foam stability	Good
8.	Skin irritation	Nil

Herbal lipbalm:

Physical evaluation:

Sr. No.	Evaluation parameters	Observation
1.	Nature	Semi Solid
2.	Odour	Pleasant
3.	Colour	Red
4.	Texture	smooth

Physicochemical evaluation:

Sr. No.	Evaluation parameters	Observation
1.	Colour	No change
2.	Odor	No change
3.	Melting point	58℃-59℃
4.	Breaking point	143 gm
5.	Softening Point	59℃
6.	Aging Stability	Smooth
7.	pH	6.5
8.	Skin irritation	Nil
9.	Perfume Stability	Good

Conclusion:

Herbal cosmetics are made from natural products, which are made from different parts of flora. The skin and hair beauty determines the physical health, habit, climatic condition, work nature and protection from different factors (Fathima *et al.*, 2011). The present work is similar to Herbal face packs are prepared from many herbs. They are protecting skin with no side effects. Now days herbal products are familiar and demand in World market (Yadav and Yadav, 2015).

Herbal lipbalm is safety and easily available products can be utilized for this preparation. Different parameters used to assess the quality such as colour, pH, skin irritation, melting point, breaking point, force of application, perfume stability, surface anomalies, Aging stability. From this study proven *Beta vulgaris* and *Curcuma longa* are the good combinations. Most of the people accepted this product (Mali *et al.*, 2019).

Skin is the sensitive part in human body, and it is a largest sense organ. Which is protecting through natural products, to cleanse the external surface of skin used this soap. Different testing used to assess the quality such as P^H, foam height and retention, total fatty matter (Kondepudi *et al.*, 2019). Herbal products are safe to our skin and manufacturing of this products are eco – friendly.

References:

Archana Dhyani, Vikas Chander, Nardev Singh (2019): Formulation and Evaluation of multipurpose Herbal cream. Journal of Drug Delivery and Therapeutics. Vol. 9(2): 341 – 343.

Ashish Aswal, Mohini Kalra and Abhiram Rout (2013): Preparation and Evaluation of Polyherbal cosmetic cream. Scholars Research Library.Vol.5(1): 83 -88,

Ashwini, Sukhdev, Pundkar. Sujata P.Ingale, (2020): Formulation and Evaluation of Herbal liquid Shampoo. World Journal of Pharmaceutical Research.9; 901-911.

Bhutkar G and Shah M, (2019): Formulation and Evaluation of Herbal antibacterial face pack. Journal of Emerging Technologies and Innovative Research, Vol.6.Issue.5.

Fathima A, Sujith Varma, Jagannath P, Aakash M, (2011): General Review on Herbal Cosmetics. International Journal of Drug formulation and Research, Vol.2, Issue.5.

Gana Manjusha K, Balakrishnaiah P, Syamala R, Mounik N, Ravi Chandra T, (2019): Formulation and Evaluation of herbal bath soap containing Methanolic Extracts of Three AyurvedicVarnya Herbs. Asian Journal of Pharmaceutical and Clinical Research. Vol. 12, Issue 11, 213-215.

Jadhav Apurva Vinodkumar, Godse Kirti Chandrahar, Deshmane Prajakta Pradip, (2019): Formulation and Evaluation of organic lip balm. Indo American Journal of Pharmaceutical Research.Vol. 9 Issue 04, 2019.

Kamlesh D. Mali, Nafisa J H H Ranwala, Hitesh S Raotole, Kajal P Rathod, Aboli A Shukla (2019): Formulation and Evaluation of Herbal Lip Rouge.International Journal of Pharmaceutical Sciences Review and Research. 55(1), Article No. 03, Pages: 13-17.

Mohammed Haneefa K.P, Shilpa NM, Junise V., Ajith Chandran, (2019): Formulation and evaluation of medicated soap of Ixoracoccinea root extract for dermal infections. Journal of Pharmaceutical Sciences and Research.Vol. 11(8), 3094-3097.

Niramala Gupta, Aditi Dubey, Pushpa Prasad, Amit Roy, (2015): Formulation and Evaluation of Herbal Fairness cream comprising Hydroalcoholic Extracts of *Pleurotusostreatus*, *Glycrrhizaglabra* and *Camellia sinensis*.UK Journal of Pharmaceutical and Biosciences. Vol.3(3), 40-45.

Pandit Deepika, Gujrati Aditi, Rathore K S, (2020): Formulation and Evaluation of Herbal Lipstick from the Extract of Papaya. International Journal of Pharmaceutical Sciences Review and Research.63(1), Article No. 18, Pages: 107-110, ISSN 0976 – 044X.

Ram Kumar Sahu, Amit Roy, Pradeep Kushwah, Manish Khare, Rajini Mudotiya, (2012): Formulation and development of whitening Polyherbal face cream.

Rashni Saxena Pal, Yogendra Pal and Pranaywal, (2017): In – House preparation and standardization of herbal face pack. The open Dermatology Journal. Vol.11, 72- 80.

Surupsing M. Vlavi, Aakash D Patil, Harish Chandra M. Yeowle, VipulH.Jain and Pawarsp, (2017): International Journal of Pharma and clinical Research, Vol.3, Issue.3:

Yadav N and Yadav R, (2015): Preparation and Evaluation of Herbal face pack. International Journal of Recent Scientific Research.Vol.6, Issue – 5, PP. 4334- 4337.

ECO-FEMINISM: WOMEN AS ENVIRONMENT CONSERVATIONIST

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Abstract:

Women are more sensitive to the earth and various problems related to it. Women and the environment are closely bound and interconnected. Closeness towards nature makes women more nurturing and caring towards their environment. Traditionally, women are responsible for resource mobilization and management. A study of was conducted to find out the existing knowledge and improve the knowledge of urban women regarding bio-aesthetical and functional role of houseplants. An educational package on selection, care and maintenance of houseplants was prepared and given to read them. Post test was done to see the improved knowledge. The findings of initial knowledge narrate that before exposure, majority of respondents had poor to average knowledge in all the aspects, with MPS ranged between 20.64 to 37.42. On the other hand, just after the exposure to information building package, then respondents improved from average to good knowledge category. Women are bearers and conservers of life, as those who first guide children, should be foremost in dedication to the environmental cause.

Keywords: Ecofeminism, Environment, Nature, Women, Environment conservation, Houseplants, Mean Per cent Score (MPS), Climate change.

An overview:

The woman is symbolized as 'Prikriti' in Indian philosophy, which means 'Nature'. She is the one who creates and nurtures the creation to bloom. Being a sign of 'shakti' or power– she drives the system. Women have always been considered as the major conservers of bio-diversity. Eventually, the status of Indian women has eroded since the Vedic times. Both, women and nature have been considered as subordinate entities, by men throughout the history, which conveys a close relationship between them.

Eco-feminism says that women are closer to nature than men are. This closeness, therefore, makes women more nurturing and caring towards their environment. Eco-feminism encompasses a variety of views but has a focus of patriarchal oppression and the social constructions relating to women and the environment. Some indicate the biology of women as the reason behind the closeness, while others credit culture and historical factors. An eco-

feminist believes in a direct connection between oppression of nature and the subordination of women. (https://en.wikipedia.org/wiki/Women_and_the_environment)

Eco-feminism itself begins with 'an awareness of the beauty of the natural world'. Moral knowledge, ethical sensibility and a sense of connection can often precede a rational understanding. The beauty of the natural world is everything, from a majestic vista to just paying attention to a tree or an animal, or human bodies. That sense of connection to nature must ground any ethic, because an ethic is not about one decision or one policy. An ethic is about the very forms of life that is cultivated and nurtured. Without that connection, where is the energy, the caring, the inspiration? Human simply have to foster that appreciation (Cuomo, 2020).

How women can manage climate change?

Women account for about six out of ten of the world's poorest people.Only about 21.5% of the world's parliamentarians are women.Almost half of the world's farmers are women- but women are less than 15% landholders around the world.2/3^{rds} of the about 796 million illiterate people globally are women.90% countries have laws that discriminate against women.

Yet, women hold the key- the education of girls could be a breakthrough in protecting the world from more climate change.By investing in girls' education, the world could reduce up-to 51.48 giga tons of emissions by 2050.This improvement can come from better family planning and women- who are more effective stewards of food, soil, trees and water- being involved meaningfully in decisions on optimally using nature's resources, and rejuvenating these (Times of India, Encyclopaedia Britannica).

Women are more sensitive to the earth and various problems related to it. People's approaches to environmental issues may depend on their relationship with nature. Conventionally & habitually, women have been responsible for subsistence, i.e., the basic survival for water, food, fuel, fodder and habitat. But they get the credit for nurturing these life support systems, very rare. Even today they perform duties such as seed selection, multiplication and conservation. The on-farm conservation traditions of rural and tribal women, with reference to agro-biodiversity are well known.

Throughout history men have looked at natural resources as commercial entities or income generating tools, while women have tended to see the environment as a resource supporting their basic needs. As an example, rural Indian women collect the dead branches that are cut by storm for fuel wood to use rather than cutting the live trees. Any changes in the environment on these areas, like deforestation, have the most effect on women of that area, and cause them to suffer until they can cope with these changes. Women play a key role in the protection of biological diversity through their varied responsibilities. They have identified the need not only to protect the bio-diversity, but also to recreate it (Sharma and Kaushik, 2011).

Women logically are there to 'care for men';'animals are to be used by humans', etc. Male supremacy is destabilized if value given to women and animals. Downgrading all that is

associated with nature, ecosystems, even certain people, is used to suit those who are in power and it seems as if nothing is wrong with this since they are thought to be less valuable. This is a toxic way of thinking. It is dangerous to all (Gruen, 2020).

Gender, dignity, work and nature are all linked:

The decisive motives driving the continuous environmental degradation, has two broad classes, both emerging in the post- WWII world, the change of the nature of the economy due to enormous technological changes, and the vast growth in human population. Neither has been an even process.

Eco-feminism is enormously significant, a field that highlighted the gender dimension to nature, which is crucial, yet often overlooked. It is extremely important to understand that production, gender, dignity and nature always go together (Rangrajan, 2020).

A real bond between women and environment:

Human societies are built on the infrastructure that is provided by the natural environment. But now, these infrastructures are affected by human actions in quite unprecedented ways. Human impacts are generally a series of activities out of economic concerns: growing food for profits, running vehicles for more convenient travels, heating and cooling buildings for comfort, etc. As environmental resources are degrading, world is already facing a critical questions: how can people make sure that they do not continue to damage the natural foundations of societies while striving for living? How can people make their activities compatible with the degrading ecological foundations?

People believe that natural infrastructures of societies have self- repairing characteristics, so they do not need to invest in their maintenance. It is a fact that when more people are there in a society, a few of them will definitely follow a lavish living pattern, ultimately demanding more on this planet 'earth'. When people start living luxurious life they consume things beyond the capacity and this result into exhausting the natural treasure that has formed millions of years ago. If this continues, many scientists believe that then the years of maintenance as well as rent-free living on the only livable planet may come to an end. There is no planetary landlord to whom people will have to pay rent, but there may be planetary repair and maintenance bills, the costs of keeping the basic systems intact and functioning well. Yalan (2007) stated that women and the environment are closely bound and interconnected. If we see throughout the historical times, women have been commemorated as strong symbols of nature, viz., Mother Earth, Earth Goddess, Artemis in the Greek mythology, and Mother River (the Yellow River) in Chinese history. Women have epitomized nature and provided nature its infinite meaning. Therefore, women as bearers and conservers of life, as those who first guide children, should be foremost in dedication to the environmental cause.

Role of women in environment protection:

Women can contribute to, they can participate in, and they can play their role in protection of the environment in many ways:

a) **Water resources management:** The men are those who are often away from home, while women are factually using and managing water in daily routine, with main emphasis on developing countries, men and women are having different priorities as well as responsibilities for water use. Women are often responsible for fetching water and using it not only for domestic chores such as cleaning, cooking and washing but for farming also. Women are the sole water decision-makers at the household level. When women influence the water management, the communities get measurably better outcomes including better-functioning water systems, expanded access, and economic and environmental benefits.

b) **Solid waste disposal:** Usually, people are in habit of throwing the rubbish and the waste after cutting the vegetables, graining, wiping and cleaning the floor, on the municipal road, just outside the houses. This creates nuisance, which gives birth to germs, flies, mosquitoes etc. and thus malaria or other viral fever. Hence, every family should use the garbage box, probably in every room. The homemaker, who is the woman obviously, only does this. The collected garbage should be thrown in the garbage boxes kept by the municipality. If this habit is developed, people will not only be able to keep their houses clean but, the colony, the city and surrounding environment will also become orderly, tidy and healthy. This presents many challenges, particularly in the large cities whereby the amount of solid waste are increasing faster that the growth of population. Solid wastes are dumped at dumping site or undeveloped land. Women because they are closer to the environment, engage in environmental management by cleaning the environment and keeping it clean especially in terms of garbage disposal. Giving the health hazard of garbage, women see to its regular disposal at the community level by doing it themselves. Segregation of the bio-degradable and non-biodegradable waste is essential. According to the nature, 3 R's can be used (Reduce, Reuse and Recycle). These days 3 R's of environment is in trend. So, be trendy.

c) **Drainage management:** Women's involvement with environmental management and problems make them to participate actively in keeping drainages around them clean and free from trash and sand. Drains in households are generally cleaned by the women, not by the men, on a regular basis **(**Wuyep *et al.,* 2014).

d) **Minimum utilization of electricity:** Theworld will surely faces another pollution i.e. light pollution, in very near future. People must make minimum use of light, only when it is needed. They should not misuse it. The women again play a contributory role, as they are the managers of their family.

e) **Use of non-conventional sources of energy:** There are limited resources of conventional energy. The mass population is dependent for fuel on forests, which is the other main cause

for the destroying forest wealth and disturbing eco-systems. In developing countries, like India, women are collecting fuel wood from nearby forests, carrying it for domestic purposes and also selling it elsewhere to supplement their family incomes The fire wood etc. burnt in open country chulha, i.e. traditional stove, wastes almost 82% of the fuel, since efficiency of heat utilization is only 12%. Soil, water and forest can be conserved if alternative kitchen fuel is provided. Women can again contribute in this direction and come forward by using solar lights, solar geyser, solar cooker, smokeless chulhas/ stoves etc.

f) Generate good habits in children: It is a universal fact that mother is the first teacher of child. She plays a fundamental role in the development of the personality characteristics of the child. She can infuse a respect for nature and the value of bio-diversity in future generations. She can develop good habits in the child from the very start as:

- Not to spit and spill/ rubbish trash here and there;
- To love and respect the nature;
- Not to spoil and harm the plants/trees, during their visits to gardens, public parks, school garden etc.
- Keep the things in a arranged and tidy manner;
- Teach the children not to waste the paper. The children are usually in habit of tearing away papers from their note books, a mother can keep an eye on this bad habit of the child. She can make them understand that for paper production, the wood is used and for wood, trees are being cut, resulting in deforestation, which can ultimately disturb the eco-system.

g) Minimalist kitchen: an eco-friendly trend: The kitchen is the center place of a home from the conventional times. In the olden days, the kitchen fire doubled as a holy place as well as a place to prepare food. But in today's hectic, fast-paced and digital world, kitchens are no longer admired, and cooking has become almost a lost art. However, it is changing now-a-days, as natural resources continue to be drained and food becomes scantier. The shooting up minimalism movement could help shift humanity back towards cooking and overall sustainability. Minimalism in life means obligating to a more sustainable, eco-friendly lifestyle, with less waste and fewer possessions. However, cultivating a minimalist lifestyle isn't only about getting rid of unnecessary possessions. It's about simplicity, treading lightly, and making mindful decisions. Minimalism honors those ancient ideals while also embracing modern, eco-friendly technology and products.

The minimalist kitchen is the center and hearth of the home and it is needed to be functional as well as sustainable. A sustainable and minimalist kitchen exactly starts from the flooring choices. Eco-friendly bamboo floors are much more sustainable than any type of hardwood and serve as an ideal base for minimalist kitchen. When compared to traditional hardwood floors, bamboo flooring truly stands out as a champion of sustainability. It takes hardwood

trees 40-80 years to re-grow, while bamboo regenerates in five years. Bamboo also beats out hardwood flooring in regards to water resistance, price, and even durability.

As far as ingredients go, keep it simple. Everyone should stock up on staples such as rice, grits, beans, and pasta, which can be used in a variety of dishes. Menu planning is one area where one can put aside commitment to reducing excess possessions (https://emagazine.com/honoring-earth-and-your-home-with-a-minimalist-kitchen/?utm_source=newsletter&utm_medium=email& utm_campaign=earthtalk_this_week_december_26_2018&utm_term=2019-01-16).

h) Sustainable fashion: Women always rendered a significant contribution in the management of the household responsibilities. Usually women are the ones, who are required to make all these decisions, too.

Minimalist Fashion gives an opportunity to create multiple looks with the same outfit by teaming it with different types of accessories.Superior quality of fabric is used for minimal clothing which is by and large generated from. The reason behind this is that the only thing visible in the garment is the fabric and pattern. That's why it is earth-friendly, comfortable, and of good quality (https://aprudha.com/blogs/news/minimalist-fashion-a-trend-that-never-ends).

Eco-clothing is often made of that material which is of natural fabric. These are non-toxic and less polluting during manufacturing, utilization and disposal. Eco-fashion is about making of clothes that particularly consider the environment, the health of consumers and the working conditions of people on priority basis. Eco-fashion clothes: are made using organic raw materials, such as Cotton, Linen, Hemp, Bamboo, Lyocell, Alpaca, Organic Wool, Silk.

Recycling or upcycling of clothes is also another way to make clothes eco-friendly is to make them from recycled materials. Recycling of clothes uses less energy, producing less pollution. The greenest choice of all should be to reuse and recycle clothing. Recycling reduces waste and energy use, but reusing clothes eliminates waste products altogether. The easiest way to reusing clothing is by passing on old clothes to new users. Clothing made from recycled fabric or recycled plastic help to divert fabric and plastic waste away from the landfills and incinerators, by giving them another use (https://www.stoodnt.com/blog/eco-friendly-fashion-the-future-of-clothing-industry/).

Adaptive fashion aimed at people with physical disabilities or impaired movement is a part of larger shift towards inclusivity. While being transferred from chair to car, to avoid painful movement, trousers with strong cloth loops, like handles are made, on both sides of waist. Being different does not exclude those from access to public spaces, jobs, education and travel so why should it deprive them of a smart wardrobe (Times of India, Jan. 2019).

i) Eco-friendly cleaning: The dry cleaner made up of biodegradable liquid silicone, essentially liquefied sand, should be used in place of the petrochemicals. Further, it breaks down into

natural elements (sand, water and carbon dioxide) that are safe for human as well as environment. In fact, liquid silicone is so safe that it is often a base ingredient in many everyday shampoos, conditioners and lotions that people put right onto their skin with no ill effects. Another sustainable option is liquid carbon dioxide (CO_2) cleaning, which uses pressurized CO_2 in combination with other gentle cleaning agents to dissolve dirt, fats and oils in clothing. Women consumers are the only who can do this function also and should be aware of this matter too (GreenEarth).

j) Application of small family concept: Now-a-days, the world is confronting the biggest problem of population explosion. It is the basic reason of all other problems. If people follow the small family norm at their individual level, they will definitely help to check the environment pollution also. Women can shoulder this responsibility too.

k) Green consumerism: This term is a form of consumption that is compatible with the safeguard of the environment for the present and for the next generations. This concept ascribes to consumers responsibility for addressing environmental problems through adoption of environmentally friendly behaviours, such as the use of organic products, clean and renewable energy and the research of goods produced by companies with zero, or almost, impact of environment. Moreover, green consumers are more likely to control their consumption in comparison to more traditional consumers and therefore, the environmental impact of green behaviours is direct (https://en.wikipedia.org/wiki/Green_consumption).

l) Developing hobby of gardening and making surroundings greener: These days all are familiar with the fact that these days houses are very small. Women can come forward by developing hobby of gardening. They can at least keep the environment of their houses healthy. Plants beautify the houses naturally, give freshness to the eyes and are helpful in keeping the surroundings clean. Again, women can make use of their management ability by using empty cans, bottles, tins etc. as pots for growing the plants.

Methods and Materials:

In continuation with last point in roles of women in environment protection, i.e., *Developing Hobby of Gardening & Making Surroundings Greener*, below is the study of master's thesis of the author (Asnani, 2004). The study was conducted with the following objectives:

1. To find out the existing knowledge of urban women regarding bioaesthetical and functional role of houseplants.
2. To develop an educational package on selection, care and maintenance of houseplants.
3. To study the impact of developed package on information empowerment of urban women about houseplants.

The study was conducted in 3 phases:

Phase-1: Development and evaluation of educational package – The information building package was a booklet, consequent to careful review of secondary data like books, journals, magazines, newspapers etc. Then, a panel of 5 experts for its appropriateness did the evaluation of booklet. Evaluation rating scores ranged between 3 to 5, i.e., above fair to very good.

Phase-2: Pretesting – The study was done in purposively selected areas of urban Udaipur. A group of 30 respondents was selected randomly. Semi-structured interview-schedule was used for data collection, in two sections, i.e., background information and knowledge test. Knowledge test had further 4 subsections, are as follows: *Knowledge regarding houseplants, arrangements of plants, selection of plants and accessories, and care and maintenance of houseplants.*

Phase-3: Delivering the Educational Package and Post testing – After the pretesting, the educational package was exposed. The time gap of exposure was 24 hours. After wards, post test was taken to assess the knowledge gain and hence the effectiveness of the booklet.

The major findings of the study were as follows:

A. Background information of the respondents: Majority of respondents (43.3%) belonged to the younger age group of 25-40 years followed by 40% in 41 to 55 years category with good level of literacy. 30% of the respondents were post graduate. 7 respondents (23.3%) were graduate and 20% ladies were educated above the post graduation. Rest 13.3 percent in each was literate up to secondary and higher secondary.

B. Development of educational package: The educational package was developed with extensive review of related literature. Then, the developed package was subjected to the respondents, which was already evaluated by the experts and modifications were incorporated as per their suggestions.

C. Assessment of existing knowledge regarding all about necessities of houseplants:

i. Respondents had poor to average knowledge on all about necessaries of houseplants with MPS (Mean Per cent Score) 27.60 percent.

ii. Regarding knowledge about houseplants, arrangements of plants, selection of plants and accessories, and care and maintenance of houseplants, all the respondents had poor to average knowledge with MPS being 37.42%, 27.50%, 24.87% and 20.63%, respectively.

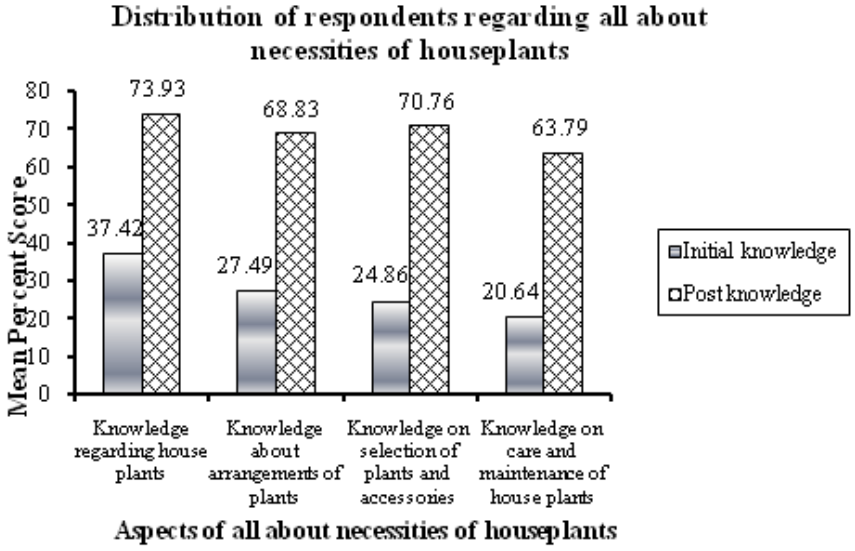
iii. Majority of the respondents (86.6%) were familiar about beautification through plants but very few respondents were aware about functionality, medicinal value and related vaastu of plants. Respondents were not aware of all types of plants. 73.33% respondents knew about flowering plants, few told about creepers, shrubs and trees, and medicinal plants. Only 1 respondent was aware about cactus and succulents. Majority of the respondents (83.33%) didn't give importance to vaastu.

iv. None of the respondents were aware about arranging plants in staircases, bedrooms, bathrooms; few respondents knew that plants can be arranged on entrance, kitchen, terrace, dividers, window – sill etc. 43.33 & 53.33 percent respondents answered that they arrange plants in balcony; verandah and dining room and majority of the respondents were limited to arrange plants in drawing room. 100 percent respondents were aware to arrange plants individually; while on the other hand none of the respondents ever heard the terms dish garden, bottle garden and terrarium.

v. Most of the respondents were aware that plants when selected should be healthy and of good quality which is the simple statement, but few of the respondents reached positively in other major reasons. Regarding qualities of pots, majority of respondents (86.66%) favored the strength of pots but only few of them were able to tell other important qualities, viz, light weight, according to size of plants and decorative.

vi. Majority of the respondents had poor knowledge regarding care and maintenance practices. Maximum respondents answered about some common practices, which are correct.

D. InformationEmpowermentin terms of Knowledge gain on all about necessities of houseplants: The package developed on houseplants was a booklet that was used for information empowerment of urban women. The impact of package was assessed in terms of knowledge gain.



Knowledge gain regarding:

- **Houseplants:**

a. The findings of the initial knowledge reveal that most of the respondents belonged to poor to average category in all the components of this aspect. The MPS in all components ranged between 16 to 56.5 percent.

b. On the implementation of educational package majority of respondents had average to good knowledge in majority of the components except lowest MPS 0 and 1.5% indicates that there

is low gain in knowledge regarding the components, viz., presence of medicinal value and plants helps in cleaning the pollution effect.

- **Arrangements of plants:**

a. The respondents had again poor to average knowledge in all the components about arrangement of plants. The MPS in different components ranged between 20.66 to 33 percent.
b. With the exposure to educational package, majority of respondents gained good knowledge in various components, regarding arrangement of plants.

- **Selectionof plants and accessories:**

a. Majority of respondents did fall under poor to average knowledge category, again in this aspect except the component 'types of plants according to light requirement, having good knowledge.
b. After exposure to the aid the MPS of the respondents increased in all the components of this aspect, ranged between 63.8 to 92 percent.

- **Care and Maintenance of houseplants:**

a. Initially, majority of the respondents had poor knowledge in maximum components of this aspect except 3 components, viz., benefits of making diary, management of ill and insect infested plants and prorogation methods of plants, having respondents with average knowledge.
b. On exposure to information building package knowledge shifted towards average to good category, MPS ranging from 10 to 86 percent.

- **Overall knowledge gain on all about necessities of houseplants:**

a. The findings of initial knowledge narrate that before exposure, majority of respondents had poor to average knowledge in all the aspects, with MPS ranged between 20.64 to 37.42.
b. On the other hand, just after the exposure to information building package, then respondents belonged to average to good knowledge category. None of the respondents belonged to poor knowledge category.
c. Knowledge gain in all aspects of all about necessities of houseplants was found significant at 1% level of significance. Therefore overall knowledge gain was also found significant.

Thus, to be concluded the results of study are that the existing knowledge of respondents regarding all about necessities of houseplants was found to be poor to average. None of the respondents possessed good knowledge at the time of pre-test.Educational package (booklet) was developed regarding "houseplants".For information empowerment housewives were exposed to the developed information-building package.After exposure to the educational package respondents had average to good knowledge in all four aspects regarding houseplants.The gain in knowledge was found to be average to good but more inclined towards average knowledge.The gain of knowledge by respondents in all the aspects was found significant.

Awaken the sacred feminine:

The feminine aspect is deeply connected to life. Planet Earth is always hospitable to life, and anything that is alive needs to be nurtured and cared for in order to survive and thrive. Due to this, mankind started calling planetary home 'Mother Earth' because nurture, care, empathy, love and compassion are inherent qualities of the feminine character and this is present in all genders, including male also. When one speak of the 'Sacred Feminine', it is of the immense creative power and potential that is super active in some of people, moderately active in others and perhaps dormant in most which is why it is needed, collectively and individually, reclaim the feminine aspect, regardless of the gender.To acknowledge and reawaken the *Sacred Feminine* is to reconnect to life and living, and this is with reference to not just human beings but all species, the planet and everything on it. By rousing the 'Feminine Principle' to action, people could revive their relationship with the environment and bond with it lovingly'. (Times of India, Feb. 2020).

Conclusion:

It is necessary for women having knowledge of houseplants / indoor plants which can be kept inside house and in garden. Hence, making indoor spaces greener add beauty as well as indoor environmental status. Though, the Government of India is working towards an environmentally sound and sustainable quality of life, the problems, challenges and issues are multi-faceted. However, women in India are playing a crucial role in protection and conservation of environment. Women have brought a different perspective to the environment debate, because of their different experience base. Poor women's lives are not compartmentalized and they see the issues in a broad and holistic perspective. They understand clearly that economics and environment are compatible. Their experience reveals to them that soil, water and vegetation, necessary for their day-to-day living and requires care and good management. Environmental degradation is related not only to the biosphere alone, but to the social sphere as well.

References:

Aditya, S.K. (2016): Role of women in environmental conservation,International Journal of Political Science& Development, 4(4): 140-145. ISSN: 2360-784X. Website referred: http://www.academicresearchjournals.org/IJPSD/Index.html

Asnani, B. (2004): Information empowerment of urban women regarding bio-aesthetical and functional uses of houseplants, Unpublished Master's Thesis, Guided by Ms. SeemaDwivedi, Associate Professor, Department of Family Resource Management, College of Home Science, MaharanaPratap University of Agriculture & Technology, Udaipur, Rajasthan.

Cuomo, C. (2020, February 8th): Times of India, Ahmedabad, Saturday,

GreenEarth, www.greenearthcleaning.com; EPA's "Outdoor Air – Industry, Business, and Home: Dry Cleaning Operations," Online retrieved and cited via: archive.epa.gov/airquality/community/web/html/drycleaning.html

https://aprudha.com/blogs/news/minimalist-fashion-a-trend-that-never-ends

https://emagazine.com/honoring-earth-and-your-home-with-a-minimalist-kitchen/?utm_source=newsletter&utm_medium=email&utm_campaign=earthtalk_this_week_december_26_2018&utm_term=2019-01-16

https://en.wikipedia.org/wiki/Green_consumption

https://en.wikipedia.org/wiki/Women_and_the_environment

https://www.stoodnt.com/blog/eco-friendly-fashion-the-future-of-clothing-industry/

Gruen, L. (2020, February 8): Times of India, Ahmedabad Ed.

Rangarajan, M.(2020, February 8): Times of India, Ahmedabad Ed.

Research: Encyclopaedia Britannica (n.d.): National Geographic, The Guardian, UN Org., UNDP, World Bank, FAO, drawdawn.org

Sharma, R. &Kaushik, B. (2011):Role of women in environmental conservation. International Journal of Multidisciplinary Management Studies, 1(2): 162-167. ISSN: 2249 8834. Online available at http://zenithresearch.org.in/

Times of India (2019, January 14th): Ahmedabad Ed., India.

Times of India (2020, February 8th): Ahmedabad Ed., India.

Yalan, Z. (2007): Women's participation in environmental protection organizations—a qualitative study of Australian women's involvement in green non-governmental organizations, Unpublished Master's Dissertation,The School of English & International Studies And the Graduate School of Beijing Foreign Studies University, Beijing Foreign Studies University, Beijing, China.

Wuyep, Z., Solomon, C., Dung, Vincent, H., Buhari, Arin, H., Madaki, Daloeng and BitrusBaminda, A. (2014): Women participation in environmental protection and management: lessons from plateau state, Nigeria. American Journal of Environmental Protection, 2(2): 32-36.

VERMICOMPOSTING OF RICE STRAW

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Abstract:

With increasing population, the demand of food is also increasing. The chemical fertilizers are used heavily to meet the requirement of food for all. But the use of chemical fertilizers has adverse effect on environment and health of all living beings. So, there is need to move towards organic farming. It is becoming popular all over the world. Every year tonnes of rice straw are burnt in the fields after harvesting especially in states like Haryana and Punjab which causes a lot of air pollution and affects health of people. This problem of waste management can be solved by vermicomposting. Vermicomposting is easy, cost effective and enriches soil with nutrients as well as microbes. So, vermicomposting of rice straw can be a better substitute of chemical fertilizers. This review paper describes requirements, steps, nutrient content and effect of vermicompost prepared from rice straw on plant growth.

Keywords: Vermicomposting, rice straw, earthworms, *Eisenia fetida,* C/N ratio

Introduction:

Vermicomposting is the process of converting organic waste into high quality manure using earthworms. It is the joint activity of earthworms and microbes. The organic waste can be agricultural waste, domestic waste and animal manure. The vermicompost so formed is dark brown, granular, fine, homogeneous, peat like material which is rich in nutrients like NPK and some micronutrients. It has many beneficial properties like good water holding capacity, aeration and drainage (Ismail, 2005; Edwards *et al.*, 2011).

It increases microbial content in the soil which is beneficial for plant growth, health and yield. It is environment friendly and used as biofertilizer in the agriculture sector.

Benefits of vermicomposting to farmers:

The vermicompost is very useful for farmers as it is rich in nutrients and easily available in the markets at low cost. It is a better substitute of chemical fertilizers (Ramnarian *et al.*, 2019). It reduces the need of expensive chemical fertilizers and thereby, reduces the cost of production and yields better price in market for organic production and increases income of farmers. These organic products are in great demand all over the world as they are free from chemical fertilizers and provide many health benefits to consumers.

Requirements of vermicomposting:

For vermicomposting, different species of earthworms are used. Earthworms are classified into following categories as:

(1) **Anecic**: These construct permanent vertical burrows in the soil and feed on organic waste on the surface of soil e.g. *Lumbricus terrestris*.

(2) **Endogeic**: These build horizontal burrows and feed on organic material in the soil e.g. *Aporrectodea calignosa*

(3) **Epigeic**: These don't build permanent burrows and feed on soil surface plant litter e.g. *Eisenia fetida, E. andrei, Perionyx excavatus, Eudrilus eugeniae* (Eisenhauer and Eisenhauser, 2020).

The most widely used species for vermicomposting is *E. fetida*. It has better fecundity rate, can survive in temperature range 0 to 35^0C and it is easy to handle. Different stages of earthworms can be identified ascocoon, hatchling, juvenile and adult earthworm with clitellum. The earthworms mature in 7 to 8 weeks. Proper conditions should be maintained for vermicomposting like temperature, pH and humidity for maximum growth and survival of earthworms. Suitable temperature range is 0 to 35^0C, humidity ranges from 80-100% and pH is 5 to 9. During vermicomposting, the temperature increases due to respiration by earthworms and decomposition of organic waste. The increase in temperature shows microbial activity.

Steps of vermicomposting:

Step 1: Building vermicompost station

First of all, a vermicompost station is built in a shady area of dimensions 10x8x3 m^3. Vermicomposting units made up of concrete of dimensions 150x100x60 cm^3 are built at the vermicomposting station for culturing earthworms. The roof ofvermicomposting station is made up of metal sheets to prevent direct sunlight and rain and maintain temperature. Walls are made of mesh to allow passage of air.

Step 2: Preparation of culture bed

According to Ismail (2005), the culture bed comprises of following layers:

1st layer: It is the lowermost layer made up of pieces of bricks and a 6-7.5cm thick layer of sand for proper drainage of water.

2nd layer: It comprises of 15cm thick layer of loamy soil where earthworms are inoculated.

3rd layer: It comprises of organic waste.

4th layer: It is the topmost layer which comprises of dry leaves or rice straw to cover the soil.

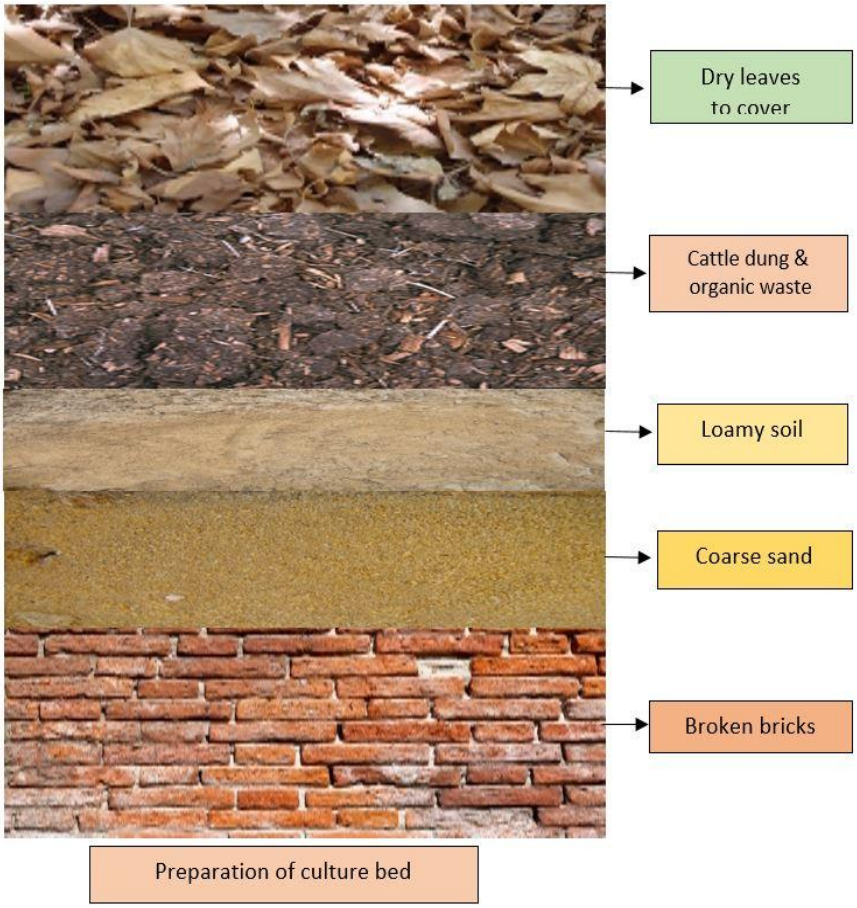

Figure 1: Schematic diagram of culture bed for vermicomposting from the rice straw

Step 3: Preparation of food (organic waste) for earthworms

Any kind of biodegradable waste can be used for vermicomposting like vegetable waste, agricultural waste, domestic waste or industrial waste. The cow dung should be decomposed before using it for vermicomposting. The waste product such as rice straw is dried and finely chopped and mixed with cow dung as bulking substrate. A suitable substrate provides necessary nutrients to the earthworms and makes the process of decomposition faster (Sabrina *et al*., 2009). The mixture is watered and turned at regular intervals and left for twenty days before transferring earthworms into it.

Step 4: Transfer of earthworms

Adult healthy clitellated earthworms are then transferred to the mixture. *E. fetida* is widely used for vermicomposting. The mixture is moistened and covered with dry leaves or gunny bags. Temperature, pH and moisture must be maintained for proper growth and survival of earthworms. The earthworms are cultured for 90 to 120 days for converting organic biodegradable waste into manure. Completion of process of vermicomposting can be analysed by the granular structure of vermicompost. Earthworms eat waste as much as their body weight. The digestion of food takes place in the gut of earthworms by the action of enzymes and microbes found in their gut. After digestion, the faecal matter is released outside the body of earthworms in the form of vermicast. This vermicast is rich in nutrients and microbes and increase diversity of soil fauna and flora.

Total production of vermicompost can be calculated as:

Productivity of vermicompost (%) = Harvested vermicompost (kg) / Total mass of feed (kg) x100%

Vermicomposting: joint activity of microbes and earthworms

The microbes found in the gut of earthworms decompose organic waste consumed by earthworms. The earthworms release the waste as vermicast which is rich in nutrients and microbes. Composting involves aerobic decomposition of organic waste while vermicomposting involves the combined activity of microbes and earthworms. In composting, the temperature may reach upto 70^0C and kills pathogens while suitable temperature range for vermicomposting is 0 to 35^0C and above this temperature causes death of earthworms and stops the process of vermicomposting. So, the pathogens are not killed in the vermicomposting. An integrated approach may provide better results like performing composting followed by vermicomposting or vermicomposting followed by composting (Ali *et al.*, 2015).

Availability of rice straw:

As population is increasing, so the demand of food is also increasing rapidly. Rice is one the staple food crop all over the world. Rice cultivation produces a large quantity of rice straw. Rice straw is the crop residue after harvesting. Annual rice straw production accounts for large fraction ranging from 100-140, 330-470 and 370-520 million t/year in South East Asia, whole Asia and the world, respectively (Hung *et al.*, 2020). The amount of rice straw depends upon the cutting height of plant. The left unburnt part of crop in the fields is called stubble. It is either burnt or incorporated in the soil for decomposition so that fields can be prepared for the cultivation of next crop (Hung *et al*., 2020). Rice straw can be used in many ways like cattle feed and bedding, paper making, fuel, thatch mulching, etc.

Properties and chemical composition of rice straw:

Properties of rice straw can be categorised as physical, chemical, and thermal. Physical property like density of rice straw varies depending upon its form. There is difference in density of loose and chopped rice straw. The density of loose rice straw ranges from 13-18 kgm^{-3} (Migo, 2019) while density of chopped rice straw ranges from 50-120 kgm^{-3} (Liu *et al*., 2011). Loose and unprocessed rice straw has comparatively lower density and higher volume which makes it difficult to store, handle, transport and process. Various methods are used to reduce volume of rice straw like using pellet mills, roller process, piston process, *etc*.

Thermal properties of rice straw:

Rice straw has high volatile matter (VOM) which includes volatile carbon, combined water, net hydrogen, nitrogen and sulphur. A high volatile matter is useful in production of bioenergy with easier ignition and burning but it may lead to rapid combustion. So, it must be handled carefully.

Chemical composition of rice straw:

Rice straw is used as feed for cattle and for replenishing soil nutrients. Its chemical composition is an important factor in determining its uses for various purposes. Rice straw is a lignocellulosic biomass that contains 38% cellulose, 25% hemicellulose and 12% lignin (Japan Institute of Energy, 2002).

Problem of burning rice straw and its alternative method:

In states like Haryana and Punjab; after harvesting of crop, the rice straw is burnt in the fields which cause a lot of air pollution, water pollution, soil pollution and health related problems such as skin and eye irritation, asthma, bronchitis, cancer, *etc*. It also causes loss of many nutrients from the soil. Burning of rice straw is being banned in some states yet farmers burn it every year. If rice straw is not handled properly, then it spreads diseases and promotes breeding of pests like rats (Sharma *et al*., 2020). One of the suitable methods for management of rice straw is vermicomposting which is very easy and cost effective for farmers. It enriches the soil with many useful nutrients like C, N, P, K, Na, Ca, Fe, Zn and S and promotes plant growth.

Nutrient content and application of vermicompost prepared from rice straw:

Vermicompost contains many important nutrients. C/N ratio is an important factor in the decomposition process. The carbon content decreases during vermicomposting due to mineralization and decomposition. Carbon is lost in the form of carbon dioxide to the atmosphere due to respiration by microbes and earthworms. The nitrogen concentration increases

due to the secretion of mucus and excretion of nitrogenous waste by the earthworms. This results in overall decrease in C/N ratio. (Ali *et al.*, 2015)

An experiment was performed by Yi-Wei *et al*. (2012) in which they used rice straw for vermicomposting using *P. excavates* and *E. eugeniae*. They analysed plant nutrients and humic acid contents in the vermicast. Total and available nitrogen, phosphorus, potassium and magnesium were higher in the vermicast of *P. excavatus* while total and available calcium was higher in the vermicast of *E. eugeniae*. C/N ratio of vermicast of *E. eugeniae* and *P. excavates* was 20.19 and 19.09, respectively suggesting maturity of vermicompost. Ansari and Jaikishun (2011) performed vermicomposting of rice straw, sugarcane bagasse and combination of rice straw and sugarcane bagasse. They compared effect of vermicompost with cow dung and chemical fertilizers and found that treatment with vermicompost showed better growth and fruit quality in *Phaseolus vulgaris*. The treatment with vermicompost of combination of rice straw and sugarcane bagasse showed improved soil quality as well.

In a study of vermicompost prepared from different organic substrates like wheat straw, rice straw, vegetable waste and sugarcane bagasse along with cow dung in bulk amount having ratio 1:5 showed decrease in carbon content and increase in nitrogen content (Yadav and Gupta, 2017). The maximum decrease in C: N ratio was found in the vermicompost of cow dung+ rice straw (22.5) followed by cow dung+wheat straw (20.8), cow dung (19.04), cow dung + vegetable waste (17.22) and cow dung + sugarcane bagasse (10.8). The decrease in C: N ratio improves quality of vermicompost. Reddy and Okhura (2004) performed vermicomposting using three species of earthworms *viz. P. excavatus, Octochaetona philloti* and *O. rosea* to analyse plant nutrients and effect on growth of sorghum plant.Vermicompost prepared by *O. rosea* showed higher concentration of total nitrogen and calcium than the normal compost. The growth of sorghum was higher in the mixture of 75% vermicompost produced by *P. excavatus* and 25% soil than the plants which are grown in vermicompost prepared by *O. philloti* and *O. rosea* and soil, normal compost, chemical fertilizers and sole soil.

Shak *et al.* (2013) showed that vermicomposting of rice residues (rice straw and rice husk) along with cow dung yields a good quality manure. The mixture of rice straw and cow dung (1:2) promoted growth of earthworms *E. eugeniae* as well as provided best quality vermicompost with highest nutrient content (calcium, magnesium, phosphorus and potassium) and the lowest C: N ratio while similar results were not observed in case of vermicomposting of rice husk. Yan *et al.* (2013) performed vermicomposting of different plant residues like grass clippings, sago waste and rice straw using *E. eugeniae*. Vermicompost from rice straw contained highest amount of plant extractable nutrients.

Conclusion:

Vermicomposting of rice straw provides a good quality biofertilizer. It improves soil quality and promotes plant growth, health and yield. Vermicompost can be prepared easily at low cost. It is a better substitute of chemical fertilizers which are polluting our environment and adversely affecting health of plants and animals. Farmers must be encouraged for organic farming. It is an eco-friendly approach towards management of rice straw.

References:

Ali, U., Sajid, N., Khalid, A., Riaz, L., Rabbani, M.M., Syed, J.H. and Malik, R.N. (2015): A Review on Vermicomposting of Organic Wastes. *Environmental Progress & Sustainable Energy*, 31(4): 1050-1062 DOI 10.1002/ep.

Ansari, A.A. and Jaikishun, S. (2011): Vermicomposting of sugarcane bagasse and rice straw and its impact on the cultivation of *Phaseolus vulgaris* L. in Guyana, South America. *J Agricultural Technology*, 7(2):225–234.

Edwards, C.A., Subler, S. and Arancon, N. (2011) Quality criteria for vermicomposts. In: Edwards CA, Arancon NQ, Sherman RL (eds.) Vermiculture technology: earthworms, organic waste and environmental management. CRC Press, Boca Raton, pp 287–301.

Eisenhauer, N. and Eisenhauer, E. (2020): The 'intestines of the soil': the taxonomic and functional diversity of earthworms – a review for young ecologists. *Eco. Evo. Rxiv.* pp 1-5 https://doi.org/10.32942/osf.io/tfm5y

Hung, N.V., Maguyon-Detras, M.C., Migo, M.V., Quilloy, R., Balingbing, C., Chivenge, P. and Gummert, M. (2020): Rice Straw Overview: Availability, Properties, and Management Practices. Sustainable rice straw management, Springer, pp 1-13. https://doi.org/10.1007/978-3-030-32373-8

Ismail, S.A. (2005): The earthworm book. Other India Press, Mapusa, pp 101.

Japan Institute of Energy. (2008): Asian biomass handbook: a guide for biomass production and utilization. Published by Ministry of Agriculture, Forestry, and Fisheries, Japan, with the help of Asian Biomass Association. Pp 338.

Liu, Z., Xu, A. and Long, B. (2011): Energy from combustion of rice straw: status and challenges to China. *Energy Power Eng.*,3:325–331.

Migo, M.V.P. (2019): Optimization and life cycle assessment of the direct combustion of rice straw using a small scale, stationary grate furnace for heat generation. Unpublished

Master's thesis. University of the Philippines Los Banos. pp 43-64. http://dx.doi.org/10.1007/978-3-030-32373-8_4

Ramnarian, Y.I., Ansari, A.A. and Ori, L. (2019): Vermicomposting of different organic materials using the epigeic earthworm *Eiseniafoetida*. *International Journal of Recycling of Organic Waste in Agriculture*, 8:23–36.

Reddy, M.V. and Okhura, K. (2004): Vermicomposting of rice-straw and its effects on sorghum growth. *Tropical Ecology*, 45(2):327-331.

Sabrina, D.T., Hanafi, M.M., Mahmud, T.M.M. and Azwady, A.A.N. (2009): Vermicomposting of oil palm empty fruit bunch and its potential in supplying of nutrients forcrop growth, *Compost Science & Utilization*, 17(1): 61-67.

Shak, K.P.Y., Wu, T.Y., Lim, S.L. and Lee, C.A. (2013): Sustainable reuse of rice residues as feedstocks in vermicomposting for organic fertilizer production. *Environ. Sci. Pollut. Res.*, 21**:**1349–1359.

Sharma, P., Narwal, G. and Kaur, K. (2020): Management of rice straw (*Oryzasativa*) by vermicomposting using epigeic earthworm, *Eiseniafetida*. *Journal of Entomology and Zoology Studies*, 8(2):1640-1643.

Yadav, J., Gupta, R.K. and Kumar, D. (2017): Changes in C: N ratio of different substrates during vermicomposting. *Ecology, Environment and Conservation*, 23(1): 368-372.

Yan, Y.W., Azwady, A.A.N., Shamsuddin, Z.H., Muskhazli, M., Aziz, S.A. and Teng, S.K. (2013): Comparison of plant nutrient contents in vermicompost from selected plant residues. *African Journal of Biotechnology*,12(17): 2207-2214.

Yi-Wei, Y., Aziz, N.A.A., Shamsuddin, Z.H., Mustafa, M., Aziz, S.A. and Suk-Kuan, T. (2012): Vermicomposting potential and plant nutrient contents in rice straw vermicast of *Perionyxexcavatus*and *Eudriluseugeniae. Scientific Research and Essays*, 7(42): 3639-3645.

STUDY OF HEMOGLOBIN LEVEL IN THE DIFFERENT AGE GROUPS

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Blood is a specialized body fluid in animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products such as carbon dioxide away from those same cells (Franklin Institute Inc., 2009) Hemoglobin is the iron containing oxygen transport metalloproteinase in the red blood cells. Hemoglobin has an oxygen binding capacity of between 1.36 to 1.37 ml oxygen per gram of hemoglobin, which increases the total blood oxygen capacity.

The mammalian hemoglobin molecule can bind (carry) up to four oxygen molecules. When the diet does not contain sufficient amounts of iron, anemia develop It is a gradual process and takes several months to show up a normal person has about 13-17g /dl of hemoglobin. Any person whose hemoglobin level is below 12g/dl is considered anemic. About 80% of the total anemic cases are due to iron deficiency, and the rest are due to deficiency of nutrient like foliate and vitamin B12.

Folic acid and vitamin B12 are important for the production of blood cells. Man rarely suffers from iron deficiency due to poor diet. Most of the iron in the body is located in the hemoglobin of circulating red blood cells. The values of hematological parameters are affected by a number of factors even in apparently healthy populations. These factors include age, sex, ethnic background, body build and social, nutritional and environmental factors. The main reason for having less amount of Hb due to by taking improper diet and some habits, like smoking.

Because iron is an important component of hemoglobin, consuming iron-rich foods will raise the hemoglobin levels, iron rich foods, like Fortified Foods (These products include breakfast cereals, pasta, bread, malted drinks and grits. The Food and Nutrition Board recommended 18 mg iron for women and 8 mg for men) , animal sources (seafood, poultry, eggs and beef), plant sources (red kidney beans, lentils, soybeans, black beans, white beans and cowpeas). Consuming iron in foods or supplements is important, but a person should also help their body to absorb that iron.Foods rich in vitamin C, such as citrus fruits, strawberries, and

leafy green vegetables, can boost the amount of iron absorbed. Taking a vitamin C supplement may also help. Vitamin A and beta-carotene can aid the body in absorbing and using iron.

References:

Costanzo, Linda S. (2007): Physiology. Hagerstown, MD: Lippincott Williams & Wilkins

Dominguez de Villota ED, Ruiz Carmona MT, Rubio JJ, de Andres S (1981): Equality of the in vivo and in vitro oxygen-binding capacity of hemoglobin in patients with severe respiratory disease. Br J Anaesh 53(12): 13258. doi: 10,1093/53.12.1325.

Evans D. M., Frazer I. H., Martin N. G. (1999): Genetic and environmental causes of variation in basal levels of blood cells. Twin Res., 2: 250-7.

Frerichs R. R., Webber L. S., Srinivasan S. R., Berenson G. S. (1977): Hemoglobin levels in children from a biracial Southern community. Am J Public Health; 67: 841-5.

Karazawa E. H. (1989): Jamra M. Parametros hematologicos normal. Rev Saudi Public., 23: 58-66.

Maton, Anthea; Jean Hopkins, Charles William McLaughlin, Susan Johnson, Maryanna Quon.

Warner, David LaHart, Jill D. Wright (1993): Human Biology and Health. Englewood cliffs, New Jersey, USA: Prentice Hall.

Petrova M. (1976): Sezonni izmeneneiia sustavana chervenata kruv u zdravidetsa. Probl Khig, 2:163-8.

HYPOXIA: ORIGIN, CONSEQUENCES AND CONTROLS IN AQUATIC ECOSYSTEMS

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Abstract:

Hypoxia refers to a state where there is not enough oxygen at the tissue level to maintain sufficient homeostasis. This may be due to insufficient blood supply or low oxygen content in the blood (hypoxemia) resulting in insufficient oxygen delivery to the tissues.Generally, hypoxic waters have dissolved oxygen concentrations of less than 2 or 3 ppm. When large stretches of open water become hypoxic they are unable to sustain life, and are thus known as dead zones. Anthropogenic emissions of carbon dioxide in the atmosphere have generated rapid variations in atmospheric composition which drives major climate changes. Climate change related effects include changes in physico-chemical proprieties of sea and freshwater, such as variations in water temperature, salinity, pH/pCO_2 and oxygen content, which can impact fish critical physiological functions including reproduction. In this context, the main aim of the present review is to discuss how climate change related effects (variation in water temperature and salinity, increases in duration and frequency of hypoxia events, water acidification) would impact reproduction by affecting the neuroendocrine axis (brain-pituitary-gonad axis).

Key words: Hypoxia, Causes, Consequences and Aquatic Ecosystems.

Introduction:

Fish form an extremely diverse group of vertebrates. At a conservative estimate at least 40% of the world's vertebrates are fish. On the one hand they are united by their adaptations to an aquatic environment and on the other they show a variety of adaptations to differing environmental conditions often to extremes of temperature, salinity, oxygen level and water

chemistry. They exhibit an array of behavioural and reproductive systems. Interesting in their own right, this suite of adaptive physiologies provides many model systems for both comparative vertebrate and human physiologists (Farrell, 2011). Though several hypotheses have been proposed, but it fall short to explain hypoxia. According to Hou *et al*. (2020a,b), Hypoxia generally refers to a dissolved oxygen (DO) level that is less than 2–3 mg/L. With ongoing global warming and environment pollution, environmental or geological studies showed hypoxia frequently occurs in global aquatic systems including ocean, river, estuaries and coasts. There have been a number of reports describing hypoxia tolerant of fish with parameters of mortality, behavior, endocrine and metabolite, identifying three DO levels including normoxia (Ctrl, 7.0 mg/L), non-lethal hypoxia (NH, 4.5 mg/L) and lethal hypoxia (LH, 3.0 mg/L).It clearly shows that the excess nutrients can promote algal overgrowth and lead to eutrophication. As dead algae decompose, oxygen is consumed in the process, resulting in low levels of oxygen in the water (EPA).Hence, there is an urgency to understand the response mechanisms of aquatic organisms to adverse environment.

Concept of Hypoxia:

Hypoxia refers to low oxygen conditions. Normally, 20.9% of the gas in the atmosphere is oxygen. The partial pressure of oxygen in the atmosphere is 20.9% of the total barometric pressure (Brandon and John, 2012). In water, oxygen levels are much lower, approximately 7 ppm 0.0007% in good quality water, and fluctuate locally depending on the presence of photosynthetic organisms and relative distance to the surface.

Atmospheric Hypoxia:

Atmospheric hypoxia occurs naturally at high altitudes. Total atmospheric pressure decreases as altitude increases, causing a lower partial pressure of oxygen which is defined as hypobaric hypoxia.

The Nobel Prize in Physiology or Medicine for 2019 is awarded to William Kaelin, Jr., Sir Peter Ratcliffe, and Gregg Semenza. The need for oxygen to sustain life has been understood since the onset of modern biology; but the molecular mechanisms underlying how cells adapt to variations in oxygen supply were unknown until the prize-winning work described here. Animal cells undergo fundamental shifts in gene expression when there are changes in the oxygen levels around them. These changes in gene expression alter cell metabolism, tissue re-modeling, and even organismal responses such as increases in heart rate and ventilation. Some studies have reported environmental hypoxia is most simply defined as the water PO2 when physiological function is compromised, thus the definition of environmental hypoxia is dependent upon the

physiological system under examination. Hypoxia-induced decrements in maximal oxygen consumption and thus reduced aerobic scope occur at higher water O2 levels than changes in routine oxygen consumption, which when compromised, is quantified as the critical oxygen tension (Pcrit) (Farrell and Richards, 2009). To address this problem, It is estimated that 30% of cases of Neonatal encephalopathy (NE) in developed populations and 60% in developing populations have some evidence of intrapartum hypoxic-ischaemia.

Aquatic Hypoxia:

Oxygen depletion is a phenomenon that occurs in aquatic environments as dissolved oxygen (DO) becomes reduced in concentration to a point where it becomes detrimental to aquatic organisms living in the system. Depleted oxygen levels was observed in water during altered pH media caused alterations in Oxygen consumption of fish (Bhaskar, 1983; Subbaiah *et al.*, 2003) and prawn (Sailaja *et al.*, 2009) on exposure to altered pH media was reported earlier.Dissolved oxygen is typically expressed as a percentage of the oxygen that would dissolve in the water at the prevailing temperature and salinity. An aquatic system lacking dissolved oxygen (0% saturation) is termed anaerobic, reducing, or anoxic; a system with low concentration-in the range between 1 and 30% saturationis called hypoxic or dysoxic. Most fish cannot live below 30% saturation. Hypoxia leads to impaired reproduction of remaining fish via endocrine disruption (Wu *et al.*, 2003). A "healthy" aquatic environment should seldom experience less than 80%. The exaerobic zone is found at the boundary of anoxic and hypoxic zones.

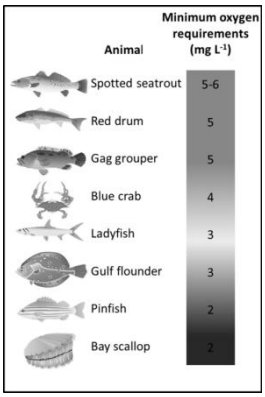

Figure 1: Minimum oxygen requirements for animals both in aquatic and marine systems

In aquatic and marine systems, low oxygen generally refers (Fig.1) to a dissolved oxygen concentration less than 2 to 3 milligrams of oxygen per liter of water (mg/L), but sensitive organisms can be affected at higher thresholds (4.5 mg/L). A complete lack of oxygen is called anoxia. Hypoxic waters generally do not have enough oxygen to support fish and other aquatic

animals, and are sometimes called dead zones because the only organisms that can live there are microbes. Hypoxia is a mounting problem affecting the world's coastal waters, with severe consequences for marine life, including death and catastrophic changes. Low oxygen conditions are forecast to increase due to increased nutrient input and global warming. Hypoxia has been shown to trigger mortality events that deplete animals in the ecosystem, resulting in so-called ''dead zones'' devoid of fisheries resources, such as fish, shrimp, and crabs.

Hypoxic Zones:

Direct effects of hypoxia include fish kills, which deplete valuable fisheries and disrupt ecosystems. Mobile animals (e.g., adult fish) can typically survive a hypoxic event by moving to waters with more oxygen. Less mobile or immobile animals, such as mussels or crabs, cannot move to waters with more oxygen and are often killed during hypoxic events. Ultimately, hypoxia causes a severe decrease in the amount of life in hypoxia zones. Hypoxia also affects the ability of young fish or shellfish to find the food and habitat necessary to become adults. As a result, fish and shellfish stocks may be reduced or become less stable because less young reach adulthood. Hypoxia can also affect species that rely on fish for food. Such species might have to leave an area to find the necessary food to survive. Diaz and Rosenberg (2008) reported in Science Journal that there are over 400 hypoxic zones in the world (Fig,2).

Figure 2: A study published in *Science* found that there are over 400 hypoxic zones in the world (Diaz and Rosenberg, 2008)

Periods of environmental hypoxia (Low Oxygen Availability) are extremely common in aquatic systems due to both natural causes such as diurnal oscillations in algal respiration, seasonal flooding, stratification, under ice cover in lakes, and isolation of densely vegetated water bodies, as well as more recent anthropogenic causes (e.g. eutrophication). In view of this, it is perhaps not surprising that among all vertebrates, fish boast the largest number of hypoxia tolerant species; hypoxia has clearly played an important role in shaping the evolution of many

unique adaptive strategies. These unique adaptive strategies either allow fish to maintain function at low oxygen levels, thus extending hypoxia tolerance limits, or permit them to defend against the metabolic consequences of oxygen levels that fall below a threshold where metabolic functions cannot be maintained (Richards *et al.,* 2009).

Causes of Hypoxia:

Oxygen depletion can result from a number of natural factors, but is most often a concern as a consequence of pollution and eutrophication in which plant nutrients enter a river, lake, or ocean, and phytoplankton blooms are encouraged. Prevail of hypoxic condition was reported on exposure to altered pH media leading to changes in various metabolic modulations in freshwater fish (Bhaskar, 1994; Bhaskar and Govindappa, 1985a, b and c). Altered pH not only caused hypoxic condition in media, but also induced changes in blood profile, respiration and metabolic modulations in different organs of fish (Bhaskar and Govindappa, 1985d and 1986). While phytoplankton, through photosynthesis, will raise DO saturation during daylight hours, the dense population of a bloom reduces DO saturation during the night by respiration. When phytoplankton cells die, they sink towards the bottom and are decomposed by bacteria, a process that further reduces DO in the water column. If oxygen depletion progresses to hypoxia, fish kills can occur and invertebrates like worms and clams on the bottom may be killed as well. Earlier studies also reported mortality of fish due to altered pH media leading to hypoxic condition causing mucous formation on gills and respiratory changes (Bhaskar, 1983; Srineetha *et al.,* 2013 and 2014).

The World Resources Institute has identified 375 hypoxic coastal zones around the world, concentrated in coastal areas in Western Europe, the Eastern and Southern coasts of the US, and East Asia, particularly in Japan (Selman Mindy, 2007). Hypoxia may also be the explanation for periodic phenomena such as the Mobile Bay jubilee, where aquatic life suddenly rushes to the shallows, perhaps trying to escape oxygen-depleted water. Recent widespread shellfish kills near the coasts of Oregon and Washington are also blamed on cyclic dead zone ecology (Oregonstate.edu, 2006).

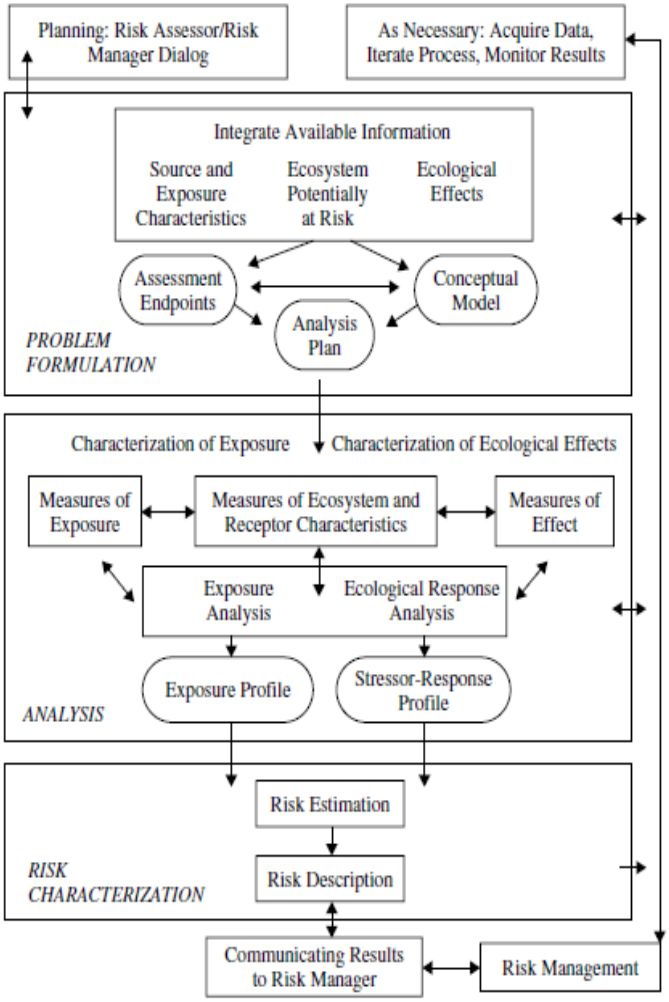

Figure 3: Ecological risk assessment framework as set forth by the US Environmental Protection Agency

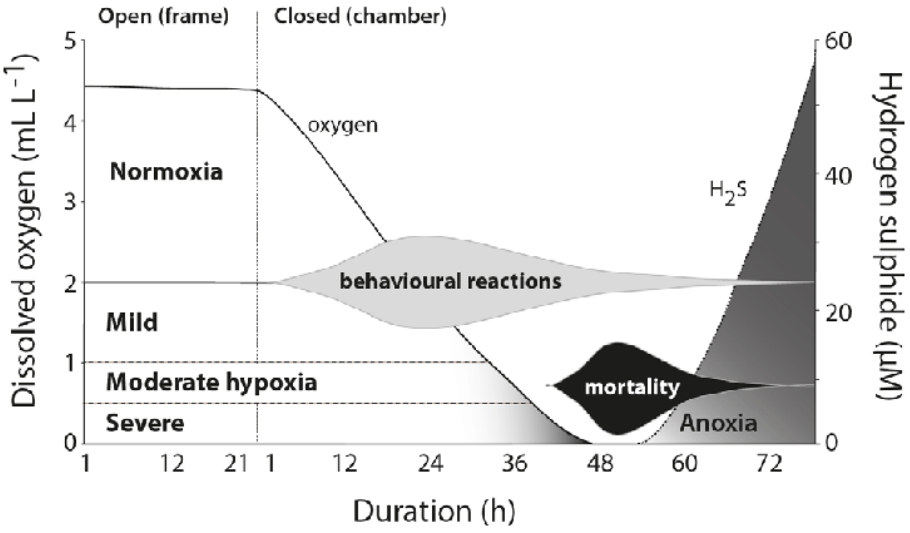

Figure 4: Schematic course of all 11 deployments (oxygen, behaviour, mortality) based on averaged values in Table A1 (Appendix A). Hypoxia threshold at 2 mL dissolved oxygen [DO] L −1; dashed lines (1 and 0.5 mL DO L −1) separate different stages of hypoxia

Hypoxia impact on fish growth:

Water quality encompasses the water physical, biological, and chemical parameters. It generally affects the fish growth and welfare. Thus, the success of a commercial aquaculture project depends on supplying the optimum water quality for prompt fish growth at the minimum cost of resources. Although the aquaculture environment is a complicated system, depending on various water quality variables, only less of them have a critical role. One of these vital parameters is dissolved oxygen (DO) level, which requires continuous oversight in aquaculture systems (Abdel-Tawwab *et al*., 2019).

Laboratory study expressed how hypoxic conditions and temperature affect growth rates of two juvenile estuary-dependent fish: the Atlantic menhaden (*Brevoortia tyrannus*) and spot (*Leiostomusx anthurus*). The results suggest that DO levels must be severely depressed, and in fact, approaching lethal limits, to negatively impact growth of juvenile spot and Atlantic menhaden (McNatt and Rice, 2004). The intermittent hypoxia may decrease habitat quality and result in ≥50% declines in juvenile fish growth rate. Incorporation of these indirect effects of hypoxia on juvenile growth rates into a population model demonstrated the potential for significant (~4%) reductions in population growth rate. As hypoxia induce stress in juvenile fish growth and development, similarly the aflatoxins (Pradeepkiran *et al.,* 2018) and pH (Krishna Murthy *et al.,* 1981; Bhaskar and Govindappa, 1985c; Bhaskar *et al.,* 1983) also will cause stress in fish was reported in our earlier studies. These changes that are induced by various stress conditions can be regulated in incorporation of probiotics in fingerlings (Svani *et al.,* 2013a), probiotics and pre-biotics in fish (Pradeepkiran *et al.,* 2015 and 2018) and Nymphaea meal in fingerlings and fish was reported (Sivani *et al.,* 2013b and c). Thus, sublethal effects of hypoxia-driven habitat degradation may impact fisheries production not only through reduced size at age, but also through reduced abundance of demersal fish populations (Eby, 2005).Evidence of the deleterious effects of oxygen depletion on species of the pelagic realm is scarce, particularly in terms of the effect of low oxygen on development, recruitment and patterns of migration and distribution (Ekau, 2009). The ratio of RNA to DNA (RNA:DNA) in white muscle tissue of juvenile summer flounder (*Paralichthys dentatus*) and weakfish (*Cynoscion regalis*) was used as a proxy for recent growth rate in an estuarine nursery. Furthermore, growth rates of wild-caught fishes (estimated from RNA:DNA) appear to be more negatively impacted by diel cycling hypoxia than would be expected from published laboratory data (Stierhoff *et al.,*2009). Temperature did not affect striped bass food consumption, but consumption increased with increased DO levels (Brandt *et al.,* 2009).

Hypoxia impact on fish reproduction and development:

Both laboratory and field evidence showed that hypoxia can cause major reproductive impairments by inhibiting testicular and ovarian development, affecting production and quality of sperm and egg, reducing fertilization and hatching success, and affecting larval survivorship as well as the quality and fitness of juveniles. In zebrafish embryos, blastomeres were arrested during the S and G2 phases of the cell cycle under anoxia. Fish embryos developed under hypoxia lost their normal synchronization, and abnormalities in spinal and vascular development are commonly observed (Wu, 2009).

Laboratory hypoxia studies showed that the endocrine disruption was associated with impairment of reproductive neuroendocrine function and decreases in hypothalamic serotonin (5-HT) content and the activity of the 5-HT biosynthetic enzyme, tryptophan hydroxylase. Pharmacological restoration of hypothalamic 5-HT levels also restored neuroendocrine function, indicating that the stimulatory serotonergic neuroendocrine pathway is a major site of hypoxia-induced inhibition(Thomas *et al.,* 2007).The masculinization and other reproductive disruptions were associated with declines in neuroendocrine function, as well as ovarian and brain expression of aromatase (the enzyme that converts androgens to oestrogens (Thomas and Rahman, 2012).Human activities are projected to have major impacts this century on our planet, especially on coastal regions. In addition to increases in temperature and sea levels, another major global change, the increased extent of seasonal hypoxia, now extending to 250 000 km2 worldwide, could dramatically affect fishery resources in coastal regions and the livelihoods of people that depend upon them. Therefore, reproductive output of fish inhabiting other coastal regions experiencing recurring seasonal hypoxia should be investigated for evidence of hypoxia-related declines (Thomas and Rahman, 2012). *Synbranchus marmoratus* (Bloch) breathes air during terrestrial excursions and while dwelling in hypoxic water and utilizes its gills and adjacent buccopharyngeal epithelium as an air-breathing organ (ABO). This fish uses gills and skin for aquatic respiration in normoxic (air-saturated) water but when exposed to progressive aquatic hypoxia it becomes a metabolic O2 conformer until facultative air breathing is initiated (Graham and Baird 1984).

Hypoxia role infishprotein-gene interaction:

Hypoxia-inducible gene that plays an important role in regulating embryonic growth and development under hypoxic stress.Earlier results suggest that HIF-1 mediates hypoxia-induced IGFBP-1(Insulin-like growth factor binding protein 1) gene expression in early development by selectively interacting with the −1090/−1086 HRE and its adjacent HAS (Kajimura*et al.,* 2006).Hypoxia-mediated changes in gene expression are likely regulated by the transcription

factor, hypoxia inducible factor (HIF), which is well characterized in mammalian systems, but has only recently been examined in fish. Hypoxia inducible factor appears to be regulated in a similar fashion in fish as in mammals, but to date, there does not appear to be a direct link between HIF function and hypoxia tolerance in fish (Richard, 2009).

Earlier study demonstrates that a reduction in the cellular energy status will not induce stress protein gene transcription in rainbow trout red blood cells and may, in fact, limit induction during extreme metabolic inhibition (Currie *et al.,* 1999).Some other studies suggest that HSP mRNA expression does not increase as a result of bioenergetic stress in nucleated red blood cells (Currie *et al.,* 1999).The New information about the bioactivity of teprenone and advanced the knowledge of this compound as a potential prophylactic agent to maintain homeostasis in fish against thermal stress and hypoxia (Dong *et al.,* 2020).Although long non-coding RNAs (lncRNAs) are involved in many biological processes, their roles in stress responses still remain unclear. Among all the significantly changed lncRNAs identified by RT-qPCR and sequencing data, binding sites were found in four other lncRNAs (MSTRG.34610, MSTRG.10941, MSTRG.81281 and MSTRG.93731) with Aja-miR-2013-3p, a key miRNA that responds to hypoxia in sea cucumbers (Huo*et al.,* 2020).Acute hypoxia and reoxygenation also that causes the level of nonspecific immunity decreased first and then increased. It can effectively protect oxidative stress and apoptosis within 0–48 h after acute hypoxia and reoxygenation and enhance non-specific immunity (Sun *et al.,* 2020).The evolutionarily conserved neuronal operators critical for locomotor development in vertebrates, and reveal a molecular mechanism of hypoxic injury (Son *et al.,* 2020).

Hypoxia reductionsolutions:

To combat hypoxia, it is essential to reduce the amount of land-derived nutrients reaching rivers in runoff. This can be done by improving sewage treatment and by reducing the amount of fertilizers leaching into the rivers. Alternately, this can be done by restoring natural environments along a river; marshes are particularly effective in reducing the amount of phosphorus and nitrogen (nutrients) in water. Other natural habitat-based solutions include restoration of shellfish populations, such as oysters. Oyster reefs remove nitrogen from the water column and filter out suspended solids, subsequently reducing the likelihood or extent of harmful algal blooms or anoxic conditions (Kroeger and Timm, 2012). New approaches of long-term monitoring of oxygen regime in the ocean observe online the behavior of fish and zooplankton, which changes drastically under reduced oxygen saturations and already at very low levels of water pollution.

Conclusions:

Despite large-scale efforts to reduce nutrient enrichment (such as the "Clean Water and Safe Drinking Water Act" in the 1970s), water quality has improved significantly, but cultural eutrophication and consequent HAB are still Many of the main causes of freshwater pollution and coastal marine ecosystems are a rapidly growing problem in developing countries.Given that the demand for freshwater resources is expected to increase dramatically, the protection of dwindling water resources has become one of the most pressing environmental issues, and as climate change, species invasion and pollution further reduce water quality and quantity, it becomes more complicated. The control and management of Hypoxia condition is a complex issue that will require scientists, decision makers and citizens to work together to reduce nutrient input, develop effective long-term biological manipulation techniques, and ultimately restore aquatic communities.

References:

Abdel-Tawwab, M., Monier, M. N., Hoseinifar, S. H., and Faggio, C. (2019): Fish response to hypoxia stress: growth, physiological, and immunological biomarkers. Fish physiology and biochemistry, 45(3), 997-1013.

Bhaskar M (1983): Tissue metabolic profiles of *Tilapia mossambica* (peters) acclimated to sublethal acidic and alkaline media. Thesis in Zoology submitted to Sri Venkateswara University,Tirupati,A.P.,India.

Bhaskar M. and Govindappa, S. (1985a): Physiological and metabolic patterns in muscle of fish *Tilapia mossambica* on acclimation to altered pH media. Ambio, 14; 349-351. (IF: 2.2) 151.

Bhaskar M. and Govindappa, S. (1985b): Studies on fish liver carbohydrate metabolism during acclimation to sublethal acidic and alkaline media, Fish. Res. 3: 345 – 350. (IF: 1.6)

Bhaskar M. and Govindappa, S. (1985c): Tissue compensatory metabolic profiles in *Tilapia mossambica* (peters) on acclimation to sub lethal acidic and alkaline media. Gill glycogen metabolism. Arch Internal. Physiol. Biochem., 93: 59- 63.

Bhaskar M. and Govindappa, S. (1986): Acclimation to sublethal acidic and alkaline media of *Tilapia mossambica* (Peters); Changes in Glycogen metabolism of red muscle. Bull. Environ. Contam. Toxicol. 37(1): 113 – 119. (IF: 1.1):

Bhaskar M., (1994): Changes in the liver protein fractions of *Tilapia mossambica* (peters) on acclimation to altered pH media. Fish Res.19: 179-196. (IF: 2.34):

Bhaskar M., Vemananda Reddy, G., Krishna murthy, V., Reddanna, P. and Govindappa, S. (1983): Branchial protein metabolism of fresh water fish, *Tilapia mossambica* (peters)

during acute exposure and acclimation of sub lethal alkaline water. Proc. Ind. Acad. Sci. 91(1) 235-241. 181.

Bhaskar, M. and Govindappa. (1985d): Effect of environmental acidity and alkalinity on the physiology of *Tilapia mossambica* during acclimation. Biochemical Systematics and Ecology 14 (4), 439-443

Brandon, John. "The Atmosphere, Pressure and Forces". Meteorology. Pilot Friend. Retrieved 21 December 2012.

Brandt, S. B., Gerken, M., Hartman, K. J., & Demers, E. (2009): Effects of hypoxia on food consumption and growth of juvenile striped bass (Moronesaxatilis): Journal of Experimental Marine Biology and Ecology, 381, S143-S149.

Currie, S., Tufts, B. L., & Moyes, C. D. (1999): Influence of bioenergetic stress on heat shock protein gene expression in nucleated red blood cells of fish. American Journal of Physiology-Regulatory, Integrative and Comparative Physiology, 276(4), R990-R996.

Dong, H., Zheng, X., Kumar, V., Roy, S., Duan, Y., Gao, H., & Zhang, J. (2020): Dietary supplementation of teprenone potentiates thermal and hypoxia tolerance as well as cellular stress protection of Epinepheluscoioides juveniles reared under multiple stressors. Aquaculture, 514, 734413.

Farrell, A. P. (2011): Encyclopedia of fish physiology: from genome to environment. Academic Press.

Farrell, A. P., & Richards, J. G. (2009): Defining hypoxia: an integrative synthesis of the responses of fish to hypoxia. In Fish physiology (Vol. 27, pp. 487-503): Academic Press.

Graham, J. B., and Baird, T. A. (1984): The transition to air breathing in fishes: III. Effects of body size and aquatic hypoxia on the aerial gas exchange of the swamp eel Synbranchusmarmoratus. Journal of experimental biology, 108(1), 357-375.

Hou, Z. S., Wen, H. S., Li, J. F., He, F., Li, Y., & Qi, X. (2020a): Environmental hypoxia causes growth retardation, osteoclast differentiation and calcium dyshomeostasis in juvenile rainbow trout (Oncorhynchus mykiss): Science of The Total Environment, 705, 135272.

https://www.epa.gov/ms-htf/hypoxia-101

https://www.nobelprize.org/prizes/medicine/2019/advanced-information/

Huo, D., Sun, L., Storey, K. B., Zhang, L., Liu, S., Sun, J., & Yang, H. (2020b): The regulation mechanism of lncRNAs and mRNAs in sea cucumbers under global climate changes: Defense against thermal and hypoxic stresses. Science of the Total Environment, 709, 136045.

Jangampalli Adi Pradeepkiran, Matcha Bhaskar. (2018): Analysis of aflatoxin B1 in contaminated feed, media and serum samples of *Cyprinus carpio* L by high performance liquid chromatography. Food Quality and Safety .2 (4): 199-204.

Kajimura, S., Aida, K., &Duan, C. (2006): Understanding hypoxia-induced gene expression in early development: in vitro and in vivo analysis of hypoxia-inducible factor 1-regulated zebra fish insulin-like growth factor binding protein 1 gene expression. *Molecular and cellular biology*, *26*(3), 1142-1155.

Krishna Murthy, V., Bhaskar M., Reddanna, P. and Govindappa, S. (1981): Muscle metabolism of fresh water fish, *Tilapia mossambica* (peters) during acute exposure and acclimation to sub lethal acidic water. Can. J. Zool. 59(10): 1909-1914. (IF: 1.4):

Kroeger, Timm (2012) Dollars and Sense: Economic Benefits and Impacts from two Oyster Reef Restoration Projects in the Northern Gulf of Mexico Archived 2016-03-04 at the Wayback Machine. TNC Report..

McNatt, R. A., & Rice, J. A. (2004): Hypoxia-induced growth rate reduction in two juvenile estuary-dependent fishes. Journal of Experimental Marine Biology and Ecology, 311(1), 147-156.

Oregonstate.edu Archived 2006-09-01 at the Wayback Machine – Dead Zone Causing a Wave of Death Off Oregon Coast (8/9/2006):

Pradeepkiran, J.A., A Sudheer Kumar, S. Mannur Ismail, E. Madhuri, M. Bhaskar. (2015): Amelioration effect of probiotics (Cheese) and prebiotic (Garlic) on aflatoxin B1 induced hematological alterations in fresh water fish *Cyprinus carpio* L. Online Journal of Animal and Feed Research. 5(4): 117-124.

Richards, J. G. (2009): Metabolic and molecular responses of fish to hypoxia. In *Fish physiology* (Vol. 27, pp. 443-485): Academic Press.

Richards, J. G., Farrell, A. P., and Brauner, C. J. (Eds.): (2009): *Fish physiology: hypoxia*. (Vol. 27, pp. 3413-375): Academic Press.

Sailaja. V., E. Madhuri, K. Ramesh Babu, S. Ramakriahna, and M. Bhaskar. (2009): Impact of Altered PH media on mortality rate, oxygen consumption and excretion in Prawn, Ecol.Env. & Cons. 15 (1): 153-157.

Selman, Mindy (2007): Eutrophication: An Overview of Status, Trends, Policies, and Strategies. World Resources Institute.

Sivani G., G.R.K. Sharma, and M. Bhaskar, (2013c): Influence of probiotics on growth performance and digestive enzyme activities among common carps (*Cyprinus carpio*). International Journal of Science, Environment and Technology 5, 564-574

Sivani, G. Reddy, D.C. and M. Bhaskar, (2013b): Effect of Nymphaea meal incorporated diets on growth, feed efficiency and body composition in fingerlings of *Cyprinuscarpio* L. Journal of Applied and Natural Science 5 (1), 5-9.

Sivani, G., G.R.K. Sharma, and M. Bhaskar, (2013a): Effect of Commercial Probiotic Supplemented Diet on the Growth and Digestive Enzyme Activity in the Fingerlings of Common Carp *Cyprinus Carpio* (L): IJASTR: 3(4); 1-11

Son, J. H., Stevenson, T. J., Bowles, M. D., Scholl, E. A., &Bonkowsky, J. L. (2020): Dopaminergic Co-Regulation of Locomotor Development and Motor Neuron Synaptogenesis is Uncoupled by Hypoxia in Zebrafish. eNeuro.

Srineetha, U, M. Venkata Reddy and M. Bhaskar. (2014): "Effect of Environmental acidic pH on Oxygen Consumption in Different stages of Fish, *Cyprinus carpio* (L)"IOSR Journal of Environmental Science, Toxicology and Food Technology, 8: (8) 17-21

Srineetha, U,M. Venkata Reddy and M. Bhaskar. (2013): Effect of Environmental Acidic pH on Oxygen Consumption of Fish, *Cyprinus carpio* (L.): Nature Environment and Pollution Technology An International Quarterly Scientific Journal 12(4); 721- 724.

Stierhoff, K. L., Targett, T. E., & Power, J. H. (2009): Hypoxia-induced growth limitation of juvenile fishes in an estuarine nursery: assessment of small-scale temporal dynamics using RNA: DNA. Canadian Journal of Fisheries and Aquatic Sciences, 66(7), 1033-1047.

Subbaiah, M.C.V., Madhuri, E., Bhaskar M. and Govindappa, S., (2003): Respiratory changes in different stages of *cyprinus carpio*, (L), on short term exposune to sublethal environmental acidic and alkaline media. Ind. J. Environ. Sci. Vol.7. No (2), 47-150

Sun, Y., Dong, H., Zhan, A., Wang, W., Duan, Y., Xie, M., ... & Zhang, J. (2020): Protection of teprenone against hypoxia and reoxygenation stress in stomach and intestine of Lateolabrax maculatus. Fish Physiology and Biochemistry, 1-10.

Thomas, P., and Rahman, M. S. (2012): Extensive reproductive disruption, ovarian masculinization and aromatase suppression in Atlantic croaker in the northern Gulf of Mexico hypoxic zone. Proceedings of the Royal Society B: Biological Sciences, 279(1726), 28-38.

Thomas, P., Rahman, M. S., Khan, I. A., and Kummer, J. A. (2007): Widespread endocrine disruption and reproductive impairment in an estuarine fish population exposed to seasonal hypoxia. Proceedings of the Royal Society B: Biological Sciences, 274(1626), 2693-2702.

Wu, R. et al. 2003. Aquatic Hypoxia Is an Endocrine Disruptor and Impairs Fish Reproduction

Wu, R. S. (2009): Effects of hypoxia on fish reproduction and development. In Fish physiology (Vol. 27, pp. 79-141): Academic Press.

MAJOR VEGETABLES INFECTING PESTS IN CHIKKAMAGALURU DISTRICT, KARNATAKA, INDIA

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Abstract:

Agriculture plays an important role in the socio-economic development of India. Agriculture remains the primary activity and main source of livelihood for the rural population in the Karnataka state. The geographical area of the Chikkamagaluru district is 722075 ha. of which an area of 319790 ha., comes under the cultivable area.112930 ha.,are covered under horticulture crops. All vegetable crops are infected by pests. The study has been carried out twice a week from December 2020 to February 2021. Pests on plants were collected by handpicking method and they were preserved in the bottles. Information regarding their effect and control was collected from the farmers and also from the Horticultural department chikkamagaluru.Different types of vegetables were cultivated at the study site and these are mainly Brinjal, Cabbage, tomato, Ridge guard and Hyacinth bean. The common pest observed on these vegetables were Brinjal shoot and fruit borer (*Leucinodes orbonails),* Diamondback moth (*Plutella xylostella*), Melon fly (*Bacterocera cucurbitae*), Corn earworm or boll worm (*Helicoverpa zea*) and Black cut worm *(Agrotis ipsilon).*

Key words: Agriculture, pests, vegetables, shoot borer,cut worm.

Introduction:

The history of Indian agriculture dates back to 10,000 years. The middle ages in India saw irrigation channels that reached a new level of sophistication. Land and water management systems were developed to provide uniform growth. The agricultural sector engaged 60% of the total workforce in India. Agriculture plays an important role in the socio-economic development of India. Karnataka is India's sixth-largest state in a geographical area covering 1.92lakh sq. km and accounting for 6.3% of the geographical area of the country. A total of 123.100km^3 of land is cultivated in Karnataka constituting 64.6% of the total geographical area of the state. The agricultural sector of Karnataka is characterized by vast stepped of the drought-prone region and

Sporadic patches of the irrigated area thus a large portion of agricultural land in the state is exposed to the vagaries of monsoon with severe agro-climatic and resource constraints agriculture employs more than 60% of Karnataka's workforce. Karnataka is highly progressive about vegetable production and enjoys this advantage because of favorable climatic conditions without any extremes in temperature. Agriculture remains the primary activity and main source of livelihood for the rural population in the state (7). The Chikkamagaluru district consists of three agro climatic zones viz., southern transition zone, hilly zone and central dry zone. Due to variable agro-climatic conditions the district is ideally suited for the cultivation of vide varieties of Horticulture crops like fruits, vegetables, flowers, plantation crops aswell as medicinal and aromatic plants. The geographical area of the district is 722075 ha .,of which an area of 319790 ha.,comes under the cultivable area ,constituting 44.29% of the geographical area for the year 2008-09.Out of the total cultivable area , 112930 ha.,are covered under horticulture crops (excluding coffee, tea). Horticultural area in the district accounts to about 35.31% of the total cultivable area (8).

All vegetable crops are infected by pests. Pest is unwanted organisms that are a nuisance to man or domestic animals and can cause injury to humans, animals, plants, and property. Pests reduce yield and quality in plants ranging from field crops. Fruits and vegetables to lawns, trees, and golf course.Insect pests cause significant damage to agricultural products intended for human foods and animal feeds. In addition to direct losses caused by insects to plant systems, fruits, and seeds, the pest (biotic agents) also cause indirect losses by leaving important contaminants such as body parts or insects eggs and off-odors. There are more than six million species of insect although only 20–30 of these are important pests for major crops (9). Various grasshopper weevils, beetles, and small insects like trips and certain fly larvae can cause significant damage. Among the most common types of detrimental insects are the Lepidoptera (moth and butterflies) and the homopterous (aphids and leafhoppers). Damage caused by moth larvae often consists of ragged chewed leaf edges or joules in leaves Homoptera insects like aphids are often difficult to see without a magnifying lens but their damage can be recognized by yellow speckles accompanied by a sticky film on leaf surfaces. Other insects cause various types of damage including defoliation or stem and fruit tunnelling when investigating insect damage look for weak or stunted plants with damaged leaves or fruit check the base of the plant near the ground and check the undersides of leaves for insects and insect eggs. Often the best time to spot insects in the process of feeding is in dark or the early morning.

Materials and Methods:

Collection of data:

The data were collected from the major vegetable-growing area of Chikamagaluru district. The study has been carried out twice a week from December 2020 to February 2021. Pests on plants were collected by handpicking method and they were preserved in the bottles. Information regarding their effect and control was collected from the farmers and also from the Horticultural department chikkamagaluru.

Identification of pest:

Identification of the preserved insects was done morphologically using identification keys and with the help of the type and parts of vegetables on which pests were infested was also noted.

Result and Discussion:

The study was carried out in the major vegetable-growing areas of Chikkmagaluru district. Different types of vegetables were cultivated at the study site and these are mainly Brinjal, Cabbage, tomato, Ridge guard and Hyacinth bean. The common pest observed on these vegetables were Brinjal shoot and fruit borer (*Leucinodes orbonails),* Diamondback moth (*Plutella xylostella*), Melon fly (*Bacterocera cucurbitae*), Corn earworm or boll worm (*Helicoverpa zea*) and Black cut worm *(Agrotis ipsilon).(*Table.1)

Table 1: Major insect pests infecting vegetables

Pest	Scientific Name	Crop Infested	Parts Damaged
Brinjal shoot and fruit borer	*Leucinodes orbonails*	Brinjal	Fruit and shoot of the plant
Diamondback moth	*Plutella xylostella*	Cabbage	Leaf of the plant
melonfly	*Bacterocera cucurbitae*	Ridge guard	Fruit and soft tissue of the plant
Black cutworm	*Agrotis ipsilon*	Hyacinth bean	Fruit and seeds of the plant
Corn earworm	*Helicoverpa zea*	Tomato	Buds and fruits

Brinjal shoot and fruit borer (BSFB) (*Leucinodes orbonails*):

Brinjal is the most important vegetable in India and Karnataka. It is cultivated by small and marginal farmers where the daily sale of the product serves as cash income. Among the

many pest species, the BSFB is the most destructive one. The pest is monophagous i.e. it feed ononly Brinjal. And it is the most important and destructive pest of Brinjal in India. The pest larvae bore inside tender shoots. More severe economic damage is caused by the larvae feeding inside the fruits, which makes damage to the fruits and unfit for human consumption. It is not only reduces the yield by making holes in the shoot as well as in fruits but also reduces the aesthetic value of the fruits. The yield loss varies with different environmental conditions. The life cycle of *Leucinodesorbonalis* includes egg, larva, pupa, and adult stages. Its life cycle is completed in 21 to 43 days.

Nature of damage:

Damage to the plants is caused mainly by the larvae, which bores through the terminal part of the midrib of large leaves and tender shoots to cause "dead hearts". Later it also enters into flower buds and fruits. It plugs the entry hole by its excreta. The infected terminal shoots and fruits ultimately drop out. The pest can cause 70% to 100 % damage to the brinjal crops.

Marks of identification:

The adult is a greyish–brown moth with white wings. The fore and hind wings are provided with marginal hairs and bear pinkish-brown spots. The adult size is 20mm across the spread wings. Larvae sludgy and pink color with a brown head.

Figure 1: Infected Brinjal

Figure 2: Brinjal fruit borer

Prevention and controlling measures:

The affected leaves, shoots, and fruits should be plucked and destroyed. The fallen fruits, leaves and shoots containing larvae should be destroyed. In heavy infection, the whole plant should be uprooted and destroyed.Spraying of Sevimol (0.1%) or Carbaryl (0.1%), Endrin (0.04%), Malathion (0.1%) at regular intervals keep the pest infection under control (10) .

Cabbage is a leafy green, red or white biennial plant grown as an annual vegetable crop for its dense-leaved head. Diamondback moths are considered pests as they feed on the leaves of

cruciferous crops and plants.. Diamondback moths are highly attracted to that plant but their larva fails to survive when eggs are laid on it. Diamondback moth attacks only plants in the family Cruciferae. All cruciferous vegetable crops are eaten by the pest including cabbage and Cauliflower. The life cycle of *Plutellaxylostella* is completed in 21-51 days.

Figure 3: Larva of Diamond back moth

Figure 4: Infected cabbage

Nature of damage:

Plant damage is caused by larval feeding.Although the larva is very small they can be quite numerous, resulting in complete removal of foliar tissue except for the leaf veins. This causes damage to seedlings and may disrupt head formation in cabbage and cauliflower. The presence of larva in florets can results in complete rejection of products.

Prevention and control measures:

Application of 4% neem seed extract at head initiation stage that is 17 to 28 days after planting. Repeated spray of NSKE 4%at 10 to 15 days interval. Where the population build-up is high and avoid the spray after seed formation because it could affect plant quality. Spray of contact insecticides like quinolphors or chloropyriphors 0.05%.

Melon fly (*Bacterocera cucurbitae*):

Figure 5: Larva of Melon fly

Ridge guard is a popular vegetable used in Indian cooking. It comes in two varieties- one with a smooth surface and the other with a ridged surface. It is a genus of tropical and subtropical vines in the Cucurbita family. Several biotic factors limit the production and

productivity of cucurbits, of which cucurbit fruit fly or Melon fly has been the most prominent pest over the last severaldecades.

The Melon fruit fly prefers to infest young, green, soft-skinned fruits. It inserts the eggs 2 to 4 mm deep in the fruit tissue; the hatched legless and headless rice-shaped maggots feed on the fleshy part of fruit causing decay of fruit and in some cases premature dropping off fruits. Egg-laying puncture marks on fruit surface oozing of fruits juice. Melon fruit flies have more than 80 hosts. They are major pests of the Cucurbita family, beans, bitter melon, eggplant, green beans, melons, peppers, pumpkins, tomatoes, bitter guard, and watermelon.The life cycle of *Bactrocera cucurbitae* includes egg, larva, pupa, and adult stages. It requires 14 to 27 days.

Marks of identification:

The adult Melon fly is 6 to 8 mm in length. Distinctive characteristics include its wing pattern, its long third antenna segment, the reddish-yellow thorax with light yellow markings, and the yellowish head with blackspots. The egg is elliptical, about 2 mm long and purewhite.The larva is a cylindrical- maggot shape, elongated with the anteriorend. It has anterior mouth hooks, ventral fusiform areas, and a causalend. The pupa has a different color from dull red or brownish yellow to dull white and is about 5 to 6 mm inlength.

Nature of damage:

The melon flies, damage the fruit and the vegetative parts of the host plant, decomposition of plant tissue by invading secondary microorganisms. Larval feeding damage the fruits, mature attacked fruits develop a water-soaked appearance. Young fruits become distorted and usuallydrop.Both the nymphs and adults possess piercing and sucking mouthparts. They occur in large numbers on the tender Shoots and lower leaf surfaces, and suck the plantsap. Slightly infected leaves exhibit yellowing. Severe aphid infections cause young leaves to curl and become deforming.

Prevention and control measure:

The affected fruits, leaves should be plucked anddestroyed.In heavy infection, the whole plant should be uprooted anddestroyed. Wrapping developing fruits with a protective covering and the use of baited traps. Toxicants in baits applied to refuge the fruit flies and sprays applied to the crop.

Corn earworm orboll worm (*Helicoverpa zea*):

Tomato, (*Solanum lycopersicum*) is an herbaceous annual in the family Solanaceae has grown for its edible fruits. The plant can be erect with short stems or vine-like with long,

spreading stems. The stems are covered in coarse hairs and the leaves are arranged spirally. The tomato plant produces yellow flowers, which can develop into a cyme of 3–12, and usually around fruit (berry) which is fleshy, smooth-skinned, and can be red, pink, purple, brown, orange, or yellow. The tomato plant can grow 0.7–2 m (2.3–6.6 ft) in height and as an annual, is harvested after only one growing season. Tomato may also be referred to as a love apple and originated from South America. During the survey, we observed that Helicoverpa zea was the most destructive pest on tomatoes. This pest has a wide host range, attacking vegetables that include corn, tomato, cabbage, cucumber, pea, potato, and watermelon. In tomatoes, it infects the fruits.The life cycle is completed in 30 days.

Nature of Damage:

The corn earworm is a major agriculturalpest.It is polyphagous (different types of plant-eating) larvae. The larvae are found associate with plant structures such as blossoms, buds, and fruits. The tomato fruit worm may feed on foliage and burrow in the Stem but most feeding occurs on tomato plants. The tomato plant is more susceptible to cotton bollworm. The pest burrows into a fruit, feed only for a short time, and then moves on to attack another fruit. This species is active throughout the year in some tropical and subtropical regions.

Larva of corn ear worm

Prevention and controlling measures

Spraying of pesticides is one method. Avoiding planting corn near tomatoes. Affected plants are removed and destroyed at the end of theseason.The affected fruits should be plucked and destroyed.

Black cut worm (*Agrotis ipsilon*):

Hyacinth bean (lablab bean) is pole beans of the Fabaceae family of legumes. Lablab bean is probably originated from India, where it is grown in the home gardens for immature pods, which are eaten as vegetables. The beans are also enjoyed in Japan as fujimame, in the Middle-East, Central America, and Brazil. Black cutworm is chiefly a pest of legume plant; it has a wide host range feeding on nearly all vegetables and many important grains, particularly hyacinth bean. The moth gets its scientific name from black markings on its forewings shaped like the letter “Y” or the Greek letter upsilon.Larvae feed on crops that include most vegetable plants like cotton, rice, sorghum, strawberry, sugarbeet, tobacco, Hyacinth bean, gram Channa and occasionally grains and grasses. Life cycle complete within 35- 60 days.

Figure 6: Black cut worm infected channa

Figure 7: Black cut worm

Nature of damage:

Hyacinth bean is mainly affected above the ground parts like Leaf, stem, pods. Pest may attack any stage of crop beginning from seed rot and results in dampingof seedlings. Pest may occur singular or closely in groups or circular to irregularly shaped holes in foliage. Due to infection, there are small dark brown to black lesions on cotyledons or eye-shaped lesions on the stem which turns sunken and brown. Feeding by the young larvae leads to skeletonized leaves, shallow dry wounds onfruits. Small patches of white powdery coating initially develop on both Surfaces of theolder leaves. The pest has a wide host range and attacks vegetables including Hyacinth bean and Gram channa.

Prevention and controlling measures:

By removing all plant residues from the soil after harvest will moniter the plants for eggs and young larvae and also removal of natural enemies that could be damaged by chemicals. Carbonyl, cyfluthrin, and permethrin are the pesticides effective against cutworm.

Conclusion:

Vegetable production is a year-round activity in the Chikkamagaluru district.This study has revealed that the occurrence of insect pests attacking a variety of vegetable growth.The common pest observed in the vegetables were Brinjal shoot and fruit borer (*Leucinodes orbonails),* Diamondback moth (*Plutella xylostella*), Melon fly (*Bacterocera cucurbitae*), Corn earworm or boll worm (*Helicoverpa zea*) and Black cut worm *(Agrotis ipsilon).* Insect pests have major effects on agricultural production and food supply. Although the application of insecticides has helped to minimize the impact of insect pests, chemical control entails economic, health, and environmental costs. Therefore, the development of new strategies or

improving the existing strategies other than chemicals for insect pest control is critical for sustaining agricultural production and improving our environment and health.

References:

Prasad, T. V. (2019): Handbook of entomology, 4th Ed. NewVishal publication.

Reddy D. S. (2010): Applied Entomology, 2nd Ed. New Vishal publication.

Srivastava P. D. and R. P. Singh (1997): Introduction to entomology.

https://pdfgoal.com/downloads/management_of_insect_pests_of_horticultural_crops.

www.agric.wa.gov.au

Johncapinera (2001): Handbook of vegetable pests.

http://www.isec.ac.in/Agri%20Profile-Karnataka.pdf

http://164.100.238.19/htmls/dept_horticulture.htm

https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/insect pests.

https://www.yourarticlelibrary.com/zoology/brinjal-shoot-and-fruit-borer-leucinodes-distribution-life-cycle-and-control/23961.

A REVIEW ON ANTI-CANCER ACTIVITY OF MEDICINAL PLANTS

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Abstract:

Cancer is a disease in which abnormal cells divide uncontrollably and kill body tissue. While technology has been improved and several new medicines have been found, the importance of medicinal plants does not go out of place. Medicinal plants play a significant role in the treatment of different types of diseases. This article delineates the anti- Cancer, phytochemical activities of medicinal plants present around the world.

Keywords: Cancer, phytochemicals, Medicinal Plants, anti-cancer activity.

Introduction:

Cancer is a group of diseases with the ability to invade or spread to other parts of the body involving irregular cell growth. The spread of cancer to other sites in the body is metastasis. The majority of deaths from cancer are due to cancer that has metastasized. Cancer is essentially a disorder of the regulation of tissue growth. The genes that control cell growth and differentiation must be altered in order for a normal cell to turn into a cancer cell (Croce, 2008). Usually, normal cells produce just about 30 percent of the energy for energy production from glycolysis (Al-Azzam, 2020). The phrase ‘Cancer’ is derived from the Greek word ‘tumour and crab’.

Cancer is largely caused by both genetic abnormalities and hereditary genetics. Tobacco use, diet and obesity, infections, ionizing and non-ionizing radiation and pollution are common environmental factors that lead to cancer death. Cancers are categorized by the type of cell resembling the tumor cells and are thus believed to be the source of the tumor. These forms include carcinoma, sarcoma, leukemia, lymphoma, tumor of germ cells, and blastoma.

It causes no symptoms as cancer starts. As the mass expands or ulcerates, signs and symptoms appear. Many are also seen in people that have other conditions. Cancer can be hard to detect and a 'healthy imitator' can be considered. Local symptoms can occur because of the

tumor's mass or its ulceration. Due to the reaction of the body to the cancer, systemic symptoms may occur. This may involve tiredness, unintentional weight loss, or changes in the skin (O'Dell *et al.,* 2009). Some cancers may cause a systemic inflammatory state, known as cachexia that leads to substantial muscle loss and weakness. Persistent fever can be caused by many forms of cancer, such as Hodgkin's disease, leukemia, and liver or kidney cancers.Hormones or other molecules formed by the tumor, known as paraneoplastic syndromes, are responsible for certain systemic symptoms of cancer. Hypercalcemiais a common paraneoplastic syndrome which can cause altered mental state, constipation and dehydration, or hyponatremia that can also cause altered mental status, vomiting, headache or seizures (Dimitriadis *et al.*, 2017)

Initially, most cancers are identified either because of the presence of signs or symptoms or by screening. Diagnostic tests are used to examine people with suspected cancer. These usually include blood checks, X-rays, CT scans and endoscopy (contrast). Other forms of tissue screening include cytogenetics and immunohistochemistry. These tests provide information on genetic modifications such as mutations, fusion genes, and changes in numerical chromosomes, so that the prognosis and best treatment can also be indicated.

Active steps to reduce cancer risk are known as cancer prevention. Environmental risk factors account for the vast majority of cases of cancer. Many of these environmental variables are lifestyle decisions that can be monitored. Cancer thus can be usually preventable. About 70% and 90% of common cancers are caused by environmental causes and can therefore be hopefully prevented (Wu *et al.*, 2016). By avoiding risk factors, including cigarettes, over weight/obesity, inadequate diet, physical inactivity, alcohol, sexually transmitted diseases and air pollution, more than 30 percent of cancer deaths may be avoided.Not all environmental factors, such as naturally occurring background radiation and cancers caused by inherited genetic defects, are controllable and are therefore not preventable by personal actions.

A type of gene treatment called CAR T-cell therapy has been approved by the FDA. It uses some of our own immune cells to treat cancer, called T cells. By inserting fresh genes, doctors take the cells out of our blood and change them so they can identify and destroy cancer cells faster. In order to treat breast cancer, the most common form of cancer, Ibrance, a targeted biologic therapy used for chemotherapy, has been developed. The medicine has been approved for use in advanced and secondary breast cancer cases and is given in combination with hormone therapy.

Review:

The assessed work was carried out through a thorough search of different research papers and patents from various web applications. The Scientifically based plant literature is also collected, which has strong anti-cancer properties.

Anti-cancer activity of medicinal plants:

***Allium bakhtiaricum* (Amaryllidaceae):**

Allium is a genus of monocotyledonous flowering plants consisting of garlic, onions, leek and chives, with thousands of species. Allium species occur in the Northern hemisphere's temperate climates. Chemical compounds, often derived from cysteine sulfoxide, are formed by plants of the genus Allium. The characteristic flavor of Allium relies on the sulfate content of the soil in which the plant grows (Block, 2010*)*. Invitro and invivo anti-cancer properties of *Allium bakhtiaricum* extracts were investigated against MDA-MB 231 cells and BAL/BC mice carrying 4T1 mammary carcinoma cells. MDA-MB is considered the most vulnerable cell line. MTT assay, flow cytometry, Annexin-V staining assay, Western blot analysis, beta-galactosidase-associated staining of senescence and microscopy of immunofluorescence is carried out and it was concluded that *Allium bakhtiaricum's* chloroform fraction had a suppressive effect on breast cancer via mitotic cell cycle arrest, implying a mechanism associated with disturbing polymerization of microtubules (Vafaee *et al.,* 2019).

***Aloe barbadensis miller* (Asphodelaceae):**

Aloe vera is the generic name of *Aloe barbadensis miller*. Aloe vera comprises polysaccharides like pectin, cellulose, hemicellulose, glucomannan and acemannan, carbohydrates, lignins, saponins, salicylic acid and amino acids. Acemannan in aloevera is the primary functional component. Aloevera has functions that are anti-bacterial, anti-cancer, anti-oxidant, anti-inflammatory, anti-fungal, anti-diabetic, and healing (Quispe *et al.,* 2018). Aloe vera heals wounds, enhances digestion, encourages oral hygiene, clears acne, relieves anal fissures, reduces blood sugar levels, improves skin and prevents wrinkles. It was reported that ethanolic leaf extracts of *Aloe barbadensis miller* have higher cytotoxic activity against the HepG2, HeLa and A549 cell lines of human cancer cell lines, but are non-cytotoxic to normal cells. The result indicated thatthe best anti-tumor agent commonly used in the treatment of many cancers is doxorubicin (Karpagam *et al.,* 2019).

***Angelica sinensis* (Apiaceae):**

Angelica sinensis in China is commonly known as 'dong quai'. It is often referred to as ‘female ginseng’. Phytosterols, polysaccharides, ligustilde, butylphthalide, cnidilde, isoenidilide,

p-cymene, ferulate, and flavonoids are phytochemical constituents present in *A.sinensis*. Z-ligustilide is the active compound found in *A. sinensis* (Chao and Lin, 2011). It has anti-inflammatory, imunostimulatory, neuroprotective, anti-cancer, anti-hepatotoxic and anti-cardiovascular effects. It is a herb that is used to enrich the blood, promote blood circulation, modulate the immune system, treat menstrual disorders and chronic constipation (Wu and Hsieh, 2011). Western blot analysis, cell proliferation assay, cell cycle analysis, cell migration and invasion assay and artificial analysis were performed and figured that there is a protective impact of female ginseng on gastric cancers (Liao *et al.,* 2018).

***Arctium lappa* (Asteraceae):**

In North America and Australia, *Arctium lappa* is commonly referred to as Greater Buddock and is an invasive plant with high-nitrogen oils. *A. lappa* contains sterols, tannins, mucilage, compounds of sulphurous acetylene, polyacetylene, bitter guaianolide, lignans of arctigenine, arctin and butyrolactone. Sequisterone lactone is considered to be the active compound in *A.lappa* (Ichihara, 2014). Heaptoprotective, antiviral, anti inflammatory, antioxidant, antiproliferative, proapoptotic, anti-neoplastic, anti-microbial and anti-cancer (Predes *et al.,* 2011) are the anti activities of *A. lappa*. Buddock is used as a diuretic, diaphoretic, purifying agent for blood, facilitating blood circulation to the surface of the skin, and curing skin diseases such as eczema (Chan *et al.,* 2010). It is used to treat gout, rheumatism, ulcers, psoriasis and acne (Nazmi *et al.,* 2018) used the cell line of HT-29 colon cancer and the cell line of MCF-7 breast cancer and performed MTT assays. *A. lappa* exhibited no cytotoxic effects on the viability of HT-29 and MCF cell line treated cells.

***Astragalus* (Fabaceae):**

Milkvetch, locoweed and goat's thorn are common names for *Astragalus*. Saponins, triterpenoids, isoflavones, flavonoids, campanulin, ononin, calycosin and formononetin are expressed in *Astragalus*. There has been no identification and characterisation of the active compound in *Astragalus*. *A.membranaceus* has cellular defensive functions that are immuno-modulatory, anti-inflammatory, anti-viral, anti-neoplastic, anti-oxidant, anti tumour, anti-aging and cardio vascular protection activities. For upper respiratory infections, allergic rhinitis, asthma, chronic fatigue syndrome and chronic kidney disorders, *A. membranaceus* is used as a nutritional supplement. HPLC analysis, MTT assay, flow cytometric analysis and western blot analysis have been carried out by (Z*hou et al., 2018)*. They reported that the supernatant method of *A. membranaceus* with water extraction-ethanol inhibits cell growth and induces apoptosis in cultured breast cancer cells and they concluded that *A.membranaceus* promises breast cancer patients an alternate approach.

***Camellia Sinensis* (Theaceae):**

The common names of *Camellia sinensis* include tea plant and tea shrub. Bioactive compounds such as alkaloids, flavonoids, hormones, terpenoids, carotenoids, tannins, folate, ascorbic acid and tocopherols (Yadav *et al.*, 2020) are found in *C. sinensis*. *C. sinensis* has anti-oxidant, anti-inflammatory, anti-hepatotoxic, anti-diabetic, anti-cancer, anti-agingand anti-microbial activity.In cognitive enhancements, diuresis, genital disorders and hyper cholesterlemia, *C. sinensis* is used. The main active constituent of *C. sinensis* is epigallocatechin-3-gallate. (*Esghaei et al., 2018)* evaluated anticancer activity of *C. sinensis* against the cell line of colorectal cancer. There is an MTT assay and an immunofluorescence assay. It is concluded that mammalian cells are safe from *C.sinensis*but toxic to cancer cells. This study showed that a good prognostic biomarker for colorectal cancer is the AQP5 protein found in intestinal cells. They have therefore verified that hydro-ethanolic extracts of *C. sinensis* which is a medicinal plant has a profound impact on cancer.

***Syzygium aromaticum* (Myrtaceae):**

S. aromaticum is usually referred to as clove and is used as a key spice. They are native to Indonesia's Maluku islands. Clove includes eugenol, vanillin, flavonoids, triterpenoids, glycosides, alkaloids, steroids, saponins andtannins. The compound that is active is eugenol. Clove is known to display anesthetic, anti-oxidant, anti-inflammatory, anti-microbial, anti-fungal, anti-bacterial, anti-canceractivities (Batiha *et al.*, 2020). It is used to relieve pain in the stomach, diarrhoea, hernia, nausea and vomiting. Anti-cancer activity against the thyroid cancer cell line was carried out by (Nirmala *et al.*, 2019) using MTT assay, colony formation assay and Annexin-V FITC assay. MTT studies indicated that cytotoxicity against the human thyroid cancer cell line was expressed in the formulation.The FITC assay of Annexin-V confirmed that cloves have an antiproliferative effect on cancer cells of Hth-7.

***Glycyrrhiza glabra* (Fabaceae):**

The common name for *G. glabra* is Liquorice. Triterpenoids, chalcones, and flavonones were identified as phytochemical compounds. The active compound present in *G.glabra*is Glcyrrhizin (Shah *et al.*, 2018). They are antispasmodic, anti-tussive, anti-ulcer, anti-cancer, and anti-inflammatory. Respiratory disorders, hyperdypsia, epilepsy, fever, paralysis, sexual weakness, stomach ulcers, rheumatism, haemorrhagic diseases, jaundice and skin conditions are treated. Nazmi *et al,* (2018) investigated the anticancer activity against the cell line of MCF-7 breast cancer and the cell line of HT-29 colon cancer. Their results showed that HT-29 and MCF-7 cell proliferation was prevented by *G.glabra*. On the HT-29 and MCF-7 cell lines, *G.*

glabra has pro-apoptotic and anti-proliferative effects. Their findings also suggested that *G. glabra* may potentially act as a chemoprotective agent for cancer.

***Psidium Guajava* (Myrtaceae):**

Guava is widely termed to as *P. guajava*. Saponins, flavonoids, phenolic compounds, carotenoids, glycosides, and ascorbic acid are the principal phytochemical constituents. The main active component present is citric acid. They have anti-cancer, anti-inflammatory, antioxidant, anti-fungal, antidiabetic and anti-inflammatory properties.They are used to treat inflammation, diabetes, hypertension, relief of wound pain, fever, diarrhoea, rheumatism, lung disease and ulcers. In order to determine their anti-angiogenic activity, (Bronwyn *et al.,* 2020) performed cell viability and rat aortic ring assays. To determine their effects on angiogenesis, cell proliferation, tube formation, colony formation and VEGF-ELISA assays have been performed.They stated that *P. guajava* ethanolic extracts have the potential to inhibit angiogenesis in the treatment of colorectal cancer.

***Carica papaya* (Caricaceae):**

C. papaya is usually regarded as papaya *C. Papaya* comprises papain, tocopherol, carotenoid, glucoside, alkaloid, saponin, flavonoid, polyphenols, tannins and prunasin (Nath *et al.,* 2016). *C. papaya* exhibits anti-inflammatory, antioxidant, anti-cancer, anti-diabetic and antimicrobial effects. They are used to treat malaria and used as abortifacient, purgative.Anti-cancer activity was carried out by (Mahendran *et al.*, 2021) against the MCF-7 breast cancer cell line. MTT, DNA fragmentation, caspase 7/9 induction detection assay and Annexin VFITC assays are performed.They concluded that *C. papaya* has possible anticancer activity against breast cancer after testing the extracts against MCF-7 breast cancer cell lines.

Discussion:

Medicinal plants have been used since ancient times for the treatment of many ailments, such as cancer. The herbs are commonly used in the treatment as it is known to be safer and more secure. Using ethno-botanical knowledge, we came to understand pharmacological importance about the medicinal plants that have potent action against cancer.The medicinal plants that are mentioned in this review paper are commonly used for cancer management.It is also seen that several researches carried out for the desire of establishing an effective treatment against cancer in India and also around the globe.

Conclusion:

Several medicinal plants in India are historically used in many methods of cancer treatment.Present review of the herbal anti-cancer activity helps to build successful herbal therapies.This article is intended to provide appropriate information and details about anti-cancer medicinal plants. The aspects that are mentioned here about the medicinal plants may be useful for more anticancer study.

References:

Akitami Ichihara, Yoshiaki Numata, Seiji kanai and SadaoSakamura (2014), "New sesquilignans from Arctium lappa L. The structure of lappaol C, D and E". Agricultural and Biological Chemistry, 41(9):1813-1814.

Al-Azzam N (2020). "Sirtuin 6 and metabolic genes interplay in Warburg effect in cancers". Journal of Clinical Biochemistry and Nutrition**. 66** (3): 169–175.

Bronwyn Lok, Doblin Sandai, Hussein M. Baharetha, Mansoureh Nazari V, Muhammad Asif, Chu Shan Tan and AMS Abdul Majid. (2020). "Anticancer effect of Psidium guajava (Guava) leaf extracts against colorectal cancer through inhibition ofangiogenesis". Asian Pacific Journal of Tropical Biomedicine. 10(7): 293-307.

Chan Y.-S.; Cheng L.-N.; Wu J.-H.; Chan E.; Kwan Y.-W.; Lee S.M.-Y.; Leung G.P.-H.; Yu P.H.-F.; Chan S.-W. (2010). "A review of the pharmacological effects of Arctium lappa (burdock)". Inflammopharmacology. 19 (5): 245–54.

Cristina Quispe, Michael Villalobos, Jorge Bórquez and Mario Simirgiotis(2018). "Chemical Composition and Antioxidant Activity of Aloe vera from the Pica Oasis (Tarapacá, Chile) by UHPLC-Q/Orbitrap/MS/MS". Journal of Chemistry.

Croce CM (January 2008). "Oncogenes and cancer". The New England Journal of Medicine. 358 (5): 502–11.

Dimitriadis GK, Angelousi A, Weickert MO, Randeva HS, Kaltsas G, Grossman A (2017). "Paraneoplastic endocrine syndromes". Endocrine-Related Cancer. **24** (6): R173–R190.

Eric Block (2010). Garlic and Other Alliums: The Lore and the Science. Royal Society of Chemistry.

Fabricia S Predes, Ana LTG Ruiz, João E Carvalho, Mary A Foglio&Heidi Dolder (2011). "Antioxidative and in vitro antiproliferative activity of Arctium lappa root extracts".BMC Complementary and Alternative Medicine . **11**(25)

Gaber El-Saber Batiha, Luay M. Alkazmi, Lamiaa G. Wasef, Amany Magdy Beshbishy, Eman H. Nadwa, and Eman K. Rashwan (2020).“Syzygiumaromaticum L. (Myrtaceae): Traditional Uses, Bioactive Chemical Constituents, Pharmacological and Toxicological Activities” .Biomolecules.10(2):202.

KarpagamT, Jannathul Firdous, Revathy, Shanmuga Priya, Varalakshmi B, Gomathi S, Geetha S and Noorzaid Muhamad (2019), “Anti-Cancer Activity of Aloe Vera Ethanolic Leaves Extract against In vitro CancerCells”, Research J. Pharm. and Tech. 12(5): 2167-2170.

KosarVafaee, SoudehDehghani, RahelehTahmasvand, Farzaneh Saeed Abadi, Saeed Irian&MonaSalimi (2019). “Potent antitumor property of Allium bakhtiaricumextracts”.BMC Complementary and Alternative medicine”.19:116

Kuan-Fu Liaoa B, Tsung-Lang Chiuc D, Sung-Ying Huange, Teng-Fu Hsiehc F, Shu-Fang Changg, Jhen-Wei Ruanh, Shee-Ping Cheni, Cheng-YoongPangj K and Sheng-Chun Chiug L M(2018).“Anti-Cancer Effects of Radix Angelica Sinensis (Danggui) and N-Butylidenephthalide on Gastric Cancer: Implications for REDD1 Activation and mTOR Inhibition”.International Journal of experimental Cellular physiology ,Biochemistry, and Pharmacology.48(6):2231-2246.

M Joyce Nirmala,LathaDurai, Vineet Gopakumar and R Nagarajan (2019). “Anticancer and antibacterial effects of a clove bud essential oil-based nanoscale emulsion system”. International Journal of Nanomedicine. 2019(14):6439-645.

Maryam Esghaei, HadiGhaffari, Bahman Rahimi Esboei, Zienab Ebrahimi Tapeh, Farah Bokharaei Salim and Manijeh Motevalian (2018), “Evaluation of Anticancer Activity of Camellia Sinensis in the Caco-2 Colorectal Cancer Cell Line”. Asian Pacific Journal of Cancer Prevention, 19(6): 1697-1701.

O'Dell, Michael D. Stubblefield andMichael W. (2009). “Cancer rehabilitation principles and practice”. New York: Demos Medical. p. 983

Rita Nath et al and Sch J Agric Vet Sci (2016).“Phytochemical and Proximate Analysis of Papaya (Carica papaya) Leaves”.An International Publisher for Academic and Scientific Resources. 3(2):85-87

Ruijuan Zhou, Hongjiu Chen, Junpeng Chen, Xuemei Chen, Yu Wen and Leqin Xu (2018). “Extract from Astragalus membranaceus inhibit breast cancer cells proliferation via PI3K/AKT/mTOR signaling pathway”, BMC Complementary Medicine and Therapies, 18:83.

Shiva Alizadeh Nazmi, Alireza Nourazarian, Reza Bahhaj and Fatemeh Khakikhatibi (2018), “The Anticancer Effect of Arctium lappa and Glycyrrhiza glabra on HT-29 Colon Cancer

and MCF-7 Breast Cancer Cell Lines". Crescent Journal of Medical and Biological Sciences, 5(2):133-137.

Syed Luqman Shah, Fazli Wahid, Noorullah Khan, Umar Farooq, Abdul Jabbar Shah, Shah Tareen, Fiaz Ahmad, and Taous Khan(2018). "Inhibitory Effects of Glycyrrhiza glabra and Its Major Constituent Glycyrrhizin on Inflammation-Associated Corneal Neovascularization".Evidence based complementary and alternative medicine.

V. S. Mahendran , K. Sophiya, S. Sruthi Malavika, B. Suganthi and E. Sujitha (2021). "Carica Papaya: Anti-Cancer Activity in MCF-7 Breast Cancer Cell Line". International Journal of Pharmaceutical Sciences and Research.12(1): 176-182

Wen-Wan Chao & Bi-Fong Lin (2011). "Bioactivities of major constituents isolated from Angelica sinensis (Danggui**)".**Chinese Medicine. 6(29)

Wu S, Powers S, Zhu W and Hannun YA (2016). "Substantial contribution of extrinsic risk factors to cancer development". Nature. 529 (7584): 43–7.

Yadav KC, Ashok Parajuli, Bishnu Bahadur Khatri, and Lila Devi Shiwakoti (2020). "Phytochemicals and Quality of Green and Black Teas from Different Clones of Tea Plant". Journal of Food Quality.

and Liang Hsieh (2011). " Pharmacological effects of Radix Angelica Sinensis (Danggui) on cerebral infarction". Chinese Medicine, 6:32.

http://repositorio.ufc.br/bitstream/riufc/34830/1/2018_art_vfpassos.pdf

https://en.wikipedia.org/wiki/Angelica_sinensis

https://www.healthline.com/health/how-to-use-aloe-vera-plant

https://www.medlife.com/blog/guava-fruit-benefits-amazing-uses-guava-leaves/

https://www.mountsinai.org/health-library/herb/astragalus

https://www.rxlist.com/burdock/supplements.htm

https://www.rxlist.com/consumer_green_tea_camellia_sinensis/drugs-condition.htm

https://www.sigmaaldrich.com/life-science/nutrition-research/learning-center/plant-profiler/arctium-lappa

https://www.webmd.com/cancer/cancer-new-research-treatment

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Dr. Vinod Kumari is currently working as an Associate Professor, Department of Applied Sciences and Humanities, Panipat Institute of Engineering and Technology, Panipat. She is having fifteen years of teaching experience and has proven her abilities as she is receiving appreciation certificates regarding the same for the past eight years. She completed her doctorate from Amity Institute of Applied Sciences, Amity University, Noida. Her area of interest is Nano-formulation of herbal plants, with a specific focus on therapeutic species of plants so that the nano-formulations could be helpful to mankind and the healthcare sector in the upcoming future. She has already authored two books on Engineering Chemistry. She is credited with 26 research papers in peer-reviewed national and international journals of high repute, conferences, and recently filed 01 patent also. She is a lifetime member of The Indian Society for Technical Education. She has been graced with the "Best Teacher Award" in 2017 and has the Certificate of Excellence to her credit.

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