SELECTED PROJECT REPORTS AND FIELD REPORTS FROM DIFFERENT DEPARTMENTS

Field Report Submitted By The Students

of

Department of Geography

THE UNIVERSITY OF BURDWAN

MANKAR COLLEGE

GEOGRAPHY HONOURS

6TH SEMESTER

A FIELD based project REPORT ON RIVER BANK EROSION:

A case study of Bhagirathi Hooghly region AT JALUIDANGA, SAMUDRAGARH, block purbasthali II

PREPARED BY:-

NAME- MANISHA SAHA

ROLL NO. - 190111700109

PAPER CODE- CC14

MANKAR COLLEGE

Mankar , Purba Bardhaman, West Bengal-713144

Department of Geography

To Whom It May Concern

This is certify that Sri/ Smt ...Manisha Saha... of 6th Semester Geography Honours, Roll No. 190111700109 of Mankar College has sincerely completed his/her fieldwork as part fulfilment of UG Geography syllabus of the University of Burdwan. He/She is herewith submitting the given field work relating to Disaster Management.

Principal 10.6.22	Dr. Srabanti Ghosh 10.6.22	Mr. Atanu Patra 10.06.2022
Mankar College	Assistant Professor	SACT, Dept. of
Principal / Secretary Mankar College	Dept. of Geography Mankar College GeographyDepartment	EnvironmentalScience

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We would like to thank the respected principal sir of Mankar College, Dr. Sukanta Bhattacharyya for providing us opportunities to undertake the field work. Finally we are thankful to all the residents and authorities of Samudragarh Village for their generous response and kind co-operation.

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All Students, B.A. Geography Hons, Semester VI, Geography Dept., Mankar College:

INTRODUCTION

Rivers are dynamic in character. They change their flow patterns continuously and naturally. These changes affect river bank soil stabilization because river bank absorbs the energy. River bank erosion is a part of this changing river flow dynamics. River banks have three zones- toe zone, bank zone and overbank area. Toe zone is situated between the ordinary water level and low water level which makes it vulnerable to erosion. If non cohesive materials are at the toe zone, vulnerability is increased. But at the time of lowering water level, cohesive banks are most susceptible to erosion because of its low water permeability.

When banks of a river wear away by watercourse, it is called river bank erosion. Important influencing factors of bank erosion are geological structure, lithological formation of bank, geomorphic processes operating on the bank area, fluid dynamics, texture characteristics of the soil of the bank etc.

Throughout the world bank erosion has been considered one of the threatening and sometimes unpredictable hazards. Every year, riverbank erosion leads to millions of people being affected as it results in damage and loss of crops, cattle, housing structures, and farmland. Loss of property, change on agricultural pattern and livelihood pattern are also important consequences. River bank failure or slump, sometimes occurred suddenly also triggers to disaster. In West Bengal river bank erosion is observed in the Ganges in Malda and Murshidabad districts and also found in Bhagirathi- Hooghly trac along Bardhaman and Nadia districts. All areas affected by river bank erosion need proper management to reduce future disaster.

Fig- Our Team At Study Area

- **Study area:**

The studied river course, Bhagirathi- Hooghly River, passes along the administrative boundary of Nadia (western side) and Burdwan (eastern side) districts of West Bengal.

Fig. : 01

The selected river reach of the Bhagirathi-Hooghly River middle course is 84 km of water track from Katwa (upstream) to Kalna (downstream), comprising a portion of the districts of Burdwan and Nadia. This present study is comprised of the bank displacement of the river Hooghly caused by erosional activities. The studied reach is located within the coordinates of (**23° 20' 52.354''N 88° 20' 15.144'' E)**

Plate-01

The average height of the study area is **(0.93+0.60+0.12)m /3 = 0.55 m (average staff reading)**above MSL and comes under the lower Ganga plain.

Plate-02

Plate-03

Three main landforms are accessible, i.e., from the Lower Ganga plains, uplands, old fluvial/deltaic plains, and young fluvial plains are established , in which the study area is situated within old deltaic plains. This area is situated geologically in the Rarh region, the lower part of the Bengal Basin's dying deltaic section and is made up of a recent Pleistocene deposit. Initially, along the river course, the region is covered by sandy clay, sand, fine silt, sandy loam, and loamy soil contained in the extensive low gradient land surface of the plain. Moreover, fertile soil of the floodplain areas is suitable for quality or productive cultivation.

- **Study area: (Minor)**

#	Place	Latitude	Longitude
1	Jaluidanga	23° 20' 58.07''N	88° 19' 36.134 E
2	Jaluidanga (Siddheswari Tala)	23° 21' 16.1''N	88° 19' 55.4'' E
3	Opp. Of Jaluidanga ghat and Bahirchara area	23° 20' 51.673'N	88° 20' 17.941'' E
4	Godkhali Malitpara	23° 23' 21.365''N	88° 8' 7.627'' E

Place 1(plate No-04): **Jaluidanga**

Place 2(Plate No-05): **Jaluidanga (Siddheswari Tala)**

Place 3(Plate No-06): **Opp. Of Jaluidanga ghat and Bahirchara area**

Place 4(Plate No-07)**Godkhali Malitpara**

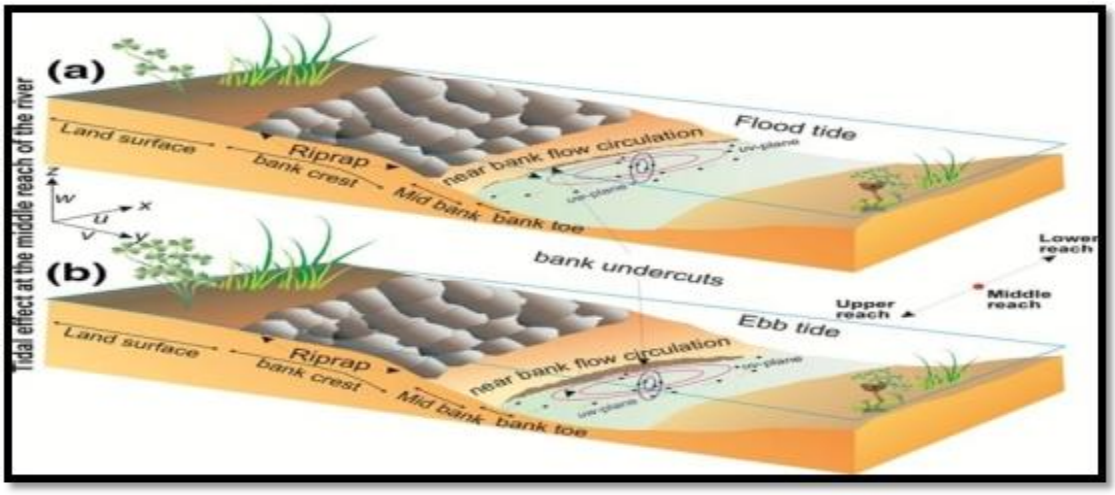
River Bank Erosion:-

Rivers are dynamic in character. They change their flow patterns continuously and naturally. These changes affect river bank soil stabilization because river bank absorbs the energy. River bank erosion is a part of this changing river flow dynamics. When banks of a river wear away by watercourse, it is called river bank erosion. Mostly river banks are made of stratified layers with cohesive and cohesion less materials. Now a daysriver bank erosion has been considered one of the threatening hazard that can sometimes turn into a disaster as a result of uncontrolled human activity.

Causes: Though river bank erosion is a natural process, human activities can increase its rate. Following are the natural causes of river bank erosion:

*1. Natural Process*s

- ✓ **Flood:** Flood is the most crucial reason of river bank erosion. The chances of flood increases in the rainy season. During flood the huge amount of water flow with higher velocity brings enough energy to tear away the top layers of soil or even causes mass failure. The water elevation is raised by centrifugal force resulting highest depth of flow at outside bend and gravitational force pulls down the water. This downward velocity against the bank is the erosive force.



(Plate-08) FLOOD

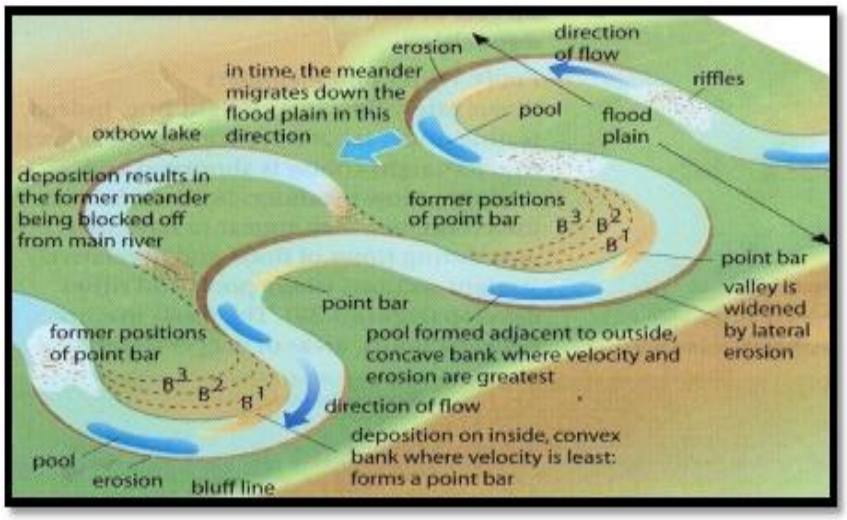
- ✓
- ✓

- ✓
- ✓
- ✓ **Heavy rainfall:**

Soil can be eroded by heavy and excessive rainfall. Heavy rainfall often causes strong waves which can loosen and wear away non cohesive bed materials.

- ✓ **Sedimentation:**

Various disturbances in the nature can cause sedimentation. Silt accumulation at the river beneath reduces water holding capacity of a river as saturation of banks occurs. So the direction of river is changed. Thus meandering rivers are formed eroding river bank.



(Plate:09))SEDIMENTATION

- ✓ **Strong current of rivers:**

Strong current generates because of the volume of water flowing or the steep stream gradient. Where the river currents are very much high, river bank erosion can occur. In case of cohesion less bed materials, these strong currents create a cantilever overhang of cohesive materials by wearing away non cohesive materials. So at the toe of the bank shear stress exceeds the critical shear and erosion occurs.

(Plate -10)STRONG CURRENT OF RIVERS

✓

✓ 2. Manmade Causes:

✓ **Deforestation causes River Bank Erosion:**

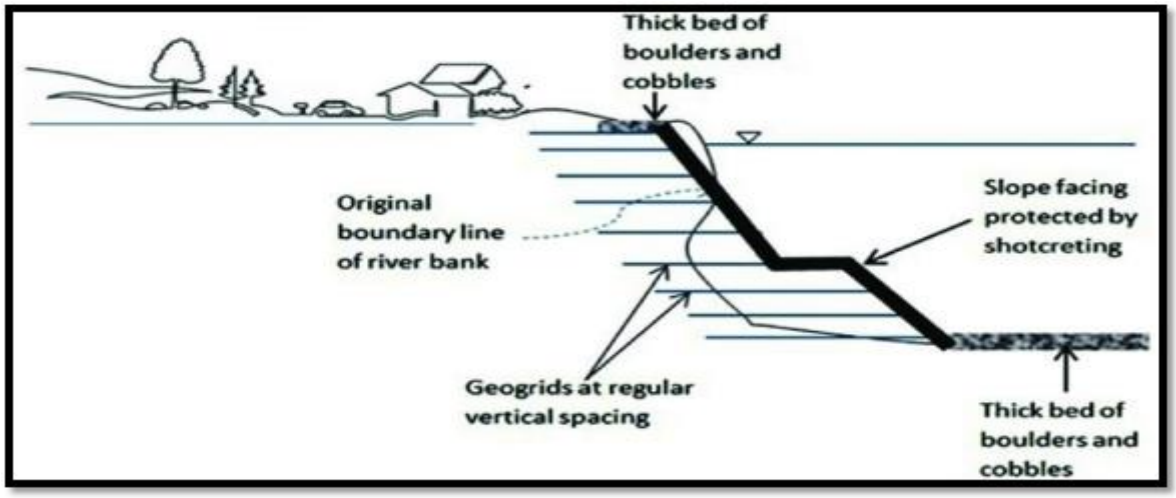
Humans facilitate erosion by cutting down trees at the bank for their own use and removing the natural reinforcement which exists there.

(Plate:11)DEFORESTATION CAUSES RIVERBANK EROSION

✓

✓ **Housing near bank:**

People in rural areas make their home near the bank which adds compressive force to the soil beyond its capacity and thus cause erosion.



(Plate-12) HOUSING NEAR

✓ **Soil extraction & River Bank Erosion:**

Humans extract excessive amount of soil from the bank for their uses or they extract huge amount of sands and gravels which help to hold back the soil. By doing this they accelerate river bank erosion.

(Plate-13)EROSION OF SEDIMENT LAYER & RIVER BANK EROSION

Materials and Methods :

In the present study both primary and secondary data have been used. As secondary data CD block map and population data from district census handbook have been collected for selection of study area and for study of its general characteristics. Satellite images (Landsat images of 1987, 2002, 2010 and 2021) have been downloaded from USGS Earth Explorer. As primary data soil sample (sample from different height of the eroded bank) has been collected from different location of the study area. Samples of different depth in a bank profile were kept in separate packets and labeled for future identification.

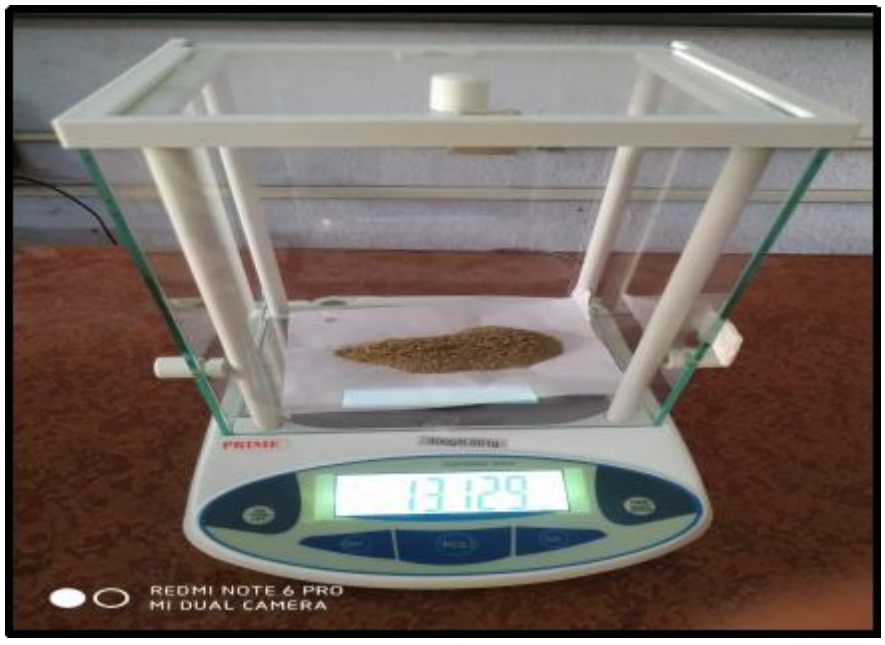
(Plate-14) Collecting of samples of sediments and labeling in the field

As a part of methodology we first processed the satellite image in QGIS platform. Through image processing and analysis we identified the part of bank affected by erosion. The course of the Bhagirathi river in our study area was digitized. Considering data of 1987, 2002, 2011 we detected the changing nature and extension of bank erosion over the study area. After that change detection maps have been prepared (Using QGIS software) showing extension of bank erosion in different years. During the field study depth of soil layer with different soil texture has been measured. Lots of photographs as evidence of bank erosion, and river shifting were captured. In these pictures soil layers of variable texture have been marked and the depths were noted.

The soil sample collected during the field work was first processed for texture analysis. Texture of all samples were determined by "feel method" (following the soil texture classes of USDA) and noted in a chart.

(Plate-15) Drying of sediments samples using Digital Hot air Oven

Each soil sample of a profile was first dried in Digital Hot Air Oven for a stipulated periodand weighted using a Digital Balance.



(Plate-16)Weighting samples of sediments using Digital balance

Then the dried samples were put in an Electric Sieve Shaker (GEOSYN). The No. of sieves used for the test were 600, 500, 425,355,300,250,212, 150,125,106, 90,75,63, 53, 45, 38,25 (sieve size in micron).

(Plate-17) Putting dried samples in an Electric Sieve Shaker to separate the particles according to their sizes:-

All samples remained separating by each sieve were weighted by the balance and recorded. Considering the average weight of the samples according to sieve size percentage of sand, silt and clay were determined compared to the total weight of the sample.

It is observed that soil texture has an important role in erodibility of river bank. Soil erodibility can be determined by Bouyoucos erodibility index as follows:

Bouyoucos erodibility index = (% Sand + % Silt)/ % Clay

If this index can be determined for all profile role of soil texture can be explained better.

RESULT AND DISCUSSION

The results of the above field work have been divided into two parts. First one is the work relating to extraction of GIS based maps from remote sensing images and second one is the results of sediment size analysis.

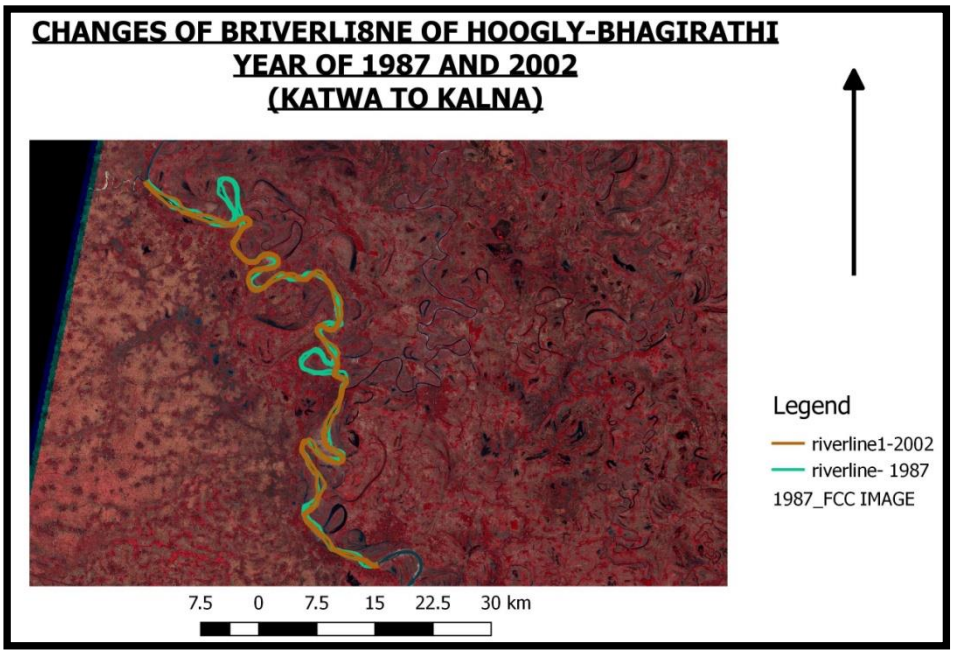
A) **GIS Based Maps**:

Three types of GIS based maps have been prepared on three different aspects. Those are:

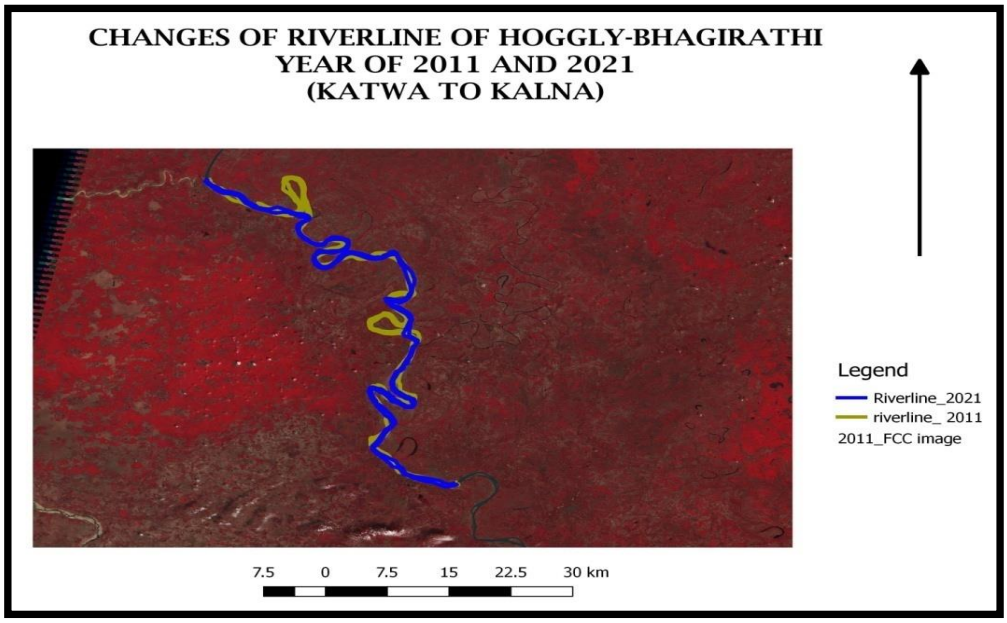
1. Temporal maps of river bank line maps
2. Temporal maps of ox-bow lakes and cut offs and
3. Temporal maps of point bars.

1. Temporal maps of river bank line maps

The figure no and figure no. represent the changes of river course from 1987 to 2021. It is clearly seen that river courses has been changes over time and the stretch of river taking new courses. The maps indicate that the region is under active geomorphological process through which erosion takes places at concave side and deposition at convex side.



(Fig. : 02)



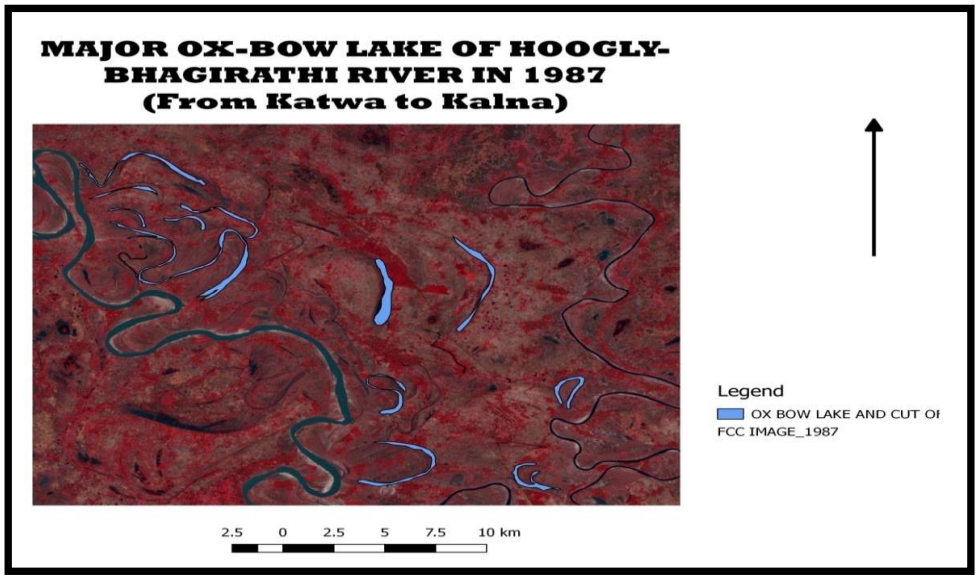
(Fig. : 03)

2. **Temporal maps of ox-bow lakes and cut offs**

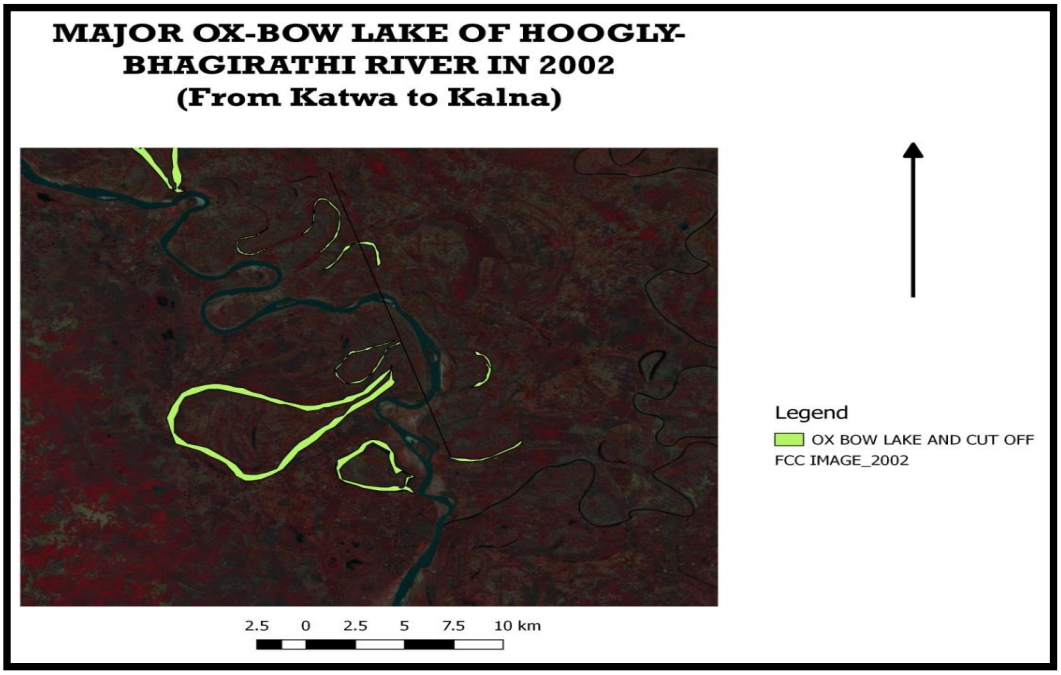
The maps of ox-bow lakes and cut offs (figure no.) clearly show the decreasing amount of the water bodies from 1987 to 2021. This clearly indicates all these water bodies are disconnected from riverine geomorphological process and with the time due to human activities, mainly transformation into agricultural land the amount of water bodies have been decreasing. The water bodies which could have store flood water during rainy season but due to shrinkage of water bodies, excess runoff water drains into river channel and instigates river bank erosion.

3. **Temporal maps of point bars**

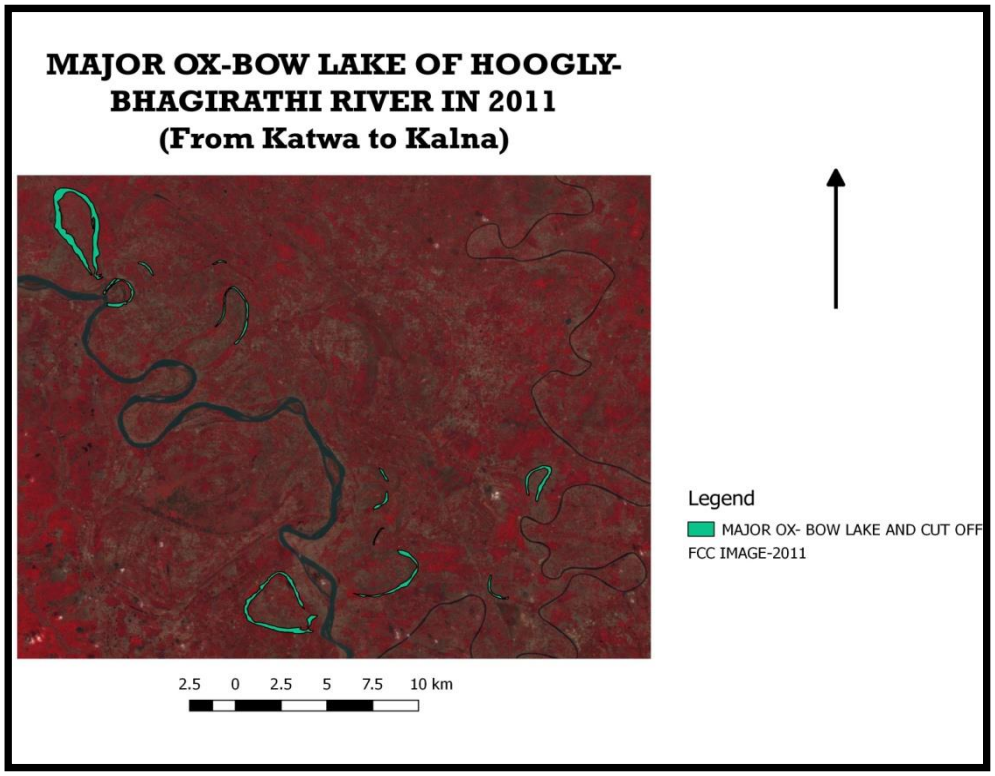
The point bar maps of four times clearly shows the decreasing trend of number of points bars i.e depositional environment. As deposition environment moves towards decreasing trends, it eventually increases erosional power of the river, which leads river bank erosion.


MAJOR OX-BOW LAKE OF HOOGLY-
BHAGIRATHI RIVER IN 1987
(From Katwa to Kalna)
Legend
OX BOW LAKE AND CUT OI
FCC IMAGE_1987
2.5 0 2.5 5 7.5 10 km

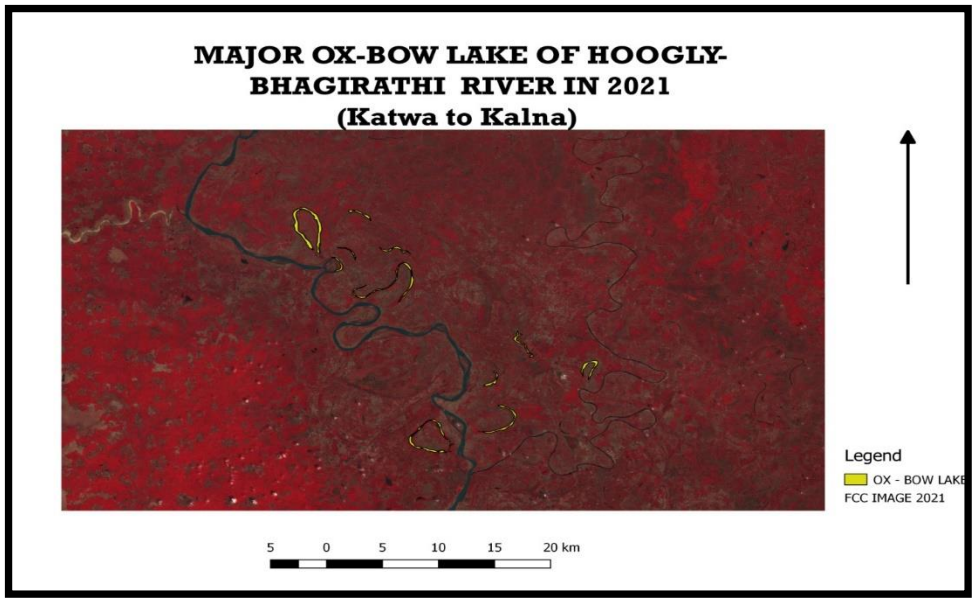
(Fig. : 04)


MAJOR OX-BOW LAKE OF HOOGLY-
BHAGIRATHI RIVER IN 2002
(From Katwa to Kalna)
Legend
OX BOW LAKE AND CUT OFF
FCC IMAGE_2002
2.5 0 2.5 5 7.5 10 km

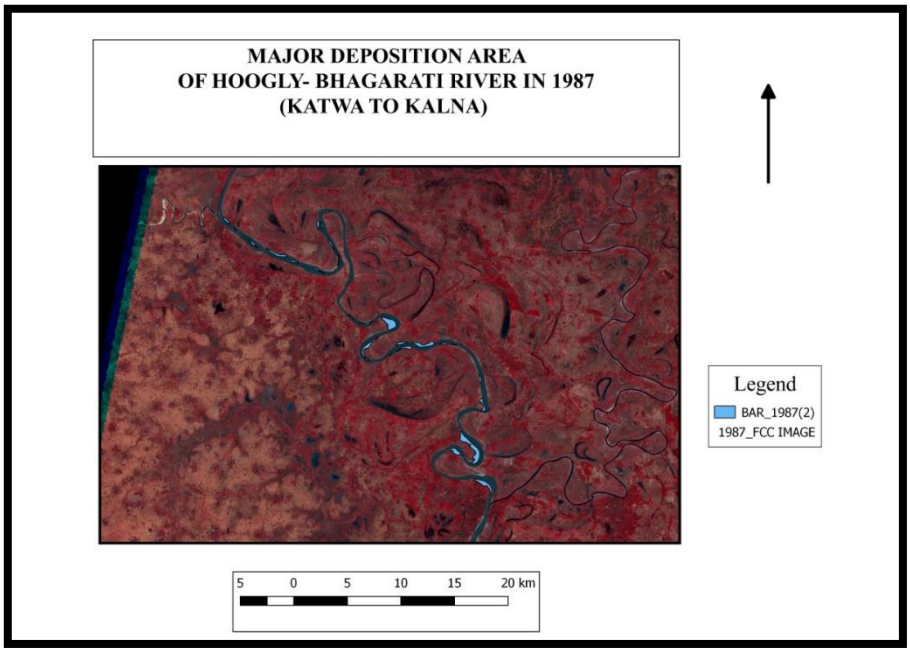
(Fig:05)


MAJOR OX-BOW LAKE OF HOOGLY-
BHAGIRATHI RIVER IN 2011
(From Katwa to Kalna)
Legend
MAJOR OX- BOW LAKE AND CUT OFF
FCC IMAGE-2011
2.5 0 2.5 5 7.5 10 km

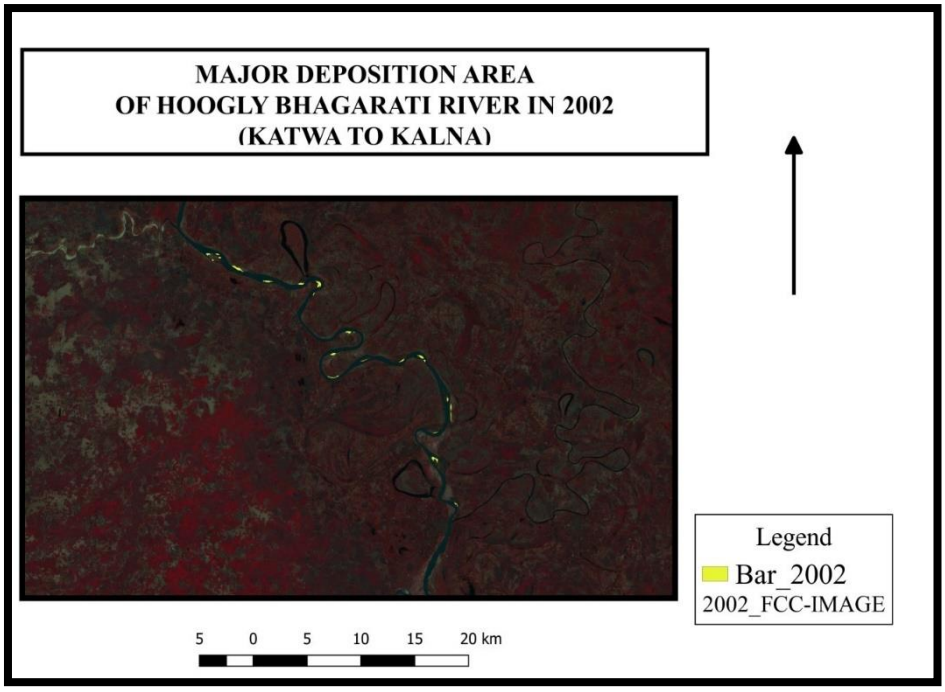
(Fig. : 06)


MAJOR OX-BOW LAKE OF HOOGLY-
BHAGIRATHI RIVER IN 2021
(Katwa to Kalna)
Legend
OX - BOW LAKE
FCC IMAGE 2021
5 0 5 10 15 20 km

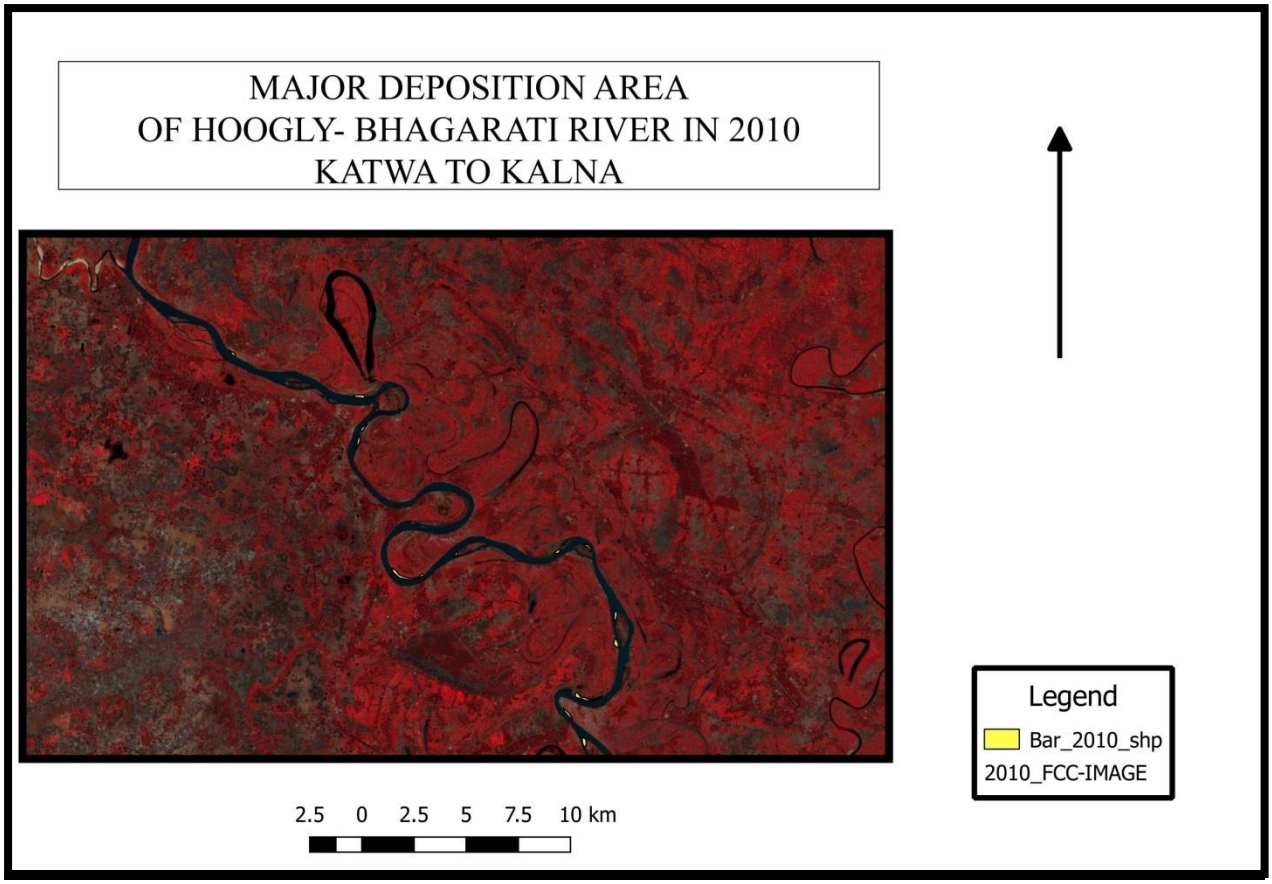
(Fig. : 07)


MAJOR DEPOSITION AREA
OF HOOGLY- BHAGARATI RIVER IN 1987
(KATWA TO KALNA)
Legend
BAR_1987(2)
1987_FCC IMAGE
5 0 5 10 15 20 km

(Fig. : 08)


MAJOR DEPOSITION AREA
OF HOOGLY BHAGARATI RIVER IN 2002
(KATWA TO KALNA)
Legend
Bar_2002
2002_FCC-IMAGE
5 0 5 10 15 20 km

(Fig. : 09)


MAJOR DEPOSITION AREA
OF HOOGLY- BHAGARATI RIVER IN 2010
KATWA TO KALNA
Legend
Bar_2010_shp
2010_FCC-IMAGE
2.5 0 2.5 5 7.5 10 km

(Fig. : 10)

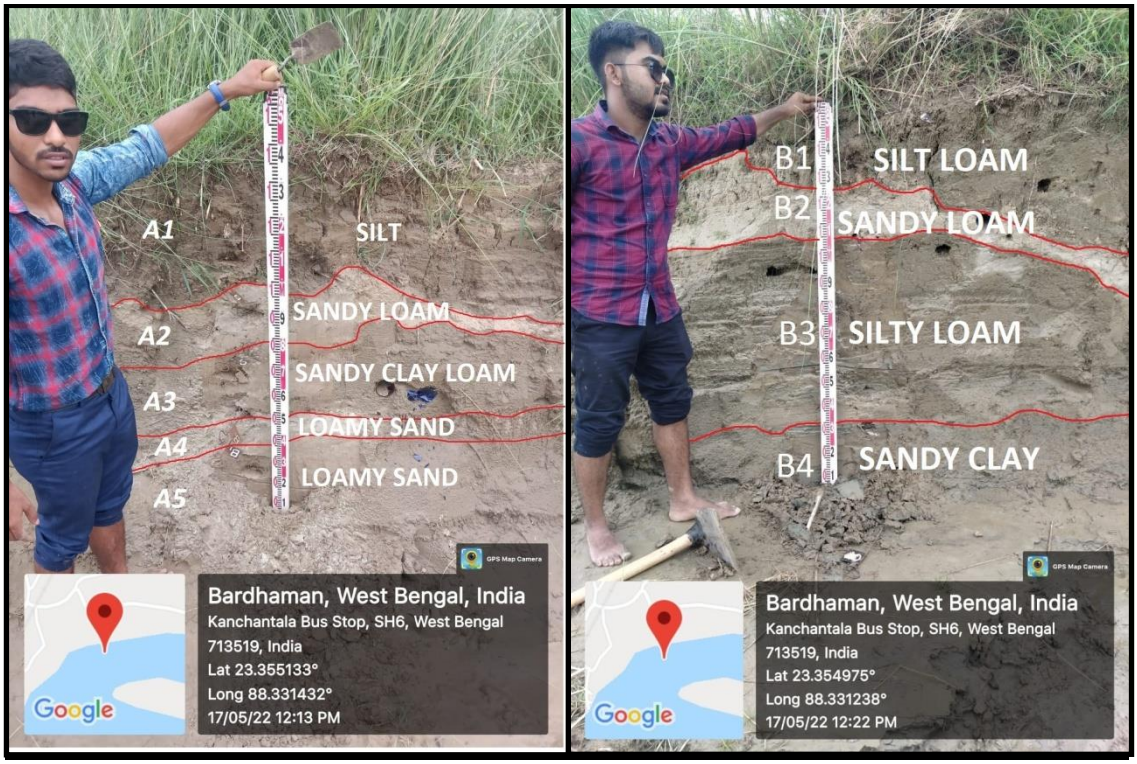
Result of Sediment Analysis:

We have studied 8 river bank vertical profiles from three different sites. From Jaluidanga we have taken 1 profile, from Jaluidanga Sidheswari area we have taken 6 profiles from a point bar and 1 profile from opposite bank of Jaluidanga ghat. Each profile includes three to six sediment samples from different textural sediment layers. The texture of all sediments has been estimated by feel method and sediment size of one profile (Profile A) has been derived through sieve shaker machine. The field photographs (Plate no: to Plate no:) represents characteristics of all eight profiles and their location maps have been represented in figure no. to figure no.

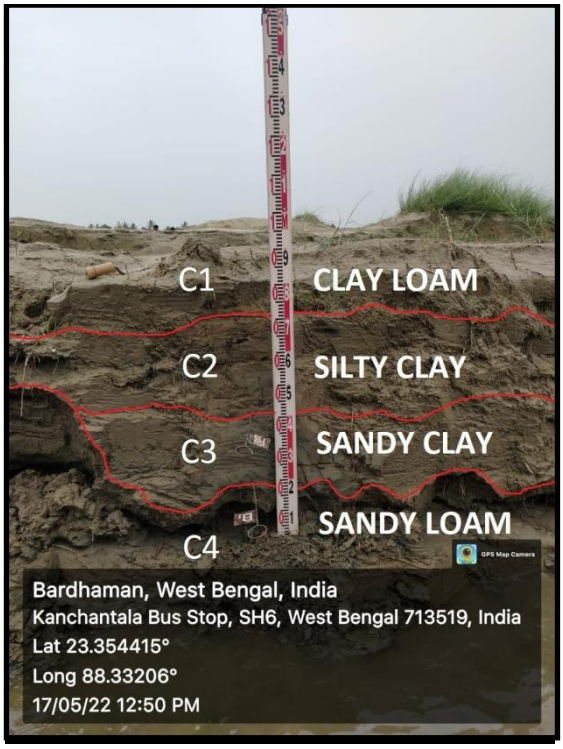
Profiles of Jaluidanga Sidheswari Area:

There are six profiles. These are profile A, B,C,D,E and F. The figure no. represents the location of all profiles.

(Fig. : 11)



Profile A, Place-04 (Plate-18) **Profile B , Place-04(Plate-19)**



Profile C, Place-02(Plate-20) **Profile D, Place-02(Plate-21)**

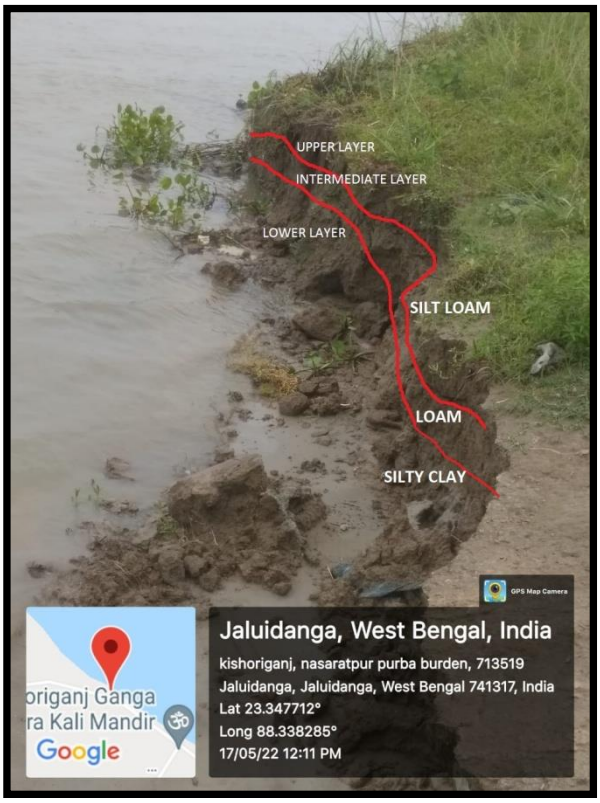
Profile E, Place-02(Plate-22) **Profile F, Place-04(Plate-23)**

Profiles of Jaluidanga and Opposite Bank of Jaluidanga:

There are two profiles. These are profile X and Y. The figure no. represents the location of profile Y.

(Fig. : 12)

Profile X , Place -01 (Plate-24)



Profile Y, Place -03(Plate-25)

The study of all sediment profiles clearly show that the bank deposition layer consists of different types of sediments of different grain size. It indicates different geo-hydrological conditions under which different size of sediments have been deposited over a long time and subject to deferent degree of present erosional process. The course grain size layer lying beneath the deposition layer is being eroded by toe erosion process and eventually upper layers of deposition are collapsed without having lower level support. This process leads river bank erosional process in the region.

To estimate Bouyoucos erodibility index, we have derived grain size of all samples in profile A through sieve shaking tools. The Table no 1 and Table no 2 represents the mentioned result:

Table no 1: Distribution of grain size of Different Samples in Profile A

Profile A	SAND (in Grams)													SILT (in Grams)			CLAY (in Grams)
SAMPLE	600	500	425	355	300	250	212	150	125	106	90	75	63	53	45	38	>25
A1	1.1	2.5	0.75	1.6	1.7	2.7	0.7	1.8	2.3	0.8	3.141	13.129	6.5	1.778	0.185	0.94	2.998
A2	X	X	1.008	0.915	0.187	0.435	0.41	1.514	1.491	2.251	1.969	7	5.993	6.9	2.463	1.85	3.032
A3	X	X	0.112	0.085	0.083	0.247	0.242	1.475	1.578	1.356	0.7	6.892	10.218	15.261	4.181	5.01	9.37
A4	X	X	0.188	0.069	0.112	0.261	0.17	0.843	2.013	5.719	5.835	18.282	6.727	9.199	1.27	1.61	3.66
A5	X	X	0.041	0.037	0.161	0.446	1.216	2.323	1.752	2.525	2.143	12.885	10.266	15.007	3.611	4.63	3.554

Table no 2: Distribution of percentage grain size of Different Samples in Profile A

SAMPLE	Total Sand	Total Silt	Total Clay	Total Amount	% of Sand	% of Silt	% of Clay	Bouyoucos erodibility index
A1	38.72	2.90	2.998	44.62	86.79	6.50	6.72	13.88
A2	23.17	11.22	3.032	37.42	61.93	29.97	8.10	11.34
A3	22.99	24.45	9.37	56.81	40.46	43.04	16.49	5.06
A4	40.22	12.08	3.66	55.96	71.87	21.59	6.54	14.29
A5	33.80	23.25	3.554	60.60	55.77	38.37	5.86	16.05

From the tables it is clear that erodibility index of the five layers are different and it is higher at the bottom layers. So, due to toe erosion process the bottom layers eroded easily and eventually the upper layers are collapsed without having any support. This is the simple mechanism of river bank erosion process of the Hooghly-Bhagirathi region.

Project Report Submitted By The

Students of

Department of Commerce

2022

PROJECT REPORT ON WOMEN ENTREPRENEURSHIP IN INDIA

Made under the guidance of my mentor Mr. Sujit Banerjee.

Krity Dubey
Roll no - 190211700015
Reg no – 201901010971 of 2019-20

Mankar College
Mankar, Burdwan - 713144
West Bengal

NAAC Accredited at 'B+'

Tel/FAX No.: +91-9475738113
Website: www.mankarcollege.ac.in
Email: principal@mankarcollege.ac.in

Ref. No.....

Date: .....

Department Of Commerce

To Whom it May Concern

Certified that **Kriti Dubey** of B.Com of Sem VI Accountancy (Hons) of Mankar college bearing Roll no 190211700015 Registration no 201901010971 of 2019-20 has undertaken a in house project titled **Women Entreprenurship in India** in 6th sem in the academic session 2021-22. He/she is permitted to submit herewith, the report pertaining to said fieldwork.

Sujit Banerjee
Sujit Banerjee
SACT II
Dept of Commerce
Mankar College

7.6.22
Dr. Sukanta Bhattacharyya
principal
Mankar College

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I would like to express my special thanks of gratitude to my teacher **Mr. Sujit Banerjee** as who gave me the golden opportunity to do this wonderful project on the topic **WOMEN ENTREPRENEURSHIP IN INDIA**, which also helped me in doing a lot of Research and I came to know about so many new things I am really thankful to her.

Secondly, I would also like to thank my parents and friends who helped me a lot in finalizing this project within the limited time frame.

CERTIFICATE

This is to certify that the project entitled **"WOMEN ENTREPRENEURSHIP IN INDIA"** has been done by **KRITY DUBEY** of **Bachelor of Commerce (Hons.)** from **Mankar College** under **The University Of Burdwan** under the guidance of **Mr. Sujit Banerjee**.

WOMEN ENTREPRENEURSHIP IN INDIA

Introduction

Entrepreneurship has traditionally been defined as the process of designing, launching and running a new business, which typically begins as a small business, such as a startup company, offering a product, process or service for sale or hire. It has been defined as the capacity and willingness to develop, organize, and manage a business venture along with any of its risks in order to make a profit. While definitions of entrepreneurship typically focus on the launching and running of businesses, due to the high risks involved in launching a start-up, a significant proportion of businesses have to close, due to lack of funding, bad business decisions, an economic crisis or a combination of all of these" or due to lack of market demand. In the 2000s, the definition of entrepreneurship has been expanded to explain how and why some individuals (or teams) identify opportunities, evaluate them as viable, and then decide to exploit them, whereas others do not, and, in turn, how entrepreneurs use these opportunities to develop new products or services, launch new firms or even new industries and create wealth.

Women entrepreneurship has been recognized as an important source of economic growth. Women entrepreneurs create new jobs for themselves and others and also provide society with different solutions to management, organization and business problems. However, they still represent a minority of all entrepreneurs. Women entrepreneurs often face gender-based barriers to starting and growing their businesses, like discriminatory property, matrimonial and inheritance laws and/or cultural practices; lack of access to formal finance mechanisms; limited mobility and access to information and networks, etc.

Women's entrepreneurship can make a particularly strong contribution to the economic well-being of the family and communities, poverty reduction and women's empowerment, thus contributing to the Millennium Development Goals (MDGs). Thus, governments across the world as well as various developmental organizations are actively undertaking promotion of women entrepreneurs through various schemes, incentives and promotional measures.

Importance of Women Entrepreneurship in India

Women in the present day have been recognized as an indivisible part of the global struggle for a stable economy. Same is the case in India where women have recently become the symbol of change.

Reasons that motivate women's entry in commerce vary but despite all of their variations in socioeconomic backgrounds, they have proved their worth time and again. They have taken risks in businesses and managed to make them pay off. Over and over, Indian women have competed with men and proven to be equal in every race, including entrepreneurship.

Role of Women Entrepreneurs in India

Indian Government defines woman owned business as an entity where a woman ora group of women owns at least "51% of the capital" and give 51% of generated employment to women. Women are 48% of Indian population but their participation is still below par as only 34% of Indian women are engaged in financial and economic activities, many of which are unpaid or underpaid workers.With gender-bias problems in some regions of India, women have also become victims of unemployment.

This bias has proven to be advantageous to certain extent as women have taken up entrepreneurship to fill the void and prove their critics wrong.

Significance of Women in India's EntrepreneurialSector

Indian women have been at the receiving end of criticism but much to the dismayof their skeptics, they have mostly appeared triumphant as the dust of criticism settled. The industry has much to gain and literally nothing to lose with women inbusiness. The merits are innumerable.

- Indian industry's think-tank gets bigger.

- New opportunities are created.
- More employment opportunities are generated.
- Per-capita income increases.
- Indians enjoy better standard of living.
- Education and awareness becomes common.
- Future becomes brighter for the next generation.
- Women gain a better understanding of managing family and business concurrently.
- Indian women achieve a sense of self-realization and self-fulfillment.
- Women gain better ability to take risks and business decisions.
- Women become more confident.

Opportunities to Indian Women Entrepreneurs

Educated, gifted, and qualified females can enter virtually any business. Successful women have been representing and still continue to represent brands like Times of India, PepsiCo, ICICI, TAFE, HP, HSBC and J.P Morgan along with other names. The list in the lines to come puts forward few sectors where women entrepreneurs of India can excel as senior managers and owners.

- Eco-friendly/ Bio-friendly sectors
- IT sector
- Event Management
- Lifestyle sector
- Beauty and cosmetic
- Healthcare
- Travel and tourism sector

- Food, food processing and beverages
- Telecommunications
- Financing
- Plastic manufacturing
- Local and international trading
- Property and estate

Barriers to Indian Women Entrepreneurs of India

But like mentioned before, countless hurdles have been laid for Indian women over the years. Surpassing all of these hurdles successfully is still a challenge. These are some of the problems women face after starting their business:

- Family problems
- Management of Finance
- Managing manpower
- Professional disrespect

The key reason of women being blocked from business is that they are women. Male prejudice is still prevalent in India. Male is still considered the dominant gender and sole bread provider. The view that Indian women lack self-confidence, willpower, mental composure and entrepreneurial attitude has made devastating effects on India. This view has kept the women from becoming leaders and has also instilled fear in women.

This age-old prejudice has also convinced a portion of women that they are unable to take risks; that they are unable to access technology, deal effectively with workers and that the best job for them is to raise a family.

However, India is full of examples new and old that a woman can be an entrepreneur and a successful one at that. Compared to men, fewer female businesses fail because of poor financial management once their business gets a kick start.

Solutions to Barriers

The problems women face pose a challenge for government and the authorities to tackle, but with the right approach and some time, they can be solved. Every Indian must understand the importance of women entrepreneurship. On top of all, women need motivation and any discouragement must be dealt with. Following are some measures that can be taken to make women empowered so that they can continue their business activities as confidently as Indian men.

- Creating better education opportunities.
- Making provisions for personality development and training.
- Improving communication skills.
- Institutions where women can learn entrepreneurial skills and risk taking abilities.
- Measures to change the attitude of society concerning women and women entrepreneurs in India.
- Attempts from nongovernmental bodies like agencies, trusts, welfare societies and NGOs.
- More women's associations for better financing and capital management.
- Providing nationwide platform for women like forums to discuss prevalent issues and solutions to deal with such shortcomings.

Policies and Schemes for Women Entrepreneurs in India

In India, the Micro, Small & Medium Enterprises development organizations, various State Small Industries Development Corporations, the Nationalized banks and even NGOs are conducting various programmes including Entrepreneurship Development Programmes (EDPs) to cater to the needs of potential women entrepreneurs, who may not have adequate educational background and skills. The Office of DC (MSME) has also opened a Women Cell to provide coordination and assistance to women entrepreneurs facing specific problems.

There are also several other schemes of the government at central and state level, which provide assistance for setting up training-cum-income generating activities for needy women to make them economically independent. Small Industries Development Bank of India (SIDBI) has also been implementing special schemes for women entrepreneurs.

In addition to the special schemes for women entrepreneurs, various government schemes for MSMEs also provide certain special incentives and concessions for women entrepreneurs. For instance, under **Prime Minister's Rozgar Yojana (PMRY)**, preference is given to women beneficiaries. The government has also made several relaxations for women to facilitate the participation of women beneficiaries in this scheme. Similarly, under the **MSE Cluster Development Programme** by Ministry of MSME, the contribution from the Ministry of MSME varies between 30-80% of the total project in case of hard intervention, but in the case of clusters owned and managed by women entrepreneurs, contribution of the M/o MSME could be upto 90% of the project cost. Similarly, under the **Credit Guarantee Fund Scheme for Micro and Small Enterprises**, the guarantee cover is generally available upto 75% of the loans extended; however the extent of guarantee cover is 80% for MSEs operated and/ or owned by women.

Some of the special schemes for women entrepreneurs implemented by the government bodies and allied institutions are provided below.

- Schemes of Ministry of MSME
  - o Trade related entrepreneurship assistance and development (TREAD) scheme for women
  - o Mahila Coir Yojana
- Schemes of Ministry of Women and Child Development
  - o Support to Training and Employment Programme for Women (STEP)
  - o Swayam Siddha
- Schemes started by various states for women development are as under:
- Schemes of Kerala State Women's Development Corporation
  - o Self employment loan programmes
  - o Educational loan schemes
  - o Single women benefit schemes
  - o Job oriented training programmes
  - o Marketing support for women entrepreneurs
- Kerala Government's Women Industries Programme
- Delhi Government's Stree Shakti Project
- Schemes of Delhi Commission for Women (Related to Skill development and training)
- Incentives to Women Entrepreneurs Scheme, 2008, Government of Goa
- Magalir Udavi Scheme, Pudhucherry Government
- Financing Schemes by Banks/ Financial Institution's

Associations Promoting Women Entrepreneur

A brief analysis of various associations and agencies that are functioning at state and national levels to promote women entrepreneurs is made for reference.

1. **Self-Help Groups (SHGs)**

   This is a voluntary association of small group of self-employed rural or urban women entrepreneurs who join together to take care of group welfare. The group with the help of financial institutions and other NGOs get their needs satisfied. Each member contributes little amount to cover seed money. Rest will be taken care off by FIs or NG0s. Governments also provide funds through FIs. For example, in Karnataka "Stree Shakti" scheme by Government of Karnataka. SHGs provide facilities to its members in the form of loan or raw material for production or skilled labor etc. These associations are helping small women entrepreneurs to start and develop home-based business. Women belonging to weaker sections of the society have been greatly benefited in their entrepreneural activities.

2. **Federation of Indian Women Entrepreneurs (FIWE)**

   FIWE is the outcome of resolution passed in 4th International Conference Women Entrepreneurs held at Hyderabad. This was founded in 1993. It mainly interacts with various women associations of the country through a network to facilitate the members in diversified activities.

   Activities of FIWE are as follows:

   1. To provide network facilities to women entrepreneurs in the country and abroad to develop their business.
   2. To provide facilities to member associations in the areas of marketing, quality control, export management, standardisation and also provides training facilities in these areas.
   3. Facilitates the member associations to participate in national and International conference, fairs, exhibitions, to provide greater exposure to women entrepreneurs in local, regional, national and global business

environment and provide an access to various business opportunities available.

4. Provides facilities to expand the business of members and of member associations. It may be new project or extension of the existing business.

3. Women's India Trust (WTI)

This trust was established in 1968. The promoter Kamila Tyabji made a small beginning with two shops in Mumbai and a training and production centre at Panvel. The trust was started with the main objective of helping women entrepreneurs. Encouraged by the growth of the activities of the trust, it further extended its activities which are as follows.

1. Establishing Kamila Trust in UK in 1994 to market the products of WTI members. The trust made its beginning by selling the products from door to door and then opened a shop in London under the name "KASHI".

2. Encouraged by its success in London, WIT extended the export activities to Australia, Europe and Germany from 1995 onwards.

3. Has started educational programme in "Nursing" and Kindergarten training.

4. Has plans to launch computer training for women.

Tips for Women Entrepreneur

- Start a business that works for you and your personal life
- Research the product/ service
- Assess the market
- Start business with adequate funds
- Do networking
- Consult with professionals

India’s most successful female entrepreneurs

Gone are the days when women were considered no match for all powerful men in this world.

The male dominated world was always reluctant to even acknowledge the fact that women were as good as men on parameters of hard work, intelligence quotient (IQ) and leadership traits.

The new generation women across the world have overcome all negative notions and have proved themselves beyond doubt in all spheres of life including the most intricate and cumbersome world of entrepreneurship.

Yes, there is a section among women who believe in short-cuts but at the same time there is no dearth of women who are confident ,believe in themselves and have enormous fire in their bellies to take on the best in the business and beat them at their own game.

India too has its own pool of such bold and fearless women who have made a mark for themselves both within the country as well as overseas.

Their relentless zeal, incessant quench for success and willingness to walk the extra mile have broken all myths about their inborn limitations that were supposed to be major roadblocks on their success expressways.

Let's meet some of such Indian women who can be easily termed as role models for every Indian- both males and females:

1. Indra Nooyi

Current position: CFO, Pepsico

Indra Nooyi,56, is the current chairman and CFO of the second largest food and beverage business, PepsiCo.

Born in Chennai, Indra did her Bachelor's in Science from Madras Christian College in 1974 and a Post Graduate Diploma in Management (MBA) from Indian Institute of Management, Calcutta in 1976.

Beginning her career in India, Nooyi held product manager positions at Johnson & Johnson and textile firm Mettur Beardsell. Nooyi joined PepsiCo in 1994 and was named president and CFO in 2001.

She has been conferred with prestigious Padma Bhushan for her business achievements and being an inspiration to India's corporate leadership.

2. Naina Lal Kidwai

Current position: Group General Manager & Country Head – HSBC,India

Naina Lal Kidwai,55, is presently the Group General Manager and Country Head of HSBC India.

Naina has a Bachelor's degree in Economics from Delhi university and an MBA from Harvard Business school. In fact, Kidwai was the first Indian woman to graduate from Harvard Business School.

She started her career with ANZ Grindlays . Presently, she is also serving as a non-executive director on the board of Nestle SA. Kidwai is also global advisor at Harvard Business school.

Indian government conferred Padma Shri award on Naina for her contributions in the field of Trade and Industry.

3. Kiran Mazumdar Shaw

Current position: CMD, Biocon

Kiran,59, is the founder Chairman and Managing Director (CMD) of Biocon Limited.

Born in Bangalore, Shaw completed her Bachelors in Zoology from Mount Carmel College, Bangalore University. She later did her post-graduation in Malting and Brewing from Ballarat College, Melbourne University.

She worked as a trainee brewer in Carlton and United Breweries, Melbourne and as a trainee maltster at Barrett Brothers and Burston, Australia.

She started Biocon in 1978 and spearheaded its evolution from an industrial enzymes manufacturing company to a fully integrated bio-pharmaceutical company.

Today Biocon under Shaw's leadership has established itself as a leading player in biomedicine research with a focus on diabetes and oncology.

Kiran is also a member of the board of governors of the prestigious Indian School of Business and Indian Institute of Technology Hyderabad.Kiran received the prestigious Padma Shri (1989) and the Padma Bhushan (2005) from the government of India.

4. Ekta Kapoor

Current position: JMD & Creative Director, Balaji Telefilms

Ekta Kapoor is the daughter of legendary star of yesteryears Jeetendra and brother of Bollywood actor Tusshar Kapoor.

Ekta has created a niche for herself in TV serial and film production. She can easily be termed as the most successful female producer of entertainment world.

Ekta has produced many successful films including Kyo Kii... Main Jhuth Nahin Bolta , Kucch To Hai Love Sex aur Dhokha, Once Upon a Time in Mumbaai, Shor in the City, Ragini MMS, Kyaa Super Kool Hai Hum and The Dirty Picture.

5. Suchi Mukherjee

Limeroad was started in 2012 by Suchi along with Manish Saksena, Ankush Mehra and Prashant Malik. The company has raised a funding of $20 Million from Lightspeed venture partners, Matrix partners and Tiger Global.

Suchi post graduated from London School of Economics and graduated from St. Stephen's College, Delhi. In his life Suchi received many awards and recognition like K.C. Nag Economics Prize for best student in Economics, George K. George Memorial Scholarship for overall contribution, all at St. Stephen's College, Delhi University, Cambridge Commonwealth Trust, Scholarship & Fellowship, and Chadburn Scholarship for merit, both at Cambridge University and British Chevening Scholarship, at the London School of Economics.

Suchi was selected as 1 of 15 women worldwide 'Rising Talents, high potential leaders under 40. Suchi is an ex-ebay, Skype and Gumtree.

6. Richa Kar

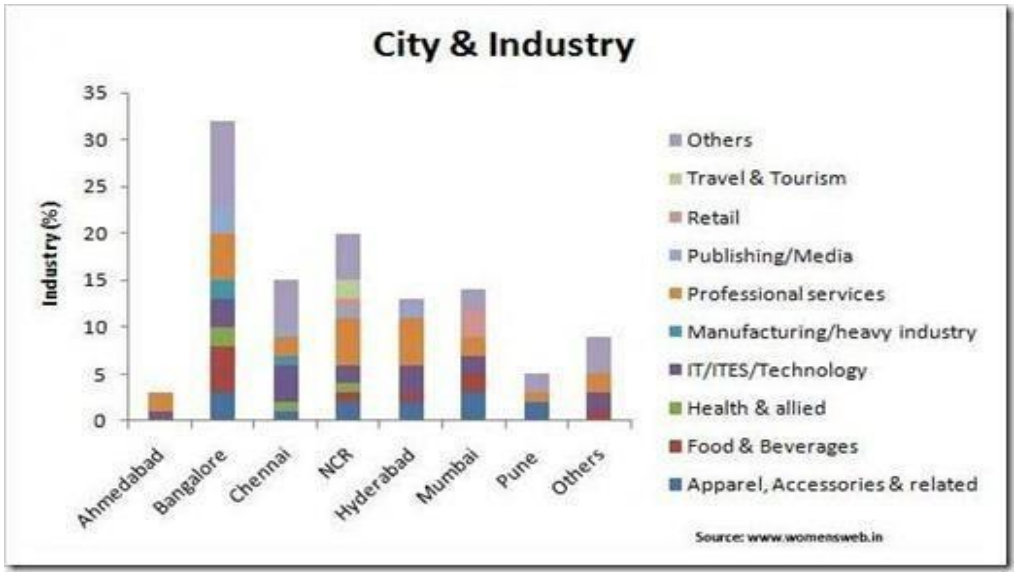
Richa is the founder of online lingerie store Zivame , she grew up in Jamshedpur and completed her engineering from BITS Pilani (2002) and after having worked briefly in the IT industry she acquired Masters' degree from Narsee Monji Institute of Management Studies in 2007, and worked with a retailer and global technology company before starting Zivame.com.

Zivame is probably the first in the online lingerie space in India and has played a role in educating women across the country about intimate wear and shaping consumer behaviour.

Statistics of Indian women entrepreneurs

WOMEN ENTREPRENEURSHIP IN INDIA

States	No of Units Registered	No. of Women Entrepreneurs	Percentage
Tamil Nadu	9618	2930	30.36
Uttar Pradesh	7980	3180	39.84
Kerala	5487	2135	38.91
Punjab	4791	1618	33.77
Maharastra	4339	1394	32.12
Gujrat	3872	1538	39.72
Karnatka	3822	1026	26.84
Madhya Pradesh	2967	842	28.38
Other States & UTS	14576	4185	28.71
Total	57,452	18,848	32.82



Conclusion

India is a male dominated society and women are assumed to be economically as well as socially dependent on male members. Women entrepreneurs faced lots of problems like lack of education, social barriers, legal formalities, high cost of production, male dominated society, limited managerial ability, lack of self confidence etc. Various factors like pull and push factors influencing women entrepreneurs. Successful leading business women in India. Government takes various steps for the upliftment of women entrepreneurs in 7th five year plan,8th five year plan and in 9th five year plan. Women have the potential the potential and determination to setup, uphold and supervise their own enterprise in a very systematic manner, appropriate support and encouragement from the society, family, government can make these women entrepreneur a part of mainstream of national ecomomy and they can contribute to the economy progress of India.

Project Report Submitted By The

Students Of

Department of Nutrition

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Mankar College
MANKAR, BURDWAN - 713144
WEST BENGAL
Estd. - 1987
NAAC Accredited at 'B'

Tel/FAX No. : 0343-2517269
Website : www.mankarcollege.org
E-mail : mail@mankarcollege.org

Ref. No. ..... Date .....

Department of Nutrition

To whom it may concern

This is to certify that Ms. Sayani Mukherjee, of B.Sc. Part III Nutrition (Hons) of Mankar College bearing Roll No.190311700038 Registration No. 201901010933 of 2019 – 20 has successfully completed her 6th semester assigned project titled " Nutraceuticals – let the be your medicine" in the year 2022. She is permitted to submit her assigned project.

Senjuti Saha 17.6.2022.
Senjuti Saha
SACT-I
Dept. of Nutrition
Mankar College

17.06.22
Dr. Sukanta Bhattacharya
Principal
Mankar College

Principal
Mankar College

Mankar College ESTD.-1987 Mankar, Burdwan

CONTENT

INTRODUCTION:-

Nutraceutical is a term derived from "nutrition" and "pharmaceutics" in 1989 by Stephen Defelice, founder and chairman of foundation for innovation in medicine, an American organization which encourages medical health.[265 pdf] The term is applied to products that are isolated from herbal products, dietary supplements (nutrients), specific diets and processed foods such as cereals, soups and beverages that other than nutrition are also in medicine. [3]

The quality of life in terms of income, spending and lifestyle has improved with economic development. However, it has also thrown up a major challenge in the form of 'lifestyle diseases'. The first victim of this lifestyle change has been food habits. Consumption of junk food has increased manifold, which has led to a number of diseases related to nutritional deficiencies. Nutraceuticals can play an important role in controlling them. No wonder more and more people are turning to nutraceuticals.

Nutraceuticals are known as bioactive substances that are present in common food or botanical-based sources that can be delivered in the form of dietary supplements or functional food, supplying beneficial effects in addition to the nutritional essential components. Nutraceuticals are well-known for their role of being involved in disease treatment and prevention, anti-aging properties, and malignancy prevention. Consuming probiotics is encouraged due to significant role in the treatment and prevention of gastrointestinal diseases. Garlic, for example has been suggested as a complementary therapy for high blood pressure and cholesterol.

Pharmaceutical drugs have some side effects and the emergence of antimicrobial resistance so nutraceuticals have gained attention as an alternative therapeutic and preventive approach alongside the advantages of being more affordable and available.[4]

Aims & Objectives:-

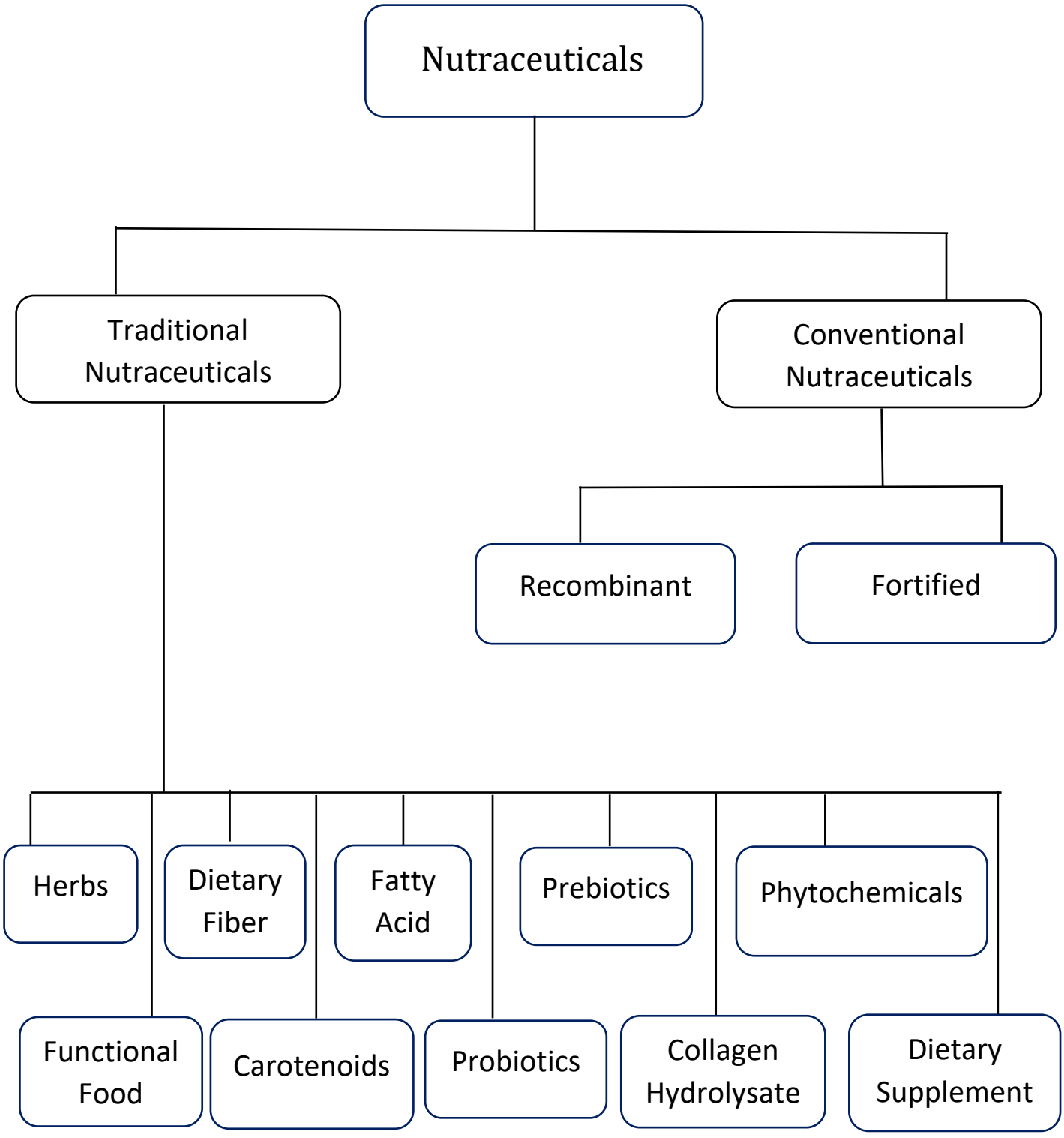
The main aim of this review is to highlight the recent studies outcomes of the pharmaceutical properties of nutraceutical compounds and the potential therapeutic activities, including an overview on several types of nutraceuticals and their different action on diseases. Additionally, the safety of nutraceuticals and future prospects are highlighted.

The reason for shift towards nutraceuticals are:

- Increasing number of consumers, concerned about healthcare costs
- Dissatisfied with pharmaceutical agents in promoting health, are turning to nutraceuticals to improve their health and prevent chronic diseases.
- Healthcare provider recognize the fact that our heavily processed food supply, coming from crops grown with chemical fertilizers, pesticides, herbicides, and often genetically modified seeds, lacks sufficient nutrients necessary for optimum health.
- People believing more in prevention than a cure.
- People who have chronic diseases and have found no solution in allopathic medicines.
- Economically challenged patients can afford this.[8]

CLASSIFICATION OF NUTRACEUTICALS :-

Nutraceuticals have been classified based on their application into traditional, non-traditional, fortified, recombinant, phytochemicals, herbal, functional foods, dietary supplements, probiotic and prebiotics. Nutraceuticals with their different classes have a variety of applications and uses depending on their nature.[4]



- ## Traditional Nutraceuticals and Products :-

Traditional nutraceuticals are defined as natural foods with their potential health attributes: this may include, but is not limited to, fruits, vegetables, grains, fish, dairy and meat products. Traditional foods or nutraceuticals can positively affect health by stimulating the immune system, and lowering the risk of heart disease and cancers.[4]

1. **Functional foods :-** Functional foods are foods with benefits in health improvement and disease prevention other than only providing nutrients. According to the International Food Information Council (IFIC), functional foods are "foods or dietary components that may provide a health benefit beyond basic nutrition".[7] These foods have ingredients that enhance antioxidant and anti-inflammatory activities, which are functional to prevent diseases such as type-2 diabetes. Examples of some functional foods are rice, wheat, kidney beans, soyabeans, lentil, chocolate, citrus fruits, nuts, and fermented milk.
2. **Carotenoids :-** Carotenoids are natural compounds and sources of pigmentation that accumulate abundantly in plants, fruits and vegetables and algae. A wide range of carotenoid derivatives are found in the human diet, including α-carotene, β-carotene, β-cryptoxanthin, lutein, lycopene, zeaxanthin, crocetin, fucoxanthin and astaxanthin. They are renowned for their wide spectrum of beneficial effects to health, including antioxidant and anti-inflammatory properties. In addition, carotenoids exert health benefits over human vision, cognitive functions, heart functions, cancer prevention, and immune functions. A study revealed the anti-inflammatory activity of two forms of carotenoids, astaxanthin and β-carotene, where both were found to be able to suppress the inflammation induced by Helicobacter pylori by inhibiting the production of reactive oxygen species and diminishing the level of inflammatory mediators being expressed.
3. **Collagen Hydrolysate :-** Collagen is a primary protein in mammals that can be extracted from bovine connective tissues such as skin, bone, cartilage, and tendons. Collagen extraction is obtained by subjecting it to sources of hot water; this provides a partially hydrolyzed product called gelatin. In order to completely hydrolyze gelatin, a process of enzymatic hydrolysis takes place to produce collagen hydrolysates. Collagen hydrolysates provide various beneficial effects such as antioxidant, anti-aging, antitumor, anti-inflammatory and anti-obesity effects. A study has shown the immune-boosting effects of collagen hydrolysates that have been extracted from domestic yak bone and its potential in improving the adaptive and innate immunity in mice. Furthermore, a study conducted to investigate the health benefits of collagen hydrolysate in females diagnosed with photoaged skin showed a remarkable improvement in skin hydration, wrinkling, and elasticity.[4]
4. **Dietary Fibers :-** Dietary fiber (DF) consists if non-digestible carbohydrates and lignins that are intrinsic and intact in plants.[5] Dietary fiber is the food material that is not hydrolyzed by enzymes secreted by the digestive tract, but digested by microflora in the gut. Chemically dietary fibers means carbohydrate

polymers with a degree of polymerization not lower than 3, which are nither digested nor absorbed in the small intestine.

Based on their water solubility, dietary fibers may be divided into two forms:-

i. **Insoluble dietary fiber (IDF),** which includes celluloses and lignins which is fermented to a limited extend in the colon.[6] Insoluble fibers tend to accelerate gastric emptying time which helps in relieving constipation.[4]
ii. **Soluble dietary fiber (SDF),** which includes β-glucans, pectins, gums, mucilage and hemicelluloses that are fermented in the colon.[6] Soluble fibers tend to delay gastric emptying time.[4]

High fiber diets are found to have a positive impact on inflammatory bowel diseases, because they can lessen the risk of Crohn's disease and ulcerative colitis.[4]

5. **Fatty Acids:-** Fatty acids are the component of oils and fats that are present in animal fats, fish oil supplements, seeds, olive oil and coconuts. Aside from their role in energy storage, they have been documented for their ability to act as an anti-inflammatory and immunomodulatory component in various studies. In one study, the omega-3 polyunsaturated fatty acids(PUFAs) administered as a dose of >2.7g/day for at least three months to patients rheumatoid arthritis showed reduction in the severity of rheumatoid arthritis symptoms.[4]

   PUFAs have two subdivisions: omega-3-(n-3) fatty acids and omega-6-(n-6) fatty acids. The major omega-3-fatty acids are α-linolenic acid (ALA), eicosapentanoic acid (EPA), docosahexanoic acid (DHA). ALA is precursor of EPA and DHA. EPA and DHA are found mainly in fatty fishes such as mackerel, salmon, herring, trout, blue fin tuna and in fish-oils. Principal sources of ALA are mainly flaxseed, soybeans, canola, some nuts and red/black current seeds. Omega-6-PUFAs mainly consists of linoleic acid(LA), γ-linolenic acid(GLA) and arachidonic acid (ARA). LA occurs mainly in vegetable oils e.g. corn, safflower, soyabean and sunflower. ARA is found in animal products such as meat, poultry and eggs.

6. **Phytochemicals:-** Phytochemicals are beneficial, concentrates or purified chemicals from plants that have active components for biochemical and metabolic reactions in humans, such as lutein and lycopene. Phytochemicals can help in maintaining chemical balance for the brain, thus providing neuroprotective activity. Additionally, high consumption of vegetables and fruits that contain phytochemicals can reduce the risk of cancers, and cardiac and neurodegenerative disorders.
7. **Herbs:-** Herbs are plants that have no woody tissue and can be processed in many ways depending on each individual preference. Herbs can be dried; however the drying process leads to a reduction in the effectiveness of herbal properties. Herbs that are rich in antioxidant have been used in flavoring and aroma for more than two thousand years. Garlic extract, ginger root, and aloe gel are herbs that have health benefits such as reducing cholesterol, wound healing and anti-ulcer and antioxidant activities.[4]

8. **Probiotics:-** The scientific interest in this area boosted from the work of Metchinkoff (1907) to transform the toxic flora of the large intestine into a host friendly colony of *Bacillus bulgaricus.* A probiotic can be defined as live microbial feed supplement, which when administered in adequate amounts beneficially affects the host animal by improving its intestinal microbial balance. Probiotics generally include the following categories of bacteria:-
    i. **Lactobacilli** such as *L. acidophilus, L. casei, L. delbrueckii subsp. Bulgaricus, L. brevis, L. cellobiosus.*
    ii. **Gram-positive cocci** such as *Lactobacillus lactis, Streptococcus salivarius subsp. Thermophilus, Enterococcus faecium.*
    iii. **Bifidobacteria** such as *B. bifidun, B. adolescentis, B. infantis, B. longum, B. thermophilum.*

Probiotics are available in various forms as powder form, liquid form, gel or paste or granule forms, capsule forms etc. Specific probiotics are generally used to treat gastrointestinal (GI) conditions such as lactose intolerance, acute diarrhea and antibiotic-associated GI side effects. There are evidences that administration of probiotics decreases the risk of systemin conditions, such as allergy, asthma, cancer and several other infections of the ear, urinary tract.[6]

9. **Prebiotics:-** Prebiotics are ingredients consisting of short chain carbohydrates that improve the probiotics' activity. These prebiotics are literally fertilizing agents for probiotics that are not affected by gastric pH and stomach acids. Prebiotics are non-digestible ingredients that promote the growth of productive microorganism and affect the composition and activity of gut microbiota. Fructo-oligosaccharides and inulin are examples of prebiotics used in functional foods to improve gastric health[4] The prebiotic consumption generally promotes the Lactobacillus and Bifidobacterial growth in the gut, thus helping in metabolism. Vegetables like chicory roots, banana, tomato, alliums are rich in fructo-oligosaccharides. Some other examples of these oligosaccharides are raffinose and stachyose, found in beans and peas. The health benefits of the prebiotics include improved lactose tolerance, antitumor properties, neutralization of toxins, and stimulation of intestinal immune system, reduction of constipation, blood lipids and blood cholesterol levels. A daily intake of 5–20 g of insulin and oligosachharides promote the growth of bifidobacteria. Again, consumption of large amounts of such oligosaccharides causes diarrhoea, abdominal distension and flatulence[6].
10. **Dietary Supplements:-** Although not entirely a traditional approach, dietary supplements are products that can be taken as a dietary ingredient by individuals to maintain and improve health and not to cure diseases. These supplements are found in various forms, such as tablets, liquid-based, capsules, powder, and concentrated with specific doses. Omega-3, vitamins A, B, C, D, and E, iron, folic acid, minerals, calcium, magnesium, etc., are some examples of dietary supplements that can either be taken by an individual with or without prescription. Moreover, these supplements can be consumed to ensure that a diet meets the sufficient nutrient requirements for the body and to prevent any deficiencies. At the beginning of the 20th century, food extracts that contain important nutrients

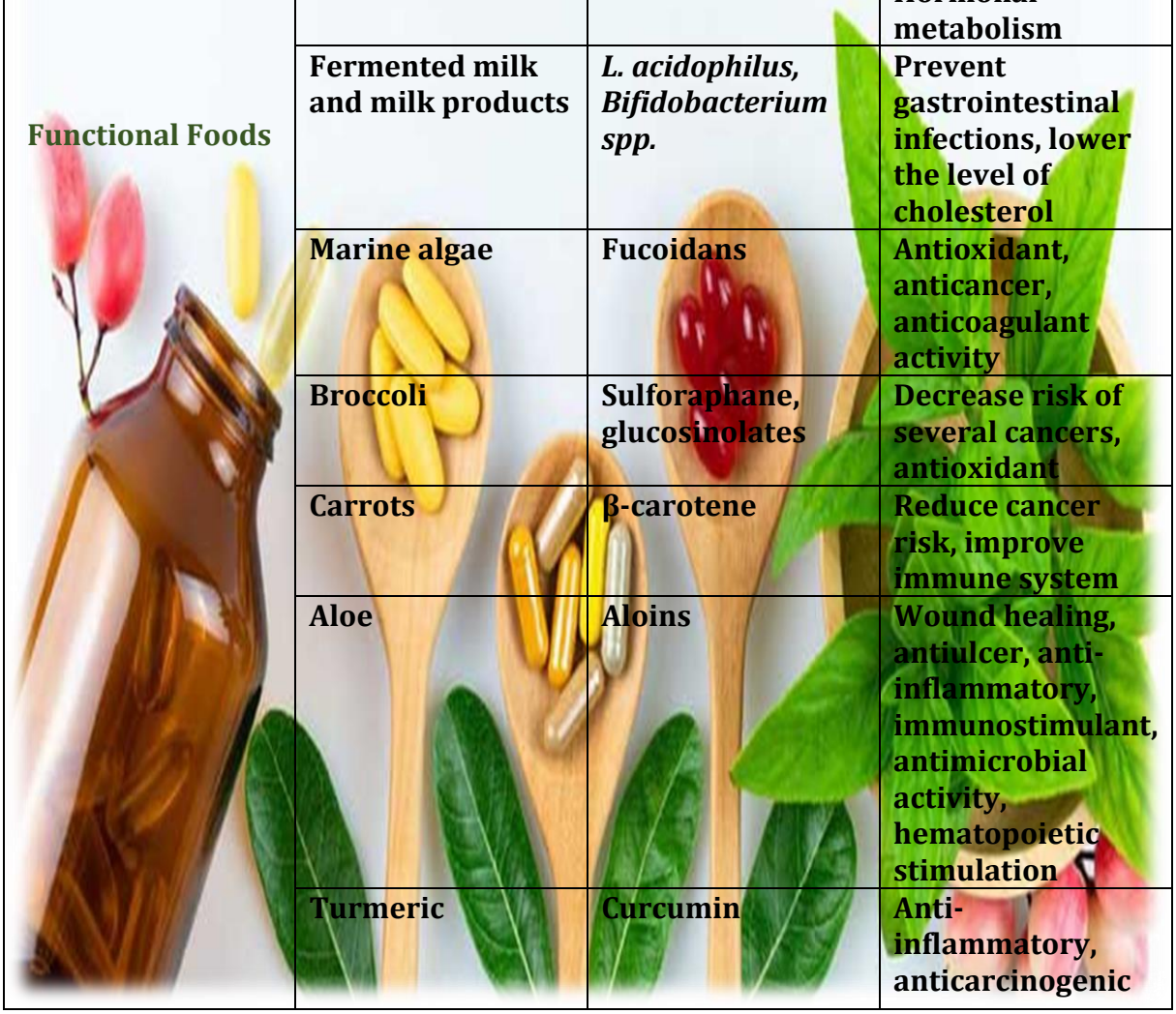
such as vitamin C, and B were shown to be helpful to prevent some serious conditions such as scurvy, pellagra, and beriberi.[4]

- ## Non-Conventional Approach:-

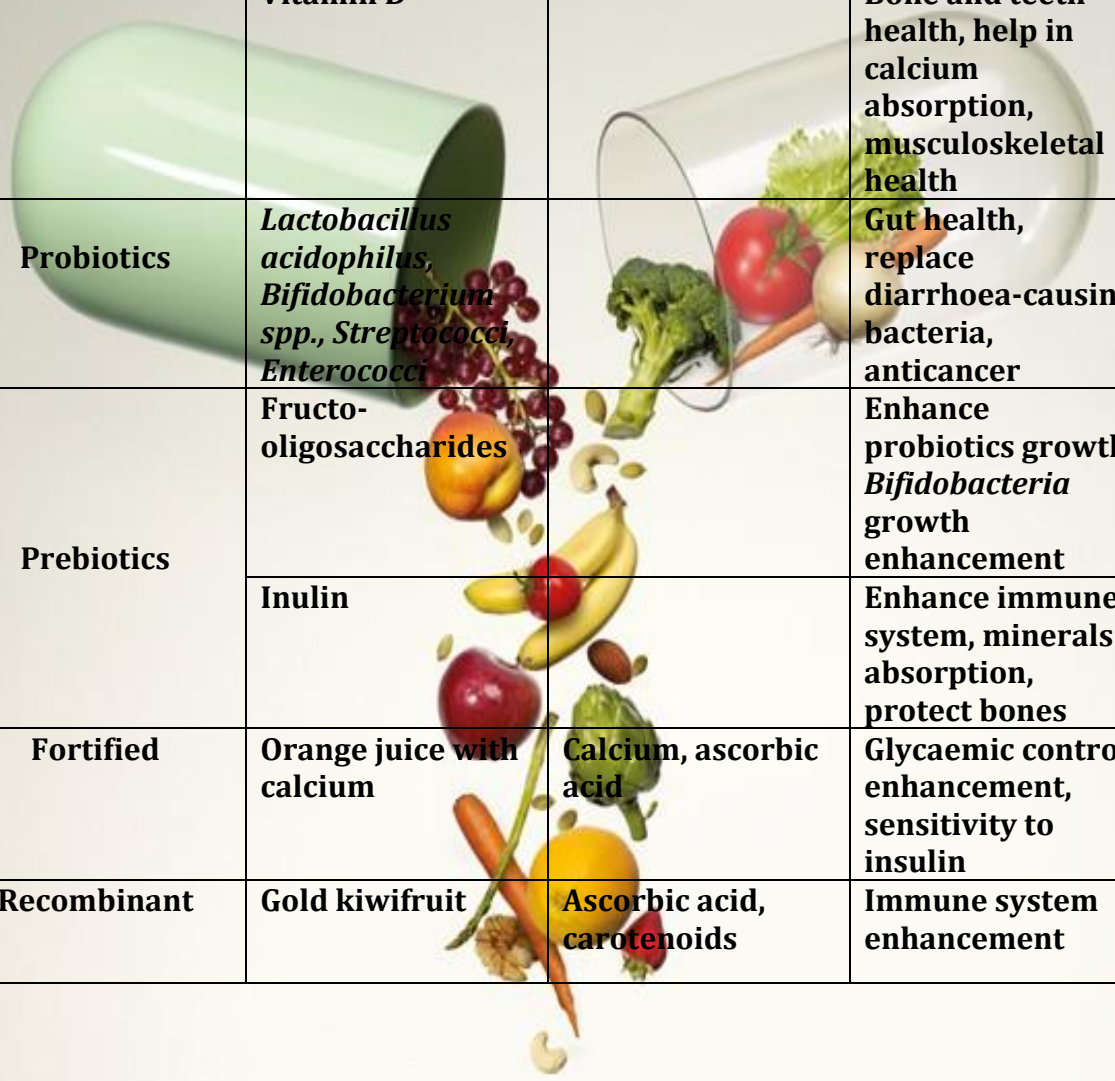
Non-traditional nutraceuticals, as a non-conventional approach, are artificially synthesized foods or food products. The application of biotechnology or agriculture breeding is used to add nutrient ingredients for the enhancement of food properties and human health. Based on the processing method, non-traditional nutraceuticals may be differentiated into fortified and recombinant nutraceuticals. Rice enriched with β-carotene, and cereals infused with vitamins and minerals are some examples of this class of nutraceuticals which contain provitamin A that can boost antioxidant activity.

1. **Fortified Nutraceuticals:-** Fortified nutraceuticals such as orange juice with calcium added, or milk with cholecalciferol vitamin are foods that contain additional micronutrients or vitamins added to them to improve their value. These foods supply the body with important nutrients that can prevent anaemia and improve health. For example, if calcium is added to specific food such as orange juice, the orange juice can enhance glycemic control[4].
2. **Recombinant Nutraceuticals:-** Recombinant nutraceuticals are foods that are produced by both genetic recombination and biotechnology. This type of foods and crops are genetically modified to develop products that contain recombinant compounds and proteins that would be make them more beneficial to health. Iron rice, golden rice, maize, golden mustard, multivitamin corn, and gold kiwifruit are examples of these nutraceuticals. Gold kiwifruit contains a recombinant gene that increases ascorbic acid levels, carotenoid, and lutein to enhance immune function. Additionally, it is considered a source of vitamins, potassium and fibre.

Summary of types of Nutraceuticals and their potential effect on health

Class/Types of nutraceuticals	Examples	Active Ingredient	Advantages
Functional Foods 	Tomato	Lycopene	Anticancer activities e.g., lung and prostate, reduce blood pressure
	Salmon	Omega 3	Lower cardiovascular, diabetes disease risk
	Soy	Saponins	Antioxidant, detoxification of enzymes, stimulate immune response, Hormonal metabolism
	Fermented milk and milk products	*L. acidophilus, Bifidobacterium spp.*	Prevent gastrointestinal infections, lower the level of cholesterol
	Marine algae	Fucoidans	Antioxidant, anticancer, anticoagulant activity
	Broccoli	Sulforaphane, glucosinolates	Decrease risk of several cancers, antioxidant
	Carrots	β-carotene	Reduce cancer risk, improve immune system
	Aloe	Aloins	Wound healing, antiulcer, anti-inflammatory, immunostimulant, antimicrobial activity, hematopoietic stimulation
	Turmeric	Curcumin	Anti-inflammatory, anticarcinogenic

Class/Types of nutraceuticals	Examples	Active Ingredient	Advantages
Dietary Supplements	Vitamin A		Antioxidant, growth, treat some skin diseases
	Folic acid		Prevent defect in neural tubes, Red blood cells formation
	Calcium		Bone, muscles, teeth nerve health, prevent osteoporosis
	Iron		Carry oxygen, produce energy
	Vitamin D		Bone and teeth health, help in calcium absorption, musculoskeletal health
Probiotics	*Lactobacillus acidophilus, Bifidobacterium spp., Streptococci, Enterococci*		Gut health, replace diarrhoea-causing bacteria, anticancer
Prebiotics	Fructo-oligosaccharides		Enhance probiotics growth, *Bifidobacteria* growth enhancement
	Inulin		Enhance immune system, minerals absorption, protect bones
Fortified	Orange juice with calcium	Calcium, ascorbic acid	Glycaemic control enhancement, sensitivity to insulin
Recombinant	Gold kiwifruit	Ascorbic acid, carotenoids	Immune system enhancement



Nutraceuticals and Diseases:-

Cardiovascular Disease:- Antioxidants, dietary fibers, omega-3 polyunsaturated fatty acids, vitamins, minerals are effective for prevention and treatment for CVD. Polyphenol (in grape) prevent and control arterial diseases. Flavonoids (in onion, vegetables, grapes, red wine, apples and cherries) strengthen the tiny capillaries that carry oxygen and essential nutrients to all cells. Rice bran lowers the serum cholesterol levels in the blood, lowers the level of LDL and increase the HDL in cardiovascular health. It is reported that low intake of fruits and vegetables is associated with a high mortality in CVD.

A. **Phytochemicals:-** Plant foods contain many bioactive compound known as 'phytochemicals'. Some groups of phytochemicals which have or appear to have significant health potentials are carotenoids, phenolic compounds (flavonoids, phytoestrogens, phenolic acids), phytosterols and phytostanols, tocotrienols, organo sulfur compounds, and non-digestable carbohydrates (dietary fibers and prebiotics). Isoflavons are found in high concentration in soyabean, soyabean products (tofu) and red clover. Lignans are mainly found in flax seed.

   i. **Polyphenol Compounds:-** Polyphenols have been shown in studies to exert anti atherosclerotic effects in the early stages of atherosclerosis development (that is decrease LDL oxidation); improve endothelial function and increase nitric oxide release (potent vasodilator); modulate inflammation and lipid metabolism (that is hypolipidemic effect); improve antioxidant status; protect against myocardial ischemia and platelet aggregation.

   ii. **Flavonoids:-** Plant derived flavonoids are the most common group of polyphenols in the human diet and are contained in vegetables and fruits as well as in beverages such as cocoa, tea and wine. Some isoflavons like lignans are phytoestrogen, a group of non-steroidal plant constituents, that elicit estrogen like biochemical response. They are associated as minor components with dietary fiber in dietary items like oil seeds, cereal grains, vegetables, fruits and legumes. Like other phenolic compounds, phytoestrogen have antioxidant activity and like estrogen they can influence lipoprotein metabolism and enhance vascular reactivity.

   Within the cardiovascular protective mechanisms of flavonoids several mechanisms have been proposed to explain the anti-inflammatory properties of flavonoids. This include their antioxidant activity and their properties as metal chelators, for transitional elements such as copper and iron that catalyze lipid oxidation; inhibitors of platelet aggregation; modulation of the activity of eicosanoid generating enzymes in

inflammatory cells enhancers of nitric oxide synthesis; lowering of superoxide production; beneficial effects on lipid profile.
Some flavonoid rich foods including chocolate or cocoa, red wine or grape, green or black tea may have some measurable effects on CVD risk factor.

iii. **Plant sterols and stanols:-** Plant sterols or phytosterols are structurally similar and functionally analogous to the animal sterols, cholesterol. Dietary sources include vegetable oils, nuts, seed and grain but the amounts are often not large enough to have significant cholesterol-lowering effects. Also they have been incorporated in foods with higher fat content, such as spreads (margarine) and salad dressings. Phytosterols and phytostanols inhibit intestinal absorption of cholesterol. Yet, effects of sterols or stanols on LDLs have been found to be additives to diets and/or cholesterol-lowering drugs. This has been basis for the development of phytosterol enriched functional foods. Similar efficacy have been observed between plant sterols and stanols when they are esterified, which is the form added to foods. Because plant sterols and stanols can reduce fat soluble vitamins, it is necessary to consume plant sterols and stanols with an appropriate intake of fruits and vegetables, including carotenoids.

iv. **Vitamin C:-** The powerful antioxidant functions of Vitamin C serve to reduce tissue reactive oxygen species concentration, which in the atherosclerotic condition help prevent endothelial disfunction, inhibit vascular smooth muscle proliferation, and reduce oxidized LDL cholesterol. Several prospective studies have assessed the role vitamin C, both dietary and supplement in CVD.

v. **Carotenoids:-** Carotenoids have been credited with other health promoting effects: immune enhancement and reduction of the risk of developing degenerative diseases such as cancer, CVD, and cataract. These physiological activities have been attributed to an antioxidant property, specifically interact with free radicals. The carotenoids, particularly lycopene and β-carotene, are other dietary antioxidants that function to reduce oxidative stress and blood markers of inflammation. Evidence for a role of carotenoids in CVD showed that higher intake of fruits and vegetables were associated with lower risk of CVD. Women who regularly eat large amounts of lycopene, from tomato and derivatives are less prone to developing CVD, since this phytochemical has the strongest antioxidant activities in the cardiovascular system. Results from another study confirmed that lower serum lycopene levels were associated with enhance risk of atherosclerosis in the common carotid artery.

vi. **Vitamin E:-** Mounting evidence supports the strong inverse association between plasma, vitamin E and CVD as well as that between vitamin E intake and risk of CHD. These may be essential to obtain effective reduction of oxidative stress. As with carotenoids, the contrast between

observational and interventional studies results suggests that the protective effect of α-tocopherol occur in the presence of other nutrients and therefore, it is most effective and safe when obtained from foods.

B. **Antioxidant Vitamin Supplementation:-** In view of the detrimental role of free radical and reactive oxygen species in the pathology of atherosclerosis, supplementation of antioxidant (Vitamin A,C,E, folic acid, β-carotene, selenium and zinc) was expected to be protective. Some supplements (that is merin n-3 fatty acids and niacin)

Epidemiologic studies have reported that a high dietary intake of food rich in Vitamin C, D and β-carotene have been inversely associated the incidence of CAD (Coronary Artery Disease). Nevertheless, firm recommendation to take antioxidant to treat or prevent CVD.

Nutraceuticals and Obesity Management:-

- Functional food like curcumin, capsaicin regulate adipocyte differentiation.
- Conjugated linolenic acid found in flax seeds, nut oil and fish oil reduces over all fat mass of the body. However, ω-3 polyunsaturated fatty acids (PUFAs) from fish oils, such as Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA), are known inflammatory factors. This agent suppress obesity mediated activation of inflammation.

- Psyllium fiber is extracted from the husks of its seeds. These seeds are used commercially for the production of mucilage. Psyllium delays gastric emptying and depresses appetite. Fiber may expand in the intestinal tract and as a result the body may feel more satiated.
- There is a wide range of calcium rich foods such as margarins and dairy product (milk, yogurt, cheese). There is increasing evidence that dietary calcium plays a role in body weight regulation. Calcium binds fat in the intestine resulting in the formation of insoluble calcium fatty acid soaps and reduces fat absorption. Increase in dietary calcium reduces 1,25 dihydroxy vitamin D concentration, resulting in down regulation of calcium fiber into adipose and pancreatic cells. Inside adipocytes, a reduction in intracellular levels leads to decrease fatty acid synthase transcription that results in lowering of lipogenesis and increase lipolysis. Reduce intracellular calcium in

pancreas decreases insulin output, which results in reduced lipogenesis and enhanced lipolysis in adipocytes.

- Resveratrol a polyphenolic compound in the skin of grapes and related food products, has been shown to prevent a number of diverse pathologic processes, including CVD, cancer, oxidative stress and inflammation and it is antiadipogenic and anticholesterolemic.

Nutraceuticals and Diabetes:- Diabetes is a metabolic syndrome, where a person suffers from high blood glucose. It is caused due to lack of insulin production or the body cells do not respond insulin or both. Some nutraceuticals use to treat or prevent diabetes are emblica officinalis, green tea, fenugreek etc. It also includes antioxidant Vitamins like Vitamin C and E and minerals like magnesium and chromium.

A balanced nutritional management, consists of nutraceuticals and abundance of bioactive components like phenolic compounds, sulfur compounds, herbs, natural antioxidants are involves in glucose metabolism which may prevent progression of diabetes and other associated complications. Some of the nutritional supplements are already available in markets which are extensively prescribed by the clinicians that is L-carnitin, α-lypoic acid, ω-3 fatty acids, chromium, soy and photoestrogens.

An increasing number of epidemiological investigation show that diet rich in foods with high content of phytochemicals, high total antioxidant capacity and polyphenolic compounds may be related to lower risk of diabetes and predisposing factors. Based on the current understanding of pathophysiology of insulin resistance and type 2 diabetes mellitus, multiple pharmacological and non-pharmacological interventions have been developed with the aim of improving glycaemic control and prevention of diabetes complications; in this area recently the use of functional foods and their bioactive components have been considered as the new approach in the prevention and management of diabetes and its complication.

There is increasing demand by patients to use the natural products with anti-diabetic activity. The efficacy of hypoglycaemic herbs is achieved by increasing insulin secretion enhancing glucose uptake by adipose and muscle tissues inhibiting glucose absorption from intestine and inhibiting glucose production from hepatocytes.

Ethyl esters of n-3 fatty acids may be essential in diabetic patients. Docosahexaenoic acid (DHA) modulates insulin resistance and is also vital for neuro visual development. Lypoic acid, an antioxidant, for treatment of diabetic neuropathy. Dietary fibers from

psyllium have been used for glucose control in diabetic patients and to reduce lipid levels in hyperlipidemia.

Diet related disease:- In Western societies, the incidence of diet-related diseases is progressively increasing due to greater availability of hyper caloric food and a sedentary lifestyle. Obesity, diabetes, atherosclerosis, and neurodegeneration are major diet-related pathologies that share a common pathogenic denominator of low-grade inflammation. Functional foods and nutraceuticals may represent a novel therapeutic approach to prevent or attenuate diet-related disease in view of their ability to exert anti-inflammatory responses. In particular, activation of intestinal T regulatory cells and homeostatic regulation of the gut microbiota have the potential to reduce low-grade inflammation in diet-related diseases.[5]

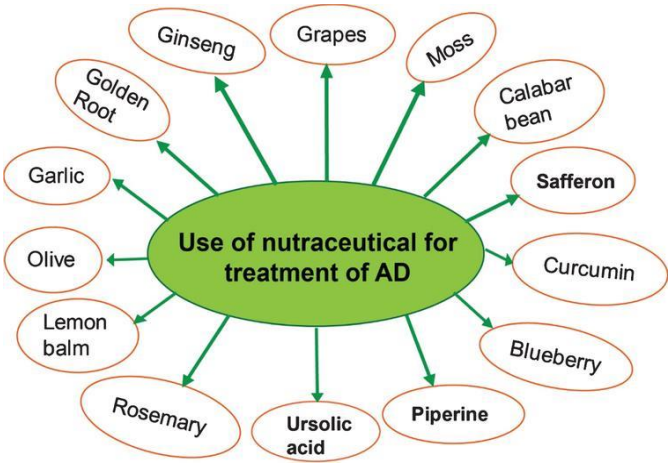
Heart attack and lung cancer:- Corn's contribution to heart health lies not just in its fiber, but in the significant amounts of folate that corn supplies. Corn maintains the homocysteine, an intermediate product is an important metabolic process called the methylation cycle. Homocysteine is directly responsible for damage of blood vessel heart attack, stroke, or peripheral vascular disease. It has been estimated that consumption of 100% of the daily value (DV) of folate would, by itself, reduce the number of heart attacks suffered by 10%. Corn also contains cryptoxanthin, a natural carotenoid pigment. It has been found that cryptoxanthin can reduce the risk of lung cancer of 27% on daily consumption.[5]

Cancer:- Flavonoids which block the enzymes that produce oestrogen reduces the oestrogen-induced cancers. Prevent prostate/breast cancer a broad range of phyto-pharmaceuticals with a claimed hormonal activity, called "phytoestrogens" is recommended. Soyfoods source of isoflavones, curcumin from curry and soya isoflavones possess cancer chemopreventive properties. Lycopene concentrates in the skin, testes, adrenal and prostate where it protects against cancer.[5]

Anti-inflammatory activities:- Curcumin (diferuloylmethane) which is a polyphenol of turmeric possesses anticarcinogenic, antioxidative and anti-inflammatory properties. Top of form Beet roots, cucumber fruits, spinach leaves, and turmeric rhizomes, were reported to possess anti-tumor activity. Gamma linolenic acid (found in green leafy vegetables, nuts, vegetable oils i.e. evening primrose oil, blackcurrant seed

oil and hemp seed oil, and from spirulina, cyanobacteria) are used for treating problems with inflammation and auto-immune diseases. Glucosamine and chondroitin sulfate are used against osteoarthritis and regulate gene expression and synthesis of PGE2Cat's claw acts as a potent anti-inflammatory agent. The two known species of cat's claw are Uncaria guianensis, used traditionally for wound healing; and Uncaria tomentosa, which has numerous medicinal uses & is most commonly found in supplements. Cat's claw is a rich source of phytochemicals 17 alkaloids, glycosides, tannins flavonoids, sterol fractions and other compounds.[5]

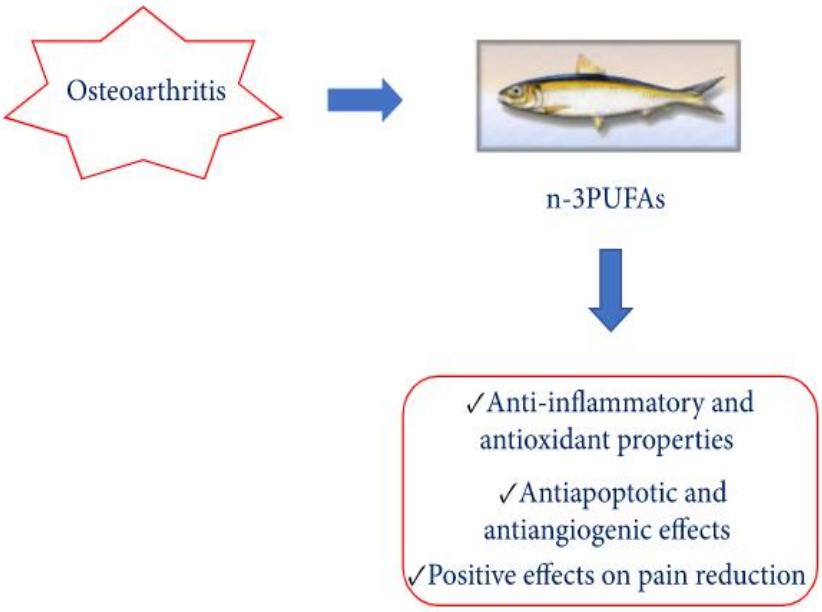
Alzheimer's Disease:- β-carotene, curcumin, lutein, lycopene and turmerin may exert positive effects on specific diseases by neutralizing the negative effects oxidative stress mitochondrial dysfunction, and various forms of neural degeneration.[5]



Parkinson's Disease:- Vitamin E in food may be protective against Parkinson's disease. Canadian researchers indicated that vitamin E in food may be protective against Parkinson's disease. Creatine appeared to modify Parkinson's disease features as measured by a decline in the clinical signs. Nutritional supplements have shown some promising results in preliminary studies, it is important to remember that there is not sufficient scientific data to recommend them for Parkinson's disease at present. The

patients should be cautioned that over-the-counter medications do have side effects and interactions with other drugs and are also expensive.[5]

Osteoarthritis:- Osteoarthritis (OA), a debilitating joint disorder, is the most common form of arthritis in the United States, where it affects an estimated 21 million people. In 2004, the direct and indirect health care costs associated with all forms of arthritis were approximately 86 billion dollars. Joint discomfort from OA and other joint disorders may reduce physical activity in individuals experiencing this condition, resulting in energy imbalance and weight gain. Increased weight can exacerbate existing problems, through additional stress on joints. Glucosamine (GLN) and chondroitin sulfate (CS) are widely used to alleviate symptoms of OA. The nutraceuticals like n-3 PUFAs have both nutrient and pharmaceutical properties and seem to regulate gene expression and synthesis of NO and PGE2, providing a plausible explanation for their anti-inflammatory activities.[5]



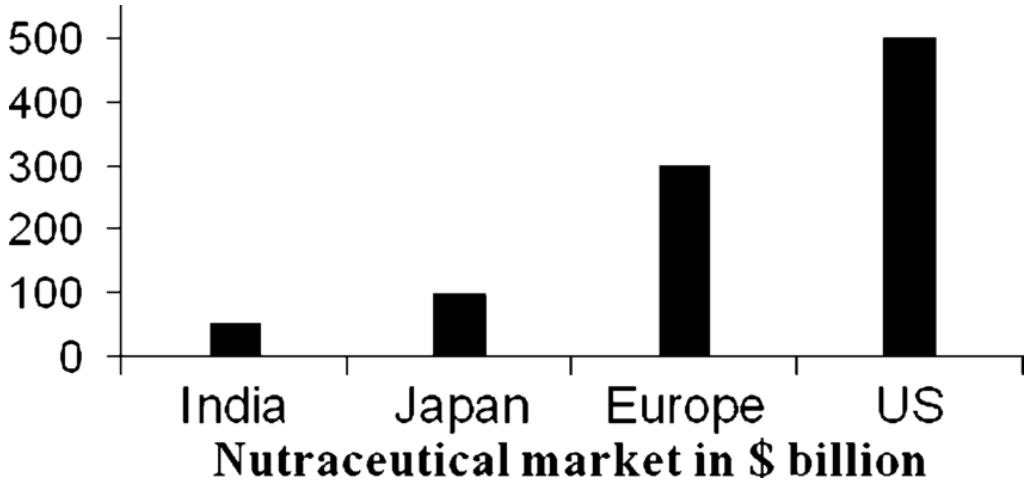
The Future of Nutraceuticals:-

Increasing awareness levels about fitness and health, spurred by media coverage are prompting the majority of people to lead healthier lifestyles, exercise more, and eat healthy. The expanding nutraceutical market indicates that end users are seeking minimally processed food with extra nutritional benefits and organoleptic value. This development, in turn, is propelling expansion in the nutraceutical markets globally. The emerging nutraceuticals industry seems destined to occupy the landscape in the new millennium. Its tremendous growth has implications for the food, pharmaceutical, healthcare, and agricultural industries Many scientists believe that enzymes represent another exciting frontier in nutraceuticals. "Enzymes have been underemployed... they're going to be a hot area in the future." Fermentation technology using microbes to create new food products also represents potential. Global trends to healthy products cannot be reversed. Companies taking the lead by investing strategically in science, product development, marketing and consumer education will not go unrewarded.

Present Market Scenario in India and Abroad:-

Global market of nutraceutical is very huge. Nutraceuticals are hugely popular among consumers in the U.S. and other parts of the world. In Japan, England and other countries, nutraceuticals already have become part of the dietary landscape. Indian nutraceutical market is in infant stage but growing at very fast rate. Indian society has always been open to new concepts and quick to adapt. Due to increased physician acceptance of the medical benefits of nutritional products increased market demand of nutraceuticals. Consumers dissatisfied with drug costs and conventional healthcare are turning to unproven and untested natural products for treatment and prevention. The expanding nutraceutical market indicates that end users are seeking minimally processed food with extra nutritional benefits and organoleptic value. This development, in turn, is propelling expansion in the nutraceutical markets globally. Future demand of nutraceutical depends on consumer perception of the relationship between diet and disease.[1]

Focus on India:- India has a long heritage of traditional medicine, which includes a conglomerate of Ayurveda, Siddha and Unani. It is one of the greatest living traditions and maintains a highly respectable place in the officially recognized healthcare system of the country. In recent times, the Indian healthcare market has emerged as a new and profitable growth avenue for both existing players and new entrants. The Indian healthcare industry has been seen to offer investors a cheap entry into the relatively stable consumer and retail segment, which is benefiting from rising consumer sentiments and affluence. According to Cygnus estimates, nutraceutical market in 2007 was INR 18.75 billion. Total market for nutraceutical in India is valued at INR 44 billion in 2009; it is estimated to reach INR 95 billion in 2013. India has now become a centre of attraction for everyone because of its huge population. In fact, India is currently experiencing massive internal consumption, due to a prosperous middle class, which has the money to invest in "nutraceutical" products. The middle class has doubled and today is the fastest growing portion of the population. In the last 60 years of independence India has met remarkable educational goals and today has moved beyond basic food security issues. India has also evolved from a savings economy to consumption economy.[1]



Review of Literature:-

1. **Mamta Kumari, Shashi Jain and Jagdeep Singh**

Traditional use of medicines is recognized as a way to learn about potential future medicines. The World Health Organization estimates that 80% of the world's population presently uses herbal medicine for some aspect of primary health care. The concept of nutraceutical has been accepted internationally. The terms "functional foods" and "nutraceuticals" are emerging out of benefits from foods that go beyond those attributable to essential nutrients. In recent years there is a growing interest in nutraceuticals which provide health benefits and are alternative to modern medicine. Nutrients, herbals and dietary supplements are major constituents of nutraceuticals which make them instrumental in maintaining health, act against various disease conditions and thus promote the quality of life.

2. **Hamid Nasri, Azar Baradaran, [...], and Mahmoud Rafieian-Kopaei**

Nutraceuticals are products, which other than nutrition are also used as medicine. A nutraceutical product may be defined as a substance, which has physiological benefit or provides protection against chronic disease. Nutraceuticals may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure or function of the body. Now days, nutraceuticals have received considerable interest due to potential nutritional, safety and therapeutic effects. Recent studies have shown promising results for these compounds in various complications. In the present review much effort has been devoted to present new concepts about nutraceuticals based on their diseases modifying indications. Emphasis has been made to present herbal nutraceuticals effective on hard curative disorders related to oxidative stress including allergy, alzheimer, cardiovascular, cancer, diabetes, eye, immune, inflammatory and Parkinson's diseases as well as obesity. The recently published papers about different aspects of nutraceuticals as alternative for pharmaceuticals were searched using scientific sites such as Medline, PubMed, and Google Scholar. The used terms included nutraceuticals and allergy, Alzheimer, cardiovascular, cancer, diabetes, eye, immune, inflammatory or Parkinson.

3. **Mudhi AlAli, Maream Alqubaisy, Mariam Nasser Aljaafari, Asma Obaid AlAli, Laila Baqais, Aidin Molouki, Aisha Abushelaibi, Kok-Song Lai and Swee-Hua Erin Lim**

Nutraceuticals are essential food constituents that provide nutritional benefits as well as medicinal effects. The benefits of these foods are due to the presence of active compounds such as carotenoids, collagen hydrolysate, and dietary fibers. Nutraceuticals have been found to positively affect cardiovascular and immune system health and have a role in infection and cancer prevention. Nutraceuticals can be categorized into different classes based on their nature and mode of action. In this review, different classifications of nutraceuticals and their potential therapeutic activity, such as anti-cancer, antioxidant, anti-inflammatory and anti-lipid activity in disease will be reviewed. Moreover, the different mechanisms of action of these products, applications,

and safety upon consumers including current trends and future prospect of nutraceuticals will be included.

4. **Garima Verma and Manoj Kumar Mishra**

Nutraceutical is the hybrid of "nutrition" and "pharmaceutical". Nutraceuticals; in broad, are food or part of food playing a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. The food products used as nutraceuticals can be categorized as dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants and other different types of herbal natural foods. These nutraceuticals used in various diseases such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. In whole, "nutraceutical" has lead to the new era of medicine and health, in which the food industry has become a research oriented sector. This article aim to provide the knowledge of nutraceutical with its uses in various diseases.

5. **Lipi Das, Eshani Bhaumik, Utpal Raychaudhuri, and Runu Chakraborty**

Nutraceutical is the hybrid of 'nutrition' and 'pharmaceutical'. Nutraceuticals, in broad, are food or part of food playing a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. The principal reasons for the growth of the nutraceutical market worldwide are the current population and the health trends. The food products used as nutraceuticals can be categorized as dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants and other different types of herbal/ natural foods. These nutraceuticals help in combating some of the major health problems of the century such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. In whole, 'nutraceutical' has lead to the new era of medicine and health, in which the food industry has become a research oriented sector.

6. **Raj K. Keservani, Rajesh K. Kesharwani, Narendra Vyas, Sarang Jain, Ramsaneh Raghuvanshi, Anil K. Sharma**

In recent years there is a growing interest in nutraceuticals which provide health benefits and are alternative to modern medicine. Nutrients, herbals and dietary supplements are major constituents of nutraceuticals which make them instrumental in maintaining health, act against various disease conditions and thus promote the quality of life. The explosive growth, research developments, lack of standards, marketing zeal, quality assurance and regulation will play a vital role in its success or failure. In India the most common forms of functional foods and nutraceuticals are available as traditional Indian Ayurvedic Medicines (IAM); these are marketed under different brand names. India is the home of a large number of medicinal herbs, spices and tree species that have a substantially large domestic market with no major foreign competition at present. However, it is important to note that there are no strict pharmaceutical regulations on Ayurvedic and nutraceutical health products in India. In India and China have large populations, in particular in rural, remote and inaccessible areas which are totally dependent upon herbal remedies and other naturally available bioresources which they use to treat common ailments, and as general preventive and

protective medications. In the global marketplace nutraceuticals and functional foods have become a multi-billion dollar industry and estimates within Canada suggest that the Canadian nutraceutical and functional food industry has potential to grow to $50 billion US. Japan is the second largest market in the world for nutraceutical products after the United States. Its nutraceutical market has exhibited a steady average growth rate of 9.6% per annum.

7. **Shilpa P. Chaudhari*, Priyatama V. Powar and Mahesh N. Pratapwar**

Nutraceuticals have received considerable interest because of their presumed safety. The Present article focuses on the need for consuming appropriate diets, health issues surrounding failure to adhere to the known healthy eating models, development of new nutraceuticals/functional foods/food supplements with novel health benefits, elucidation mechanisms of action of these products, to define and understand the analytical, formulation and regulatory aspects of nutraceutical. This article may act as a tool to abreast with the recent developments in nutraceutical research.

Discussion:-

Nutraceuticals are products, which other than nutrition are also used as medicine. A nutraceutical product may be defined as a substance, which has physiological benefit or provides protection against chronic disease. Nutraceuticals may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure or function of the body. Nowadays, nutraceuticals have received considerable interest due to potential nutritional, safety and therapeutic effects. Recent studies have shown promising results for these compounds in various complications. In the present review much effort has been devoted to present new concepts about nutraceuticals based on their diseases modifying indications. Emphasis has been made to present herbal nutraceuticals effective on hard curative disorders related to oxidative stress including allergy, alzheimer, cardiovascular, cancer, diabetes, eye, immune, inflammatory and Parkinson's diseases as well as obesity.

Traditional use of medicines is recognized as a way to learn about potential future medicines. The World Health Organization estimates that 80 percent of the world's population presently uses herbal medicine for some aspect of primary health care. The concept of nutraceutical has been accepted internationally. The terms “functional foods” and “nutraceuticals” are emerging out of benefits from foods that go beyond those attributable to essential nutrients. In recent years there is a growing interest in nutraceuticals which provide health benefits and are alternative to modern medicine. Nutrients, herbals and dietary supplements are major constituents of nutraceuticals which make them instrumental in maintaining health, act against various disease conditions and thus promote the quality of life.

The nutraceutical revolution will lead us into a new era of medicine and health, in which the food industry will become a research oriented one similar to the pharmaceutical industry.

Conclusion:-

The nutraceutical industry is growing at a rate far exceeding expansion in the food and pharmaceutical industries. In tomorrow's market, the most successful nutraceutical players are likely to be those companies in which functional product are just a part of a broad line of goods satisfying both conventional and health value point. Future demand of nutraceutical depends on consumer perception of the relationship between diet and disease. Although nutraceuticals have significant promise in the promotion of human health and disease prevention, health professional, nutritionists and regulatory toxicologist should strategically work together to plan appropriate regulation to provide the ultimate health and therapeutic benefit to mankind. Long-term clinical studies are required to scientifically validate the nutraceuticals in various medical conditions. The interaction of nutraceuticals with food and drugs is another area, which should be taken into consideration. The effect of different processing methods on the biological availability and effectiveness of nutraceuticals remains to be determined. As like drugs, there should be strict regulatory controls for nutraceuticals.

References:-

1. https://www.researchgate.net/publication/312525325_Nutraceutical-Medicine_of_Future
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4336979/
3. https://www.mdpi.com/1420-3049/26/9/2540/pdf
4. https://www.researchgate.net/publication/323834599_A_review_on_nutraceuticals_Classification_and_its_role_in_various_disease
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3550857/#!po=11.9792
6. https://www.researchgate.net/publication/267915464_Nutraceutical_and_Functional_Food_as_Future_Food_A_Review
7. https://www.researchgate.net/publication/319014320_NUTRACEUTICALS_A_REVIEW

Project Report Submitted By The

Students of

Department of Mathematics

THE UNIVERSITY OF BURDWAN

MANKAR COLLEGE

B.Sc 6th Semester

PREDATOR-PREY MODEL

Paper:- PW01

Name- ARITRA ROY

University Roll No- 19031170008

Reg. No-201901010902 of 2019-20

Mankar College
Mankar, Burdwan - 713144
West Bengal

NAAC Accredited at 'B+'

Tel/FAX No.: +91-9475738113
Website: www.mankarcollege.ac.in
Email: principal@mankarcollege.ac.in

Ref. No.....

Date: .....

Department Of Mathematics

To Whom it May Concern

Certified that **Aritra Roy** of B.A/B.SC of Sem VI Mathematics(Hons) of Mankar college bearing Roll no 19031170008 Registration no 201901010902 of 2019-20 has undertaken a in house project titled **Predator-Prey Model** in 6th sem in the academic session 2021-22. He/she is permitted to submit herewith, the report pertaining to said fieldwork.

Sujata Mondal

Dr. Sujata Mondal
Assistant Professor
Dept of Mathematics
Mankar College

11.6.22

Dr. Sukanta Bhattacharyya
Principal
Mankar College

Principal
Mankar College

Mankar College ESTD.-1987 Mankar, Burdwan

Contents

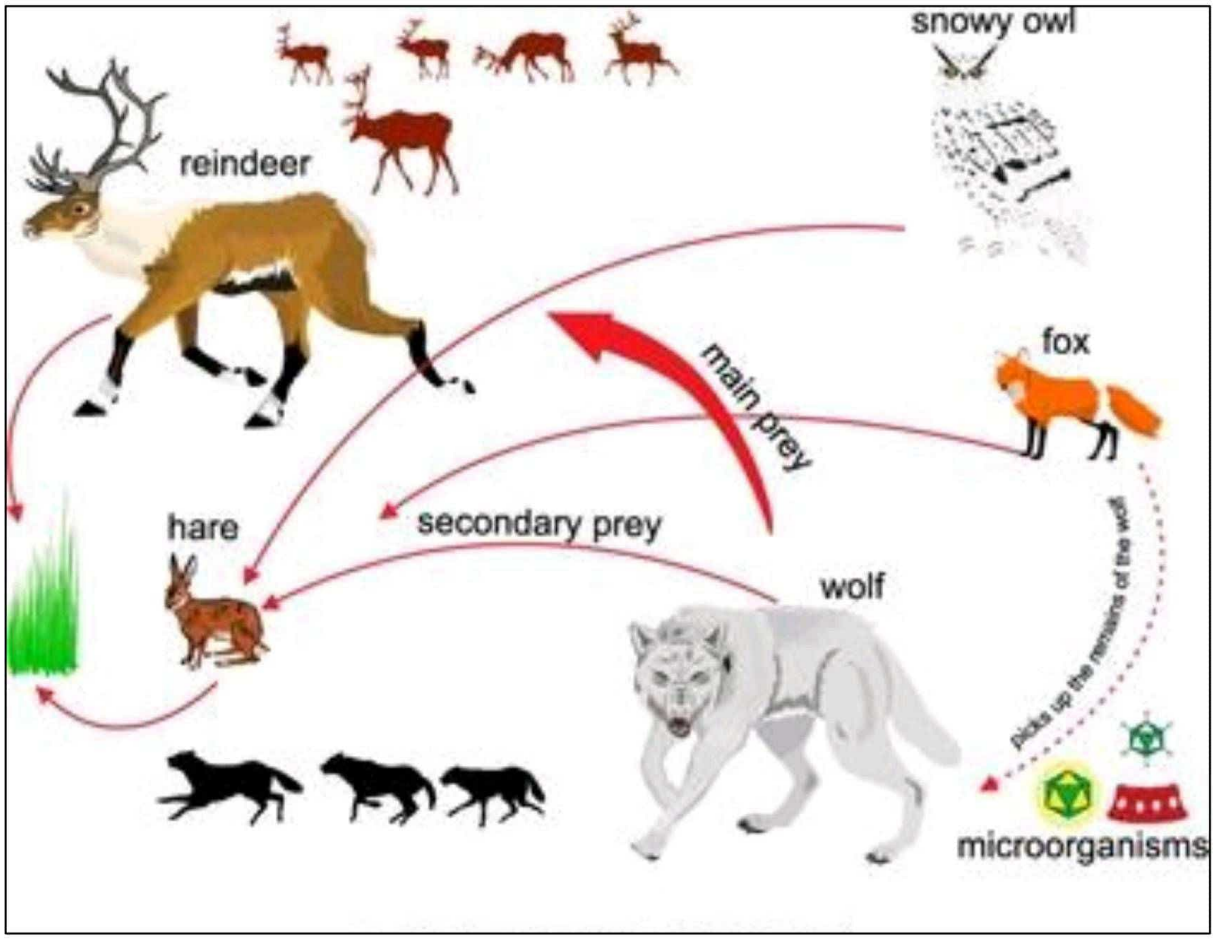
Chapter 1: Introduction

Overview of predator-prey interaction

There are over 1000 animal species around the world that are endangered at varied levels - creating a deepening importance for monitoring the populations of natural wildlife. As the human population increases, natural habitats are being affected through destruction and environmental changes, which in turn affects the populations of wildlife, including predator prey communities. To understand the progression of predator-prey native environments involves understanding many issues, such as predator- prey interactions and population dynamics among others.

All animals are either predators or prey and, in most cases, they are both. The interactions involved in attempting to eat and avoid being eaten have strong and wide-reaching influences across all facets of ecology, from individual phenotypic responses and population dynamics, to community interactions, and even to how we attempt to manage and conserve the natural world. As in many subfields of ecology, the science behind predator-prey investigations has been driven by theory, including important advances in generating and testing predictions.

This article highlights the breadth of influence that predator-prey interactions have on ecology. The sections that follow address the effects of predator-prey interactions, such as those at the individual level, expressed through behavior, morphology, physiology, and life history, as well as their effects on population dynamics and community composition. At the individual level, the predator-prey interaction will be arranged in two perspectives: those of the predator and those of the prey. The article also considers the less typical and more integrative aspects of predator-prey interactions, such as their physiological and neurological mechanisms and their relevance for questions associated with conservation. In addition, this article will consider the validity of including parasitism and herbivory within the broad definition of predation. A great deal of debate is ongoing as to whether these two ecological interactions possess similar enough qualities with predation to be characterized as one phenomenon. Those sections of this article will cover this debate and provide the reader with resources with which to consider this question.



In order to predict, describe, and explain such population changes in a species, mathematical models are developed, studied and improved. Such models can predict future patterns of

many situations. Developments in science and technology have enabled people to increase the predictability of changes in natural populations and guide changes. Many mathematicians and scientists have modelled situations of various predator-prey groups with different differential equations. These models can be used to make predictions about the behaviour of several different predator-prey populations and provide clues as to why they behave as they do. As some populations near extinction, it becomes necessary for biologists and ecologists to look at manipulations of such populations to determine if populations can be recovered through human intervention. Therefore, the equations used for modelling become important to analyse and predict the populations to eliminate extinction.

Chapter 2: Methodology and Basic Terminologies

The Logistic Growth Model

When studying population dynamics, we usually begin by modelling the population growth and then we add other features to this model so that it better reflects the reality.
The population growth *can* be described by discrete models or continuous models.
The simplest continuous model of population growth

$$\frac{dx}{dt} = rx \dots\dots\dots\dots\dots\dots (1)$$

has been studied by **Malthus in 1798**. In this equation**. *r* represents the net proportional growth rate. that is. $r = b - d$, where *b*is the birth rate and d is the death rate.**

The solution of (1) is

$$x(t) = x(0)e^{rt}$$

We can *see* that the population *x goes* to infinity for $r > 0$ and goes to 0 for $r < 0$. The case $r > 0$ is biologically impossible since every population is restricted by the carrying capacity of its environment. Considering the carrying capacity we obtain –

$$\frac{dx}{dt} = rx\left(1 - \frac{x}{k}\right) = F(x) \dots\dots\dots\dots (2)$$

where $k > 0$ is the carrying capacity of the environment and *r >O* is the intrinsic growth rate. This mode1 has first been studied by Verhulst in 1838. It is easy to see that for $0 < x < k, \frac{dx}{dt} > 0$ and for $x > k, \frac{dx}{dt} < 0$.
Using separation of variables, we can solve the equation (2), and obtain,

$$\mathrm{x(t)} = \frac{\mathrm{k}}{1 + \mathrm{ce}^{-\mathrm{rt}}}, \text{where}, \mathrm{c} = \frac{\mathrm{k} - \mathrm{x_0}}{\mathrm{x_0}}$$

It has been noticed that the logistic growth mode1 will always give a good representation of populations increasing to an asymptotic le&. The growth of several populations has been studied such as *Drosophila melanogaster* (fruit fly) populations.

Harvesting in Population Models

We wish to study the effect on a population model of the removal of members of the population at a specified rate. If a population modelled by a differential equation

$$x' = f(x)$$

is subject to a harvest at a rate of $h(t)$ members per unit time for some given function $h(t)$ then the harvested population is modelled by the differential equation

$$x' = f(x) - h(x)$$

Constant-Yield Harvesting

If the function $h(t)$ is a constant H, so that members are removed at the constant rate of H per unit time the model is –

$$x' = f(x) - H$$

This type of harvesting is called *constant-rate* or *constant yield* harvesting. It arises when a quota is specified (for example, through permits, as in deer hunting seasons in many states, or by agreement as sometimes occurs in whaling).

If the population is governed by a logistic equation, the model with harvesting is –

$$\frac{dx}{dt} = rx\left(1 - \frac{x}{k}\right) - H \ldots\ldots\ldots\ldots (3)$$

and equilibria of (3) may be found by solving the quadratic equation

$$rx\left(1 - \frac{x}{k}\right) - H = 0$$

i.e.

$$x^2 - kx + \frac{Hk}{r} = 0$$

There are two equilibria,

$$xL = \frac{\left(k - \sqrt{k^2 - \frac{4Hk}{r}}\right)}{2}, \qquad xU = \frac{\left(k + \sqrt{k^2 - \frac{4Hk}{r}}\right)}{2}$$

Provided,

$$k^2 - \frac{4Hk}{r} \geq 0, \qquad or, H \leq \frac{rk}{4}.$$

If , $H > \frac{rk}{4}$, both roots are complex, $x'(t) < 0$ for all *x*, and every solution crash, hitting zero in finite time. If a solution reaches zero in finite time, we consider the system to have collapsed. If $0 \leq H < rK/4$, there are two equilibria: xL, which increases from 0 to *K*/2 as *H* increases from 0 to $\frac{rk}{4}$, and xU, which decreases from *K* to *K*/2 as *H* increases. The stability of an equilibrium $x_\infty$of

$$x' = f(x) - H$$

requires $F'(x_\infty) < 0$, which for the logistic model means $x_\infty > K/2$. Thus, $xL$is always unstable and $xU$is always asymptotically stable. When *H* increases to the critical value$H_c = rK/4$, there is a discontinuity in the behaviour of the system–the two equilibria coalesce and annihilate each other. For $H < H_c$the population size tends to an equilibrium size that approaches *K*/2 as $H \rightarrow H_c$(provided the initial population size is at least *xL*), but for $H > H_c$the population size reaches zero in finite time for all initial population sizes.

Constant-Effort Harvesting

If the function $h(t)$ is a linear function of population size $h(t) = Ex(t)$, the model is

$$x' = f(x) - E(x)$$

This type of harvesting is called *proportional* or *constant-effort harvesting*. It arises in the modelling of fisheries, where it is often assumed that x, the number of fish caught per unit time, is proportional to E, the effort expended in fishing. This fishing effort may be measured, for example, by the number of boats fishing at a given time. The assumption that the catch is proportional to effort may be questioned on the grounds that more effort per fish caught may be necessary if the fish population is very small, but it appears to be a reasonable hypothesis for many actual fisheries.

If the population is governed by a logistic model, the harvested model is

$$\frac{dx}{dt} = rx\left(1 - \frac{x}{k}\right) - Ex$$

and there are two equilibria, one at $x = 0$ and one obtained by solving

$$r\left(1 - \frac{x}{k}\right) - E = 0$$

which we denote by $x_\infty(E) = K(r - E)/r$, provided $0 \le E \le r$. It is easy to verify that the equilibrium at $x = 0$ is unstable and the equilibrium at $x_\infty(E)$is asymptotically stable for $0 \le E \le r$. As the effort increases from zero to r, the equilibrium decreases from K to zero. For a given effort E the yield is

$$Ex_\infty(E) = KE(r - E)/r$$

This yield attains a maximum value of $rK/4\ for\ E = r/2$, with$x_\infty(E) = \frac{k}{2}$; increasing the effort beyond $r/2$ is counterproductive in that it decreases the yield.

The Lotka–Volterra Equations

In the 1920's Vito Volterra was asked whether it would be possible to explain the fluctuations that had been observed in the fish population of the Adriatic Sea– fluctuations that were of great concern to fishermen in times of low fish populations. Volterra (1926) constructed the model that has become known as the Lotka-Volterra model (because A.J. Lotka (1925) constructed a similar model in a different context about the same time), based on the assumptions that fish and sharks were in a predator–prey relationship.

Here is a description of the model suggested by Volterra. Let $x(t)$ be the number of fish and $y(t)$ the number of sharks at time t. We assume that the plankton, which is the food supply for the fish, is unlimited, and thus that the per capita growth rate of the fish population in the absence of sharks would be constant. Thus, if there were no sharks the fish population would satisfy a differential equation of the form $\frac{dx}{dt} = \lambda x$. The sharks, on the other hand, depend on fish as their food supply, and we assume that if there were no fish, the sharks would have a constant per capita death rate; thus, in the absence of fish, the shark population would satisfy a differential equation of the form $\frac{dy}{dt} = -\mu y$. We assume that the presence of fish increases the shark growth rate, changing the per capita shark growth rate from $-\mu$ to $-\mu + cx$. The presence of sharks reduces the fish population, changing the per capita fish growth rate from λ to $\lambda - by$. This gives the *Lotka–Volterra equations*

$$\frac{dx}{dt} = x(\lambda - by), \frac{dy}{dt} = y(-\mu + cx)$$

We cannot solve this system of equations analytically, but we can obtain some information about the behaviour of its solutions. Instead of trying to solve for x and y as functions of t, we eliminate t and look for the relation between x and y. In geometric terms, we study the (x, y) *phase plane*. We look for *orbits*, or *trajectories* of solutions (that is, curves in the phase plane representing the functional relation between x and y with the time t as the parameter). We may eliminate t from the Lotka–Volterra equations by division:

$$\frac{dy}{dx} = \frac{y(-\mu + cx)}{x(\lambda - by)}$$

We may solve this differential equation by separation of variables:

$$\int \frac{-\mu + cx}{x} dx = \int \frac{(\lambda - by)}{y} dy$$
$$\Rightarrow -\mu log x + cx = \lambda log y - by + h$$

where h is a constant of integration, or

$$-\mu log x + cx - \lambda log y + by = h$$

The minimum value of the function

$$V(x, y) = -\mu log x + cx - \lambda log y + by$$

is obtained by setting $\frac{\partial V}{\partial x} = 0, \frac{\partial V}{\partial y} = 0$. Then $c - \mu/x = 0, b - \lambda/y = 0, or\ x = \mu/c, y = \lambda/b$. This is an equilibrium of the Lotka–Volterra system (i.e., aconstant solution $x \equiv \mu/c = x_\infty, y \equiv \lambda/b = y_\infty$),which may also be described bythe equation –

$$V(x_\infty, y_\infty) = -\mu log x_\infty + cx_\infty - \lambda log y_\infty + by_\infty$$
$$= -\mu \log\left(\frac{\mu}{c}\right) - \lambda \log\left(\frac{\lambda}{b}\right) + \mu + \lambda$$

Every orbit of the system is given implicitly by an equation $V(x, y) = h$for some constant $h \geq h_0$, which is determined by the initial conditions. We make the change of variable $x = x_\infty + u = \frac{\mu}{c} + u, y = y_\infty + v = \frac{\lambda}{b} + v$, obtaining –

$$V(x, y) = -\mu \log\left(\frac{\mu}{c} + u\right) - \lambda \log\left(\frac{\lambda}{b} + v\right) + c\left(\frac{\mu}{c} + u\right) + b\left(\frac{\lambda}{b} + v\right) = h$$

We observe that –

$$\log\left(\frac{\mu}{c} + u\right) = \log\left(\frac{\mu}{c}\right) + \log\left(1 + \frac{cu}{\mu}\right)$$

and if $h - h_0$ is small, we may use the approximation $log(1 + x) \approx x - x^2/2$ to approximate this expression by –

$$\log\left(\frac{\mu}{c}\right) + \frac{cu}{\mu} - \frac{c^2u^2}{\mu^2}$$

Similarly, we may approximate $log(\lambda/b + v)$ by $log\lambda/b + bv/\lambda - b^2v^2/\lambda^2$. Then the orbits $V(x, y) = h$are approximated by –

$$-\mu \log\left(\frac{\mu}{c}\right) - cu + \frac{c^2u^2}{\mu} - \lambda \log\left(\frac{\lambda}{b}\right) - bv + \frac{b^2}{\lambda}v^2 + \mu + \lambda = h$$

$$\frac{c^2}{\mu}u^2 + \frac{b^2}{\lambda}v^2 = h + \mu \log\left(\frac{\mu}{c}\right) + \lambda \log\left(\frac{\lambda}{b}\right) - \mu - \lambda = h - h_0$$

which represents an ellipse (if $h > h0$) with the equilibrium (x_∞, y_∞) as its centre. This shows that for $h-h_0$ small and positive, the orbits are closed curves around the equilibrium; since the solutions run around closed orbits, they must be *periodic*.

Thus, the Lotka–Volterra model predicts the fluctuations that had been observed experimentally. It is possible to show that the period of oscillation is approximately $2\pi/\lambda\mu$, and it is easy to see from the phase portrait that the maximum prey population comes one quarter of a cycle before the maximum predator population (Figure-).

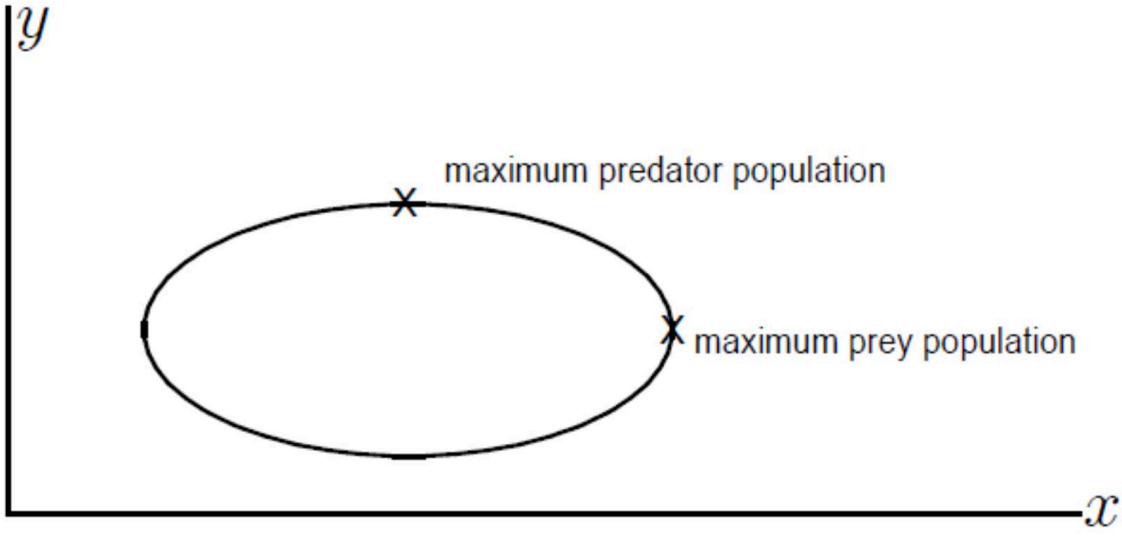


Figure-

The Lotka–Volterra model represented one of the triumphs of early attempts at mathematical modelling in population biology.

Equilibria and Linearization

One of the main tools in studying continuous models for two interacting populations is linearization at equilibria, just as for models for single species. However, since linearization results can give information only about behaviour of solutions near an equilibrium, they will not enable us to examine such questions as the existence of periodic orbits

The basic fact is the analogue of the result established for one-dimensional systems (or first-order equations), namely that the behaviour of solutions near an equilibrium is determined by the behaviour of solutions of the linearization at the equilibrium. Since there is a variety of possible behaviours of solutions of the linearization, we will also have to carry out a classification of equilibria according to the behaviour of solutions at the equilibrium. We will consider populations of two interacting species with population sizes $x(t)$ and $y(t)$ respectively. As in our study of continuous single species models, we will assume that $x(t)$ and $y(t)$ are continuously differentiable functions of t whose derivatives are functions of the two population sizes at the same time. Thus, our models will be systems of two first order differential equations,

$$x' = F(x, y), \quad y' = G(x, y)$$

As in our study of single-species models, the assumptions that lead to this form neglect many factors of importance in many real populations, but the model is a useful first step and may model some real populations quite well. An *equilibrium* is a solution (x_∞, y_∞) of the pair of equations $F(x_\infty, y_\infty) = 0, G(x_\infty, y_\infty) = 0$. Thus, an equilibrium is a constant solution of the system of differential equations. Geometrically, an equilibrium is a point in the phase plane that is the orbit of a constant solution. If (x_∞, y_∞) is an equilibrium, we make the change of variables $u = x - x_\infty, v = y - y_\infty$, obtaining the system –

$$u' = F(x_\infty + u, y_\infty + v),$$
$$v' = G(x_\infty + u, y_\infty + v).$$

Using Taylor's theorem for functions of two variables, we may write –

$$F(x_\infty + u, y_\infty + v) = F(x_\infty, y_\infty) + F_x(x_\infty, y_\infty)u + F_y(x_\infty, y_\infty)v + h_1$$
$$G(x_\infty + u, y_\infty + v) = G(x_\infty, y_\infty) + G_x(x_\infty, y_\infty)u + G_y(x_\infty, y_\infty)v + h_2$$

where h_1 and h_2 are functions that are small for small *u, v* in the sense that –

$$\lim_{\substack{u\to 0\\ v\to 0}} \frac{h_1(u,v)}{\sqrt{u^2+v^2}} = \lim_{\substack{u\to 0\\ v\to 0}} \frac{h_2(u,v)}{\sqrt{u^2+v^2}} = 0$$

The *linearization* of the system, obtained by using –

$$F(x_\infty, y_\infty) = 0, G(x_\infty, y_\infty) = 0$$

and neglecting the higher-order terms *h*1(*u, v*) and *h*2(*u, v*), is defined to be the two dimensional

linear system –

$$u' = F_x(x_\infty, y_\infty)u + F_y(x_\infty, y_\infty)v$$
$$v' = G_x(x_\infty, y_\infty)u + G_y(x_\infty, y_\infty)v$$

The coefficient matrix of the above system –

$$\begin{bmatrix} F_x(x_\infty, y_\infty) & F_y(x_\infty, y_\infty) \\ G_x(x_\infty, y_\infty) & G_y(x_\infty, y_\infty) \end{bmatrix}$$

is called the *community matrix* of the system at the equilibrium (x_∞, y_∞). It describes the effect of the size of each species on the growth rate of itself and the other species at equilibrium. Frequently we shall write a system in the form –

$$x' = xf(x,y), \qquad y' = yg(x,y)$$

so that *f* (*x, y*) and *g*(*x, y*) are the per capita growth rates of the two species. The community matrix at equilibrium then has the form –

$$\begin{bmatrix} x_\infty f_x(x_\infty, y_\infty) + f(x_\infty, y_\infty) & x_\infty f_y(x_\infty, y_\infty) \\ y_\infty g_x(x_\infty, y_\infty) & y_\infty g_y(x_\infty, y_\infty) + g(x_\infty, y_\infty) \end{bmatrix}$$

There are four distinct kinds of possible equilibria, as follows:

(i) (0,0), with community matrix –

$$\begin{bmatrix} f(0,0) & 0 \\ 0 & g(0,0) \end{bmatrix}$$

(ii) $(K, 0)$ with $K > 0, (K, 0) = 0$, having community matrix

$$\begin{bmatrix} Kf_x(K,0) & Kf_y(K,0) \\ 0 & g(K,0) \end{bmatrix}$$

(iii) $(0, M)$ with $M > 0, g(0, M) = 0$, having community matrix –

$$\begin{bmatrix} f(0,M) & 0 \\ Mg_x(0,M) & Mg_y(0,M) \end{bmatrix}$$

(iv) (x_∞, y_∞) with$x_\infty > 0, y_\infty > 0, f\ (x_\infty, y_\infty) = 0, g(x_\infty, y_\infty) = 0$, having community matrix –

$$\begin{bmatrix} x_\infty f_x(x_\infty, y_\infty) & x_\infty f_y(x_\infty, y_\infty) \\ y_\infty g_x(x_\infty, y_\infty) & y_\infty g_y(x_\infty, y_\infty) \end{bmatrix}$$

We should remark that since from a biological point of view, only nonnegative population sizes are of interest, we consider only equilibria having nonnegative coordinates and we are concerned with only the first quadrant of the phase plane. In the case (iv) of coexistence of the two species, the terms$f_x(x_\infty, y_\infty)$and $g_y(x_\infty, y_\infty)$ in the community matrix are self-regulating terms that are normally nonpositive.

The terms $f_y(x_\infty, y_\infty)g_x(x_\infty, y_\infty)$are *interaction* terms. There are three possible sign combinations, which we shall study separately. If both interaction terms are negative, the two species are said to be in *competition*. If there is one positive and one negative interaction term, the species are said to be in a *predator–prey* relation. Such systems include herbivore–vegetation systems, in which we may be interested mainly in the herbivore species but include its food supply in the model for greater realism. The simple chemostat modelled in the previous section is an example of this type. A system in which both interaction terms are positive is called *mutualistic*.

An equilibrium(x_∞, y_∞) is said to be *stable* if every solution $(x(t), y(t))$ with $(x(0), y(0))$ sufficiently close to the equilibrium remains close to the equilibrium for all $t \geq 0$. An equilibrium(x_∞, y_∞) is said to be *asymptotically stable* if it is stable and if, in addition, solutions with $(x(0), y(0))$ sufficiently close to the equilibrium tend to the equilibrium

$as\ t\ \rightarrow \infty$.These definitions are the natural analogues of the definitions given previously for first-order equations.

Chapter 3: Model Formulation

Introduction

The Lotka-Volterra model is one of the earliest predator-prey models to be based on sound mathematical principles. It forms the basis of many models used today in the analysis of population dynamics and is one of the most popular models in mathematical ecology. In both the analysis and experiment, the predator and prey can coexist by reducing the frequency of contact between them, Luckinbill [13]. In the context of predator-prey interaction, some studies that treat population can be extended by considering harvesting, stocking, diffusion, and time delay. In the model with harvesting, some studies relate the population to the economic problems. The time delay is considered into the population dynamics when the rate of change of the population is not only a function of the present population but also depends on the past population.

One predator-one prey system in Hogart et al. [10] where both the predator and prey are harvested with constant yield has been considered and the stability at maximum sustainable yield is established. Martin and Ruan [14] have analyzed generalized Gause predatorprey models where the prey is harvested with constant rate while Kar [12] considered the predator-prey model with the predator harvested and suggested that it is ideal to study the combined harvesting of predator and prey population models. The effect of constant rate of harvesting has been studied by Holmberg [11] and the results showed that the constant catch quota can lead to both oscillations and chaos and an increased risk for over exploitation. While the effects on population size and yield of different levels of harvesting of a predator in a predator-prey system have been explored by Matsuda and Abrams [15] and showed that the predator may increase in population size with increasing fshing effort.

Brauer and Soudack [3] have analyzed the global behavior of a predator-prey system under constant rate predator harvesting. They showed how to classify the possibilities and determine the region of stability. They found that if the equilibrium point is asymptotically stable, which is determined by a local linearization, then every solution whose initial value is in some neighborhood of the stable equilibrium point tends to it as the time approaches infnity. There exists an asymptotically stable limit cycle when the constant rate is small and the equilibrium point is unstable. A predator-prey model with Holling type using harvesting efforts as control has been presented by Srinivasu et al. [17] and showed that with harvesting, it is possible to break the cyclic behavior of the system and introduces a globally stable limit cycle in the system.

The effect of constant rate of harvesting on the dynamics of predator-prey systems has been investigated by many authors, see, for example, Brauer and Soudack [2, 4], Myerscough et al. [16], Dai and Tang [7], Xiao and Ruan [18]. Some interesting dynamical behaviors have been observed such as the stability of the equilibria, existence of Hopf bifurcation and limit cycles. It is also

observed that in some cases, before a catastrophic harvest rate is reached the effect of harvesting is to stabilize the equilibrium point of the population system. In this paper we present a deterministic and continuous model for predator - prey population based on Lotka - Volterra model which is extended by incorporating time delay and constant rates of harvesting of both populations. The objective of this paper is to study the combined effects of harvesting and time delay on the dynamics of predator-prey model.

The Predator - Prey Population Model

We consider a predator - prey model based on Lotka - Volterra model with one predator and one prey populations. The model for the rate of change of prey population (x) and predator population (y) is

$$\frac{dx}{dt} = rx\left(1 - \frac{x}{K}\right) - \alpha xy$$

$$\frac{dy}{dt} = -cy + \beta xy. \qquad (2.1)$$

The model includes parameter K, the carrying capacity, for the prey population in the absence of the predator. The parameter r is the intrinsic growth rate of the prey, c is the mortality rate if the predator without prey, α measures the rate of consumption of prey by the predator, β measures the conversion of prey consumed into the predator reproduction rate. All the parameters are assumed to be positive.

The equilibrium points of model (2.1) are $(0,0)$, $(K, 0)$ and $E^* = (x^*, y^*) = \left(\frac{c}{b}, \frac{r(K\beta - c)}{\alpha\beta K}\right)$. In order to get a positive equilibrium point we assume that $K\beta - c > 0$. The Jacobian matrix model (2.1) takes the for

$$J = \begin{pmatrix} r - \frac{2rx}{K} - \alpha y & -\alpha x \\ \beta y & -c + bx \end{pmatrix}$$

The characteristic equation of the Jacobian matrix J at the equilibrium point $E*$ is $f(\lambda) = \lambda^2 + \frac{cr}{\beta K}\lambda + \frac{cr}{\beta K}(\beta K - c)$ and the eigenvalues have negative real parts. It means that the equilibrium points $E*$ is locally asymptotically stable. Furthermore, since $K\beta - c > 0$ then the equilibrium point $E*$ is also globally asymptotically stable, see Ho and Ou [9].

The Predator-Prey Model With Time Delay And Constant Rate Of Harvesting

We consider the predator and prey populations of model (2.1) where both populations are subjected to a constant rate of harvesting. Before we go to the model with time delay, we need to analyze the stability of the equilibrium point of the model without time delay. The model without time delay is

$$\frac{dx}{dt} = x(r - bx - \alpha y) - H_x$$

$$\frac{dy}{dt} = y(-c + \beta x) - H_y \tag{3.1}$$

Where $r, b = \frac{r}{K}, \alpha, c, \beta, H_{x,} H_y$ are positive constants. The constants H_x and H_y denote the rate of harvesting for the populations x and y respectively.

By setting $\frac{dx}{dt} = 0$ and $\frac{dy}{dt} = 0$ then we have the relations

$$x(r - bx - \alpha y) = H_x \tag{3.2}$$

$$y(-c + \beta x) = H_y \tag{3.3}$$

From (3.2) we have $y = \frac{rx - bx^2 - H_x}{\alpha x}$ which follows that $r^2 - 4bH_\chi$ should be positive in order to get the equilibrium point in the positive quadrant. Hence we have to assume that $H_x < \frac{r^2}{4b}$. Since Hy is positive, then from (3.3) we should assume that $x > \frac{c}{\beta}$.

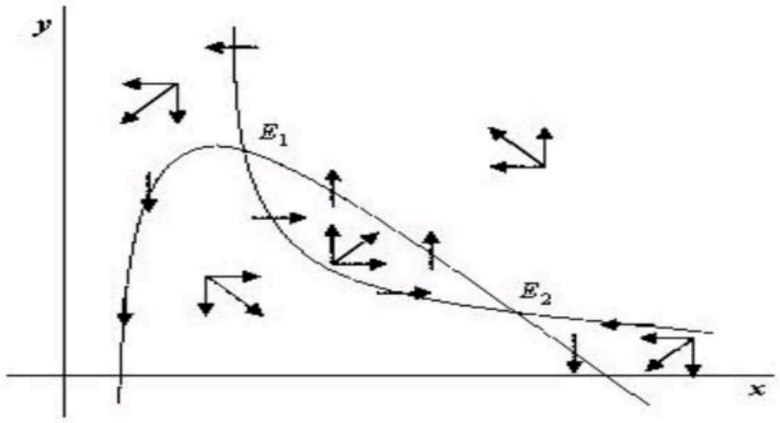


FIGURE 1. Phase plane and directions of the trajectories

From the phase plane, we know that it is possible to get two, one or no equilibrium points, Figure 1. There are two positive equilibrium points of the model when $b\beta x^3 - (r\beta + bc)x^2 + \big(H_\chi\beta + H_y\alpha + rc\big)x - H_x c < 0$, for some positive $x > \frac{c}{\beta}$. Let the two equilibrium points be $E_1 = (x_1, y_1)$ and $E_2 = (x_2, y_2)$. The equilibrium point E_1 is possible to be asymptotically stable, while the equilibrium point E_2 is not stable, it is a saddle point.

To analyze the stability of the equilibrium point E_1 we linearize the model around the equilibrium point E_1 . The Jacobian matrix of the model is

$$J = \begin{pmatrix} r - 2bx - \alpha y & -\alpha x \\ \beta y & -c + \beta x \end{pmatrix}$$

The characteristic equation of the Jacobian matrix at this point is

$$\lambda^2 - (P + S)\lambda + PS + QR = 0, \tag{3.4}$$

Where

$$P = r - 2bx_1 - \alpha y_1,$$

$$Q = \alpha x_1,$$

$$R = \beta y_{1,} \text{ and}$$

$$S = -c + \beta x_1.$$

Then the equilibrium point E_1 is asymptotically stable when $PS + QR > 0$ and $P + S < 0$.

Example

Consider model with parameters $r = 1, b = 0.01, \alpha = 1, c = 0.3, \beta = 0.05$, H_x = 0.01, and H_y = 0.02. The equilibrium points of the model in the positive quadrant are $E_1 = (6.42819, 0.93416)$ and $E_2 = (99.56243, 0.00428)$. The eigenvalues associated with the equilibrium point E_1 are $-0.02066 \pm 0.54633i$ and the eigenvalues associated with equilibrium point E_2 are -0.99177 and 4.67437. This reveals that the equilibrium point E_1 is asymptotically stable while the equilibrium point E_2 is a saddle point and unstable.

From Examples we know that the equilibrium E^* may be a stable or an unstable equilibrium point. It depends on the values of the parameters and the level of constant rate of harvesting. Apparently, the equilibrium point E_1 tends to the equilibrium point E^* when the harvesting function H_x and H_y approach zero. If the equilibrium point E^* for the non-harvesting model is asymptotically stable, then the eigenvalues of the Jacobian matrix of the linearized system have negative real parts. Since the eigenvalues are continuous in H_x and H_y , the equilibrium point E_1 is asymptotically stable for suf£ciently small $H_x > 0$ and $H_y > 0$. On the other hand, when the equilibrium point E_1 is unstable, there exists an asymptotically stable limit cycle. Theory of perturbation of periodic solutions, Coddington and Levinson, shows that there is an asymptotically stable limit cycle for small $H_x > 0$ and $H_y > 0$. Thus, the qualitative behavior of the system for $H_x = 0$ and $H_y = 0$ carries over to small $H_x > 0$ and $H_y > 0$.

Now we consider the predator - prey population model with time delay and constant rate of harvesting. Both predator and prey populations are subjected to constant rate of harvesting. The model is

$$\frac{dx(t)}{dt} = rx(t) - bx(t)x(t-\tau) - \alpha x(t)y(t) - H_x,$$
$$\frac{dy(t)}{dt} = -cy(t) + \beta x(t)y(t) - H_y$$

A predator-prey model with time delays in the growth rate of the predator population and the prey harvested with constant rate has been analyzed by Martin and Ruan.They showed that the time delays can induce instability, oscillations via Hopf bifurcation and switching stability.

To linearize the model about the equilibrium point E_1 of model,let $u(t) = x(t) - x_1$ and $v(t) = y(t) - y_1$. We then obtain the linearized model

$$\dot{u}(t) = (r - bx_1 - \alpha y_1)\, u(t) - bx_1 u(t-\tau) - \alpha x_1 v(t)$$
$$\dot{v}(t) = \beta y_1 u(t) + (-c + \beta x_1) v(t).$$

From the linearized model we obtain the characteristic equation

$$\Delta(\lambda, \tau) = \lambda^2 + a_1 \lambda e^{-\lambda\tau} - a_2\lambda - a_3\lambda e^{-\lambda\tau} + a_4,$$

Where

$$a_1 = bx_1$$
$$a_2 = r - c - bx_1 + \beta x_1 - \alpha y_1$$
$$a_3 = -bcx_1 + b\beta {x_1}^2, \text{ and}$$
$$a_4 = -rc + \alpha\beta x_1 + bcx_1 + b\beta {x_1}^2 - \alpha c y_1.$$

For $\tau = 0$, the characteristic equation becomes $\lambda^2 + (a_1 - a_2)\lambda - a_3 + a_4 = 0$. This characteristic equation is the same with the characteristic equation. The eigenvalues of the characteristic equation are either real and negative or complex conjugate with negative real parts if and only if

$$a_1 - a_2 > 0 \quad \text{and} \quad -a_3 + a_4 > 0.$$

Hence, in the absence of time delay, the equilibrium point E_1 is locally asymptotically stable if and only if both conditions $a_1 - a_2 = 0$ and $-a_3 + a_4 > 0$ are satisfed.

Now for $\tau \neq 0$, if $\lambda = i\omega, \omega > 0$, is a root for the characteristic equation, then we have

$$\omega^2 + a_1 i\omega \cos(\omega\tau) + a_1\omega \sin(\omega\tau) - a_2 i\omega - a_3 \cos(\omega\tau) + a_3 i \sin(\omega\tau) + a_4 = 0$$

Separating the real and imaginary parts, we get

$$\omega^2 + a_4 + a_1\omega \sin(\omega\tau) - a_3 \cos(\omega\tau) = 0$$
$$-a_2\omega + a_1\omega\, cos(\omega\tau) + a_3\, sin(\omega\tau) = 0$$

or equivalently

$$\omega^2 + a_4 = -a_1\omega \sin(\omega\tau) + a_3 \cos(\omega\tau)$$
$$a_2\omega = a_1\omega\, cos(\omega\tau) + a_3\, sin(\omega\tau).$$

Squaring both sides gives

$$\omega^4 - 2a_4\omega^2 + {a_4}^2 = {a_1}^2\omega^2 \sin^2(\omega\tau) - 2a_1a_3\, \omega \sin(\omega\tau)\cos(\omega\tau) + {a_3}^2 \cos^2(\omega\tau)$$
$${a_2}^2\, \omega^2 = {a_1}^2\omega^2\, cos^2(\omega\tau) + 2a_1a_3\, \omega\, sin(\omega\tau)\, cos(\omega\tau) + {a_3}^2\, sin^2(\omega\tau).$$

Adding both equations and regrouping by powers of ω, we obtain the following fourth degree polynomial

$$\omega^4 - ({a_1}^2 + 2a_4 - {a_2}^2)\omega^2 + {a_4}^2 - {a_3}^2 = 0$$

Then we obtain

$$\omega^2 = \frac{1}{2}\left\{({a_1}^2 + 2a_4 - {a_2}^2) \pm \sqrt{({a_1}^2 + 2a_4 - {a_2}^2)^2 - 4({a_4}^2 - {a_3}^2)}\right\}$$

From the equation, it follows that if

$${a_1}^2 + 2a_4 - {a_2}^2 > 0 \quad \text{and} \quad {a_4}^2 - {a_3}^2 > 0,$$

then the equation does not have any real solutions.

Field Report Submitted By The Students

of

Department of Nutrition

UNIVERSITY OF BURDWAN

MANKAR COLLEGE

SEMESTER – 6th

TOPIC :- DAIRY INDUSTRY VISIT

REGISTRATION NO :- 201901010933 OF 2019-20

ROLL NO :- 190311700038

24.6.22

Principal / Secretary
Mankar College

Introduction:-

Red Cow Dairy, the largest private sector dairy procedure in Eastern India stands on the four pillars of Skill, Service, Super Quality, and Safety. At Red Cow Dairy they are enthusiastic about moving forward sustainably, with their community and their customers every step of the way. Every product that comes out from their factories passes through stringent quality checks at every step. They intend to deliver not only dairy products but items so pure that they make every moment happy in homes they reach.

Origin:-

In 1997, Narayan Majumdar started his dairy business by collecting milk from farmers in his village on a bicycle. Two decades and many years of struggle later, he can boast of an annual turnover of Rs 255 crore, three milk processing plants and 22 milk chilling plants spread across eight districts of West Bengal. His company, Red Cow Dairy Private Limited, is now of the largest suppliers of milk and milk products in eastern India. From collecting milk from farmers on his bicycle and supplying to a dairy firm where he was employed, Narayan Majumdar has risen to great heights. His company, Red Cow Dairy Private Limited, sells five types of milk, apart from dahi, ghee, paneer and rasagulla. They sell 1.8 lakh litres of packaged milk, 1.2 metric tons of paneer, 10 metric tons of dahi, 10-12 metric tons of ghee, 1,500 cans of rasagullas and 500 cans of gulab jamuns every day. For 2017-18, he is aiming at a turnover of Rs 300 crore. In 1999, he got his

first milk chilling plant in Arambagh, Hooghly District, at a monthly rent of Rs 10,000. At this time, he was still employed. By 2000 his collection of raw milk had increased to 30,000-35,000 litres, and his company's annual turnover rose up to Rs.4 crore. In the same year, he entered into an equal-share partnership with his wife and named the company Red Cow Dairy Partnership Company. In 2003, he turned this company into Red Cow Dairy Private Limited, with both him and his wife as directors and with equal shares in the company. In the same year, he also purchased 59 decimals of land at

Udaynarayanpur in Howrah District and set-up his own chilling and pasteurisation plant at a cost of around Rs 25 lakh. With this, he began to supply milk in Jharkhand and Assam, and the turnover of 2003-04 went up to Rs 6.65 crore. He now had 20 employees. Things really took off from here on and the company began to grow at a rate of 30 percent per year. By 2008, his milk procurement had increased to 70,000- 80,000 litres every day. He decided to expand his product line to sell toned and double toned milk, and outsourced the packaging of Red Cow milk packets to a private firm in Dankuni.

At present, Red Cow sells five types of milk, apart from dahi, ghee, paneer and rasagulla. In 2016, he built another state-of-the-art seven-acre plant in Jaugram, in Burdwan District, at an investment of Rs 18 crore. The plant has the production capacity of 3.5 lakh litres per day.

Summary of Visit:-

We arrived at Red Cow at around 11:30am which is located at Jaugram in Burdwan district. There were 9 of us with our 3 teachers from 6th semester of Nutrition department of Mankar College.

They warmly welcomed us and offered us some refreshments. Then the technical team's head gave us a short description about the industry.

After that the we visited different sections of Red Cow Industry:

1. Milk process unit, where we were informed about milk storage and pasteurized milk production
2. Dahi unit, where we saw 3 type of dahi- Mango Dahi Amrit Dahi and Mishti Dahi
3. Paneer Section, where we were getting a knowledge about Sterilized Paneer and Normal Paneer
4. Lassi Section, where we saw two types of lassi – rose lassi and mango lassi
5. Flavoured Milk Section, where we saw Badam Milk
6. Powdered Milk Section, where we knew about the processing of powdered milk
7. Ghee section.

From the farm to our fridge:-

Dairy milk, a wholesome beverage, has just three ingredients – milk, vitamin A and vitamin D. With Red Cow Dairy Milk manufacturers, the milk is Minimally Processed and Farm Fresh.

Let's dive a little bit deeper into the process of Milk's Journey from the farm to our table and explore the meticulous process that keeps the milk safe and delicious.

Pure milk is firstly collected from the dairy farmers after multiple stringent checks. Once the milk reaches the holding tank, it is instantly cooled to 39 degrees Fahrenheit.

The raw milk is then pumped to an insulated and refrigerated milk truck after several samples are taken to ensure the milk is safe and healthy.

Once the milk arrives at the processing pants, it is tested again before it is pumped into the insulated silos at the processing plant.

The product will then go through pasteurization, where the chilled raw milk is heated and cooled back down to its original temperature of 39 degrees Fahrenheit. The process of pasteurization is one of the necessary steps as raw milk can harbor bacteria.

Then comes the Homogenization process. In this simple process, the tiny particles stay suspended in the milk to create a more uniform texture. Milk is homogenized, not for taste, but to prevent separation.

Their product is processed at their 3 world-class & ultra-modern facilities along with 24 stringent quality tests to ensure that only top-quality milk is used in their products. An insulated, refrigerated truck then delivers the packed products to local grocery store within 48 hours, ready for purchase and consumption.

Products:-

Milk, Dahi, Lassi, Paneer, Flavored milk, Ghee, Powdered milk.

Types of Milk:-

At present Red Cow sells five types of milk :-

- **Creamy Delight Milk :-** The richness of taste, high protein and calcium makes Red Cow's Creamy Delight the best of all. It can be used for both domestic and commercial usage.

SNF	-	8.5%
Fat	-	4.5%
Energy value	-	79 Kcal
Protein	-	3.0g
Carbohydrate	-	4.8g
Fat	-	4.6g

- **Full Cream Milk :-** Red Cow Dairy's full cream milk is mothing but a gourmet choice. The highest quality, deliciously creamy, single-source milk on the market. Like all their products, this award winner is traceable back to the very cow that made it.

Milk Fat	-	99.7%
Energy Value	-	897 Kcal
Protein	-	0.0g
Carbohydrate	-	99.7g
Fat	-	99.7g
Added Sugar	-	0.0g
Vitamin A	-	700mcg

- **Premium Milk :-** A morning can be started in a cheerful manner with Red Cow Dairy's Premium Milk. Drink it or use it to enhance the test of hot and cold beverages.

SNF	-	9.0%
Fat	-	6.0%
Energy Value	-	88.4g
Protein	-	3.15g
Carbohydrate	-	5.1g

- **Gold Milk :-** One can enjoy the taste of real milk with Red Cow Dairy's GOLD. It can be one of the main ingredients of all homely deserts. Even children will enjoy the creamy texture and will become back wanting more. Red Cow Gold Milk pours richness and purity in every drop.

SNF	-	8.5%
Fat	-	3.5%
Energy Value	-	63.6Kacal
Protein	-	3.0g
Carbohydrate	-	4.8g

- **Regular Milk :-** Red Coe Dairy's Regular Milk is mostly loved by fitness freak. It is prepared by maintaining a proper ratio of carbohydrate, protein and fat that will help to build fit body.

SNF	-	9.0%
Fat	-	1.5%
Energy Value	-	47 Kcal
Protein	-	3.15g
Carbohydrate	-	5.15g

The Manufacturing Process of Milk:-

Milk is a perishable commodity. For this reason, it is usually processed locally within thousand milk processing plants. Some plants produce only fluid milk, while others also produce butter, cheese, and other milk products.

Collecting:-

- Dairy cows are milked twice a day using mechanical vacuum milking machines. The raw milk flows through stainless steel or glass pipes to a refrigerated bulk milk tank where it is cooled to about 40° F (4.4° C).
- A refrigerated bulk tank truck makes collections from dairy farms in the area within a few hours. Before pumping the milk from each farm's tank, the driver collects a sample and checks the flavour and temperature and records the volume.
- At the milk processing plant, the milk in the truck is weighed and is pumped into refrigerated tanks in the plant through flexible stainless steel or plastic hoses

Separating:-

The cold raw milk passes through either a clarifier or a separator, which spins the milk through a series of conical disks inside an enclosure. A clarifier removes debris, some bacteria, and any sediment that may be present in the raw milk. A separator performs the same task, but also separates the heavier milk fat from the lighter milk to produce both cream and skim milk. Some processing plants use a standardizer-clarifier, which regulates the amount of milk fat content in excess milk fat is drawn off and processed into cream or butter.

Pasteurizing:-

The milk - either whole milk, skim milk, or standardized milk—is piped into a pasteurizer to kill any bacteria. There are several methods used to pasteurize milk. The most common is called the high-temperature, short-time (HTST) process in which the milk is heated as it flows through the pasteurizer continuously. Whole milk, skim milk, and standardized milk must be heated to 161° F (72° C) for 15 seconds. Other milk products have different time and temperature requirements. The hot milk passes through a long pipe whose length and diameter are sized so that it takes the liquid exactly 15 seconds to pass from one end to the other. A temperature sensor at the end of the pipe diverts the milk back to the inlet for reprocessing if the temperature has fallen below the required standard.

Homogenizing:-

- Most milk is homogenized to reduce the size of the remaining milk fat particles. This prevents the milk fat from separating and floating to the surface as cream. It also ensures that the milk fat will be evenly distributed through the milk. The hot milk from the pasteurizer is pressurized to 2,500-3,000 psi (17,200-20,700 kPa) by a multiple cylinder piston pump and is forced through very small passages in an adjustable valve. The shearing effect of being forced through the tiny openings breaks down the fat particles into the proper size.
- The milk is then quickly cooled to 40° F (4.4°C) to avoid harming its taste.

Fortifying:-

Vitamins A and D may be added to the milk at this time by a peristaltic pump, which automatically dispenses the correct amount of vitamin concentrate into the flow of milk.

Packaging:-

- The milk is pumped into coated paper cartons or plastic bottles and is sealed. In the United States most milk destined for retail sale in grocery stores is packaged in one-gallon (3.8-liter) plastic bottles. The bottles or cartons are stamped with a "sell by" date to ensure that the retailers do not allow the milk to stay on their shelves longer than it can be safely stored.

- The milk cartons or bottles are placed in protective shipping containers and kept refrigerated. They are shipped to distribution warehouses in refrigerated trailers and then on to the individual markets, where they are kept in refrigerated display cases.

Cleaning:-

- To ensure sanitary conditions, the inner surfaces of the process equipment and piping system are cleaned once a day. Almost all the equipment and piping used in the processing plant and on the farm are made from stainless steel.
- Highly automated clean-in-place systems are incorporated into this equipment that allows solvents to be run through the system and then flushed clean. This is done at a time between the normal influx of milk from the farms.

DAHI:-

They have 2 types of Dahi – Amrit Dahi, Aam Dahi, Mishti Dahi.

Red Cow Dairy's **Amrit Dahi** is creamy, delicious, and full of all the goodness of their good old gut cooling dish. It makes a delicious addition to meals, or have it as a great snack.

Red Cow Dairy's **Aam Dahi** gives the real taste of the fruit. This high protein yogurt is loved by the kids and their parents alike.

Mishti Dahi – Red Cow Dairy brings this delicious treat from the land of sweets, their pride all over the world. Combining the richness of Dahi and palm jaggery, their delicious Red Cow Dairy Mishti Dahi will keep everybody to come back for more with every bite.

Processing:-

- **Reception of milk**

Fresh, good quality milk is received and analysed for SNF and fat%

- **Pre-heating**

Done at 30-40°C

- **Standardization**

5% to 3.0% fat and 10% solids not fat.

- **Homogenization**

Milk is subjected to high pressure pump forcing milk through extremely small orifice for even distribution of fat globules. Homogenization reduces the cream layer formation during incubation and single-stage Homogenizer, or double stage homogenizer can be used as per process requirement. After homogenization all the fat globules of the milk has an average size below 1 micron.

- **Pasteurization**

Milk is heated to 85-90°C for 15-30 minutes and temperature bought down to 3-4°C.

- **Inoculation**

Milk is inoculated with 1-2% of specific curd starter culture at 37°C. The incubation tanks are insulated, to ensure that the temperature remains constant during the incubation period. The tanks can be fitted with pH meters to check the development of acidity (4.2 – 4.5)

- **Packaging**

The inoculated milk is then packaged in separate cups with lids. Dahi is generally packaged in polyethylene, polypropylene, polystyrene packaging material and plastic cups.

- **Incubation**

Cups are arranged in crates which are then transferred to hot room (37˚C) where the fermentation process proceeds. In case of set curd, incubation is done when the product is in its final retail container at 30-42°C for around 4-5 hours, while for stirred types of products it can be done within the inoculum/incubation tank and then packed in pouches.

- **Cooling**

The pH of the milk in the cups should be regularly checked and when it reaches 4.4-4.5, these crates are transferred to room with temperature 3-4oC for proper setting.

- **Storage**

It is stored in the cold store below 6°C.

- **Add flavor**

Fruit and flavours are added at different steps depending on the type of curd. For set style curd the fruit is added in the bottom of the cup and then the inoculated curd is poured on top, and the curd is fermented in the cup. For Swiss style curd the fruit is blended with the fermented, cooled curd prior to packaging.

LASSI

Lassi (stirred dahi) is a ready-to-serve fermented milk beverage popular in India particularly in summer months. Good quality lassi should have creamy consistency, smooth texture, glossy sheen and white colour with yellowish tinge. Mild acidic flavour and sweetish taste of lassi make it a refreshing soft drink. It is flavoured either with salt or sugar and other condiments or spices like ginger, coriander, and mint, depending on regional preferences. Lassi is obtained from pasteurized whole milk or partly skim milk, cultured with lactic and aroma/flavour producing organisms. In many parts of the country products, like butter milk, chhach, mattha obtained after churning of sweet cream, or whole milk dahi and removal of butter are termed as lassi and usually consumed in salted or spiced form. Also a product prepared from cultured skim milk, commonly known as cultured butter milk is classified as lassi.

Manufacture process of Lassi:-

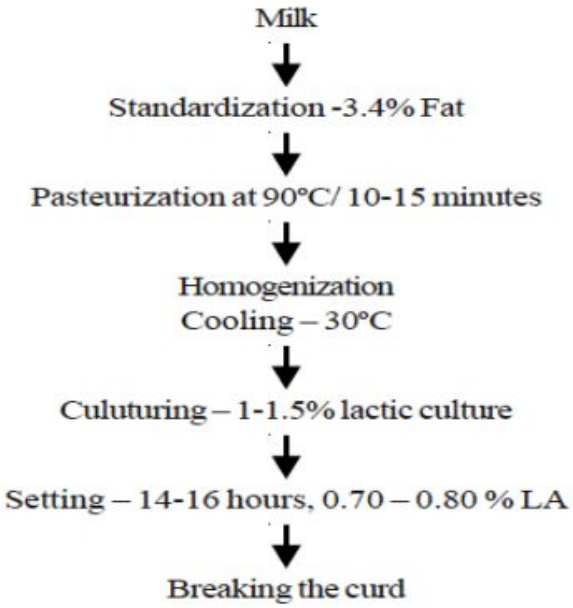
Production of lassi has been confined, to a large extent, to the households mainly because of non-availability of a standardized technique for the manufacture of uniform quality lassi and its limited shelf life. In 1972 the technology was standardized at NDRI, Karnal and regular production of lassi started. The method of manufacture of lassi involves standardization, heating and cooling of milk to inoculation temperature, addition of starter culture and setting of milk. Sugar @ 12-15% of milk dissolved in equal quantity of water is added in the form of a syrup which has been pasteurized and cooled separately.

Smooth consistency of lassi is obtained by homogenization of the mix. Flavour is added before packaging. In general, the quality of milk, starter culture and the method of manufacture influence the quality of lassi. Chemical quality of milk is important for desired body and texture and consistency and to meet the legal requirements, if any. But the more important effect of chemical and bacteriological quality of raw milk is on the growth of starter organisms. Therefore, the milk, which

serves as a growth medium for the microorganisms must be of high microbial quality and free from mastitis milk, lipolytic rancidity, residual antibiotics and germicides. There should not be any bacteriophage contamination.

Pooled milk is considered to be the most suitable for the manufacture of fermented milk products, like, yoghurt, dahi, shrikhand etc. A suitable heat treatment is applied to milk to make it free form most of the vegetative cell of microorganisms associated with raw milk. However, some spore formers and stable enzymes remain unaffected by the commonly employed heat treatment in the manufacture of fermented milks. basic role of starter culture is to bring about acid coagulation of milk and impart characteristic flavour. The culture must be pure, active and free from gas producing microorganisms. Presence of more than one type of lactose fermenting microorganisms in the starter culture is required for the production of diacetyl flavour in dahi. A lactic culture comprising of Lactococcus lactis ssp. lactis, Lactococcus lactis ssp. cremoris and Lactococcus lactis ssp. diacetilactis is used for dahi for lassi making. Setting of milk is terminated at an acidity of 0.70 – 0.80 per cent. To the set curd sugar syrup is added which requires sufficient heat treatment (80- 90^{0}C) to prevent microbial contamination through sugar. It is also essential to cool the syrup to room temperature before addition to dahi to prevent hardening of fine curd particles and whey separation. Homogenization prevents cluster formation, rising of fat to the surface and improves consistency.

In a typical method of manufacture of lassi, standardized milk (4% fat) is heated to 90oC for 10 min and cooled to 25oC before addition of starter culture (1%). Cultured milk is incubated for 12-16 hr at 25-28oC, the set curd is broken by stirring and sugar syrup is mixed. The mixture is homogenized and packaged after the addition of flavour. On an average the product contains 3 per cent fat., 6-7 per cent SNF and 10-11 per cent sugar. The acidity ranges from 0.6 to 0.7%.



Lassi keeps good only for a day or two at room temperature. Under refrigeration, the keeping quality of lassi is extended considerably. Further extension of shelf life is achieved by UHT processing after fermentation and packaging aseptically. Wheying off may occur but it can be avoided by using a suitable stabilizer and proper processing conditions.

Add flavour

Flavours are added at different steps depending on the type of lassi. For set style lassi the fruit is added in the bottom of the package and then the inoculated lassi is poured on top and the lassi is fermented in the package. For swiss style curd the fruit is blended with the fermented, cooled curd prior to packaging.

GHEE

Process of ghee making:-

The method is also known as the Vedic ghee manufacturing process and it is mostly divided into five interrelated steps. These steps are extending from procuring raw material (milk) to making the end product ghee, clarified butter. In the traditional method, these five steps are important because it is believed that diligent following of these 5 steps is the secret of making the best quality of ghee. Each of these steps is called sanskar in this ayurvedic ghee manufacturing method.

Step 1

Procurement and Boiling:

Procurement is a vital issue for making ghee in the traditional ghee manufacturing process. The quality of raw material, milk-butter, is largely dependent on farming and the diet of the cow. Grass fed milk is always better than grain-fed milk. In the traditional ghee manufacturing process, 25-30 litre cow milk is required for making around 1 liter of cow ghee. In Ayurveda, grass-fed cow's milk is considered as the best raw material for premium quality ghee. The milk is thoroughly boiled. This long boiling process helps in two ways. The milk collected from the dairy farm gets completely disinfected. On the

other hand, by using the boiling process, the manufacturers make the texture of the cow milk more concentrated.

Step 2

Curdling:

In the ghee manufacturing process, boiled milk is converted into curd. In the traditional process, one tablespoon curd is added into the milk. Instead of curd, in-home sometimes lemon juice, or any natural sour ingredient is added to milk. The milk stays overnight in a covered pot and gets converted to curd. Once the curd is fully prepared, it is churned thoroughly.

Step 3

Churning:

The curd is churned now by a wooden churner, which is called Bilona. Traditionally, card churning is done in two-way direction of bilona, one is clockwise and the other is anticlockwise. Churning is mostly a lengthy method. Once the curd gets divided into butter and buttermilk, the raw ingredients of ghee, the milk butter gets prepared.

Step 4

Separating:

At the end of the churning in the ghee manufacturing process, butter and the buttermilk gets segregated. This butter is then used to produce ghee. The butter is also called ghee butter. It is still not free from the milky part, which means this ghee butter may contain lactose and casein. By heating-process of cooking, clarified butter, ghee is produced, which is lactose and casein-free.

Step 5

Heating:

In the ghee manufacturing process, the produced butter is now placed in a heavy-bottom steel pot and it gets heated against a medium-high flame. Once the ghee butter starts boiling, the ghee manufacturer offers some more time to boiling so that the water in ghee butter gets entirely evaporated. During the boiling process, the milk butter gets clarified, and a visible layer of solids is found at the bottom of the pot that indicates that the ghee is almost ready. At this phase you will get to smell the nutty aroma of pure cow ghee and the butter will turn yellow-golden. In the final step, the golden liquid ghee is filtered via a strainer and stored in jars for later use. It is extremely vital to store the pure Ghee in a dry jar away from the exposure of light, heat, and moisture.

PANEER

Paneer involves 6 steps:-

Milk Standardization:-

For commercial manufacture of paneer buffalo milk is standardized to 5.8% fat having 9.5% SNF (standardize the buffalo milk to a fat: SNF ratio of 1:1.65).

Heat Treatment:-

After standardization of milk, it is heated to 90°C without holding (or 82°C with 5 minutes holding) in a jacketed closed vessel known as Paneer Vat. Then milk is allowed to cool down to 70°C. Heat treatment of milk causes destruction of microorganisms, denatures whey proteins and retards colloidal calcium phosphate solubility.

Coagulation and Draining of Whey:-

Coagulation is done at about 70°C by slowly pouring 1% hot (70°C) citric acid solution with constant stirring till a clean whey is separated (pH 5.30 to 5.35) and coagulum is allowed to settle for 5 minutes, after which the whey is drained off.

Hooping:-

The curd so obtained is filled into hoops lined with cloth.

Pressing:-

Pressure is applied on top of the hoop at a rate of 0.5 to 1kg/cm2. The surface of hoops must contain holes to facilitate whey expulsion. Good quality product can be prepared by pressing for around 15 min.

Dipping in chilled water:-

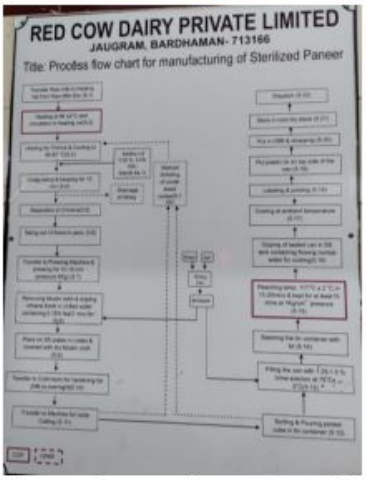
The pressed blocks of paneer are removed from the hoops and immersed in chilled water for 2-3 hrs. The chilled paneer is then removed from water to drain out. This step assists in developing texture and speeds up the cooling process. The water used for chilling should be of good bacteriological quality.

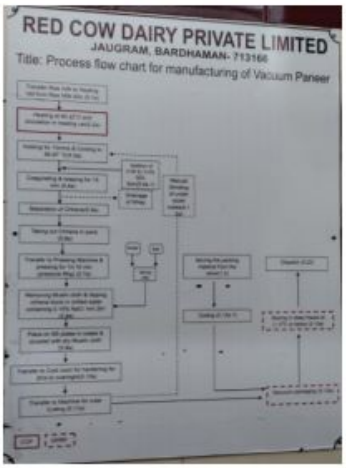
Packaging:-

Finally, paneer blocks are wrapped in parchment paper / polyethylene bags and placed in cold room at about 5 to 10°C.

Sterilized Paneer:-

Paneer sterilised is soft and creamy cubes of paneer. Product is kept in a brine solution which gives it a caramelised taste that makes it excellent for gravy preparations or enjoy it directly from the tin pack. Processed Paneer Cubes (Milk Solids, Citric Acid) And Brine (Water, Common Salt).



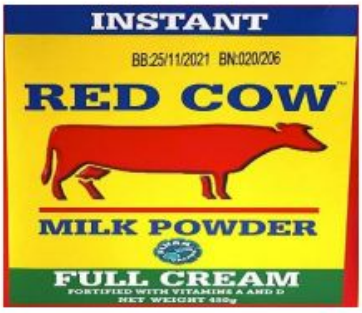


Flow chart of manufacturing of Sterilized and Vaccum Paneer

FLAVOURED MILK

Red Cow Badam Flavoured Milk is an on-the-go energizing health drink that will keep you refreshed. It is sterilized at high temperatures and packed aseptically to ensure high quality and purity. Pour it in your favourite glass or drink straight from the can to feel the creamy flavour of Badam Milk.

POWDERED MILK



Powdered milk or dried milk is a manufactured dairy product made by dehydrating liquid milk through several drying processes until it is a powder. Their purpose of drying milk is to preserve it; milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated.

Production process:-

Standardization/Separation:

The conventional process for the production of milk powders starts with taking the raw milk received at the dairy factory and pasteurizing and separating it into skim milk and cream using a centrifugal cream separator. If WMP is to be manufactured, a portion of the cream is added back to the skim milk to produce a milk with a standardized fat content (typically 26- 30% fat in the powder). Surplus cream is used to make butter or anhydrous milk fat.

Preheating:

The next step in the process is "preheating" during which the standardized milk is heated to temperatures between 75 and 120 °C. The milk is held in this condition for a specified time ranging from a few seconds up to several minutes (pasteurization: 72 °C for 15 s). Preheating causes a controlled denaturation of the whey proteins in the milk and it destroys bacteria, inactivates enzymes, generates natural antioxidants and imparts heat stability. The exact heating/holding regime depends on the type of product and its intended end-use. High preheats in WMP are associated with improved shelf life but reduced solubility. Preheating may be either indirect (via heat exchangers), or direct (via steam injection or infusion into the product), or a mixture of the two. Indirect

heaters generally use waste heat from other parts of the process in order to reduce energy costs.

Evaporation:

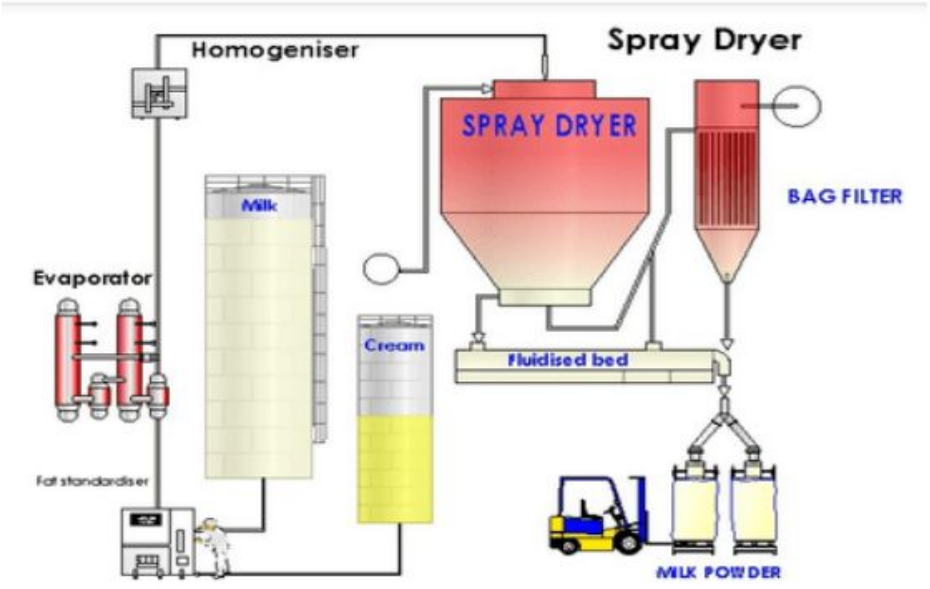
In the evaporator, the preheated milk is concentrated in stages or "effects" from around 9.0% total solids content for skim milk and 13% for whole milk, up to 45-52% total solids. This is achieved by boiling the milk under a vacuum at temperatures below 72 °C in a falling film on the inside of vertical tubes, and removing the water as vapor. This vapor, which may be mechanically or thermally compressed, is then used to heat the milk in the next effect of the evaporator which may be operated at a lower pressure and temperature than the preceding effect. Modern plants may have up to seven effects for maximum energy efficiency. More than 85% of the water in the milk may be removed in the evaporator. Evaporators are extremely noisy because of the large quantity of water vapor travelling at very high speeds inside the tubes.

Spray Drying:

Spray drying involves atomizing the milk concentrate from the evaporator into fine droplets. This is done inside a large drying chamber in a flow of hot air (up to 200 °C) using either a spinning disk atomizer or a series of high pressure nozzles. The milk droplets are cooled by evaporation and they never reach the temperature of the air. The concentrate may be heated prior to atomization to reduce its viscosity and to increase the energy available for drying. Much of the remaining water is evaporated in the drying chamber, leaving a fine powder with around 6% moisture content with a mean particle size typically of ‹0.1mm diameter. Final or "secondary" drying takes place in a fluid bed, or in a series of such beds, in which hot air is blown through a layer of fluidized powder removing water to the point of a moisture content between 2-4%.

Packaging and Store:

Milk powders are immensely more stable than fresh milk but protection from moisture, oxygen, light and heat is needed in order to maintain their quality and shelf life. Milk powders readily take up moisture from the air, leading to a rapid loss of quality and caking or lumping. The fat in WMPs can react with oxygen in the air to give off-flavors, especially at higher storage temperatures (> 30 °C) such as found in the lower lattitudes of the Tropics. Milk powder is packed into either plastic-lined multi-wall bags (25 kg) or bulk bins (600 kg).



Milk powder making process

Conclusion:-

At Red Cow Dairy, passion and integrity are the main ingredients in everything they do. This starts from the very first step of procuring carefully selected milk, all the way till its products reach our table.

To lead the market in producing quality dairy products for every person, every occasion, every day. While doing this they want to be one of the most admired Milk Dairy companies in India, one that is admired for their fair-trade practices and sustainable approach in every step of their journey.

Their mission is :

- To ensure the customers get quality dairy products at their own comfort.
- To inspire sustainable growth and fair-trade practices.
- To stay at the forefront of technology and management whilst of transforming the lives of their dairy farmers.

Project Report Submitted By The Students of 1st Semester Honours & General on Environmental Science

MANKAR COLLEGE

SUB-ENVIRONMENT STUDIES

PROJECT TITLE-INDOOR AIR POLLUTION

NAME- BAPPA BAGDI

ROLL NO-415 {B.A GENERAL}

REG NO-202101012456

SEMESTER-1ST

SESSION-2021-2022

THE UNIVERSITY OF BURDWAN

ATTESTED
Principal 13.3.23
Mankar College

Indoor Air Pollution: sources and Effects :-

categories: Energy conservation

Wheather its in school, the offices, on the subway or simple at home, most people spend about 90% of their time indoors. And while we often talk about the amount of pollution in our atmosphere, we rarely consider the quality of the air that we're breathing when we are inside.

However, indoor air pollution has been shown to have considerable effect on both long and short term health and is thought to be responsible for 4.3 million deaths each year. [1] Find out what you can do to improve the quality of air in your home.

What is indoor Air Pollution ?

Simply put, indoor air pollution refers to any contamination of the air within a building. Pollutant are generally grouped into the following categories: molds, solvents, pesticides, smoke, pet dander, and gase most properties will suffer from indoor air pollution some degree. The quality of your indoor air (IAQ) is a measure of how the air inside of a building effect its occupants' health and comfort.

Indoor air pollution has become a more prossing conce in recent years due to the construction of more energy -efficient homes. These properties tend to be relatively airtight, meaning that the air inside can quickly become stagnat and pollutant levels rapidly rise.

Elsewhere, the burning of fuels such as coal, wood and for heating and cooking product a large numbers of toxic chemicals. These include formaldehyde and carbon mon- oxide, as well as perticulates, without effective vent- ilation, these chemicals are inhald and can cause serious damage to your health in a myriad of ways.

How Dose indoor Air Pollution Affect Human Health:

A reduction in fresh air exchange in modern building has given rise to modern a Phenomenon know as "sick building syndrom caused by a combination of poor ventilation and poorly-maintaind air conditioning.

The symptoms of sick building syndrome improve when you leave the permises and get worse the longer you stay there. The most common symptoms include.

- Headaches
- Blocked sinuses or a runny nose.
- Skin rashes
- Itchy eyes
- Drowsiness
- Difficulty breathing

Bear in mind that these symptoms are extremely common and can be caused by a wide range of issues incding ypical allergies. If you are experencing these symptoms poradically, or continully no matter where you are, it unlikely that Sick building syndrome is the cause.

however, you experience these symptoms – and they ntinue to get worse – every time you are in a certain ilding, SBS may be to blame. To alleviate the symptoms urself, you can try the following.

- open windows or doors to let fresh air in
- Reduce the themostat to about 66°F
- Try taking more regular breaks from your desk.
- Where possibee take in some fresh air by walking outside.

If you are experiencing these symptoms while you are at work you should ask your manager or employer to look into the cause of the problem. Alternatively, if this occurs in another building you rent, talk to your building manager. Sick building syndrome can be highly dangerous given continue exposure and should not be treated lightly.

Sources of Indoor Air pollution :-

There are many sources that can be responsible for indoor air pollution, some of which are recognizable due to their odor, but there are many that fly under the radar.

Mold :- mold is a form of fungus which grows from spores that latch into damp areas in building. it digests the materials it lands on and can grow on many types of surface. it is prevalent in moist environments and it is most common during the winter months and airin more humid climates.

As there are many types of fungus that cause mold, it can talk on a wide variety of features. Mold may be white, black, green or yellow, and can appear to be slick, fuzzy or range of hazardous toxins into the air and can cause many different symptoms and is a particular concern to babies, children, olders adults, and those with existing skin problems respiratory problems or weakned immune systems.

Fig !!

Tobacco Smoke :-

A major cause of indoors air Pollution, environmental tobacco smoke, or secondhand smoke causes over 40,000 deaths in the U.S. each year.[2] The inhalation of cigarette smoke is particulary harmful to children, increasing the risk of sudden infant death syndroms (SIDS), severe asthma, ear problems, and acute respiratory infections.[3]

Moreover, cigaretter smoke contains at least 70 carcinogens, chemicals that have been proven to cause cancers, as well as around 7,000 other chemicals that your body could do without.[4]

When inhaled, these chemicals can cause illnesses such ass chronic obstructive pulmonary disease (COPD) and other cardiovascular disease which load to heart attacks, as well as other serious complications.

Carpet :-

Carpets act like traps for indoor pollutants, easily absorbing mold spores, particulates from smoke allergens and other harmful substance. Researchers has found that even some toxic gases can settle into carpet.(5) While some may argue that this trap keeps occupants safe. Pollutants caught in carpets can be easily disturbed simply by walking on them.

every home cause indoor air pollution these incide.

- cleaning agents and disinfectants.
- Paints.
- Glutes and products.
- Personal care Product.
- Air- fresheners.
- candles.

These Products way emit valable organic compound (VOCs). which can cause issuse such as eys nose or throat irritation heads ches, housea, organ damage and even caner conceer in some extreme cases[6]

Appliances

Many homes and offices contain space heatere, ovens, furnoces, fireplaces and water heaters that barn fuels such as gas kepesen and air, coal or wood for energy. AS combustion can be extremently dongerous, most application are rigorously tested to hsure they are sape for use. However, it the appliance is faulty. it can produce toxic gas such as carbon monoxide, sulfur dioxide, and other compounds including hazardous redicles.

Randon :- A completly odorless and inert gas, ra don can seep up through the ground and diffuse into the air in your building when it undergoes decay. randon emits rediation which can attach to dust particles.

Pet Dander :- You might no think of pet dander when you think of indoor Pollutants, but for many allergy Suffer-ese, its an acute irritant that can make some indoor environment vexing. Pet dander is composed of microscopic flakes of skin shed by household pets meaning that hairless breed can cause symptoms like coughing sneezing, watery eyes, and chest tightness.[8]

it is important to note that air temperature humidity, and circulation can product symptoms similar, and simple turning down the thermostat may help.

How to improve indoor Air quality :-

So if you are suffering from indoor air Pollution, how do you improve the quality of the air youre breathing in, let's take a look at a few solutions.

HEPA-filters :— High-efficiency particulate air (HEPA)-filters can be employed as air purifiers or attached to vacuum devices in order to remove dust, spore, mites other pollutants from the air, Accor ding to the institute of Environmental Science and Technology [9], an appliance can only be considered a HEPA-filter if it traps 99.97% of particles 0.3 microns or large for context begin at 1 micron.

Vacuum :— vacuuming is extremely important to improve indoor air quality, especially if you re commended that you vacuum at least 3 times a we in order to keep dust leaves low

Plants :— Houseplants have been shown by NASA to be nature's life support system" and are an essential component in improving indoor air quality. The not only absorb carbon dioxide from air but particulates that attach to CO_2 100 mi. er organisms in the soil have also been found to remove volatile organic compounds from the air : [10]

Reduce clutter :- The more clutter you have in your home, the more places there are for dust to hide. Decluttering will not only help clear your mind, but help clean the air too!

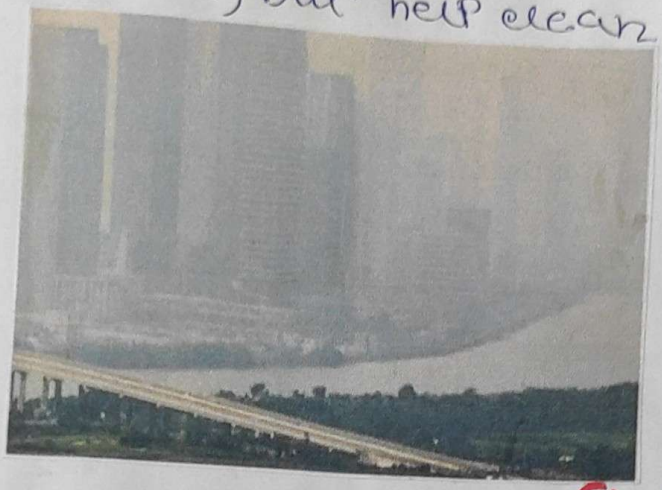


Fig:- ?.

Next Steps in Reducing Air Pollution :-

Aside from all the household sources of indoor air pollution, you might also be worried about outdoor air pollution, especially if you life live in an area with lots of car traffice or local industry. outdoor air pollution is a public health problem in many densely populated areas, but any where you live, you can make contribution by using less energy, or even go car-free certain days of the week to help lower your individual footpraint!

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