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ADVANCED TECHNIQUES IN WATER QUALITY ASSESSMENT AND MANAGEMENT

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ABSTRACT

Water quality assessment and management are concerned because declining of water quality affects economic growth in Asian countries. Water quality assessment includes three kinds of parameters; Chemical, Physical and Biological. Chemical parameters include Hardness, pH, alkalinity, BOD, Nitrate, Phosphate etc. Biological parameters refer to the number and types of organisms present. Physical parameters include odour, colour, etc. Water quality is affected by human activities as well as natural phenomena. The effects of polluted water on human health, aquatics, agriculture, etc. are devastating. It becomes very difficult to assign a single water quality standard which can be used for all the needs. For example, all the parameter i.e., chemical, biological, and physical of water that are suitable for irrigation are not same as that required for drinking purpose. There are several methods for characterization and management of water quality impairments. Single factor assessment, comprehensive pollution index, water quality grading, the numerous pollution index, principle component analysis, fuzzy comprehensive evaluation, comprehensive water quality identification index, harmony degree equation and remote sensing techniques are some of the water quality assessment methods. Traditionally, assessments were resulted by cost efficiency, emission reduction, etc. Water quality assessment, water quality management, quality index, assessment methods.

INTRODUCTION

The world's water resources are under increasing threats from a wide range of pollutants, resulting in deteriorating water quality in rivers, lakes, aquifers and seas.

Nowadays, it is driven by pollutants discharges via sewage system. Water quality management therefore involves the planning, development, implementation, monitoring and auditing of water quality. Water quality (WQ) modelling plays an important role in better understanding the magnitude and impact of WQ issues and in providing evidence for policy making and implementing measures to mitigate water pollution.

The operations involved in water quality assessment are many and complex. They can be compared to a chain of about a dozen links and the failure of any one of them can weaken the whole assessment. The main reason for the assessment of the quality of the aquatic environment has been, traditionally, the need to verify whether the observed water quality is suitable for intended uses. Monitoring and assessing the quality of surface waters are critical for managing and improving its quality.

In situ measurements and collection of water samples for subsequent laboratory analyses are currently used to evaluate water quality. Major factors affecting water quality in water bodies across the landscape are suspended sediments (turbidity), algae (i.e., chlorophylls, carotenoids), chemicals (i.e., nutrients, pesticides, metals), dissolved organic matter (DOM), thermal releases, aquatic vascular plants, pathogens, and oils. Suspended sediments, algae, DOM, oils, aquatic vascular plants, and thermal releases change the energy spectra of reflected solar and/or emitting thermal radiation from surface waters which can be measured using remote sensing techniques. Most chemicals and pathogens do not directly affect or change the spectral or thermal properties of surface waters, so they can only be inferred indirectly from measurements of other water quality parameters affected by these chemicals. Remote sensing tools provide spatial and temporal views of surface water quality parameters that are not readily available from in situ measurements, thus making it possible to monitor the landscape effectively and efficiently, identifying and quantifying water quality parameters and problems. The water quality varies according to the type of use.

OBJECTIVE

1. Assess the overall chemical and microbial factors that influence the water quality using a targeted sample approach.
 2. To obtain advance techniques for water quality assessment.
 3. To maintain the water quality according to its requirement that is water quality management.
 4. To measure concentration of the constituents in quantity for characterisation of water for different uses.
 5. To obtain COD reduction by freeze crystallization.
-

Water quality assessment

Water quality is determined by assessing three classes of parameters: biological, chemical, and physical. Biological parameter : Biological attributes refer to the number and types of organisms that inhabit a waterway. Chemical parameters: include DO, COD, BOD, HARDNESS, Silanity, pH etc.. Assessment of water quality by its chemistry includes measures of many elements and molecules dissolved or suspended. Physical parameters : includes TSS, TDS, Temp, colour, odour, etc. There are considered of primary importance to the quality of drinking water. The EPA drinking water standards are categorized as primary drinking water standards and secondary drinking water standards. Primary drinking water standards regulate organic and inorganic chemicals, microbial pathogens, and radioactive elements that may affect the safety of drinking water. Secondary drinking water standards regulate chloride, colour, copper, corrosivity, foaming agents, iron, manganese, odour, pH, sulfates, total dissolved solids, and zinc, all of which may affect qualities of drinking water like taste, odour, colour, and appearance. Commonly measured chemical parameters include pH, alkalinity, hardness, nitrates, nitrites and ammonia, ortho and total phosphates, and dissolved oxygen and biochemical oxygen demand. Chemical measures can also be used to detect imbalances within the ecosystem. In addition, some "chemical" measurements actually indicate the physical presence of pollutants in water. These include measurements such as conductivity and density.

Treatment of Chemical Parameters

Reduction of COD by an advanced technique- Multistage Freeze Crystallization

This test is widely used to determine

- a) Degree of pollution in water bodies.
- b) Efficiency of treatment plants.
- c) It also provides idea about the amount of bio chemical oxygen demand (BOD).

Principle

Many of the organisms get destroyed when boiled with a solution of potassium dichromate and sulphuric acid giving out carbon dioxide and water. A sample is refluxed with a known amount of potassium dichromate and sulphuric acid medium and excess of dichromate is titrated against ferrous ammonium sulphate.

Procedure

- I. In one reflux, take 10 ml H₂SO₄, 10 ml K₂Cr₂O₇ (0.25), 10 ml effluent and 0.4g of HgSO₄ in 250 ml reflux sample and mix these well.
- II. Now, if the colour turns to green, either take fresh sample with lesser aliquot or add more potassium dichromate with sulfuric acid.
- III. In an another reflux, take 10 ml H₂SO₄, 10 ml K₂Cr₂O₇ (0.25), 10 ml distilled water and 0.4g of HgSO₄ in 250 ml reflux sample again mix well.
- IV. Connect the flask to condenser and then mix the contents well before heating since improper mixing results into bumping.
- V. Reflux for atleast 2 hours. Cool and then wash down condenser with fresh water.
- VI. Disconnect reflux condenser.
- VII. Cool to room temperature and titrate excess K₂Cr₂O₇ with 0.1M Ferrous Ammonium Sulphate using 2-3 drops of ferroin as indicator. The sharp colour changes from bluish green to reddish brown indicates completion of the titration. After sometime, the blue-green colour may reappear. Use the same quantity of ferroin indicator for all titrations.
- VIII. Reflux blank in the same manner using distilled water instead of sample.

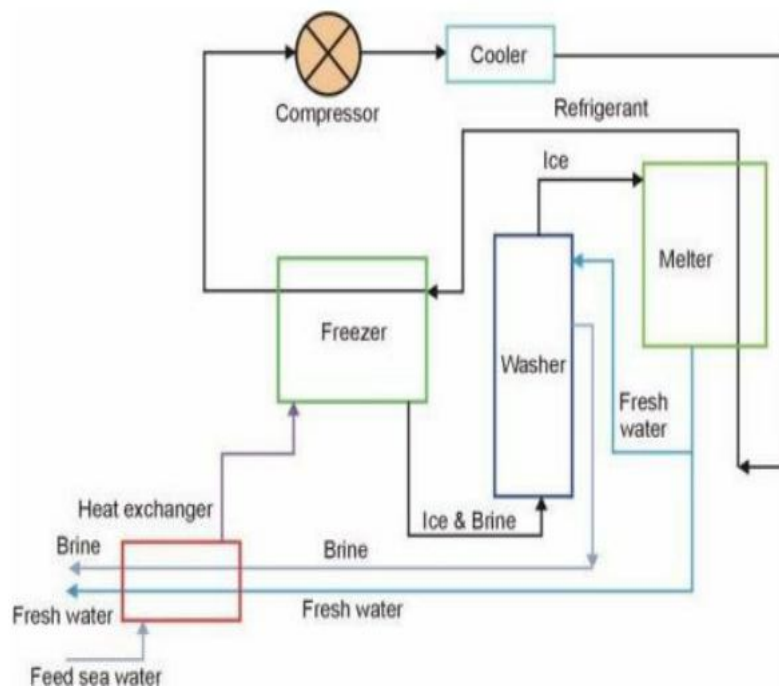


Fig-1: Freeze Crystallization

Calculation

Formula to calculate Chemical oxygen demand (COD)

$$COD = \frac{\text{Blank reading} - \text{Burette Reading} \times 0.1 \times 8000}{\text{SAMPLE VOLUME}}$$

0.1= Normality of ammonium ferrous sulphate hexahydrate

8000= Oxidation number of oxygen

*Blank Reading= 25.0 ml & variant between 23.0 to 26.0

Table-1: Result summary for COD Reduction

Sample	Volume of sample (ml)	Temp. (°C)	Burette Reading	COD (ppm)
Feed sample	0.49	35	19.50	8979.6
Melted sample 1	0.39	-5	17.88	14605.1
Crystals obtained 1	1.23	-5	15.20	6374
Melted sample 2	1	-8	14.50	8400
Crystals obtained 2	1.5	-8	17.00	4000
Melted sample 3	1	-10	13.20	9440
Crystals obtained 3	2.5	-10	19.60	1728

The process involves nucleation, crystal growth washing and melting. There is still much to learn on the nucleation and crystallization aspects of the process. Recent Freeze Crystallization development enable to shed more light on the overall crystallization. Results shows that 2 hours of continuous freezing is eligible to reduce the liquid fraction to the half. The results show that there is approx. 80% reduction in COD in just three stages of freeze crystallization.

Treatment of all the parameter of assessment

Effluent Treatment Plant

To clean industry effluent and recycle it for further use. To reduce the usage of fresh/potable water in Industries. To safeguard environment against pollution and contribute in sustainable development. Effluent Treatment Plants or (ETPs) are used by leading companies in the pharmaceutical and chemical industry to purify water and remove any toxic and nontoxic materials or chemicals

from it. These plants are used by all companies for environment protection. An ETP is a plant where the treatment of industrial effluents and waste waters is done. The ETP plants are used widely in industrial sector, for example, pharmaceutical industry, to remove the effluents from the bulk drugs.

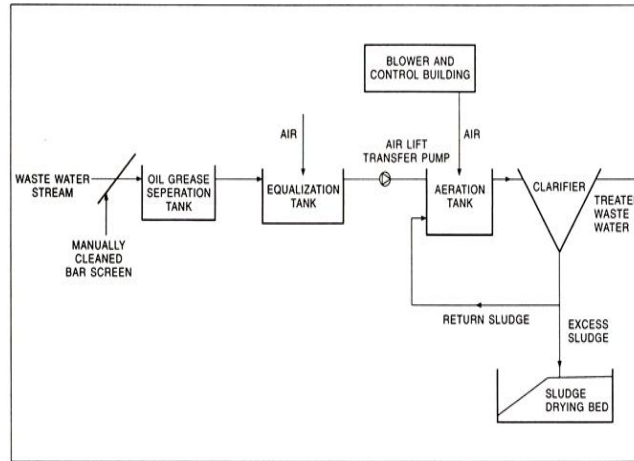


Fig-2: Effluent treatment plant

Water Quality Management

Water quality management involves planning, development, implementation and auditing of water quality. The steps perform in water quality management are

- 1) Setting water quality goal.
- 2) Water quality monitoring.
- 3) Identification of nature and magnitude of pollution.
- 4) Source inventory.
- 5) Water quantity information.
- 6) Selection of technology.
- 7) Financing waste management.
- 8) Maintenance of sewage treatment plant.
- 9) Pollution from industrial sources.
- 10) Pollution from non point sources.
- 11) Some other important options for water quality management.

There are several methods for management of water quality impairments.

A) Basis for Using Remote Sensing

Substances in surface water can significantly change the backscattering characteristics of surface water. Remote sensing techniques depend on the ability to measure these changes in the spectral signature backscattered from water and relate these measured changes by empirical or analytical models to a water quality parameter. The optimal wavelength used to measure a water quality parameter is dependent on the substance being measured, its concentration, and the sensor characteristics. Major factors affecting water quality in water bodies across the landscape are suspended sediments (turbidity), algae (i.e., chlorophylls, carotenoids), chemicals (i.e., nutrients, pesticides, metals), dissolved organic matter (DOM), thermal releases, aquatic vascular plants, pathogens, and oils. Suspended sediments, algae, DOM, oils, aquatic vascular plants, and thermal releases change the energy spectra of reflected solar and/or emitting thermal radiation from surface waters which can be measured using remote sensing techniques. Most chemicals and pathogens do not directly affect or change the spectral or thermal properties of surface waters, so they can only be inferred indirectly from measurements of other water quality parameters affected by these chemicals. Remote sensing tools provide spatial and temporal views of surface water quality parameters that are not readily available from in situ measurements, thus making it possible to monitor the landscape effectively and efficiently, identifying and quantifying water quality parameters and problems. Development of remote sensing techniques for monitoring water quality began in the early 1970s. These early techniques measured spectral and thermal differences in emitted energy from water surfaces. Developed an empirical approach to estimate suspended sediments. The general forms of these empirical equations are

$$Y = A + BX \text{ or } Y = AB^X$$

Where Y is the remote sensing measurement (i.e., radiance, reflectance, energy) and X is the water quality parameter of interest (i.e., suspended sediment, chlorophyll). A and B are empirically derived factors. In empirical approaches. Statistical relationships are determined between measured spectral/thermal properties and measured water quality parameters. Often information about the spectral/optical characteristic of the water quality parameter is used to aid in the selection of best wavelength(s) or best model in this empirical approach. A discussion of in situ sensors for remote monitoring is also included because these are essential for measuring water quality parameters that cannot be measured with remote sensing techniques and for data to calibrate remote sensing models for determining water quality.

Most researchers have concluded that surface suspended sediments can be mapped and monitored in large water bodies using sensors available on current satellites. The mapping was done in categories related to a management plan proposed for the lake.

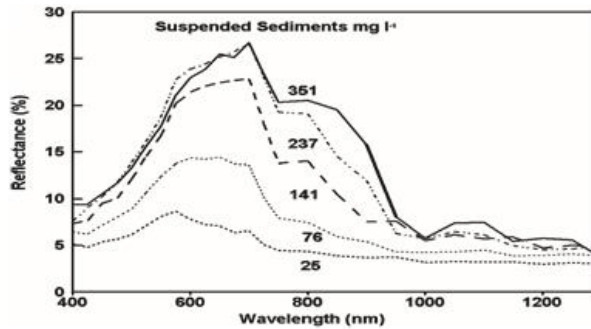


Fig-3: The relationship between reflectance and wave length as affected by the concentration of suspended sediments

B) Single factor assessment

For water quality evaluation, this determines that if only one parameter exceeds the standard, all functions of the water body will be lost. The formula for the SFA method is:

$$F = F_a \max$$

F is the class of surface water

Table-2: Value of Surface Water Quality Standard

	Class 1	Class 2	Class 3	Class 4	Class 5
Permanganate Index (mg/L)	2.0	4.0	6.0	10.0	15.0
COD (mg/L)	15.0	15.0	20.0	30.0	40.0
BOD5 (mg/L)	3.0	3.0	4.0	6.0	10.0
NH ₃ -N (mg/L)	0.15	0.5	1.0	1.5	2.0
TP (mg/L)	0.02	0.1	0.2	0.3	0.4
Petroleum (mg/L)	0.05	0.05	0.05	0.5	1.0

C) Comprehensive Water Pollution Index (CWPI)

The Single Factor Evaluation (SFE) method is used to create a Comprehensive Water Pollution Index (CWPI). The SFE (excluding DO) increases with the pollutant’s concentration, and its equation is as follows:

$$I_a = \frac{Ca}{Soa}$$

Where I_a is the pollution index of water quality index, Ca (mg/L), was the measured concentration of water quality index of a, and Soa (mg/L) was the concentration limit of water quality index of a.

F_{cpi} referred to the arithmetic mean of n water quality indexes. The equation was as follows:

$$F_{cpi} = \frac{1}{n} \sum_{n=1}^n I_a$$

Where n is the number of selected pollutants.

D) Harmony degree equation.

Water quality assessment is an important basic work in the development, utilization, management, and protection of water resources, and also a prerequisite for water safety. In this paper, the harmony degree equation (HDE) was introduced into the research of water quality assessment, and a new method for water quality assessment was proposed according to the HDE: by harmony degree equation (WQA-HDE). The results

showed that the calculation steps of WQA-HDE are similar to the comprehensive assessment method, and WQA-HDE is more operational comparing with the results of other water quality assessment methods. In addition, this new method shows good flexibility by setting the judgment criteria value HD0 of water quality; when HD0 = 0.8, the results are closer to reality, and more realistic and reliable. Particularly, when HD0 = 1, the results of WQA-HDE are consistent with the single factor assessment method, both methods are subject to the most stringent "one vote veto" judgment condition.

So, WQA-HDE is a composite method that combines the single factor assessment and comprehensive assessment. The research field of theoretical method system of harmony theory but also promotes the unity of water quality assessment method and can be used for reference in other comprehensive assessment.

E) Comprehensive Water Quality Identification Index (CWQII)

Based on the single factor water quality identification index, the comprehensive water quality identification index, which is a new tool for general water quality assessment of surface water, is presented. The comprehensive water quality identification index can fully depict the general water quality of surface water, and its characteristics are listed as follows. Firstly, it can evaluate general water quality both qualitatively and quantitatively. Secondly, it assesses general water quality by a group of typical assessing items instead of deciding by the worst assessing item, so the assessment of general water quality is reasonable. Thirdly, it can be used to compare general water quality of different stations of the same river and different rivers, and it can also be used to compare general water quality with the same classification of classes I-V and the class worse than class V. Nowadays the comprehensive water quality identification index has been applied in evaluating the general water quality of Shanghai rivers, and very convincing conclusions have been drawn. In addition, the criterion for river blackness and stink is ascertained .

As a relatively new method, the CWQII could be used to evaluate the water quality of surface water. The Single Factor Identification Index (SFII) is a basic part of the CWQII, and its equation was as follows (excludes DO).

$$P_{SF1} = P_1 P_2$$

Where P_1 is between 1 and 5, corresponding to its water quality, from Class 1 to 5. When the index was not the index for dissolved oxygen (DO), the equation was as follows:

$$P_2 = \frac{C_a - S_{ab}}{S_{abmax} - S_{abmin}} * 10$$

C_a is the concentration of the ath water quality index, and S_{abmax} and S_{abmin} are the upper limit and lower limit of the concentration interval of Class b water in the ath index, respectively. The equation is as follows:

$$P_c = P_1 P_2 P_3 P_4$$

$$P_1 P_2 = P_{COD} + P_{BOD} + P_{NH3-N} + P_{Tp} + P_{petroleum} + \sum_{a=1}^n P_a$$

CONCLUSIONS

Multistage Freeze crystallization seems to be successful mainly due to its ability of producing high quality product with much lower energy requirement as compared to other available technologies. This technology it comes at different configuration and setups from direct crystallization to indirect and at promising cost reduction compared to conventional thermal and RO processes. Using this advanced Technology we can reduce COD to about 80% which is a very high amount. Water quality management is equally important as assessment and in that current remote sensing technologies have many actual and potential applications for assessing water resources and for monitoring water quality. Comprehensive water quality identification index can be applied to judge whether the water quality meets environmental water functions and suitable for assessment of the overall water quality when the water is seriously polluted. Comparing four methods of evaluating surface water quality, the Comprehensive Water Quality Identification Index (CWQII) is a feasible method for evaluating the water quality conditions. The Single Factor Evaluation (SFE) method only considers the most prominent factor and not all factors are considered in the resulting water quality evaluation. This means that the SFE method is limited in its ability to characterize the comprehensive water quality condition. Because of overemphasizing the influence of the maximum factor, the Comprehensive Water Pollution Index method cannot effectively evaluate the comprehensive water quality condition. Moreover, these methods could not determine the water quality classes. The CWQII method was the best method because this method used a group of evaluation factors instead of using only single evaluation factor, giving a more balanced result. This method can also evaluate the comprehensive water quality qualitatively and quantitatively. However, in order to achieve the environment targets of the ‘Water Pollution Prevention Action Plan’ by 2020, water quality management policies and water

environmental controls need to be improved. The CWQII method is an efficient tool to classify the water quality of the river and give rapid and precise information about the situation of the river that can provide useful information for water quality management and decision making.

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CONSUMER BUYING BEHAVIOUR AT SHOPPING MALLS

Niraj Dilip Sharma

ABSTRACT

“A retail revolution is happening at newer markets, India presents exciting opportunities on account of its vast middle-class and a virtually untapped retail industry”.

Shopping Malls are replacing ‘kirana’ stores all over India. India’s retail infrastructure is slowly undergoing a change with many hi-fi Shopping Malls being constructed and operating in various cities. The mall concept has come to stay for good. The Indian consumer seems to be undergoing a shift in terms of personality, buying motives, interests, attitudes, beliefs and values when he or she is making a shift from ‘kirana’ stores towards shopping malls. In this context it assumes significance to study the buying behaviour of consumers, especially with changes taking place in India’s retail scenario. The scope of this research is to assess the overall customer satisfaction, response of customers with regard to the availability and quality of products and services offered at shopping malls and the comfort level of the respondents towards shopping in the shopping malls. Factors influencing the customer to shop in the shopping malls, such as socioeconomic profiles, income, frequency of visit, period of relationship between the respondents and shopping malls, purpose of visit, occasion to visit shopping malls are some of the aspects studied in the present study.

Keywords: Shopping Malls, Retail, ‘Kirana’ Stores, Consumer Buying Behavior

I INTRODUCTION

Before business can develop marketing strategies, they must understand what factors influence buyer’s behavior and how they make purchase decisions to satisfy their needs and wants. Buyers are moved by a complex set of deep and subtle emotions. Their behavior result from deeply held values and attitudes, their perception of the world and their place in it, from common sense, impulse or just plain whimsy.

There are also several stages through which the consumer exhibit before deciding to purchase goods or services .These includes 5 steps which are: problem or need recognition, information search, alternative evaluation, purchase and post-purchase evaluation.

II REVIEW OF LITERATURE

Consumer buying decision process is the processes undertaken by consumer in regard to a potential market transaction before, during and after the purchase of a product or service. (Source: Mr. Niraj Dilip Sharma) **“The Influence of Multi-Store Environmental Clues on Perceived Merchandise Value and Patronage Intentions”**

22 previously done projects has been reviewed for this research work, out of 22 8 were from the internal research of big bazaar, which derived the results of usage and they implemented changes like Wednesday big bazaar and paanch din ka maha bachath offer and more.6 are from wall-mart perceptual experiments, which stated the availability of merchandise which makes more purchases. Another 8 are from student’s research reports from various stores in the world which showed the need for continuous research in the field of retailing. Hence we can carry on further research. The following conclusions have been made from the above review. Objectives have been designed from this review study.

III NEED FOR THE STUDY

The field of consumer behavior is interdisciplinary, i.e., it uses concepts from a large variety of fields like anthropology, sociology, marketing, psychology, etc. The belief that consumer behavior could be predicted and consumers influenced gave an added impetus to the study of consumer behavior. There are, thus, four underlying principles on which the field of consumer behavior is based.

- Sovereignty of the consumers.
- Consumer research facilitates an in-depth understanding of the consumers.
- It is possible to influence consumers.
- It is socially acceptable to influence consumers.

IV OBJECTIVES OF THE STUDY

- To know the perception of customers towards the purchasing.

- To know the buying behavior of customers in retail store.
- To know the strategy of retail store for attracting customers
- To know the satisfaction level of customers.
- To know what are the main factors that influence buying decision process.

V SCOPE FOR THE STUDY

Consumer behavior has been studied by numerous scientists including psychologists, sociologists, economists, behavior analysts and anthropologists. These scientists are attempting to understand the buyer decision making process, both individually and in groups. It studies characteristics of individual consumers such as demographics, and behavioral variables in an attempt to understand people's wants. It also tries to assess influences on the consumer from groups such as family, friends, reference groups, and society in general.

Some of the areas that are considered are

1. Consumer recognition of a problem in their lives and the attempt to solve it by buying something.
2. How consumers search for things that they need.
3. How consumers evaluate the products that they buy.
4. What is the impact on dissatisfaction on consumer purchases?
5. How do consumers make purchase decisions?
6. What kinds of advertising is the most effective?

VI LIMITATIONS OF THE STUDY

Though the detailed investigation is made in the present study, still there are following limitations.

- This study is restricted only to the Big Bazaar Vasai (West) only. So, the results may not be applicable to other areas.
- This study is based on the prevailing customer's behavior. But the customer's behavior may change according to time, fashion, technology, development, etc.
- As per the population of the study is huge, a sample size of 100 sample respondents is only covered.
- Data collection of exact data for the research is not possible because there is a gap between what respondent say and what they actually do.
- Information provided by the customers may not be accurate. They may hide some of the information at the time of filling up the questionnaires
- Scientific methods of post testing could not be conducted.

VII METHODOLOGY

The research has been done through descriptive questionnaire survey, the data required from this study is collected from primary and secondary sources the data collected are both Quantitative and Qualitative. The primary source used for gathering data required for this survey, in the survey method a Survey of the consumer's behavior towards a product in retail outlet is done. A planned effort is made using structured questionnaire to interview the respondents. The respondents had chosen using non probability sampling method. The survey can be done through personal interviews. In this study respondents are interviewed personally so that the errors involved in gathering primary data are minimize. The sample size covered for the purpose of this study is 100. This study covers Big Bazaar L. B. Nagar, Hyderabad only.

VIII RETAILING IN INDIA

Retailing is the interface between the producer and the individual consumer buying for personal consumption. This excludes direct interface between the manufacturer and institutional buyers such as the government and other bulk customers. A retailer is one who stocks the producer's goods and is involved in the act of selling it to the individual consumer, at a margin of profit. As such, retailing is the last link that connects the individual consumer with the manufacturing and distribution chain.

The retail industry is divided into organized and unorganized sectors. Organized retailing refers to trading activities undertaken by licensed retailers, that is, those who are registered for sales tax, income tax, etc. These include the corporate-backed hypermarkets and retail chains, and also the privately owned large retail businesses. Unorganized retailing, on the other hand, refers to the traditional formats of low-cost retailing, for

example, the local kirana shops, owner manned general stores, paan/beedi shops, convenience stores, hand cart and pavement vendors, etc.

The Indian Scenario

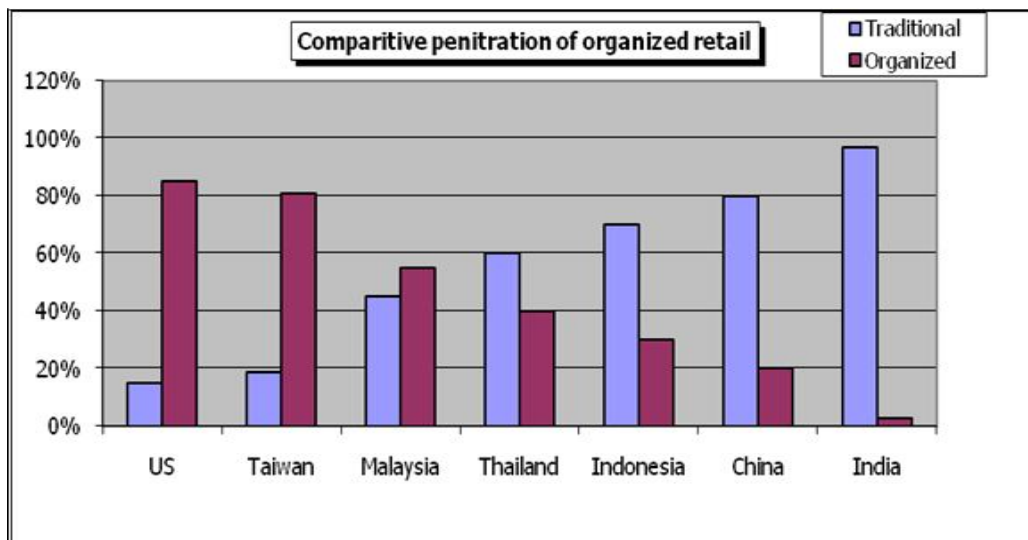
Trade or retailing is the single largest component of the services sector in terms of contribution to GDP. Its massive share of 14% is double the figure of the next largest broad economic activity in the sector. India is the “second most attractive retail destination” globally from among thirty emergent markets. It has made India the cause of a good deal of excitement and the cynosure of many foreign eyes. With a contribution of 14% to the national GDP and employing 7% of the total workforce (only agriculture employs more) in the country, the retail industry is definitely one of the pillars of the Indian economy.

The sector is on a high growth trajectory and is expected to grow by more than 27 per cent over the next 5 to 6 years. Retail is one of India’s largest industries, contributing to about 10 per cent of the GDP and providing employment to 8 per cent of the nation’s workforce. Indian retail business promises to be one of the core sectors of the Indian economy, with organized retail sector estimated to grow by 400 per cent of its current size by 2007-08.

Income, technology and life styles of consumers are changing, even from whom they buy are changing. The location or the place where they buy is changing; the shops are opened closed according to the convenience of the buyers. The buying process has changed due to Internet buying, which brings new and better deals and also saves time.

Changing social attitudes towards work, home and leisure affect the retail strategies. Political decisions relating to the environment, shopping locations and fair trade affect, where and how retailers can trade. Changes in technology bring new attitudes to buying products and services and to better organization of the supply chain.

India has the highest shop density in the world and the present retail market in India. We are ranked second in the global retail development index out of 30 by AT Kearney. This figure shows the comparative penetration of organized retail in India.



Evolution of Retail Market in India

In the beginning there were only kirana stores called Mom and Pop Stores, the friendly neighborhood stores selling every day needs. In the 1980s manufacturer’s retail chains like DCM, Gwalior Suitings, Bombay Dying, Calico, Titan etc started making its appearance in Metros and small towns. Multi brand retailers came into the picture in the 1990s. In the food and FMCG sectors retailers like Food world, Subhiksha, Nilgris are some of the examples. In music Segment Planet M, Music world and in books Crossword and Fountainhead are some others. Shopping Centres began to be established from 1995 onwards. A unique example was the Establishment of margin free markets in Kerala. The millennium year saw the emergence of super markets and hypermarkets. Now big players like Reliance, Bharti, Tatas, HLL, ITC are entering into the organized retail segment. The big international retail bigwigs are waiting in the wings, as the present FDI guidelines do not allow them to own retail outlets in the country. WalMart is testing the waters by agreeing to provide back end and logistic support to Bharti for establishment of retail chains with a view to study the market for future entry when the FDI guidelines change and to establish a backbone supply chain. Table 1 shows the different phases in the growth of organized retailing in India.

Table:1. Journey of Organized Retail in India

Year	Growth	Function
2000	First Phase	Entry, Growth, Expansion, Top line focus
2005	Second Phase	Range, Portfolio, Former options
2008	Third Phase	ment, Backend operation, Technology
2011	Fourth Phase	M&A, Shakeout, Consolidation, High investment

Global Scenario

Retail stores constitute 20% of US GDP & are the 3 rd largest employer segment in USA. China on the other hand has attracted several global retailers in recent times. Retail sector employs 7% of the population in China. Major retailers like Wal-Mart & Carrefour have already entered the Chinese market. In the year 2003, Wal-Mart & Carrefour had sales of US \$ 70.4 Crore & US \$ 160 Crore respectively. The global retail industry has traveled a long way from a small beginning to an industry where the world wide retail sale is valued at \$ 7 x 10¹¹ Crore. The top 200 retailers alone accounts for 30 % of the worldwide demand. Retail turnover in the EU is approximately Euros 2, 00,000 Crore and the sector average growth is showing an upward pattern. The Asian economies (excluding Japan) are expected to grow at 6% consistently till 2005-06. On the global Retail stage, little has remained same over the last decade. One of the few similarities with today is that Wal-Mart was ranked the top retailer in the world then & it still holds that distinction. Other than Wal-Mart's dominance, there's a little about today's environment that looks like the mid-1990s. The global economy has changed, consumer demand has shifted & retailers' operating systems today are infused with far more technology than was the case six years ago.

The Top Five

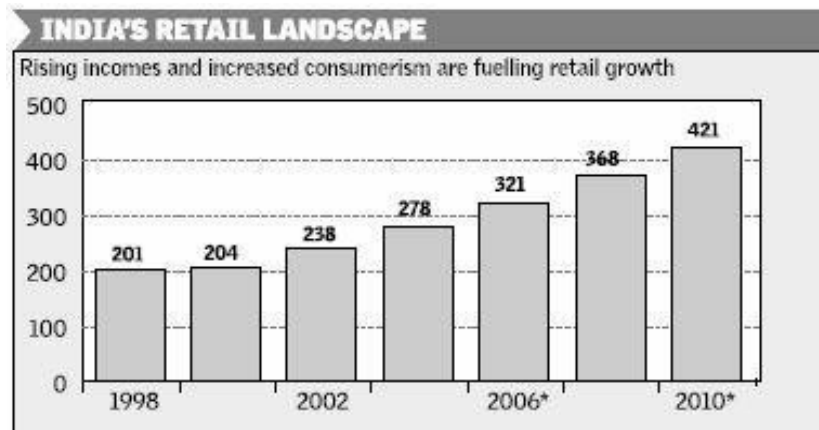
Company	Investment
Wal-Mart -	Bharti Yet to announce
Reliance	\$ 5.5 billion
Aditya Birla Group	\$ 3.3 billion
Pantaloon	\$ 1 billion
Tatas	\$ 89 million

Source: The Economic Times

Present Indian Scenario

India's retail market that is seen as the GOLDMINE by global players has grabbed attention of the most developed nations. This is no wonder to the one who knows that the total Indian retail market is US \$350bn. (16, 00,000 crore INR approx.) of which organized retailing is only around 3 percent i.e. US \$8bn (36,000 crore INR approx).

Modern retail has entered India as seen in sprawling shopping centers, multi-stored malls and huge complexes offer shopping, entertainment and food all under one roof. The future of Indian retailing may even witness the concept of 24 hour retailing. The urban retail market has been embracing various new formats and the malls turned out to be the trendsetters by promising the concept of shoppertainment. The trends in the rural market also have been changing from the old Haats and Melas to the rural malls like „Chaupal Sagar“ launched by ITC, DCM Shriram Groups one- stop shopping destination called „Hariyali Bazaar“, Godrej groups agri store „Adhar“ etc.



The trend in grocery retailing, however, has been slightly different with a growth concentration in the South. Though there were traditional family owned retail chains in South India such as Nilgris as early as 1904, the retail revolution happened with various major business houses foraying into the starting of chains of food retail outlets in South India with focus on Chennai, Hyderabad and Bangalore markets, preliminarily. In the Indian context, a countrywide chain in food retailing is yet to be established as lots of Supply Chain issues need to be answered due to the vast expanse of the country and also diverse cultures that are present.

- Unorganized market: Rs. 583,000 crores*
- Organized market: Rs.5, 000 crores* 5X growth in organized retailing between 2000-2005 * Over 4,000 new modern Outlets in the last 3 years* Over 5,000,000 sq. ft. of mall space under development

Major players

- Food and grocery-
- Food world-
- Shoppers' Stop-
- Subhiksha- Working at certain places
- Westside
- Planet M
- Nilgris
- Lifestyle
- Music World
- Nirma-Radhey
- Globus
- Reliance Fresh
- RPG's Spencers

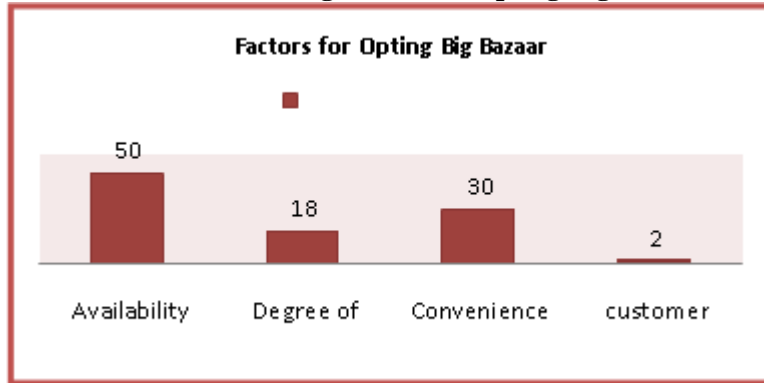
Indian consumers are rapidly evolving and accepting modern formats overwhelmingly. Retail Space is no more a constraint for growth.

Few of India's top retailers are

1. **Big Bazaar-Pantaloon:** Big Bazaar, a division of Pantaloon Retail (India) Ltd is already India's biggest retailer. In the year 2003-04, it had revenue of Rs 658.31 crores & by 2010; it is targeting revenue of Rs 8,800 Crore.
2. **Food World:** Food World in India is an alliance between the RPG group in India with Dairy Farm International of the Jardine Matheson Group
3. **Trinethra:** It is a supermarket chain that has predominant presence in the southern state of Andhra Pradesh. Their turnover was Rs 78.8 Crore for the year 2002-03.
4. **Apna Bazaar:** It is a Rs 140-crore consumer co-operative society with a customer base of over 12 lakh, plans to cater to an upwardly mobile urban population.
5. **Margin Free:** It is a Kerala based discount store, which is uniformly spread across 240 Margin Free franchisees in Kerala, Tamil Nadu and Karnataka. Wholesale trading is another area, which has potential for rapid growth. German giant Metro AG and South African Shoprite Holdings have already made headway in this segment by setting up stores selling merchandise on a wholesale basis in Bangalore and Mumbai respectively. These new-format cash-and-carry stores attract large volumes from a sizeable number of retailers who do not have to maintain relationships with multiple suppliers for all their needs.

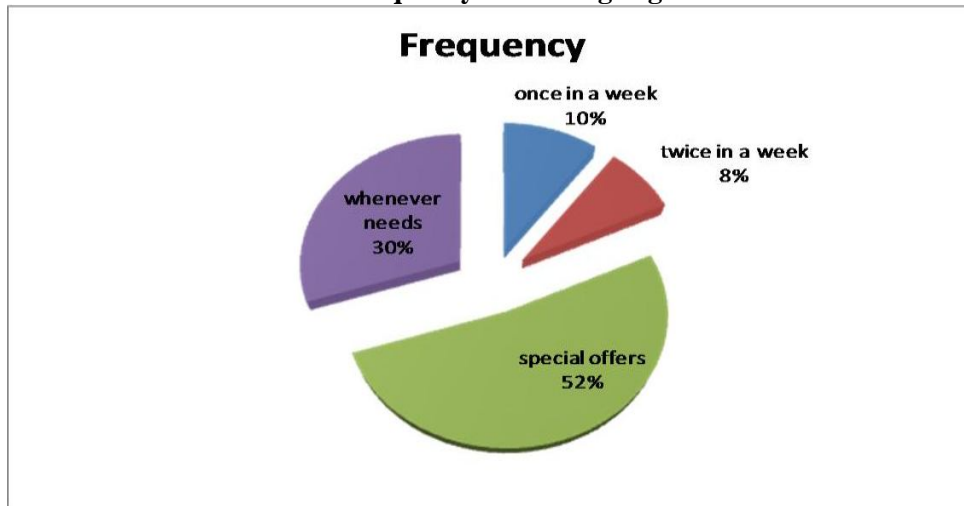
IX DATA ANALYSIS

Chart-3: Influencing factors for opting Big Bazaar



Big bazaar is basically very spacious. The graph indicates that 50% of the big bazaar customers visit it only on the basis of availability of goods. The other major factor is convinces. There are also other factors which are driving forces for the costomers to visit big bazaar.

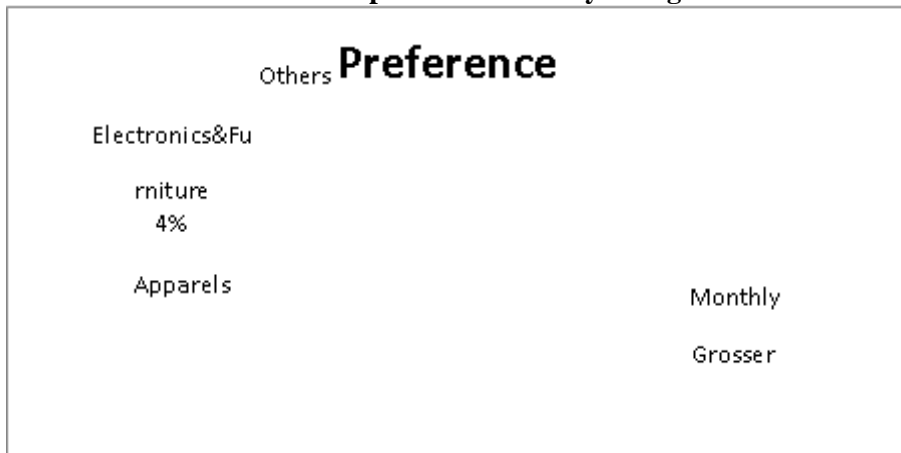
Chart-5: Frequency of Visiting Big Bazaar



Source: Primary Source - Questionnaire

People visit big bazaar whenever they need some product. Apart from their needs, its big bazaar’s special offers that make people to visit. The graph clearly indicates that 52% of the people visit big bazaar it’s only because of special offers.

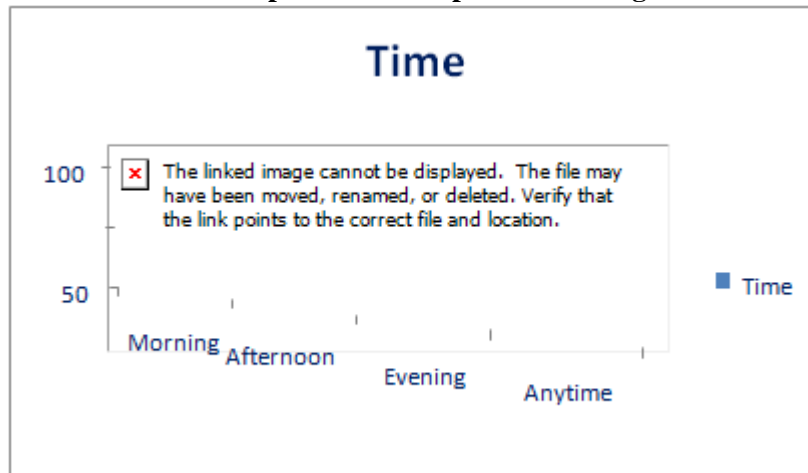
Chart-6: Product preferences to buy in Big Bazaar



Source: Primary Source - Questionnaire

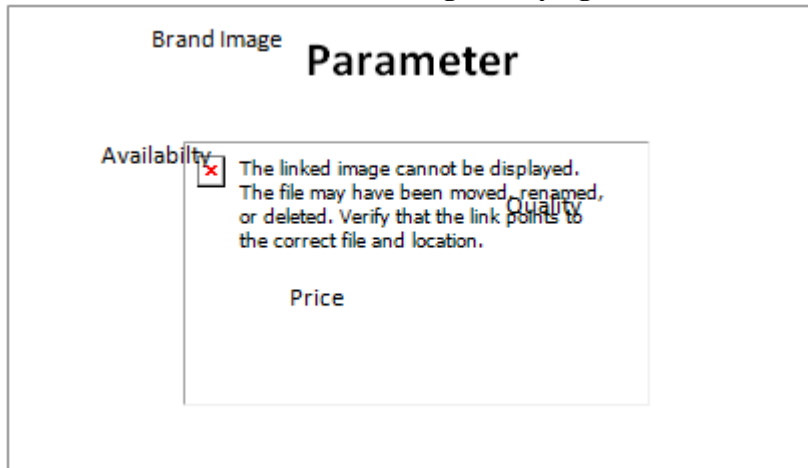
Though there are varies of products in big bazaar, its monthly grocery that attracts the customers to big bazaar. The above graph indicates that 62% of the big bazaar customers come to it only for the Monthly grocery. The next section is apparels. It shares about 22% of the total contribution.

Chart-7: Time preferences to purchase in Big Bazaar



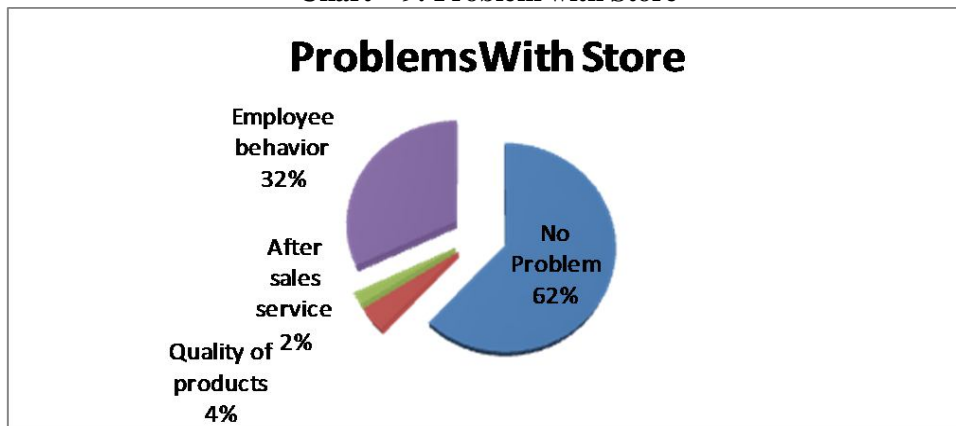
Customers are willing to buy the product mainly in the evening. Above graph indicates that 68% people are willing to buy in the evening. The next best percent of 24% indicates that people who are in need may buy the product at any time. Very few are willing to buy in the morning as well as in the afternoon.

Chart – 8: Factors Effecting on Buying Decisions



Quality is the well known parameter to buy any product. In the above its clearly indicates that 45% of the customers are will to buy products from the big bazaar because of its quality products. Its good to observe that the next priority is given to price. The graph indicates that 31% are mainly the products because of price as their main priority. The remaining people are willing to buy because of availability and brand image.

Chart – 9: Problem with Store



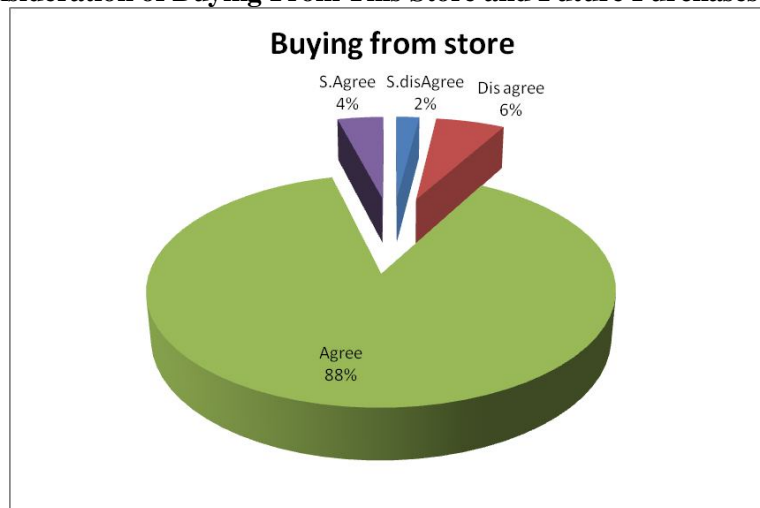
Majority of the customers of big bazaar do not face any problem. People are willing to come to big bazaar. The next major concern for the customers is employees who are working at big bazaar. The above graph indicates that 32% of the customers are facing problems regarding way of approach to the customers, not attentive to the customers.

Chart- 10: Total Quality of Service



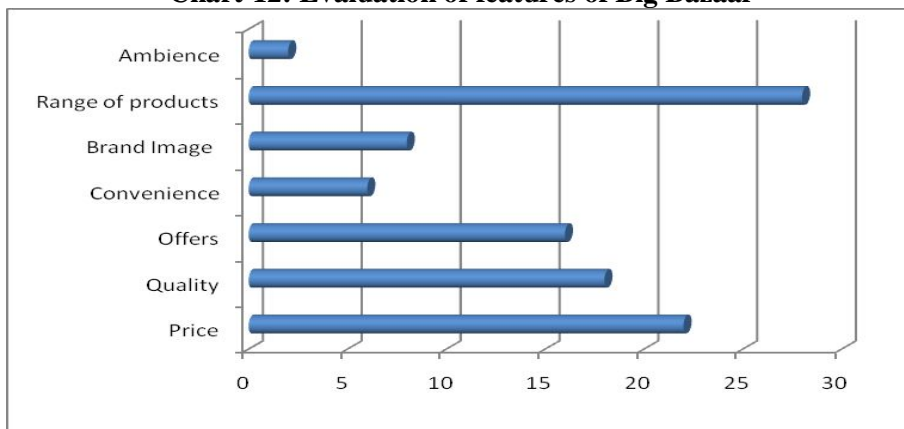
A good number of the customers have accepted that the total quality service provided by the big bazaar is good. Very few have accepted that it is excellent. There are also some customers (5%) who are not satisfied with the quality service.

Chart -11: Consideration of Buying From This Store and Future Purchases from This Store



Around 88% of the customers are willing to buy different products in future from this story. They agreed that they will increase sales from this store in future. And only few numbers of customers disagreed that they wont purchase and increase sales from this store they may be due to their dissatisfaction, chart 11 shows the details.

Chart-12: Evaluation of features of Big Bazaar



Big bazaar is well to its range of products. In the above its clearly indicates that majority of the customers are willing to come to big bazaar because of its variety of products. Price quality and offers are also having the major role to play in buying behavior of the customers.

X FINDINGS

In the surveys, interviews and study conducted above, I came across many factors that influence the consumers' perception of a store and their subsequent shopping and buying decisions. Here, I present the findings gathered and the suggestions we offer to companies based on the data gathered and analyzed.

- As I analyze its clearly indicates that special offers, quality, variety and price are the major determinants which makes customers to visit Big Bazaar.
- Majority of the customers are willing to buy products at big bazaar in the evening times.
- In Big bazaar major proportion of customers are attracted by food bazaar's special offers and prices.
- Its variety of range of products which influences the buying behavior of customers at Big Bazaar.
- Next to food bazaar section, Apparels which attracts the customers.
- As my observation goes it's the quality of the products at big bazaar which makes the customers to buy.
- There are also good numbers of customers who wish to buy branded products.
- Advertisement is the main promotional tool for knowing about Big Bazaar, which attracts the customers to come to outlet.

XI SUGGESTIONS

Lower quality of goods: As Big bazaar aims more toward the middle income group, the quality of goods is not of the highest quality, and this is sometimes a disadvantage as some would prefer better quality to the price, making customers to search for different places.

Does not appeal to the elite: As mentioned above, the main customers are middle income and a few high income groups,

The elite do not like to shop at Big Bazaar as the quality of goods is lower and they would prefer a higher price and get a better brand, this decreases sales from the elite class

Not acclaimed for very good service: Big Bazaar is not known for high class service. The staff recruited is not very well trained and the billing queues take a long time to move, this irritates customers which makes them visit the store more seldom

Quality of goods: As the store is trying to concentrate on the middle income group the type of products used is not of the most superior quality and most of the times nor branded, this may dissatisfy certain customers

Consumer satisfaction: Long queues and lower quality leads to dissatisfaction of customers. Due to factors mentioned above Big Bazaar shoppers are not always satisfied, this is not a positive for the store.

XII CONCLUSIONS

Variety: Big Bazaar offers a wide variety of products of different prices and different qualities satisfying most of its customers.

Quality: Providing quality at low prices and having different types of products for different income customers is another advantage, Normally what the consumers want.

Price: As noted the prices and offers in Big Bazaar have been one of the main attractions and reasons for its popularity. The price ranges and the products offered are very satisfying to the customers.

Location: The location of Big Bazaar has been mainly in the heart of the city or in the out skirts giving a chance to both the City and the people living outside the city to shop.

Advertisements: Big bazaar has endorsed very popular figure like M S Dhoni and other famous personalities which has attracted a lot of customers. This has resulted in increase of sale and the outdoor advertising techniques have also helped Big Bazaar.

Middle class appeal: Considering the fact that there are a lot middle class families in India, Big bazaar has had a huge impact on the middle class section of India, the prices, quality and sales strategy has helped in getting the middle income groups getting attracted towards Big Bazaar.

Attractive sales: Big bazaar has been known for its great sale and great offers. Big bazaar has had long lines of people waiting to get into the store for the sale. Therefore, the sales that Big Bazaar has had has increased sales in a huge way due to the sales and offers, thus this has been one of the main advantages of Big Bazaar.

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UNCERTAINTIES IN CLIMATE CHANGE PROJECTIONS

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ABSTRACT

The meteorological parameters Rainfall and temperature, simulated using Global Climate Models (GCMs), serve as a key inputs for hydrological models in studying catchment response to climate scenarios. GCM simulations of rainfall and temperature, however, are uncertain due to model structure, scenarios and initial conditions, which results in biased outcomes if used for impact assessment without due consideration of the uncertainties. This is mainly due to three factors: natural variability, model uncertainty, and GHG emission scenario uncertainty. In general, scenario and model configuration uncertainty dominate for long term climate change, especially at the global scale. The contribution of internal variability increases for near term projections and for higher order climate statistics. Downscaling uncertainty is significant for variables primarily affected by local processes, such as summer convective precipitation. It is argued that because of these sources of uncertainty, the climate prediction problem should be addressed in a probabilistic, rather than deterministic way. Resolving inter-model differences could reduce uncertainty significantly, but there is still a large irreducible uncertainty due to climate variability in the near-term and, particularly for temperature, future emissions scenarios in the long-term.

Keywords: Climate change, General Circulation Model, Global Climate Models, Green House Gases, Monsoon

INTRODUCTION

Projections of climate change for the 21st century at the global to regional scale in response to increased emissions of greenhouse gases (GHG) are necessary in order to assess the impacts of GHG-induced global warming and to develop suitable adaptation and mitigation response strategies. Climate change can occur not only because of anthropogenic forcings, e.g. increased atmospheric GHG and aerosol concentrations, but also because of natural forcings, e.g. changes in solar activity, and/or natural unforced variability of the climate system. All these anthropogenic and natural factors, along with the uncertainties that characterize them, need to be accounted for in producing future climate projections.

In addition, climate projections are produced via a range of modeling tools, from coupled Atmosphere-Ocean Global Climate Models (AOGCMs) to statistical and dynamical downscaling techniques (e.g. Regional Climate Models or RCMs). These tools are also affected by substantial uncertainties related to our imperfect knowledge and description of relevant processes in the climate system.

It is thus clear that multiple sources of uncertainty are present in the production of climate change projections for the 21st century. They compound in the cascade of steps involved in generating the projections and their full characterization is a key element of the climate change problem, since it is an essential piece of information needed to assess the risks related to climate change and the costs of adaptation and mitigation options. Indeed, during the last decade or so increasing research interest has gone into the assessment, quantification and representation of the uncertainties in climate change projections for use in impact assessment and risk analysis studies.

It is important to note that the term “uncertainty” has a generally negative connotation, implying that uncertainty is related to our poor knowledge of the problem and thus needs to be reduced as much as possible by advancing research. This is certainly true for some sources of uncertainty, which we can broadly refer to as “Knowledge Uncertainty”. On the other hand, as will be clear by the following discussion, some elements of uncertainty are intrinsic to the climate change problem and thus it is most important that they are fully characterized in order to provide the full range of possible outcomes, and in particular low probability-high impact outcomes. We can refer to this as “Intrinsic Uncertainty” and in this case, paradoxically, increased knowledge might lead to an increase in uncertainty. Understanding and relating the problems of Knowledge (or “bad”) uncertainty and Intrinsic (or “good”) uncertainty is a difficult task, especially when communicating this issue to non-experts.

Climate models have been evaluated (e.g. Flato et al. 2013) by assessing how well model results fit observation based data (empirical accuracy) and how well they agree with other models or model versions (robustness). Parker (2011) has argued that robustness does not objectively increase confidence in simulations of future climate change. Baumberger et al. (2017) address the challenge of building confidence in future climate model predictions through a combination of empirical accuracy, robustness and coherence with background

knowledge. Assessing coherence with background knowledge is limited because of empirical parameterizations and the epistemic opacity of complex models (Lenhard and Winsberg 2010).

Sung et al, 2018 selected 26 climate projections that provide daily precipitation under the representative concentration pathway (RCP) 4.5. The results show that a 20-year return period of precipitation event during a reference period (1980~2005) corresponds to a 16.6 yr for 2011 to 2040, 14.1 yr for 2041 to 2070, and 12.8 yr for 2071 to 2100, indicating more frequent extreme maximum daily precipitation may occur in the future and further indicates that the design standard under the reference climate is not managed to cope with climate change, and accordingly the revision of the design standard is required to improve sustainability in infrastructures.

Inconsistencies in the calculation of radiative forcing by CO₂ introduce uncertainties in model projections of climate change, a problem that has persisted for more than two decades (Soden, et al. 2018). The explicit calculation of radiative forcing and a careful vetting of radiative transfer parameterizations provide a straightforward means to substantially reduce these uncertainties and improve the projections.

Uncertainties in projections of different climate variables are usually described only by the ranges of possible values. For assessing the possible impact of climate change, it would be more useful to have probability distributions for these variables. Obtaining such distributions is usually very computationally expensive and requires knowledge of probability distributions for characteristics of the climate system that affect climate projections. A few studies of this kind have been carried out with energy balance/upwelling diffusion models (Webster and Sokolov, 2000).

This article illustrates some of the potential sources of uncertainty. However, the answers to such uncertainties can provide guidance for how much care should be taken when using climate projections for planning efforts.

CLIMATE PREDICTIONS VS PROJECTIONS

Climate predictions are claims about the actual evolution of the climate system given knowledge of the current state of the climate system (and an external forcing scenario). They are usually obtained by starting from an initial conditions ensemble representing the uncertainty in the observations. Then models are used to evolve this ensemble forward to obtain forecasts of the climate variables, assuming a certain external climate forcing scenario. (Climate forcings are the factors that affect the climate: they drive or “force” the climate system to change. Examples are variations in the energy output of the sun, greenhouse gases or volcanic eruptions. External forcings are forcings external to the climate system (as it is modelled), e.g., the variation in energy output of the sun).

Climate projections are claims about the response of the climate system to external forcing scenarios (IPCC 2014). They are usually obtained by starting from initial conditions ensembles that (in contrast to predictions) represent possible (and not observation-based) initial conditions of the climate system at pre-industrial times (where the system has at least partially adjusted to the external forcings at pre-industrial times). Then models are used to evolve this ensemble forward to obtain a forecast of the climate variables (assuming a certain external forcing scenario). Predictions and projections are crucial: they provide the most important information about the future climate system and routinely inform policy decisions. Indeed, it seems no exaggeration to claim that the forecasts that have been most often shown to policy makers are projections.

SOURCES OF UNCERTAINTY IN CLIMATE CHANGE PROJECTIONS

Uncertainty in future climate change presents a key challenge for adaptation planning. Uncertainties in climate change projections arise from three primary sources:

- *Natural climate variability* resulting from natural processes within the climate system which cause changes in climate over relatively short time scales;
- *Future emissions of greenhouse gases* arising from uncertainty over the scale of future global emissions of greenhouse gases by human society, and thus the scale of future radiative forcing; this becomes a dominant source of uncertainty on time scales of 50 years or more.
- *Modelling uncertainty* arising from incomplete understanding of Earth system processes and incomplete representation of these processes in climate models.

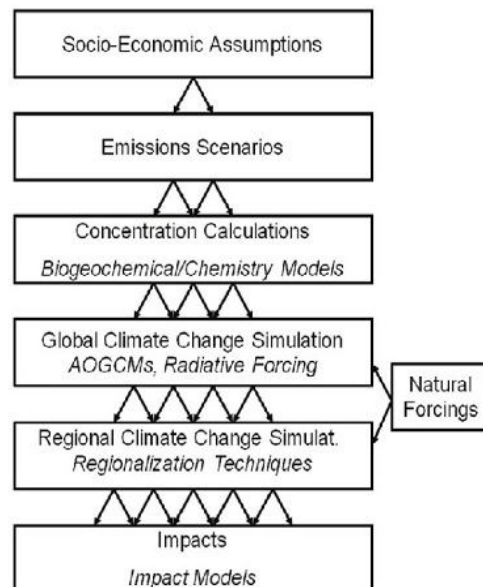


Figure-1: Cascade of Uncertainties in Climate Projections.

Figure 1 shows the sequence of steps that are usually undertaken to produce a climate change projection at global and regional scales. Each step of the process described in Fig. 1 is affected by ascertain level of uncertainty, which is compounded to that of the next step in a cascade process that results in an overall level of uncertainty in the projection.

Key Uncertainties in Projections of Global and Regional Climate Change (IPCC)

- Based on model results there is limited confidence in the predictability of yearly to decadal averages of temperature both for the global average and for some geographical regions. Multi-model results for precipitation indicate a generally low predictability. Short-term climate projection is also limited by the uncertainty in projections of natural forcing.
- There is medium confidence in near-term projections of a northward shift of NH storm track and westerlies.
- There is generally low confidence in basin-scale projections of significant trends in tropical cyclone frequency and intensity in the 21st century.
- Projected changes in soil moisture and surface run off are not robust in many regions.
- Several components or phenomena in the climate system could potentially exhibit abrupt or nonlinear changes, but for many phenomena there is low confidence and little consensus on the likelihood of such events over the 21st century.
- There is low confidence on magnitude of carbon losses through CO₂ or CH₄ emissions to the atmosphere from thawing permafrost. There is low confidence in projected future CH₄ emissions from natural sources due to changes in wetlands and gas hydrate release from the sea floor.
- There is medium confidence in the projected contributions to sea level rise by models of ice sheet dynamics for the 21st century, and low confidence in their projections beyond 2100.
- There is low confidence in semi-empirical model projections of global mean sea level rise, and no consensus in the scientific community about their reliability.
- There is low confidence in projections of many aspects of climate phenomena that influence regional climate change, including changes in amplitude and spatial pattern of modes of climate variability.

DOWNSCALING UNCERTAINTY

Downscaling comes in two main types: statistical and dynamical. In the case of dynamical downscaling, regional climate models (RCMs) are used to translate GCM information to local scales. Given their similar construction, it is a reasonable assumption that RCMs have similar internal sources of uncertainty as GCMs (structural and parametric; Knutti et al. 2008). However, what are the sources of uncertainty internal to statistical downscaling? Statistical downscaling is defined by creating a statistical relationship between GCMs and observations, which is effectively an exercise in statistical modeling. Therefore, one could argue that statistical downscaling has model uncertainty as described by the statistics community (Chatfield 1995),

including structural and parametric. However, a close examination of the literature suggests that statistical downscaling includes more sources of uncertainty than simply the model uncertainty associated with the downscaling technique (e.g. Pourmokhtarian et al. 2016; Olyer and Nicholas, 2018). Statistical downscaling also includes numerous sets of data handling and special processing approaches. These are processes that include those implemented prior to downscaling (such as data transformations, regridding, or interpolation) and processes implemented alongside a downscaling technique (such as treatments for extreme values).

IMPACT MODELS

The primary sources of uncertainty of impact models stem from measurement errors, variability and model structure (Morgan & Henrion, 1990). For the analysis of changes in discharge and flood risk, hydrological models are used. Hydrological modelling represents the physical process of runoff production through mathematical formulations. Two main uncertainties of hydrological modelling are derived from measurements and structural uncertainty of the model (Prudhomme, Jakob, & Svensson, 2003). The measurement uncertainty is related to the measurements that are used to calibrate and validate the model.

Representing uncertainty in climate change projections

The presence of “Intrinsic” uncertainty sources, such as the scenario and internal variability ones, essentially precludes a deterministic approach to the problem. The unpredictable nature of future socio-economic and technological development and the non-linearities in the climate system (which determine its internal unforced variability), are such that it is essentially impossible to exactly predict what will be the climate of the 21st century. This is the case even if we had perfect climate models and observing systems. The imperfect knowledge in present day models and observation systems further adds to preventing a deterministic climate prediction.

This implies that the problem of climate change prediction has to be approached in a probabilistic way, by which we can evaluate the range of possible outcomes and assign to each outcome a certain probability to occur. From the technical point of view this can be achieved by producing Probability Density Functions (PDFs) of future climate (or climate change) variables. The width of the PDF (for example its standard deviation) is a measure of the overall uncertainty in the projection and the PDF can be used in risk-based impact assessment studies in conjunction to the calculation of the costs (in the broad sense) of the impacts. The real change that the Earth's climate system will experience will then be one realization hopefully falling within the PDF of the predicted outcomes.

INDIA SUMMER MONSOON

At present, the general circulation models (GCMs) are the best tools to understand and project climate change due to global warming. Compared to the earlier versions, the latest Intergovernmental Panel on Climate Change (IPCC) Coupled Model Intercomparison Project, Phase 5 (CMIP5) coupled general circulation models (CGCMs) projects climate change with slightly better skill in representing the important characteristics of the present-day Indian summer monsoon (ISM, Sperber et al., 2012; Jayasankar et al., 2015). In spite of their ability to characterize large-scale weather systems, they fail to capture some important phenomena of regional and fine-scale structures, viz., coastal area's information and orographic impacts that affect regional climate, due to their coarse resolution of the order of $\sim 2^\circ$. This seriously limits CMIP5 models particularly to resolve the narrow orographic and vegetation heterogeneity of the west coast. Jayasankar et al. (2015) showed that a group of CMIP5 CGCMs with the highest reliability still projected future intensification of Indian summer monsoon rainfall (ISMR) including rainfall over the west coast, which was however opposite to the observed trend in rainfall. This suggests that it is deficient to use climate change information projected by global GCMs directly for regional-scale climate change assessments and impact studies.

The only way to understand the impact of global warming on the Indian monsoon and to assess future monsoon climate is to use climate models based on the scenarios of emission of greenhouse gases (Rajeevan and Nanjundiah, 2009). Various climate models have been developed to study the Earth's climate system in the past and future at a global as well as regional scales, driven by assumptions based on different emission scenarios, which attempt to address the uncertainty in future emissions and might be an important aspect of assessing the future climate conditions. Using a range of different climate model simulations provides a better understanding of uncertainty in the projections (Jones et al., 2012) and by using ensemble approach (Jacob, 2007; Reichler and Kim, 2008), the uncertainty in the projections can be estimated quantitatively. The simulation of several GCMs over the Indian monsoon region concludes that GCMs have difficulties in simulating the mean monsoon climate of Indian region (Sperber and Palmer, 1996; Giorgi and Mearns, 2002; Kang et al., 2002; Douville, 2005; Turner and Annamalai, 2012). The analysis of many GCMs (both atmospheric and atmosphere-ocean coupled models) showed that there are several problems in the representation of the mean Indian monsoon climate

(Gadgil and Sajini, 1998; Kang et al., 2002; Wang et al., 2004b, 2005; Rajeevan and Nanjundiah, 2009). Furthermore, GCMs are often run at a very coarse resolution to depict the influence of complex topography on regional climate dynamics. As a result, "GCMs cannot access the spatial scales that are required for climate impact and adaptation studies" (WMO, 2002), whereas the high resolution RCMs are capable of producing more realistic precipitation climatologies (Kumar et al., 2013) and they can also produce appropriate projections to generate climate scenario at a regional scale. In the recent years, there has been an increase in the interest among different research groups in developing high resolution climate scenarios for India at a regional scale by using various high resolution RCMs. In this aspect, the simulation of the Indian summer monsoon circulation features and the associated rainfall by a numerical model had been the most challenging problems so far. Although some attempts have been made to simulate monsoon features and extreme weather events over India by RCMs. Kumar et al. (2013), in a series of simulations by using two RCMs (HadRM3 and REMO) forced by two GCMs (ECHAM5-MPIOM and HadCM3), observed that RCMs forced with GCMs are more efficient than GCM in simulating the inter-annual variability of the mean monsoon precipitation. The predictions of the temperature and precipitation by RCMs are quite close to the observations. Various attempts have been made to analyse the uncertainty of RCMs in simulating Indian summer monsoon (Bhaskaran et al., 1996, 2012; Dash et al., 2006). Earlier studies (Bhaskaran et al., 1996; May, 2004; Dash et al., 2006; Mukhopadhyay et al., 2010; Bhaskaran et al., 2012) analysed the possible impacts of the global warming on Indian summer monsoon using the output of different RCMs and most of them reported that the model outputs concord well with the observations; and the high resolution RCMs are able to show improvement in the distribution of monsoon rainfall at spatial and temporal scales.

Furthermore, several studies emphasised on regional climate modelling systems to predict the future uncertainty of the climate variability and climate change at a regional scale over different regions of the globe with a coarse resolution using the Providing REgional Climates for Impacts Studies (PRECIS), that is the third generation Hadley Centre RCM (Zhang et al., 2006; Islam et al., 2007; Kotroni et al., 2008; Marengo et al., 2009; Nazrul Islam, 2009; Jones et al., 2012; Mohammad et al., 2012; Met Office Report, 2012), and the PRECIS simulations showed good performance when the temperature and rainfall for the analysed regions were calibrated. Hence, extensive debates still exist in understanding the possible characteristics of monsoon variability and its provenience in climate change. Many studies (Rupa Kumar et al., 2006; Krishna Kumar et al., 2010, 2011; Geethalakshmi et al., 2011; Revadekar et al., 2012; Kulkarni et al., 2013; Rajbhandari et al., 2014; Caesar et al., 2015) have used PRECIS to simulate high resolution climate change scenarios for the whole India at 50 km × 50 km horizontal resolution with limited ensemble members, and produced quite reasonable results for the prediction of meteorological parameters like rainfall and temperature over the region. These studies also provided a robust evaluation of the 17 HadCM3Q downscaled experiments over South Asia but most of these regional studies considered only single model projections and few had been in India that used RCM with multi ensemble and high resolution downscaling approaches to assess the future climate change uncertainties.

SUMMARY AND CONCLUSIONS

Clearly, the issue of uncertainty is at the heart of the climate change prediction problem and due to its complexity, both conceptual and when applied to specific impact issues, it will remain a central issue within the climate change debate. This paper discusses in detail the contribution of different sources of uncertainty, scenario, model configuration, model bias, internal model variability and downscaling, on the overall uncertainty range in climate projections from the global to the regional scale. None of these recognized uncertainties can make the problem go away. It is virtually certain that human-caused greenhouse warming is going to continue to unfold, slowly but inexorably, for a long time into the future. The severity of the impacts can be modest or large, depending on how some of the remaining key uncertainties are resolved through the eventual changes in the real climate system, and on our success in reducing emissions of long-lived greenhouse gases.

For early 21st century projections, the scenario uncertainty becomes secondary and the contribution of internal model variability becomes of primary importance. The contribution of internal variability increases when going from the global to the regional scale and it increases for higher order climate statistics.

A full characterization of uncertainty will require large ensembles of model projections, which in turn will necessarily require large international cooperative programs such as CMIP5, ENSEMBLES, and CORDEX in which climate change projections are carried out by a large number of models and laboratories worldwide in a coordinated fashion. Both climate scientists and policy makers need to accept the limits of probabilistic methods in conditions of ambiguity and deep uncertainty that characterize climate change.

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NALGAD DAM AND RESERVOIR OPERATION SIMULATION USING HEC-RESSIM MODEL FOR HYDROPOWER GENERATION**Hari Bahadur Oli¹, J. P. Patra² and S. K. Mishra³**Student¹ and Professor & Head³, Department of Water Resources Development & Management, Indian Institute of Technology, RoorkeeScientist², National Institute of Hydrology, Roorkee

ABSTRACT

This study aims to develop the Nalgad dam and reservoir operation simulation model using HEC-ResSim for hydropower generation. Simulations are carried out to develop reservoir operation rule for maximum dry season energy generation under four different operation scenarios using historical daily discharge data for the period 1966 to 2016. From first operation scenario per time step (day) maximum average energy generation obtained is 3407.04 MWh/day when four turbine units are in operation for 24 hour without using any hydropower rule. In second operation scenario hydropower schedule rule with different energy generation pattern as 24, 16, 12 and 8 hours operation throughout the year without seasonal variation (daily simulation). Maximum and minimum reservoir operation levels are 1580 msl and 1498 msl. Results of this scenario show that the maximum annual dry season energy generation is 515.088 GWh/year for 18 hour. From third operation scenario (daily simulation) the optimum dry season energy generation is 742.727 GWh/year with annual reliability 92.67% and total annual energy generation is 1250.75 GWh/year when hydropower schedule rule with energy generation pattern as eleven-hour operation during dry season and one-hour operation during wet season and reservoir level in between 1580 masl to 1489 masl. From forth operation scenario (hourly simulation) the optimum dry season energy generation is 735.04/year with half annual reliability 90.19 % and total annual energy generation is 1247.12 GWh/year when hydropower schedule rule with energy generation pattern as ten-hour operation during dry season and one-hour operation during wet season and reservoir level in between 1580 masl to 1498 masl. Further, these scenarios are analyzed by comparing the inflow, water level in reservoir, total annual energy production and firm energy production etc. From the analysis of results of these four scenarios, the operation rule/policy for optimum dry season energy generation from Nalgad reservoir is operation of reservoir using Hydropower–Schedule–Rule through generation pattern as ten hours peaking operation in dry season and one hour evening peaking operation in wet season with four turbine units in operation and maintain minimum and maximum reservoir level as defined in forth operation scenario.

Keywords: Nalgad Dam Reservoir, HEC-ResSim, Simulation, Hydropower-Schedule-Rule, Optimum energy.

1. INTRODUCTION

Water resources are one of the most important natural resources available in abundance in Nepal. It has been rightly believed as a major source for economic development of the country. Hydropower development is one of the most beneficial uses of water resources which can play a major role in the overall development of the country. Nepal has been endowed with tremendous hydropower potential due to numerous rivers and favorable terrain. Nepal has a theoretical power generation potential was estimated to be 83,500 MW in 1966, out of which 42,000 MW is technically and economically feasible to be produced (Jha 2010). At present, the Integrated Nepal Power System (INPS) has only one seasonal storage project - Kulekhani -I. After the completion of this project in 1982, the peak power demand of the country was met for almost a decade. However, the country has been facing an acute shortage of both base and peak load since the last few years. Despite having an estimated potential of 83,500 MW and an economically feasible potential of about 42000 MW. The actual grid connected generating capacity as reported for 2016-17 was approximately 968 MW (NEA Annual Report 2016-17, page 161). The approximate total of 968 MW is comprised mainly of hydropower generation, except for 53.4 MW of thermal and a negligible amount of solar. Much of the capacity is run-of-river and is therefore not always available for meeting peak power demands, although Kaligandaki, Marsyangdi and Middle Marsyangdi power plants (combined capacity of 283 MW) were run for peaking operation during the 2016-17 dry season (Annual Report 2016-17, page 12). There are some 60 hydropower plants in operation: 38 in the public sector, 22 in the private sector and some 23 small hydropower plants in isolated operation. Only about 40 % of the total population has access to electricity. The quality of supply is relatively poor. The dry season generation as well as wet season capacity is inadequate. System losses are fairly high at 25 % and outages are quite frequent. Out of 25%, approximately 16% is the technical loss and the rest is system loss. To cope with system demand, there is urgent need of combined RoR and Storage Project for the system. The Nalgad Storage Hydroelectric Project (417MW) was conceived as one of the attractive project among the screened and ranked storage projects during (IFSSP-2001).

HEC-ResSim is reservoir simulation model that has been developed by the Hydrologic Engineering Center of the US Army Corps of Engineers to aid engineers and planners in predicting the behavior of reservoir systems in water management studies and to help reservoir operators plan releases in real time during day-to-day and emergency operations. This study aims to model dams and reservoirs operation in the Nalgad river basin to simulate reservoir operation for hydropower generation using HEC-ResSim (Hydrologic Engineering Center – Reservoir System Simulation) model. In this study various operational scenarios with different generation patterns are studied through the developed simulation model and the generation pattern (defined in hydropower schedule rule in HEC-ResSim) which results the optimum dry season energy generation above 90% reliability is selected as reservoir operation rule /policy. Average reservoir water level of different month (Jan–Dec) corresponding to selected generation pattern are the reservoir minimum target level to maintain at any time is reservoir operation guide rule curve.

2. STUDY AREA DESCRIPTION

The Nalgad Storage Hydroelectric Project is located in Jajarkot District in the Karnali Province of Nepal. Nalgad is a tributary of the Bheri River in the Karnali Basin. The dam site of the project is located approximately 9.25 km upstream from the confluence of the Nalgad and the Bheri-River and the powerhouse is located on the left bank of Nalgad River approximately 500 m upstream from the suspension bridge at Dalli. The index map of the study area is shown in Figure 2.1. Extending from 800 m to 5,500 m, the area experiences wide variation in climatic conditions from sub-tropical to alpine climates. Areas above 4,500 m lie in the freezing zone during most of the year. Precipitation in the form of rain is expected in areas below 2,500 m, whereas snowfall is expected above 5,000 m throughout the year. Seasonal snow is observed in areas between 5,000 m and 2,500 m. The lower valleys are hot in summer but most of the mountainous areas with settlements have a relatively comfortable climate. Under the strong influence of monsoons, the watershed is wet with greenery in most of the areas during the summer monsoon season. Winter is generally dry with chilly weather conditions. Average elevations of the Nalgad basin at the Bheri River confluence and at the intake site are 2,890 and 3,110 m which indicate an annual average temperature of 8°C and 9°C respectively (based on the annual average temperature of 12.7°C at Jumla). Average precipitation ranges from 1244 mm to 1793 mm.



Figure-2.1: Location of Nalgad Hydropower Project

3. DATA AND METHODOLOGY

Prior to any river basin simulation, it is mandatory to search and collect basic inputs about the principal simulation components to be used for the proper simulation of the basin. The Daily inflow to reservoir and physical characteristics of reservoirs, spillways and outlet works, hydroelectric power plants, and other water control facilities etc. were collected from review of previous studies as well as data from institutions various organization viz. Ministry of Energy, Water Resources & Irrigation Nepal, Water and Energy Commission Secretariat (WECS), Nepal, Nalgad Hydropower Company Limited (NHCL), Nepal, Nepal Electricity Authority (NEA), Nepal. HEC-ResSim model computes reservoir storage contents, evaporation, hydroelectric energy generation, and river flows for specified system operating rules and input sequences of stream inflows and evaporation rates. In this study four different operation scenarios are considered and number of alternatives in each scenarios are made for different generation patterns then simulation for each created alternatives was carried out. Results of each simulation were analyzed and best alternative is selected based on; maximum energy generation per time step for scenario1. Maximum energy generation per time step and maximum total annual energy generation for scenario2. Maximum total annual energy generation, maximum dry season energy and reliability of dry season energy for scenario 3 & scenario 4. Then finally best operation set (Alternative) is

selected as reservoir operation rule/policy for hydropower generation based on maximum annual energy generation, maximum dry season energy generation above 90% reliability, water level maintained in reservoir etc.

3.1 Development of reservoir model in HEC-ResSim

The initiation of the basin model development includes importing the ArcGIS stream alignment data, shape file of the watershed in HEC-ResSim. The common approach of the reservoir simulation model setup may include more than one reservoir creating the reservoir network. Here, in this study, only one reservoir network has been created. The river reach created in ArcGIS was imported for the Nalgad Reservoir Project.

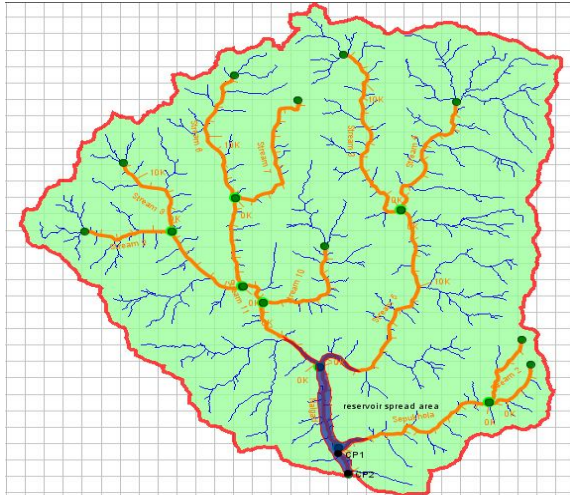


Figure-3.1: Watershed setup

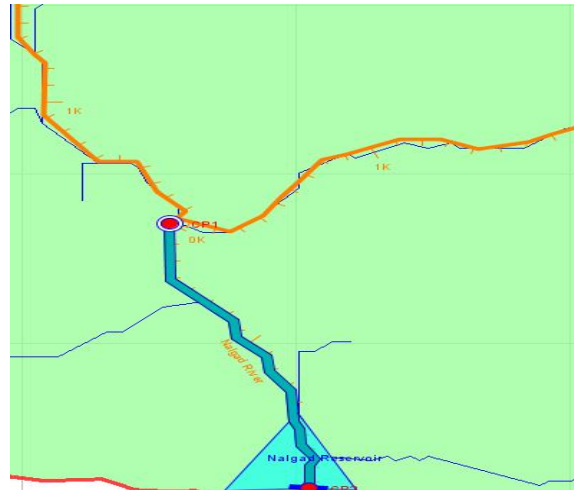


Figure-3.2: Reservoir network

3.2 Data input for HEC-ResSim model setup

The data input for the model setup can be basically divided into Physical part, operation rule and the creation of the HEC-DSS time series data for running the simulation for specified time control. HEC-DSS system is designed to efficiently store and retrieve scientific data that is typically sequential. The daily inflow data for 51 years (1965 to 2016) is created in the HEC-DSS system.

Definition of physical parts is most important part in HEC-ResSim model. Even small changes affect significantly the system behavior and the impacts deteriorate or meliorate the result in the simulation part. Input that should be considered for the physical part consists of reservoir details and dam stretchers that here for this project consist of spillways and power plants, for reservoirs, storage and area is needed, for dam crest and length in terms of structures and spillways and power plants for regulating part must be considered. The general data requirement for this model included the physical and operational characteristics of Nalgad Reservoir. The physical reservoir data is described through the use of Reservoir Elevation-Area-Capacity curve, evaporation & seepage loss from the reservoir and the type and capacity of each outlet. Seepage is considered as 100 lps. There is a bell mouth type power intake having two gates of size (Height * Width) 4.5m*3m of capacity 78.4 m³/sec. Ogee shaped, non-gated overflow weir spillway of crest width 60m, crest elevation 1580 masl and designed PMF 4759 m³/sec. Nalgad power plant installed capacity 417 MW having four units of capacity 104.25 MW each. Tail water elevation is 867.6 masl. Overload factor is considered as 1.0 and station use as 0 for this study. Hydraulic losses is 2.5% of gross head.

The operational data includes, the zone or pool level definitions along with the rules governing the operations in each zone. Nalgad reservoir has three major water management zones or pools; these are flood control, conservation and inactive zone. The inactive zone is often referred to as dead storage since this is water that is below the elevation of the lowest outlet in the dam and is considered for the sediment accumulation space. The top of conservation zone is assigned to the maximum operating level of reservoir 1580 masl, level above which the water is automatically spilled through the uncontrolled spillway. The top of inactive zone is assigned to the minimum operating level of reservoir 1498 masl, level below which no release. Low level uncontrolled outlet for continues environmental release 0.6 m³/sec is provided at level 1416 masl.

4. RESULTS AND DISCUSSION

The reservoir simulation study was carried out for Nalgad Reservoir Project using the estimated long term daily inflow data of Nalgad reservoir at intake site for the period 1966 to 2016. The total storage zone was divided into flood control zone, conservation/storage zone and the inactive storage zone. The maximum operating levels

considered in this study is full Supply Level at the elevation of 1580 masl which is set as top of conservation zone .The excess flow above that maximum operating level is spill through uncontrolled spillway. Minimum operating level 1498 masl is set as the top of inactive zone which is the minimum drawdown level. The operation rule for the conservation zone is to set the target to fill the reservoir to that level. The hydropower system schedule rule was applied to this level varying the hourly and seasonal generation pattern. The optimum energy is selected based on the comparison of energy generated per time step, total annual energy generated, annual dry season energy generated, total return from generated energy and system reliability for different operation scenarios with different generation patterns. There are four different alternate operation scenarios with number of generation patterns are considered and studies through simulation process in this study. Each of these operation scenarios results are presented and described as below. Operational zone used in this study are presented in table 4.1.

Table-4. 1: Water Management Zone of Nalgad Reservoir

Operational Zone	Elevation at top of Operational Zone
Flood Control	1589 masl
Conservation	1580 masl
Inactive	1498 masl

Operation Scenario 1

In this scenario operation rule was assigned for the twenty-four hours generation pattern for all seasons. The power guide rule curve is not used here and the power generation is totally based on the variation of inflow throughout the year. It is further analyzed by varying the number of turbine units in operation as two, three and four throughout the year. Best alternative is selected based on maximum energy generation per time step. The energy generated per time Step for 2, 3 and 4 turbine units are 3185.52, 3363.36 and 3407.04 MWh/day respectively. Energy generated per time step is maximum when the four turbine units are in operation. However, the increase is small from three to four turbine units. Hence run four turbine units together to get maximum energy generation for upcoming scenarios.

Operation Scenario 2

This operation scenario includes twenty-four hours generation pattern throughout the year varying the minimum total daily energy requirement. The power guide rule curve used here is hydropower schedule rule. Five different alternatives were considered for the different minimum daily energy requirement such as one-fourth, one-third, one-half, three-fourth and full energy of the maximum daily total energy generated. In this scenario HEC-ResSim try to meet the total daily energy requirement as daily time step was assigned for simulation. Summary of simulation result of each alternative shown in table 4.2.

Table-4.2: Comparison of results of various competitive alternatives of scenario 2

Parameters		Alternatives				
Alternatives		1	2	3	4	5
Total daily Energy Requirement		100%	75%	50%	33.33%	25%
Equivalent Operation Hour		24	18	12	8	6
Average Energy Generated Per Time Step (MWh)		152.21	151.35	148.75	145.03	138.6
Dry Season Energy Generated (MWh/year)		193.33	277.527	429.129	515.088	451.057
Wet Season Energy Generated (MWh/year)		1141.00	1049.27	874.9	733.911	763.884
Total Annual Energy Generated (MWh/year)		1334.3	1326.8	1304.03	1249.00	1214.942
Spill (m ³ /s)	Average	0.189	0.48	1.04	1.85	3.23
	Maximum	187	187	211	239	297
Annual Energy Generation Reliability (%)		15.26	34.46	57.1	87.34	98.84
Remarks					Selected	

In this operation scenario the maximum total annual energy generation is 1334.3 GWh/year when hydropower schedule rule with minimum daily energy requirement is equal to maximum total energy generation capacity i.e. total annual energy generation is maximum when the power plant operated /run for 24 equivalent hours. But as per the study objective maximum dry season energy generation is 515.088 GWh/year when the minimum daily energy requirement assigned is one-third that means dry season energy generation is maximum when power plant operated/run for 8 equivalent hours throughout the year. Hence from this scenario hydropower schedule rule with 8 hours energy generation pattern throughout the year is selected as best operation policy/rule to generate maximum dry season energy.

Operation Scenario 3

This operation scenario includes seven different generation pattern with seasonal and hourly variation in energy requirement. The power guide rule curve used here is hydropower schedule rule and the daily energy requirement varies with season as dry season (Dec to May) and wet season (Jun to Nov). As daily time step was assigned for simulation in this scenario HEC-ResSim try to meet the total daily energy requirement. This scenario result gives the operation policy for maximum total annual energy generation, optimum dry season energy generation with reliability above 90 % and reservoir level in between 1580 and 1498 masl. Summary of simulation result of each alternative presented in table 4.3.

Table-4.3: Comparison of various competitive alternatives of scenario 3

Parameters		Alternatives						
Alternate		1	2	3	4	5	6	7
Daily total Energy Requirement (MWh/day)	Dry	4170	4170	4587	4587	5004	3753	3336
	Wet	417	1668	417	1251	417	2502	2919
Equivalent Operation Hour	Dry	10	10	11	11	12	9	8
	Wet	1	4	1	3	1	6	7
Energy Generated per Time Step (MWh)		3417.84	3459.36	3424.32	3452.4	3422.88	3466.32	3453.6
Dry Season Energy Generated (GWh/year)		731.917	699.167	742.727	726.036	743.021	617.286	552.522
Wet Season Energy Generated (GWh/year)		516.414	564.394	508.023	534.973	507.231	648.642	708.845
Total Annual Energy Generated (GWh/year)		1248.33	1263.56	1250.75	1261.009	1250.25	1265.93	1261.37
Annual Energy Generation Reliability (%)		97.8	92.42	92.67	90.47	88.07	90.81	91.1
Remarks				Selected				

From the results of this operation scenario, the maximum total annual energy generation is 1265.93 GWh/year when hydropower schedule rule with generation pattern nine-hour operation during dry season and six-hour operation in wet season is assigned. But as per the study objective maximum dry season energy generation is 742.727 GWh/year with 92.67 % reliability (reliability is calculated for both season i.e. 612 month) of total annual energy generation when the power plant operated/run for eleven hours during dry season and one hour during wet season. Hence from this scenario hydropower schedule rule with energy generation pattern as eleven-hour operation during dry season and one-hour operation during wet season is selected as best operation policy/rule to generate maximum dry season energy. Application of this operation rule resulting almost uniform reservoir level throughout the simulation period however the energy violation is much during dry as well as even in wet year also that’s why it is necessary to consider reliability for dry season energy only because wet season energy requirement is meet out in all historical years and which is not much important for this project.

Operation Scenario 4

In this operation scenario seasonal variation is considered, for that whole year is divided in to two seasons as dry season (Dec to May) and wet season (Jun to Nov) according to inflow availability. This operation scenario includes seven different generation pattern with seasonal and hourly variation in energy requirement. The power guide rule curve used here is hydropower schedule with seasonal and hourly variation in generation pattern. Hourly time step was assigned for simulation so that the HEC-ResSim distribute defined monthly total energy requirement in to each operation hours defined in hourly generation pattern. Hourly generation pattern is defined by putting 1 for operation hour and 0 for non-operation hour that means value 1 represent open gate to release water required to generate target energy and 0 represent close the gate no release of water. Summary of results different alternative are presented in table 4.4

Table-4.4: Comparison of results of different competitive alternatives of scenario 4

Parameter	Alternatives				
	1	2	3	4	5
Operation Hours (Dry_Wet)	9_4	9_5	10_1	10_2	11_1
Energy Generated per Time Step (MWh)	142.72	143.38	142.34	142.88	142.62
Plant Capacity Factor Total Energy (%)	34.24	34.38	34.1	34.2	34.2
Plant Capacity Factor Target Energy (%)	27.05	29.14	22.86	24.95	24.95
Dry Season Target Energy (GWh/year)	683.046	683.046	758.94	758.94	834.834
Wet Season Target Energy (GWh/year)	305.244	381.555	76.31	152.622	76.311
Total Dry Season Energy Generated (GWh/year)	660.454	640.184	735.04	728.8	746.202
Total Wet Season Energy Generated (GWh/year)	590.661	615.862	512.68	523.641	503.935
Total Spill Energy (GWh/year)	287.081	239.604	436.37	371.019	427.624
Total Annual Energy Generated (GWh/year)	1251.12	1256.05	1247.72	1252.44	1250.14
Annual Energy Value (Million NRS)	11045.85	11222.35	10703.59	11011.16	10820.98
Average Spill (m ³ /s)	2.45	2.23	2.62	2.47	2.54
Dry Season Energy Generation Reliability (%)	92.48	87.58	90.19	88.56	78.1
Remarks			Selected		

Simulation result of this scenario shows that the optimum dry season energy generation is 735.04GWh/year with 90.19% reliability (reliability is calculated for dry season only i.e. 306 month) and total annual energy generation is 1247.72 GWh/year when plant is operated for 10 hours peaking in dry season and 1 hour evening peaking in wet season, hydropower schedule rule is used with seasonal variation.

Developed Operation rule/policy

Hydropower schedule rule with generation pattern 10 hours operation during dry season (Dec to May) and 1 hour evening peak operation during wet season (Jun to November) is selected as the optimal reservoir operation rule/policy for hydropower generation from Nalgad hydropower project. Further the reservoir release rules for each time step are as: (i) Seepage and evaporation losses are always accounted for and the Environmental releases with highest priority, (ii) Release to generate energy in accordance with Hydropower Schedule Rule is made with least priority. If the resulting end of day reservoir content would result in spill, the power plant is used to release water and generate secondary/Spill energy. Lastly, spill is made to maintain the end of day reservoir content no greater than the reservoir volume corresponding to the FSL. Application of the above operational rules results in a reservoir operational guide rule curve as indicated in figure 4.1.

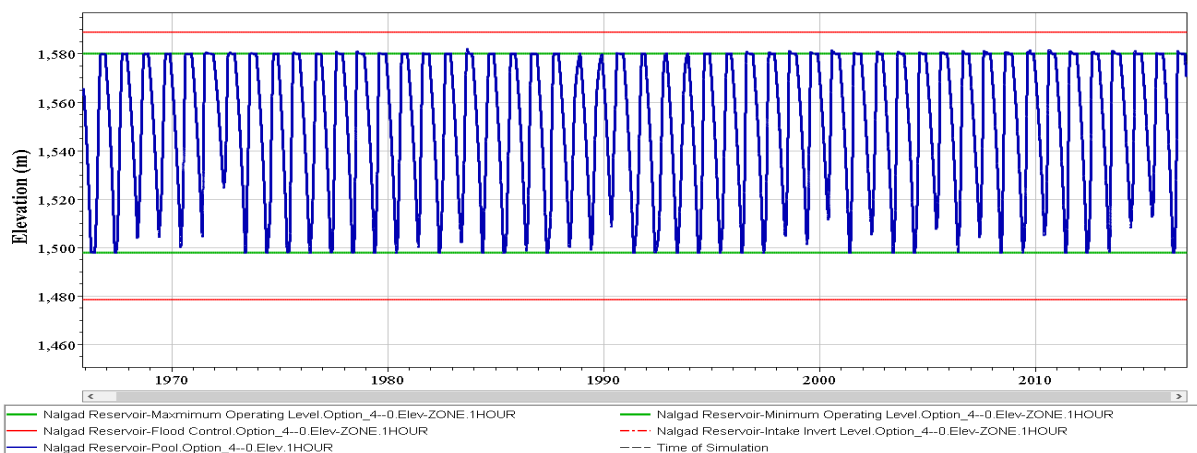


Figure-4.1: Developed Reservoir Operation Guide Rule Curve

5. CONCLUSIONS

In this study HEC-ResSim is used to develop reservoir operation rule for hydropower generation of the Nalgad hydropower project in Nepal. Optimum reservoir operation rule to utilize the available inflow to reservoir for hydropower generation is developed through simulation study of long term estimated daily inflow of time

period 1966 to 2016. From this study it is observed that the optimum dry season energy generation is 735.04 GWh/year with 90.19% reliability and total annual energy generation is 1247.72 GWh/year when hydropower schedule rule with energy generation pattern as ten hours operation during dry season and one hour operation during wet season is employed. Hence the operation rule/policy for optimum power generation from Nalgad reservoir is operation of reservoir using Hydropower–Schedule–Rule through generation pattern as ten hours peaking operation in dry season and one hour evening peaking operation in wet season with four turbine units in operation and maintain minimum and maximum reservoir level as defined in forth operation scenario. On evaluating the reliability of the reservoir system to meet the specified hydropower targets it is found that system is in unsatisfactory condition over the 9.81% of dry season time period (306 month). That unsatisfactory condition occurs mostly during dry season month of May and in case of some critical water year's unsatisfactory condition also occurs in dry season month of March, April and even in December also but that unsatisfactory condition exist for very few time. . Hence during the month of May deficit energy managed either from other power plant or from other source of energy and this power plant can operate as per developed guide rule curve during May month for better system performance and better utilization of available reservoir inflow.

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FLOOD HAZARD ASSESSMENT FOR A DAM FAILURE

Jagadish Prasad Patra¹, Rakesh Kumar² and Pankaj Mani³^{1,2}SWHD, National Institute of Hydrology, Roorkee³CFMS, National Institute of Hydrology, Patna**ABSTRACT**

Flood hazard assessment in downstream valley from a possible dam failure requires a comprehensive modelling of breach formation in the dam, outflow through breach and routing of flood wave in the downstream valley. Over the years, several analytical and numerical methods have been developed to simulate the entire process. This paper presents an application of the hydraulic model (Mike Flood) and GIS for studying various failure scenarios of an earthen dam in Odisha. The design flood of 100 year return period at the dam site and other river reaches are estimated using synthetic unit hydrograph and design rainfall. The Hydrologic Modelling System (HEC-HMS) is used for hydrological routing of flow from the six sub-catchments. The estimated peak flow to dam is about 11590.2 m³/s and the time to peak is 32 h. The Mike 11 model is calibrated and validated by comparing the simulated and observed water levels at the Gomali gauging site. The Nash–Sutcliffe model efficiency for various manning's coefficients of 0.035, 0.03, 0.04, 0.038 and 0.033 are found to be 0.937, 0.922, 0.879, 0.909, and 0.941 respectively for the calibration period. The Nash–Sutcliffe model efficiency of 0.937 for manning's coefficient of 0.035 is identified for simulations as it reproduces the peaks with reasonable accuracy. The estimated Nash–Sutcliffe model efficiency is 0.86 for the validation period for the year 2013. The dam break model setup developed in Mike Flood is simulated with inflow of 100 year return period. It is observed that a time of about 15.5 h is required for peak flow to reach the downstream location at 100 km. The simulated discharge also shows that there is very high discharge just below the dam location and it gradually reduces towards downstream. This occurs due to storage of flood water in the river channel as well as in the flood plain. The sensitivity analysis of the various parameters of the dam breach model viz. breach width, duration of breach is carried out by comparing the combined outflow from dam. It is observed that in this case breach width is a more sensitive parameter. The output from the hydrodynamic modelling in the form of floods characteristic maps viz. flood depth, velocity, time to peak etc. are used for hazard assessment. The flooded area is classified into five hazard categories viz. Low, Medium, High, Very High and Extreme depending on maximum flood depth, maximum velocity and time to peak. It is observed that about 84 km² of possible inundated area is under water depth of more than 4 m. Further the reclassified land use land cover map may be overlaid to prepare a risk map of the study area.

Keywords: Dam break, Design flood, Flood risk, Hazard Category, Mike Flood.

1. INTRODUCTION

Dam is a very important hydraulic structure, which has very economic importance. Benefits like supplying of water for drinking, irrigation, industrial purposes, hydropower, recreation activities etc. Besides being multifunctional, it also provides safety to human lives and properties downstream by storing water in the reservoir and releasing water when there is huge demand and emergency. Besides being an asset to a country, its failure or collapse leads to the huge loss of human beings and properties. Dam break analysis is primarily carried out to find the potential of the downstream disastrous for a dam break. It gives the appropriate guidance for the standards to adopt for dam design, construction, operation, and monitoring. Though the probability of dam break is low but its failure resulted in high casualties. Many cases studies have resulted in two perspectives dealing with dam failure. First perspective gives answer to the question whether a dam will fail or not referring to the strength of material of which dam is built. It also deals with the breaching process of dam. Second perspectives assume a dam failure and study its disastrous effect in the downstream areas. This leads to the preparation of the emergency action plans for dam failure. The Dam Rehabilitation and Improvement Project (DRIP) basically envisaged the rehabilitation and improvement of about 223 dams in many places of India, it aims to promote a new technology and improving institutional capacity for dam safety evaluation and implementation at the Central and State levels and in some particular premier academic and research institutes of India. During this project the Guidelines for Developing Emergency Action Plans for Dams is developed describing all elements of an EAP and comprehensively covers requirements for notification flow charts, emergency conditions, inundation maps, emergency detection, evaluation and classification, emergency preparedness and implementation methodologies are developed (CWC, 2016). This guideline recommends preparation of inundation map for possible dam failure scenario along with time to flood (the time from the breach to the time that critical structures are flooded) and the time to peak flow.

Mitigation is the proactive effort to decrease the loss of life and property by reducing the effect of disasters. This is achieved through identification of potential hazards and the risks they pose in any given area, identification of mitigation alternatives to reduce the risk, and risk analysis of mitigation alternatives. The most appropriate method for flood hazard assessment is a combination of hydrologic and geomorphologic approach (Bates and Roo, 2000; Hunter et al., 2007; Chen et al., 2009, Mani et al. 2014). The flood hazard maps are produced by simulation of detailed hydrological and hydraulic models with various flooding scenarios. These models are forced and parameterized by locally available, high resolution and preferably high quality spatio-temporal data. The hydrological-hydraulic mechanisms integrated with GIS approach for modelling of flood provides, systematic and consistent analyses of flooding together with their likelihood of occurrence in a given time period. The hydraulic packages solve 1D (river/drain) and 2D (overland) shallow water equations considering the topography of area. The combination of GIS and 1D hydrodynamic modelling may provide a cost efficient system for planning and management of flood. This paper presents an application of the hydraulic model (Mike Flood) and GIS for studying various failure scenarios of an earthen dam in Odisha. Further attempts have been made to classify the flooded area is various hazard categories depending on maximum flood depth, maximum velocity and time to peak.

2. STUDY AREA AND DATA

The Mandira dam is located near Kansbahal in Sundergarh district of Odisha located about 16 km upstream from Mandira. The water from the dam is mainly used to meet the water requirement for Rourkela Steel Plant. In addition, the dam supplies water to more than 250 surrounding villages. Water is stored in dam during rainy seasons and provided from the reservoir to the plant region through the weir constructed in Brahmani River. This is an earth dam with height of about 35.38 m from the foundation level. The Brahmani river is formed by the confluence of the rivers Koel and Sankh river at Ved Vyasa near the major industrial town of Rourkela. Both of these sources are in the Chota Nagpur Plateau. The index map of study area is shown in Figure 1. The SRTM DEM is used for delineation of various sub basins and estimation of catchment characteristics. The various data requirements for dam break analysis includes; dam and spill way characteristics, reservoir storage characteristics, downstream river cross section, reservoir inflow information are collected from various state and central government organizations.

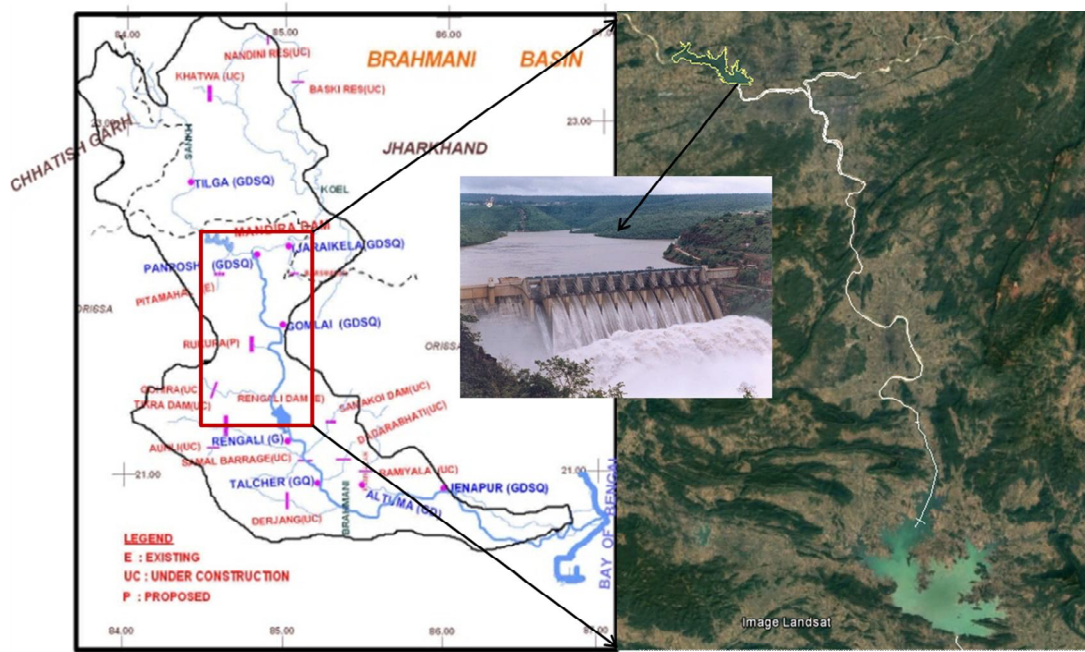


Figure-1: Index map of the study area.

3 METHODOLOGIES

3.1 Estimation of Design Floods

The design flood for 100 year return period to Mandira dam and other river reaches are estimated using synthetic unit hydrograph approach (CWC, 1997). The SUHs are derived from catchment characteristics viz. drainage area, slope, longest flow length, flow length from basin centroid, etc. of the study area and relationships provided in the Flood Estimation Report (CWC, 1997). The Hydrologic Modelling System (HEC-HMS) is used for estimating discharge from each sub basin from the developed unit hydrograph, hourly

effective rainfall and base flow. Further, hydrologic routing for the reaches is carried out by ‘Muskingum-Cunge routing’ method. The model setup in HEC-HMS with six sub basins, five junctions and three reaches is shown in Figure 2.

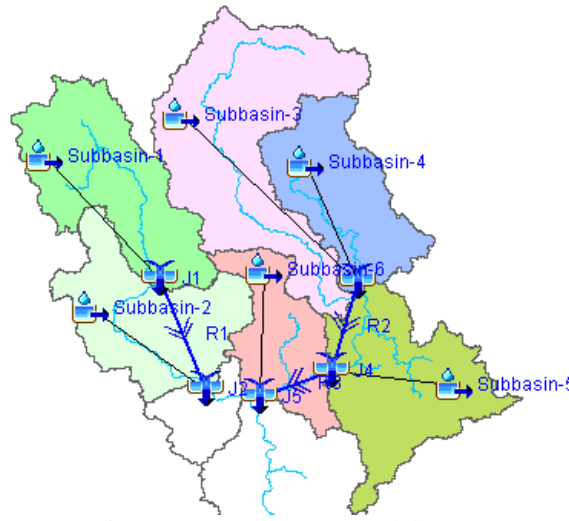


Figure-2: HEC-HMS model setup.

3.2 Dam Break Model Set-up

The MIKE FLOOD couples MIKE 11 (1-D) and MIKE 21 (2-D) into a solitary framework utilizing a coupled approach. MIKE FLOOD empowers to remove the best elements of both MIKE 11 and MIKE 21 to reproduce surges, while in the meantime staying away from large portions of the confinements of determination and exactness experienced when utilizing MIKE 11 or MIKE 21 independently. The hydrodynamic (HD) model is known as nucleus for MIKE 11 model. The governing equations in MIKE 11 is a one-dimensional (1-D) & shallow water type. This is the modification of the basic Saint-Venant equation, which is converted into a set of implicit and finite difference equation help to solve by applying the double sweep algorithm (Abbot and Ionescu, 1967). Computational grids are used to comprise of alternating Q & H_I points spontaneously and generated with the help of model. The Q points are to put at the middle of between the nearest H_I pt. The H_I points are pointed at the cross sections or at an equal interval. The dx is specified by users ($dx=500$ m in the present setup) if the distance between the cross-sections is more than maximum space intervals. In MIKE 11 Model, dam break portion, helps to simulate the hydrograph for outflow, resulting from dam break. The speeding of flood causes of failure of dam is to be a highly unsteady nature. The river course required to describe correctly by using a no. of cross-sections where the cross-sections are changing frequently. Generally the cross-sections are extended as it is possible further, for covering a higher modelled water level, this is counted as the highest recorded of the level of flood generally. However in this case the cross-sections are limited up to river banks as the flood plain is modelled in Mike 21. The dam break modelling is similar as for hydrodynamic model besides the failure of dam structure which is located at a reservoir branch separately modelled. Here three analysis points are counting .i.e. (2-h points and one Q point). The river set-up with a dam is shown in Figure 3. The reservoir is regularly demonstrated as a solitary h-indicate in the model get an exact depiction of the supply stockpiling qualities. The surface stockpiling scope of the dam is portrayed as a component of the water level and it is entered as additional storage area. At the Q point where the structure of dam break locate, the equation that describes flow through structure is placed the momentum equation. Since at Q point that momentum equation is not used, there is no relevance of Δx set up.

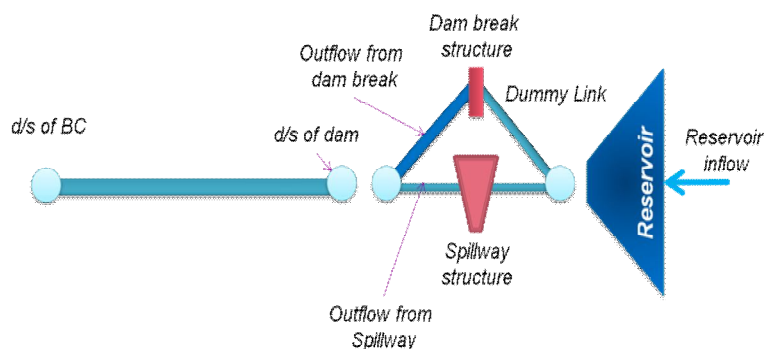


Figure-3: River set up with dam

The setup of Mike-21 is necessary for simulating of MIKEFLOOD. The basic unit parameters which used in this study are bathymetry, simulated period, mass budget, flood and dry thresholds, boundry, point source, precipitation, initial surface elevation. For different simulation the Δt (computational time set up) is set to 15 seconds as lower and the prepared bathymetry for resolution is taken as is 180 m \times 180 m.

3.3 Calibration and Validation of MIKE 11

Calibration of a model is the way toward modifying model parameters to get a nearby assertion between the observed and simulated values. The Mike 11 model is calibrated for manning’s coefficient by simulating water level at Gomali gauging site for the period November 2011. The Nash–Sutcliffe model efficiency is estimated for comparing observed and simulated water levels. Further, the model is validated by comparing observed and simulated water level for the period 15 June 2013 to 15 December 2013.

3.4 Flood Hazard Assessment

The validated model is used for dam break flood simulation for 100 year return period flood using Mike Flood. The model provides outputs in terms of inundation area, time series of flood depth, velocity, the time from the breach to the time that critical structures are flooded, the time to peak flow etc. These parameters are used for assessing the flood hazard in a GIS environment (ArcGIS). Further flood risk map are derived by incorporating Land use and Land cover map in to the flood hazard map.

4 RESULTS AND DISCUSSIONS

4.1 Flood Hydrographs

The 100 year 24 h rainfalls for each sub catchments are extracted from figure given in CWC (1997) report. These rainfall values are transferred for design storm duration. Finally, rainfall reduction factor is multiplied to obtain the sub catchment average rainfall. The rainfalls are then distributed to incremental hourly value as methods mentioned in the flood estimation report (CWC, 1997). The effective rainfall hyetographs and unit hydrographs are convoluted using HEC-HMS. The estimated design flood hydrographs at Mandira dam and Koel River at junction are shown in Figure 4.

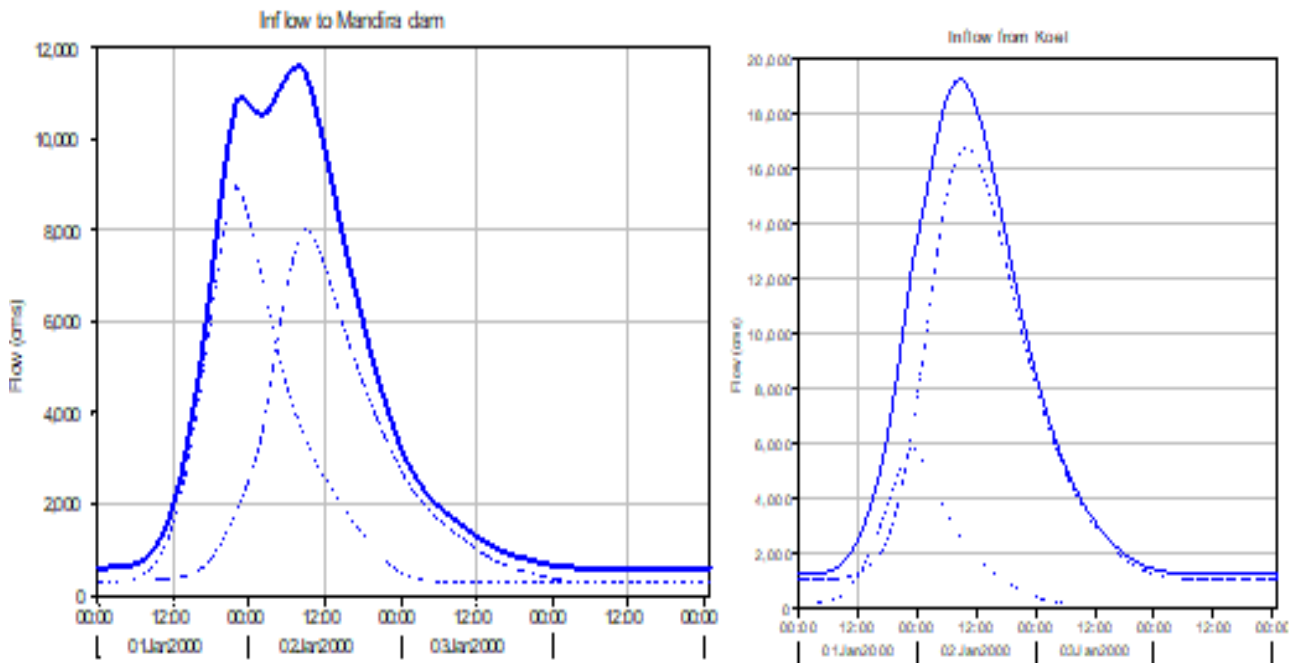


Figure-4: Design flood hydrographs for 100 year return period flood

4.2 Calibration and Validation of Mike 11

The Mike 11 model is calibrated and validated for manning’s coefficient by comparing the simulated and observed water levels at the Gomali gauging site. The Nash–Sutcliffe model efficiency for various manning’s coefficient of 0.035, 0.03, 0.04, 0.038 and 0.033 are found to be 0.937, 0.922, 0.879, 0.909, and 0.941 respectively for the calibration period. The Nash–Sutcliffe model efficiency is 0.937 for manning’s coefficient of 0.035 is selected as it reproduces the peaks. Further, the model is validated by comparing observed and simulated water level for the period 15 June 2013 to 15 December 2013. The estimated Nash–Sutcliffe model efficiency is 0.86 for the validation period. The comparatively lower value of Nash–Sutcliffe model efficiency is due to a relatively larger period with low flow values. However, from the Figure 5 it may be noted that the peak floods are well matched.

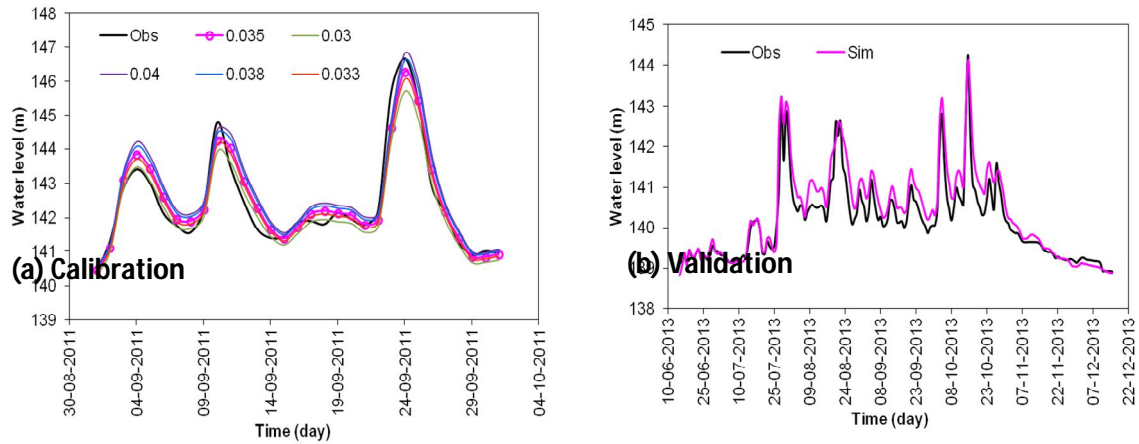


Figure-5: Comparison of the observed and the simulated water level at Gomali.

4.3 Dam Break Simulations

The dam break model setup developed in Mike Flood is simulated with inflow of 100 year return period both at Mandira dam and Koel river. In Mike-11 the results of simulated discharge and stages are available at alternate grid points. The simulated discharge and water level due of dam break simulation are shown in Figure 6. It may be noted that about 15.5 h is required for peak flow to reach downstream located at 100 km. The simulated discharge also shows that there is very high discharge just below the dam location and it gradually reduces towards downstream. This occurs due to storage of flood water in the river channel as well as in the flood plain.

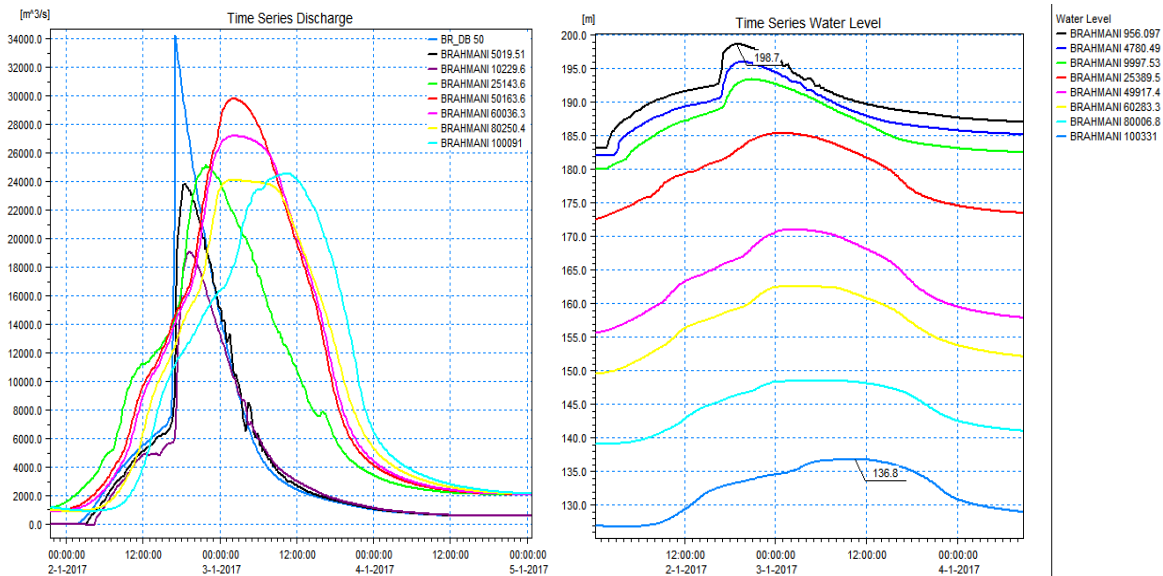


Figure-6: Simulate discharge water level due to dam failure at various downstream locations.

4.4 Flood Hazard Assessment

The output from the hydrodynamic modelling in the form of floods characteristic maps viz. flood depth, velocity, time to peak etc. are used for hazard assessment. The five hazard classes and range of the flood characteristics are shown in Table 1. Figure 7 show the classified hazard map. The combined hazard map is prepared by integrating these factors. Further the reclassified LULC map is overlaid to obtain risk map.

Table-1: Various hazard classes

Classes	Max. Depth(m)	Max. Velocity (m/s)	Time to peak (h)
Low	< 0.25	< 0.2	> 12
Medium	0.25 - 1	0.2 -0.8	6 -12
High	1 - 2	0.8 – 1.2	3 - 6
Very High	2 - 5	1.2 - 2	1 - 3
Extreme	> 5	> 2	> 1

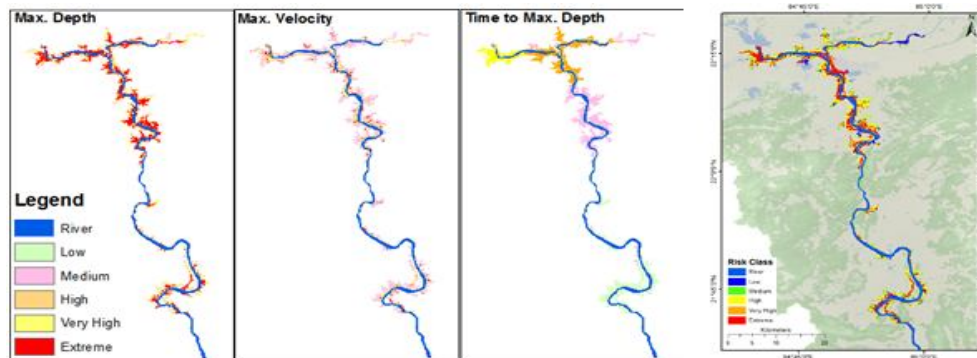


Figure-7: Classified flood hazard and risk maps.

5. CONCLUSIONS

The design flood for 100 year return period to Mandira dam and other river reaches are estimated using synthetic unit hydrograph approach. The SUHs are derived from catchment characteristics viz. drainage area, slope, longest flow length, flow length from basin centroid, etc. of the study area and relationships provided in the Flood Estimation Report. The Hydrologic Modelling System (HEC-HMS) is used for estimating discharge from each six sub basins from the developed unit hydrograph, hourly effective rainfall and base flow. Further, hydrologic routing for the reaches is carried out by 'Muskingum-Cunge routing' method. The estimated peak flow to dam is about 11590.2 m³/s and the time to peak is 32 h from start of the simulation. The 1-D Mike 11 model is calibrated and validated by comparing the simulated and observed water levels at the Gomali gauging site. The Nash–Sutcliffe model efficiency for various manning's coefficients of 0.035, 0.03, 0.04, 0.038 and 0.033 are found to be 0.937, 0.922, 0.879, 0.909, and 0.941 respectively for the calibration period. The Nash–Sutcliffe model efficiency of 0.937 for manning's coefficient of 0.035 is identified for simulations as it reproduces the peaks with reasonable accuracy. The estimated Nash–Sutcliffe model efficiency is 0.86 for the validation period for the year 2013. The dam break model setup developed in Mike 11 and coupled with Mike 21 in Mike Flood. The dam break simulation is carried out with inflow of 100 year return period flood. It is observed that a time of about 15.5 h is required for peak flow to reach the downstream location at 100 km. The simulated discharge also shows that there is very high discharge just below the dam location and it gradually reduces towards downstream. This occurs due to storage of flood water in the river channel as well as in the flood plain. Further, sensitivity analysis, it is observed that in the breach width is a most sensitive parameter. The output from the hydrodynamic modelling in the form of floods characteristic maps viz. flood depth, velocity, time to peak etc. are used for hazard assessment. The flooded area is classified into five hazard categories viz. Low, Medium, High, Very High and Extreme depending on maximum flood depth, maximum velocity and time to peak. Further the reclassified land use land cover map may be overlaid to prepare a risk map of the study area. However, for policy implementation the flood hazard maps need to be developed with high resolution DEM and needs regularly updated as variations in hydrologic and LULC changes are expected in the area.

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REVIEW STUDY OF RHIZOFILTRATION BY WATER HYACINTH (*Eichhornia crassipes*): A METHOD TO REMOVE HEAVY METAL CONTAMINANTS FROM TEXTILE INDUSTRY EFFLUENTS

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ABSTRACT

*Developing Cost Effective and Environment-friendly technologies for the remediation of soils and waste water polluted with toxic substances is an issue of global interest. Increasing pollution of surface and ground water bodies is posing new challenges while dealing with the problem of Water Crisis. Rhizofiltration is a technique of bioremediation which uses plant roots for removal of different categories of pollutants from water. Water Hyacinth (*Eichhornia crassipes*, Family Pontederiaceae) is a fast growing vascular aquatic macrophyte and commonly found in tropical and subtropical regions. Being a worse invasive aquatic weed, if cultivated in controlled form it can be used in rhizofiltration of toxic trace substances from water bodies. It has been utilised for various research activities over the last few decades and its absorption capacity responsible for minimising various organic & inorganic contaminants, heavy metals, TDS, TSS, BOD, COD etc. in the industrial wastewater, has been explored in detail.*

Jaipur City has large number of textile mills & industries. Safe disposal of water discharged from these industries is a big challenge because effluent is of very complex nature containing different chemicals and dyes in varied concentrations. Research needs to be done on the direct application of water hyacinth and its derived products in removal of dyes and heavy metals from textile effluent as well as from wastewater. Present study is aimed to review and find out the possibilities of In-situ application of Water Hyacinth roots in Effluent Treatment Plants of textile industries for removal of heavy metal contaminants. It could prove to be a cost effective and eco-friendly method to reduce heavy metal concentrations in industrial discharge. Due to its high rate of biomass production, high tolerance to pollution and capacity to absorb heavy metal and reducing organic load, Water Hyacinth has enormous potential to become a promising material for control of water pollution in Jaipur.

Keywords: Effluent Treatment, Jaipur, Rhizofiltration, Textile Industry, Water Hyacinth.

INTRODUCTION

According to recent study conducted by Central Ground Water Board (CGWB), Rajasthan is facing severe water crisis due to a sharp decline in ground water by 62.7% at majority of places and only 37.2% rise at some places. These results can be explained by the fact that due to scanty rainfall in the state, the extraction of ground water occurs at a faster rate than its recharge.

Jaipur, the capital city of Rajasthan is the 10th largest Indian city with a population of 3.1 millions and annual growth rate of nearly 5%. It is located in the semi-arid zone of India, which is characterized by high temperatures, low rainfall (Average annual rainfall nearly 600mm), and a mild winter. For its water supply, Jaipur relies extensively on ground water and a single surface water source, the Bisalpur Dam, which is located 120km southwest of Jaipur and shared with Ajmer and Tonk district village.

Major economic activities of the city include tourism, trading, administration along with the local handcraft, textile, dyeing and printing industries. These industries in and around the city have deteriorated the surface as well as ground water quality. Therefore it has become essential to follow waste water treatment and reuse to combat with the situation of water crisis.

The present research paper mainly focuses on the treatment of waste water effluents from textile industries as they are present here in majority. The discharge of toxic effluents from various industries adversely affects water resources, soil fertility, aquatic organisms and ecosystem integrity. Appearance of colour in discharges from various industries is one of the major problems encountered in the textile industry.

The textile waste water is rated as the most polluting among all in the industrial sectors (Vilaseca et al., 2010; Awomeso et al., 2010). It is a complex and variable mixture of polluting substances like inorganic, organic, elemental and polymeric products (Brown and Laboureur, 1983). Among complex industrial wastewater with various types of colouring agents, dye wastes are predominant. The textile wastewater containing dye substances is not only toxic to the biological world, its dark colour blocks sunlight that leads to severe problems to the ecosystem. (Choi et al., 2004).

RHIZOFILTRATION POTENTIAL OF WATER HYACINTH

Water hyacinth belongs to family *Pontederiaceae* and genus *Eichhornia*. It grows through out the tropics and sub-tropics as a free-floating perennial. The growth is adversely affected by low temperature and completely ceases in freezing cold. Therefore, water hyacinth shows seasonal growth during summers and no growth during winter season (Gopal 1987). In India, the plant was first introduced in early 1890s in Bengal and due to its invasive nature soon it became a serious problem by the year 1914.

Water hyacinth is fast growing perennial with great reproduction potential. Growth of water hyacinth is primary dependent on ability of plant to use solar energy, nutrient composition of water, cultural methods and environmental factors. Optimal water pH for its growth is neutral but it can tolerate pH values from 4 to 10. This is very important fact because it points that water hyacinth can be used for treatment of different types of wastewater. Optimal water temperature for growth is 28-30°C. It is well-known for its reproduction potential and as a plant that can double its population in only twelve days. Water hyacinth is also known for its ability to grow in severe polluted waters. (Rajendra et.al 2017)

(I) POTENTIAL TO REMOVE HEAVY METALS FROM TEXTILE EFFLUENT

Aquatic macrophytes have great potential to accumulate heavy metals inside their plant bodies. These plants can accumulate heavy metals up to 100,000 times greater than the amount in the associated water. Therefore, these macrophytes have been used for heavy metal removal from a variety of sources (Mishra and Tripathi, 2008). Survival of water hyacinth is based on the nutrients provided by various habitats. These can range from clean waters which can be lacking in key nutrients to extremely contaminated waters with high amounts of nutrients. Although the growth of water hyacinth is more vibrant in neutral water bodies, the weed can grow well in waters severely polluted by organic matter and heavy metals, like in sewage lagoons waters, due to phyto-extractive properties (So et al., 2003, Jafari, 2010).

Phytoextraction is the uptake of pollutants by roots with successive accumulation in the aerial parts of a plant (Pivetz, 2001). A study by Zhu et al. (1999) on phyto-accumulation of various elements by water hyacinth revealed that the weed builds up trace elements like silver, lead, cadmium and so many other metals. In addition, the plant proved to be effective in phyto-remediation of wastewater contaminated with cadmium, chromium, copper and selenium. Similar research conducted by Shao and Chang (2004), indicated that water hyacinth is capable of absorbing, as well as translocating heavy metals like Pb, Cd, Ni, Zn, and Cu. Mahamadi (2011) in a related study attributed these properties to numerous poly-functional metal-binding sites in the plant, for both anionic and cationic metal complexes, thus the ability to absorb heavy metals along with other contaminants.

In Pakistan, an investigation by Hussain et al. (2010) on phytoremediation of nickel ions by water hyacinth, reported an accumulation of heavy metals in the roots. Water hyacinth has a high content of fermentable matter, as well as nitrogen and essential nutrients. Mokhtar et al., 2011 reported *E. crassipes* as a hyperaccumulator for copper with an efficiency of 97.3% removal from an aqueous solution containing various concentrations of copper. (1.5, 2.5 and 5.5 mg/L of copper for a period of 21 days). Ajayi and Ogunbayo, 2012 studied the efficiency of water hyacinth in removing Cd, Cu and Fe from various wastewaters like textile, pharmaceutical and metallurgical in which it seems to be a good choice for removing cadmium but not so much for the removal of iron and copper. During the 5 weeks duration of the experiment, the removal of cadmium by the water hyacinth was 94.87% in textile wastewater, 95.59% in metallurgical wastewater and 93.55% in pharmaceutical wastewater.

(II) POTENTIAL TO REMOVE CHEMICAL DYES FROM TEXTILE EFFLUENT

The textile industry consumes large quantities of water and produces large volumes of wastewater through various steps in dyeing and finishing processes. The textile waste water is a complex and variable mixture of polluting substances like inorganic, organic, elemental and polymeric products (Brown and Laboureur, 1983). Among complex industrial wastewater with various types of colouring agents, dye wastes are predominant. The textile wastewater containing dye substances is not only toxic to the biological world, its dark colour blocks sunlight that leads to severe problems to the ecosystem. (Choi et.al., 2004).

Textile industries utilize substantial volumes of water and chemicals ranging from inorganic compounds, polymers and organic products for wet-processing of textiles (Dos Santos et al., 2007). The cationic dye methylene blue was widely studied for its removal from aqueous solution by the water hyacinth (Low et.al., 1995). The author concluded the water hyacinth root as a cheap source of biosorbent for basic dyes.

Kanawade and Gaikwad (2011) studied the adsorption property of the water hyacinth and activated carbon in removing methylene blue from aqueous solution. Soni et al., 2012 found the water hyacinth root to be an

efficient adsorbent for removing methylene blue from aqueous solution as it had shown 95% dye removal efficiency in an optimum experimental condition. (Nath et al., 2013) where maximum percentages of removal of the dyes were found to be 90%, 88%, 92%, and 90% for methylene blue, congo red, crystal violet, and malachite green, respectively. Vasanthi et al., 2011 removed the textile dyes red RB and Black B from their aqueous solutions by water hyacinth plant material. The efficiency of *E. crassipes* to remove the colour and degrade the dye was about 95% with Red RB and 99.5% with black B. r, adsorption of an anionic dye Congo red by activated water hyacinth roots was studied by Rajamohan (2009). An effective pH of 6 was optimised for the adsorption of Congo red through batch studies.

(III) REUSE OF WATER HYACINTH PLANT AFTER WASTE WATER TREATMENT

After the use of Water Hyacinth for effluent treatment, the huge biomass can be used for various purposes. Its biomass is rich in nitrogen and other essential nutrients and this aquatic macrophyte can be used in biogas production. Apart from biogas (Singhal and Rai 2003), its sludge contains almost all nutrients and can be used as a good fertilizer with no detrimental effects on the environment (Patil et al. 2011). After harvesting, it can be used for composting, anaerobic digestion for production of methane, and fermentation of sugars into alcohol (Patil et al. 2011), green fertilizer, compost, and ash in regenerating degraded soils. These operations can help in recovering expenses of wastewater treatment.

(IV) COMPARISON OF ADVANCED METHODS WITH RHIZOFILTRATION BY WATER HYACINTH

Although various physical, chemical and biological processes like reverse osmosis, flocculation, activated carbon adsorption, and microbial treatment are involved as dye treatment techniques, adsorption process plays a major role and was preferred as a promising and efficient method for the treatment of dyes and dye effluents. Various studies are reported in the literatures using different adsorbents like alumina, zeolite, and polyurethane foam etc. The disadvantages of advance technology are high operating cost which makes them ineffective to treat the wide range of effluents. Thus still the search for simple, economic, eco-friendly, and highly effective adsorbents is continuing.

E. crassipes being one of the worst weeds in the world as a vigorous grower which is known to double its population within two weeks was worked out as a cheap and easily available adsorbent for dye and effluent treatment by various researchers. It is highly suitable for tropical wet and dry climate. Also, it requires minimal space for the setup and if the waste water flow is high, then a series or parallel set up of water hyacinth can be done, thus using land and space to the maximum extent. The weed and its dried root/ shoot powder have been found be suitable for improving water quality and effluent polishing. The plant does not require any energy for its function and hence it is suitable where there isn't proper supply of powder or where the cost of energy is too high (Rajendra et.al., 2017).

CONCLUSION

Currently, the Pink city (Jaipur) is facing a rapid growth of water scarcity and water demand. Although city has a glorious past of having different traditional water management systems, but lack of maintenance, awareness, rapid urbanisation and industrialization, old water management strategies have proved to be insufficient. Under such circumstances, waste water treatment has become the only viable solution to overcome the Water crisis.

Water hyacinth has huge potential in waste water treatment process. If it can be combined with existing waste water treatment technologies, cost effective and eco-friendly effluent treatment process can be developed. The process can be adjusted according to the effluent characteristic of different type of textile industries and can be executed with less skilled man power.

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GEOSTATISTICAL ANALYSIS OF SPATIAL AND TEMPORAL VARIATIONS OF GROUNDWATER LEVEL: A CASE STUDY OF BHILWARA DISTRICT RAJASTHAN.

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ABSTRACT

Water is one of the natural resources that cannot be generated but only be preserved. In future water scarcity will be one of the biggest challenges in the world. In the current scenario the ground water is a major source of drinking water for the Bhilwara district as well as irrigation & industries. Thus the study is used to analyzed the spatial and temporal variation in the pre and post monsoon ground water level. Ground water level plays a key role in conserving the sustainable conditions in arid and semi-arid regions. Rajasthan state of India is located in arid & semi-climatic region with poor water level. Same is the situation in Bhilwara district located in the central part of Rajasthan where availability of ground water level is very poor because ground water draft is very high and the deeper level of water gives the poor quality of water. The present study is focused on spatial variability of groundwater level using geo-spatial techniques. The study has analyzed the spatial-temporal variations in groundwater level to understand the hydrological behavior and status of both pre & post monsoon water level in the study area. Various thematic maps were prepared for both pre-monsoon and post-monsoon groundwater level for the period 2007 to 2016. The main objective of the study is to identify the temporal trends in annual groundwater level through Remote Sensing & Geographical Information Systems (GIS) and ground water level relate with rainfall. In this study the analysis of pre and post monsoon ground water level with rainfall gives good idea about status of water level in the study area.

Keywords: Ground water level, Remote Sensing, GIS, Interpolation.

INTRODUCTION

Water is one of the precious natural resources present on the earth and it is very necessary for survival of flora and fauna. Water can be considered as one of the most vital for human existence out of all the natural resources such as drinking purposes and irrigation needs for higher level of crop production. The demand for the water has been increasing day by day due to increase in population and industrial growth. Looking towards shortage of ground water level, which restrict the development of industries, irrigation etc.

From last decade the mica mining has played a vital role for the economic development and social condition of Bhilwara and it is famous for mica mining centre all over the country. There is a huge scarcity of water for drinking and irrigation purpose, because this area has less rainfall and deeper ground water level. This area is selected for study because it is situated in the central part of Rajasthan state and falling in semi-arid zone which is suffering from a viral scarcity of water for irrigation as well as domestic purposes. The district is also facing the problem of industrial growth due to the water crisis.

Distribution of water level plays an important role in understanding the ground water level. Analysis of pre and post monsoon ground water level with rainfall gives good idea about status of water level in the study area. In the study the analysis of ground water level and rainfall is used to understand the variability of ground water level with rainfall for last 10 year. Rainfall pattern is very important to understand spatial and temporal variations in ground water level. The ground water availability depends on rainfall of the particular year as the district has hard rocks having very low permeability and poor water holding capacity.

Remote sensing and GIS technology is being used to monitor agriculture and crop growth status in term of both space and time (Jeyaseelan 2003; Seelan et al. 2003). In this study Ordinary Kriging interpolation method is used for the surface generation of both pre & post monsoon water level. Kriging is often regarded as one of the most popular and robust interpolation techniques (Irabor et al., 2008). The Kriging method performs a weighted averaging on point values where the output estimates equal the sum of product of point value and weights divided by sum of weights (Babiker et al., 2007).

Spatial distribution of ground water level data for both pre and post monsoon is generated using Ordinary Kriging interpolation method and prepare the layout map in ArcGIS 10.4. Spatial interpolation techniques were implemented in ESRI's ArcGIS 10.4 software using Spatial Analyst Tool. ArcGIS 10.4 software is used for surface generation of water level data for the year 2007 to 2016 of Bhilwara District.

Previous Work

The number of researchers worked on rainfall analysis using the remote sensing and GIS techniques. In previous study most of the work used to extract the information from the satellite image to get the feature of the earth surface and the analysis of water level and rainfall using interpolation and image processing techniques. we got that Bhilwara district suffer from the deteriorating of ground water in both quality and quantity. In recent years ground water level has become major concern in the study area.

Study Area

Bhilwara district is located in south eastern part of Rajasthan state. The coordinates of this district are 25° 00' 38.87 to 25° 57' 53.70 North latitude and 74° 00' 31.67 to 75° 27' 46.25 east longitude. The total geographical area of the district is 10,455 sq km. It is bounded in the north by Ajmer district in the north-west, west and south-west by Rajsamand district; in the south and south-east by Chittaurgarh district and in the east and north-east by Bundi and Tonk District. The area of the district generally slopes gently except in western & northwestern part where slope is high (Ministry of Water Resources, Govt of India). Figure shows the geographical extent of study area.

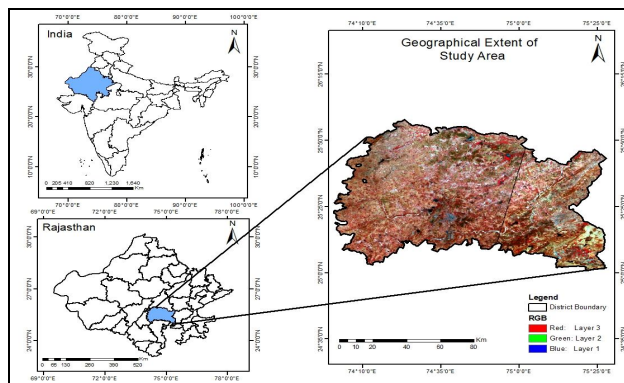


Fig-1: Geographical Extent of Study Area.

Data Requirement

In the research, Landsat 8 satellite data was downloaded from <https://www.usgs.gov/>. Landsat 8 data which is used for study area.

Administrative map were collected from Survey of India and prepared the district boundary through the digitization in ArcGIS 10.4. Ground water level data for both pre and post monsoon is collected from Central Ground Water Board (CGWB), Rajasthan.

Rainfall datasets of study area were acquired from the website of India Meteorological Department (IMD) & website of India Water Portal <http://www.indiawaterportal.org/> for the period 2007-2016.

Methodology

Methodology adopted for this study is given below in the form of a flow chart which is presented in Fig.2.

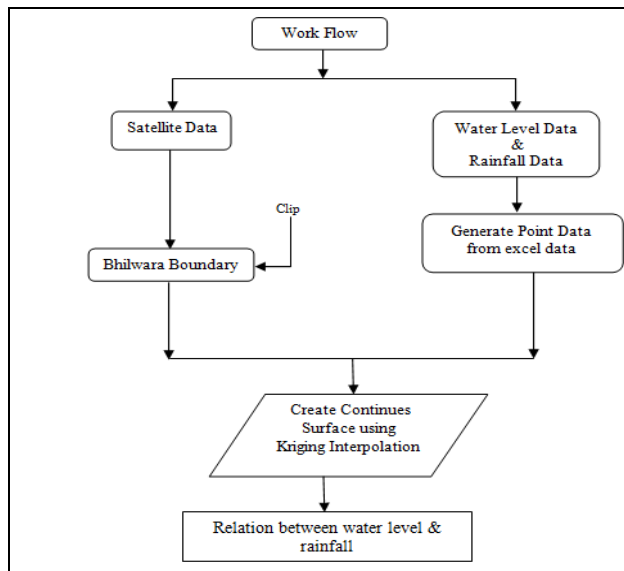


Fig-2: Methodology

Remote Sensing & GIS Analysis

Spatial distributions of ground water level for pre-post monsoon is generated using “Ordinary Kriging Interpolation” method and prepare the layout map in ArcGIS 10.4.

By using the Geo-statistical analysis points with known values to estimate values at other points. These points with known values are called known points, control points, sampled points, or observations. Spatial interpolation is therefore a means of converting point data to surface data so that the surface data can be used with other surfaces for analysis (pandey et al., 2016).

Pre-Post monsoon water level and rainfall data has been analyzed to illustrate spatial distribution of ground water level and its categorization under different ranges in ArcGIS 10.4. Water table may be change due to the topography, structural geology and seasonal changes. The water table is the level at which the groundwater pressure is equal to atmospheric pressure (Sukumar.S et al. 2011). Fluctuation of ground water level is the variation of pre and post monsoon water level and it is depends on the overall behavior of groundwater. The study of rainfall pattern is very important for understanding spatial and temporal variations in water level.

Surface Generation (Ordinary Kriging) for ground water level

Ground water level for Bhilwara district is collected from Central Ground Water Board (CGWB), Rajasthan for the year 2007 to 2016. The thematic maps generated by Kriging interpolation method which is shown in figure 3(a) & 3(t) which depicts a continuous surface for water level. Blue colour shows high water level whereas low water level is illustrated by shades of green colour.

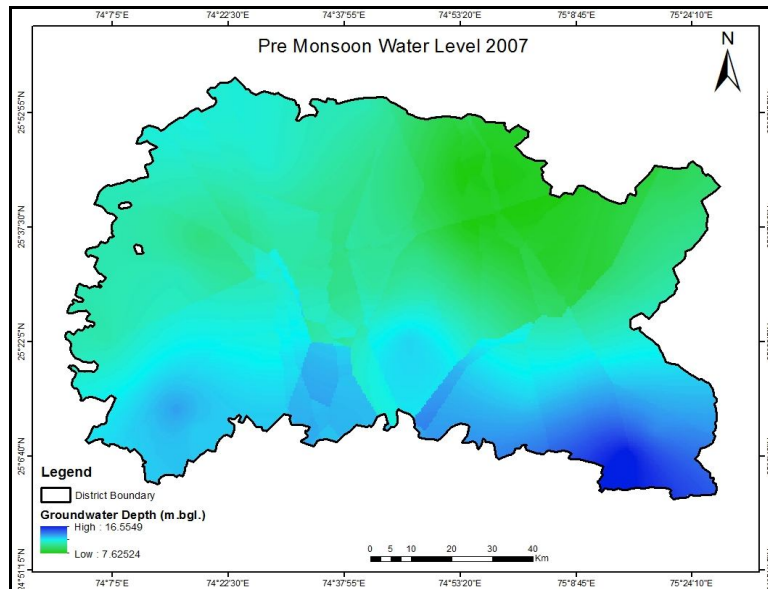


Fig.3 (a). Pre-monsoon water level 2007

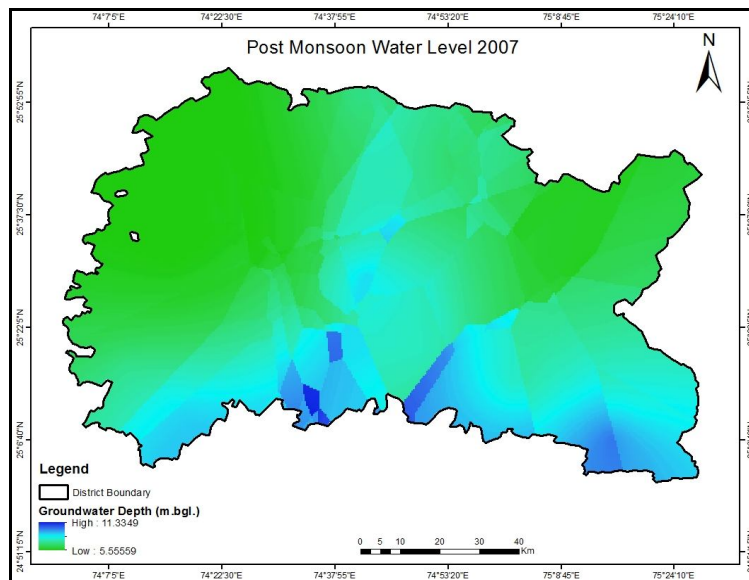


Fig.3 (b). Post-monsoon water level 2007

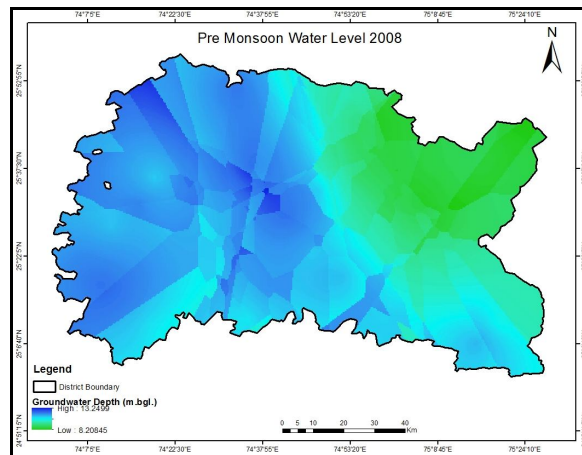


Fig.3 (c). Pre-monsoon water level 2008

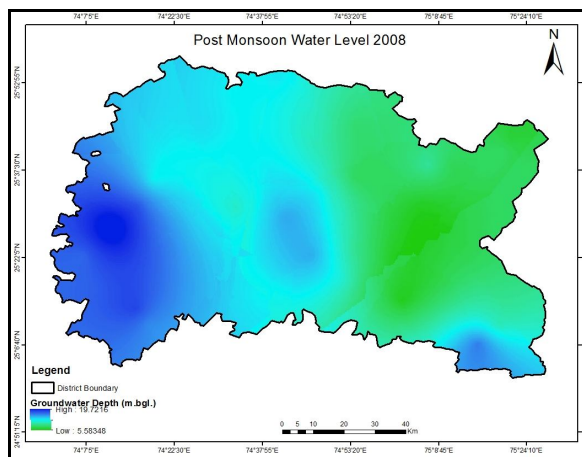


Fig.3 (d). Post-monsoon water level 2008

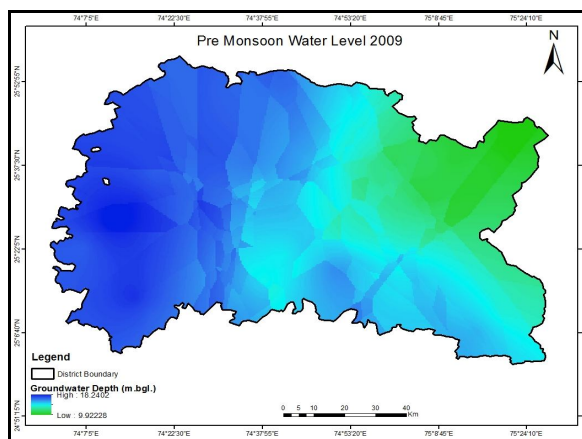


Fig.3 (e). Pre-monsoon water level 2009

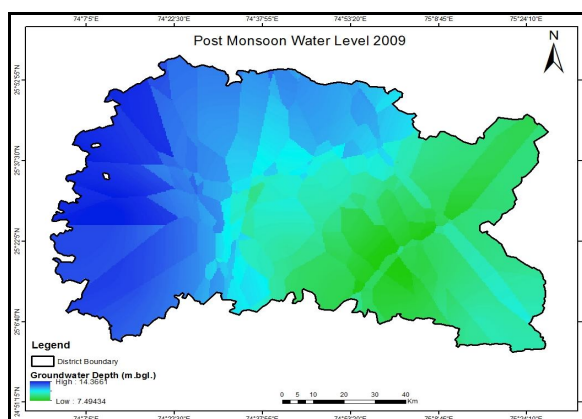


Fig.3 (f). Post-monsoon water level 2009

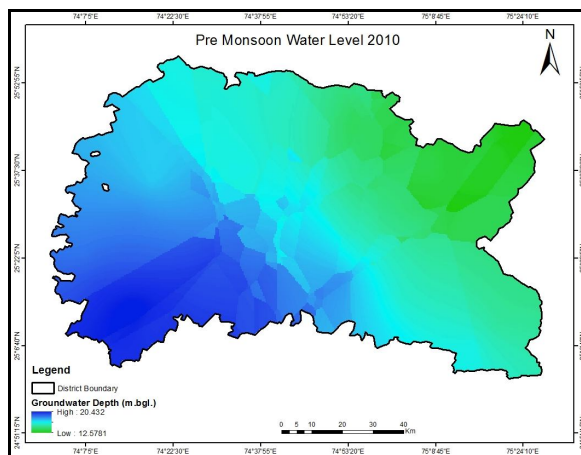


Fig.3 (g). Pre-monsoon water level 2010

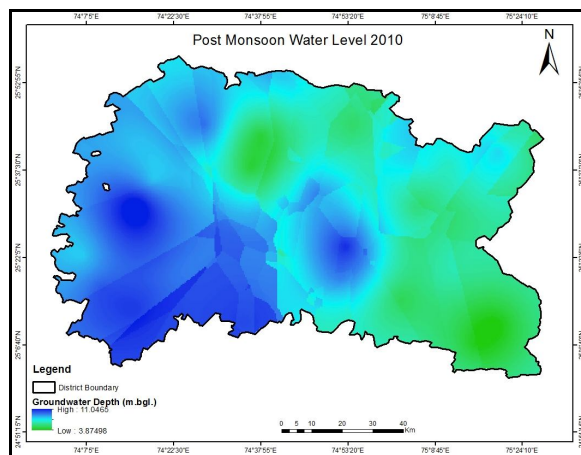


Fig.3 (h). Post-monsoon water level 2010

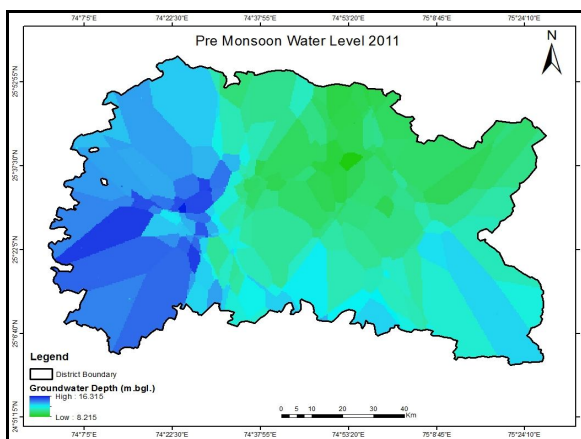


Fig.3 (i). Pre-monsoon water level 2011

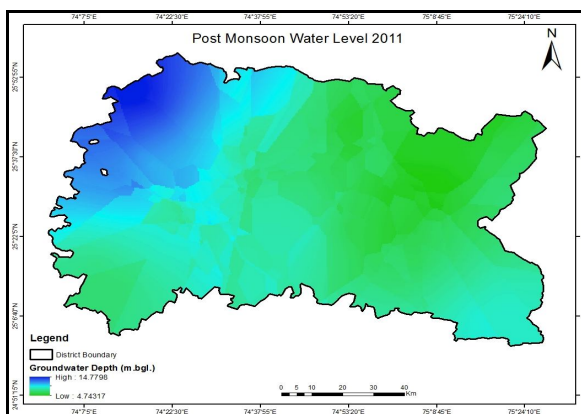


Fig.3 (j). Post-monsoon water level 2011

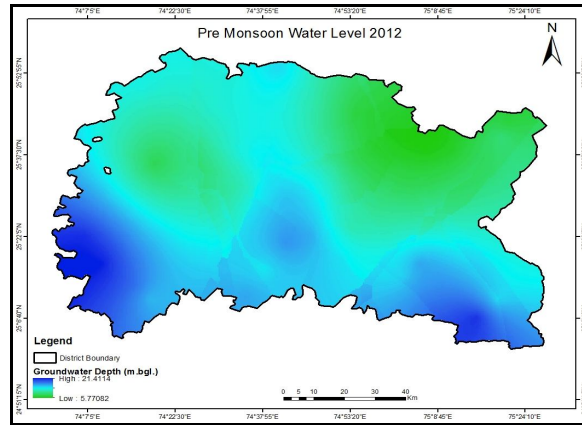


Fig.3 (k). Pre-monsoon water level 2012

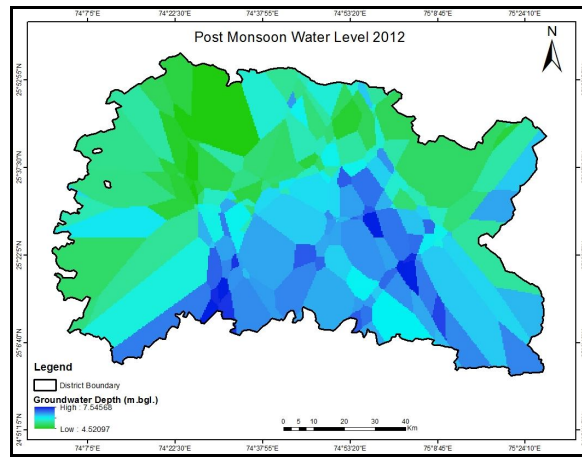


Fig.3 (l). Post-monsoon water level 2012

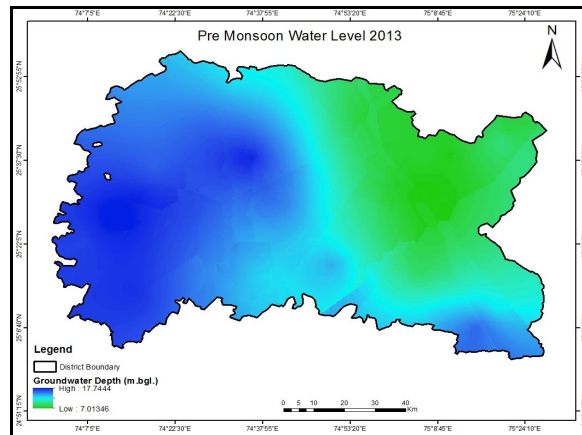


Fig.3 (m). Pre-monsoon water level 2013

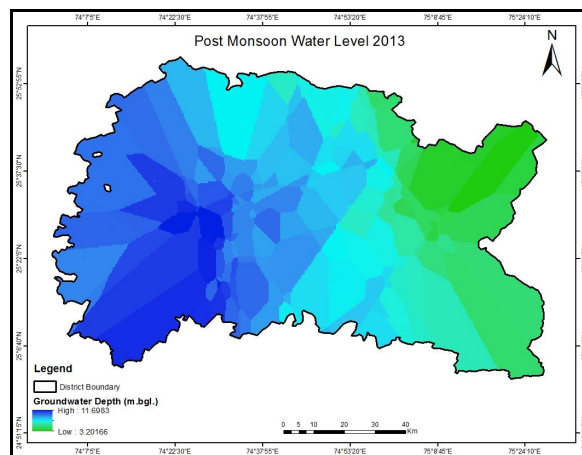


Fig.3 (n). Post-monsoon water level 2013

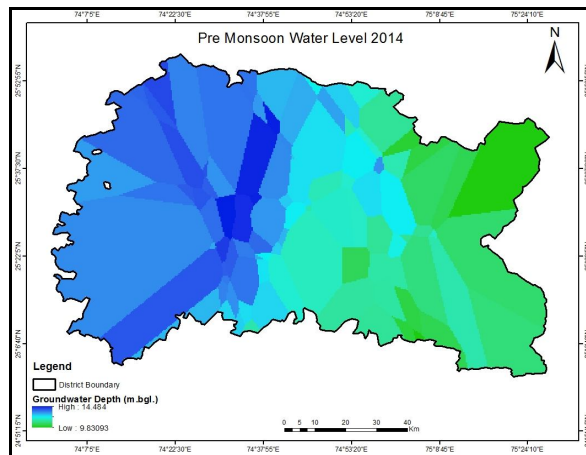


Fig.3 (o). Pre-monsoon water level 2014

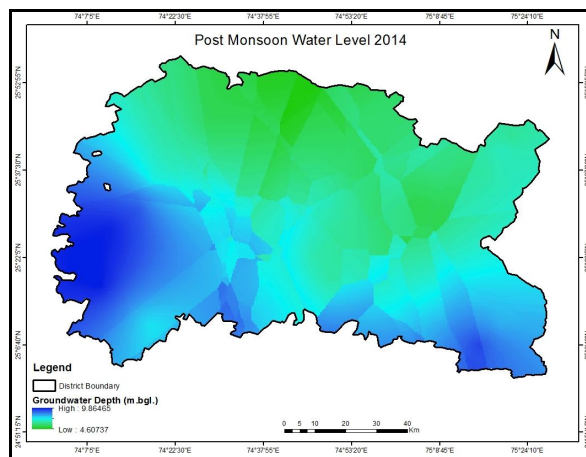


Fig.3 (p). Post-monsoon water level 2014

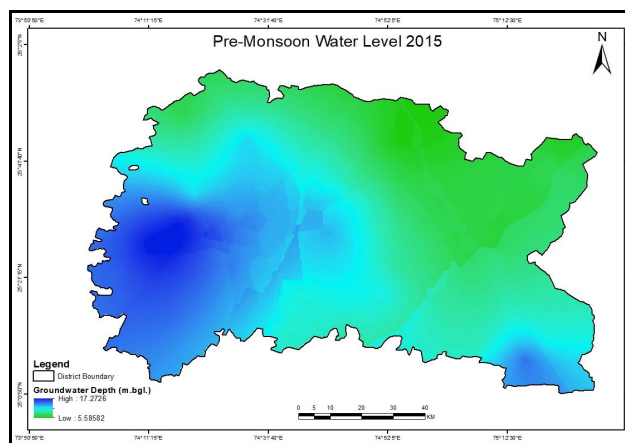


Fig.3 (q). Pre-monsoon water level 2015

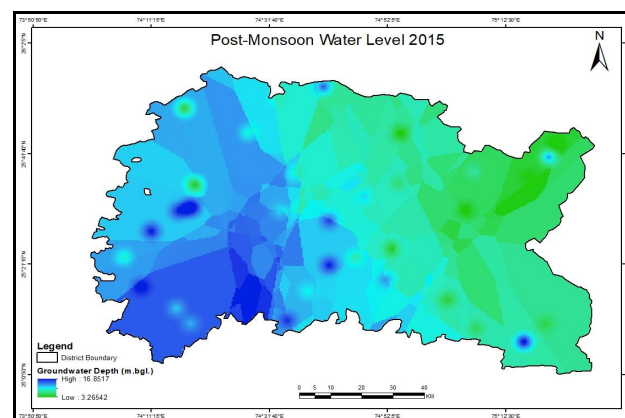


Fig.3 (r). Post-monsoon water level 2015

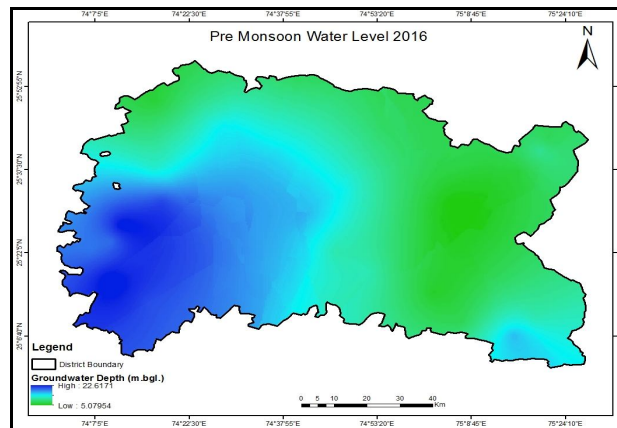


Fig.3 (s). Pre-monsoon water level 2016

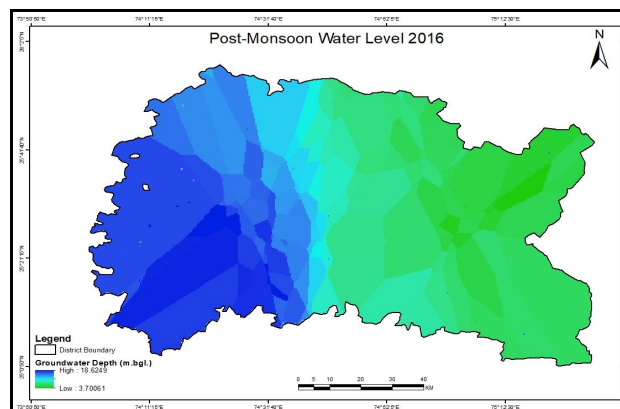


Fig.3 (t). Post-monsoon water level 2016

Figure 3(a) to 3(t): Ground water level for the year 2007 to 2016

Surface Generation (Ordinary Kriging) for Rainfall Data

Rainfall map has been generated using Kriging interpolation method of ArcGIS 10.4 for the year 2007 to 2016. Which is shown in figure 4(a) & 4(j) which depicts a continuous rainfall surface. Blue colour shows high rainfall whereas low rainfall is illustrated by shades of orange colour.

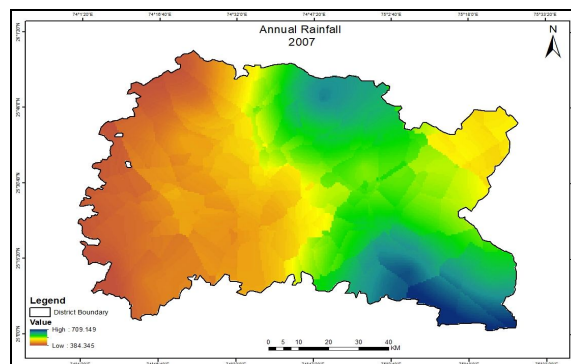


Fig.4 (a) Rainfall 2007

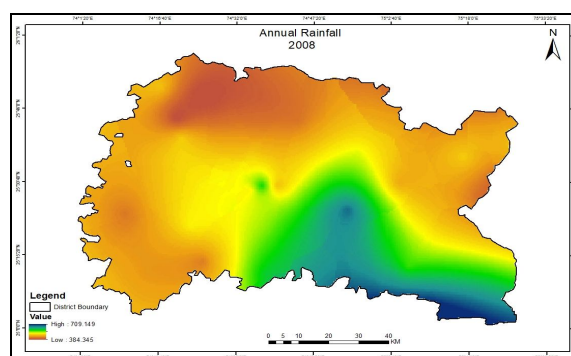


Fig.4 (b) Rainfall 2008

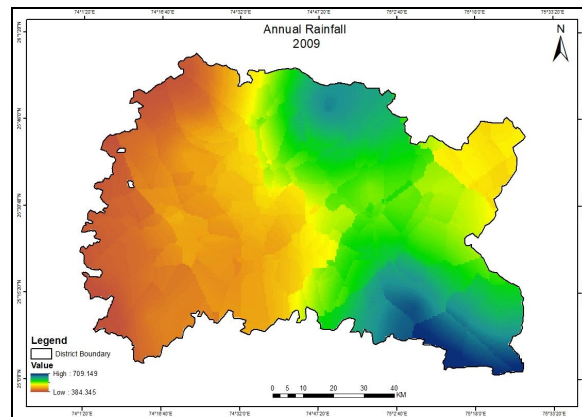


Fig.4 (c) Rainfall 2009

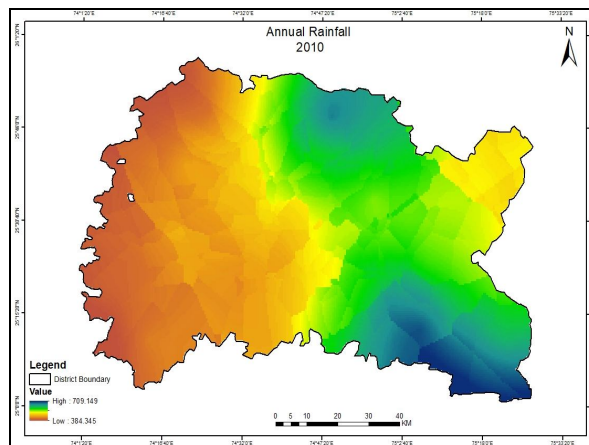


Fig.4 (d) Rainfall 2010

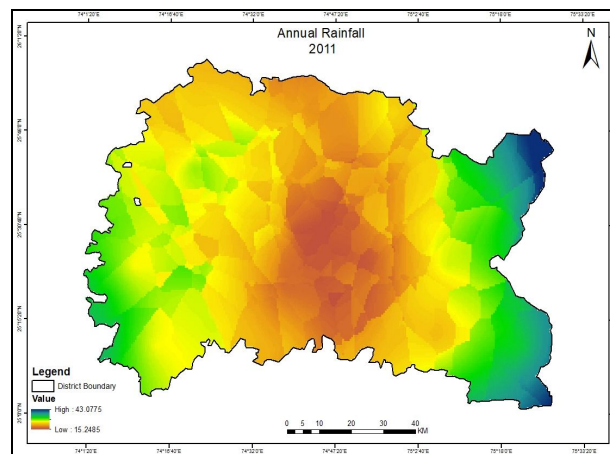


Fig.4 (e) Rainfall 2011

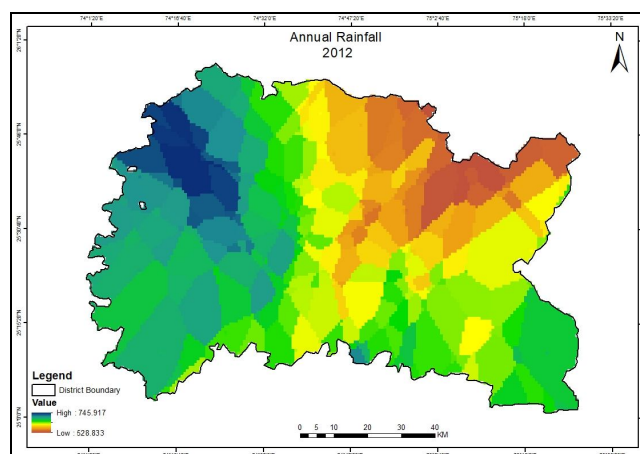


Fig.4 (f) Rainfall 2012

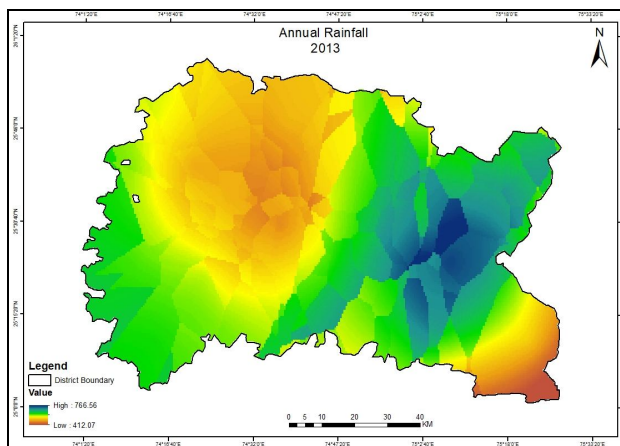


Fig.4 (g) Rainfall 2013

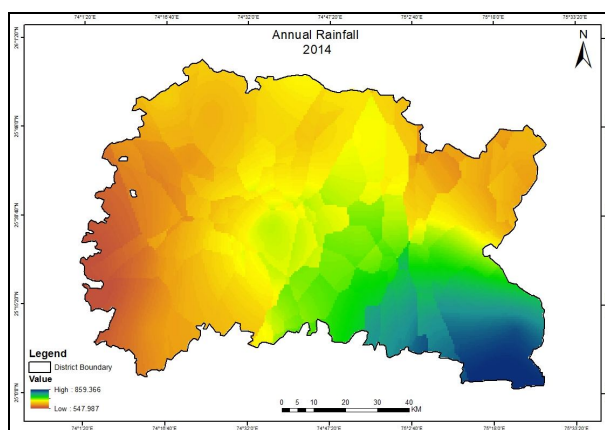


Fig.4 (h) Rainfall 2014

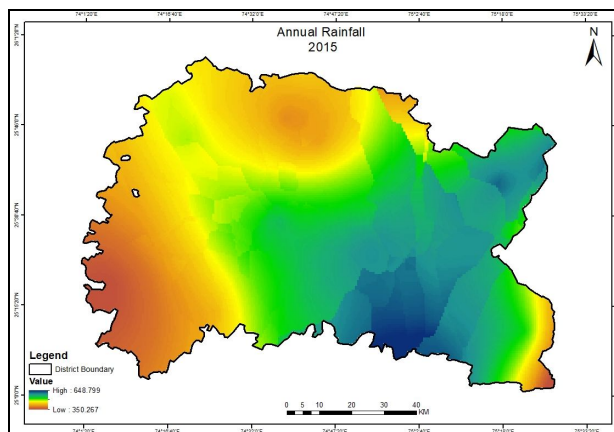


Fig.4 (i) Rainfall 2015

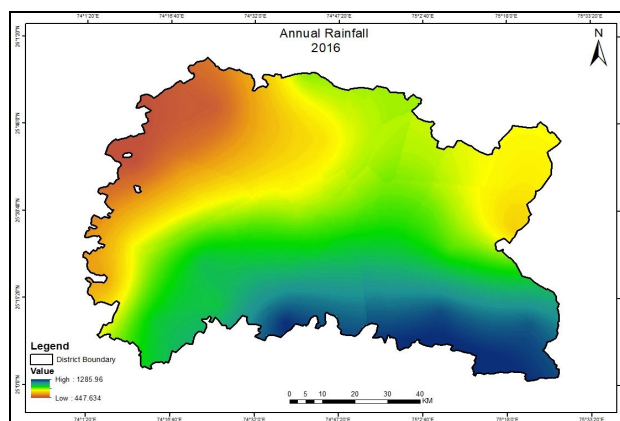


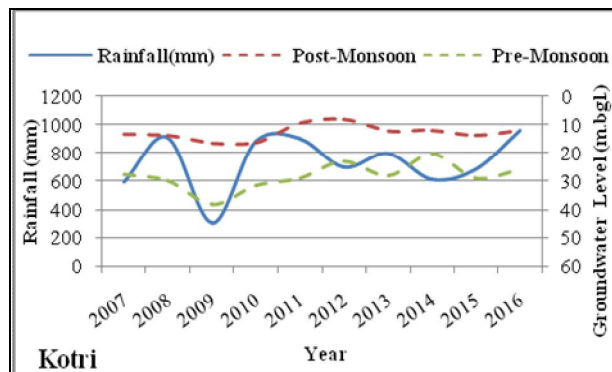
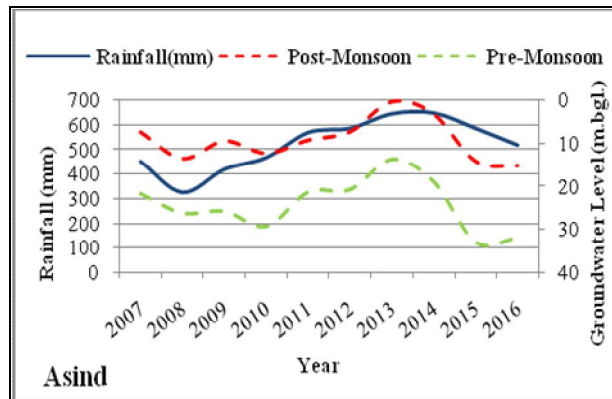
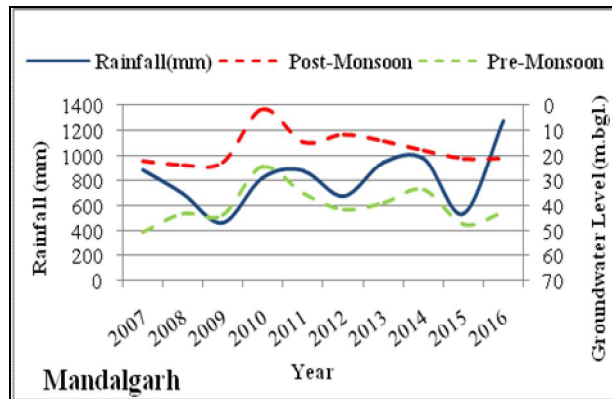
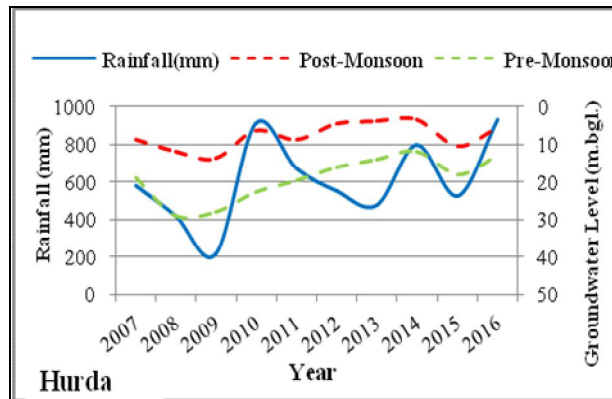
Fig.4 (j) Rainfall 2016

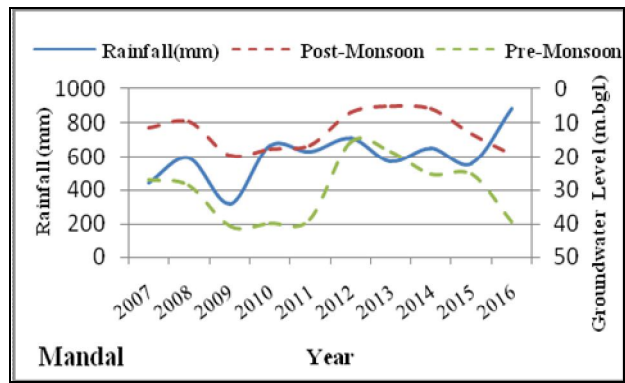
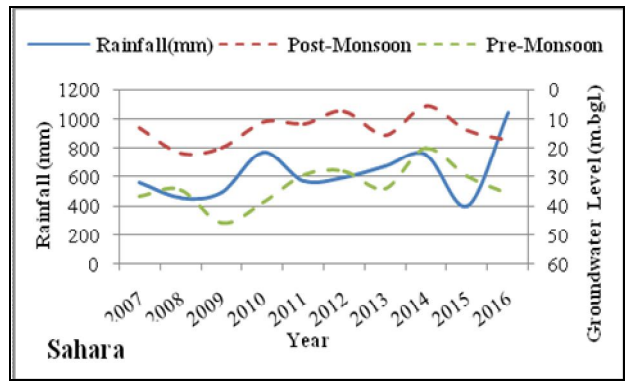
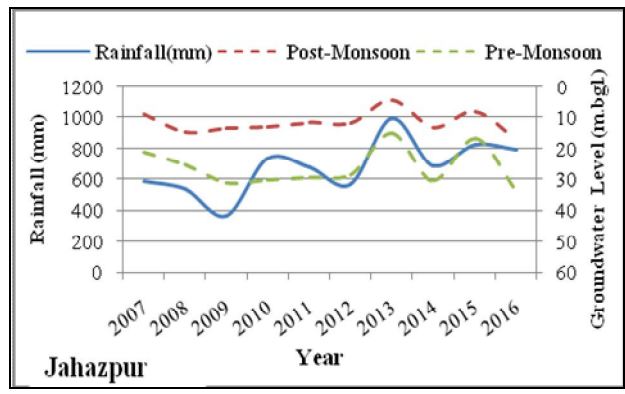
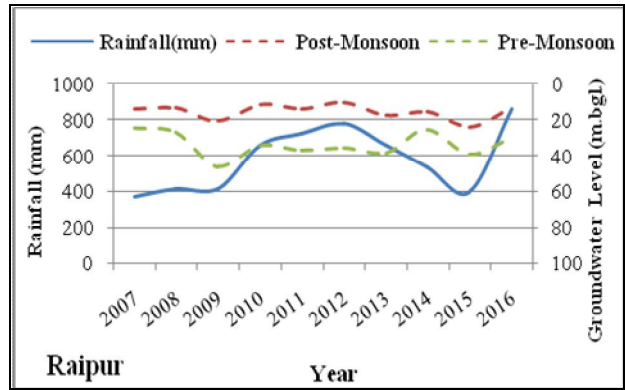
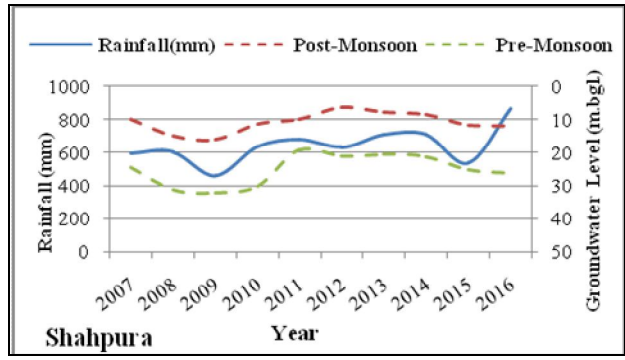
Fig 4(a) to 4(j): Geo-Statistical Models of Kriging interpolation technique for rainfall data.

RESULTS & DISCUSSION

Pre and post monsoon water level for the years 2007 to 2016 have been analyzed with the rainfall data of the study area to understand the variability of ground water level for last 10 year, water table fluctuation in pre and post monsoon, possible causes of low and high recharge zones and show the overall behavior of groundwater. Figure.5 shows the relation between rainfall, pre & Post monsoon ground water level according to geographical location of station.

Two groundwater level series were plotted on the same chart together with annual average rainfall. The relation of rainfall with groundwater level (Pre-monsoon and Post-monsoon) is interpreted here. It was observed that this rise is sustained at sufficient level till 2016.





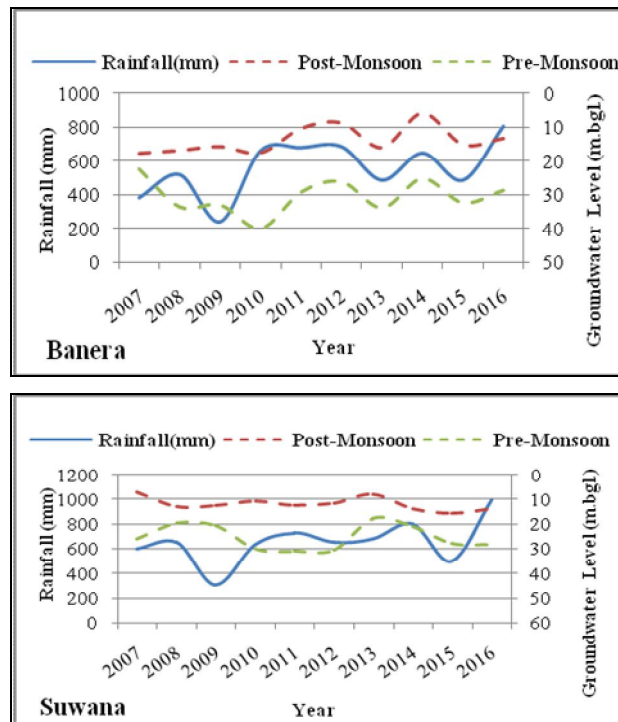


Fig.5. Relation between rainfall, pre & Post monsoon ground water level according to geographical location of station.

This study will give a fairly good idea about status, availability and distribution of surface and ground water throughout the year.

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REDUCTION OF PHYSICOCHEMICAL PROPERTIES OF DYE INDUSTRIAL WASTEWATER

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ABSTRACT

Environmental Pollution is becoming a threat around the world due to the release of hazardous substances and influence of contaminated water is a global issue. To protect the environment from the harmful effect of the waste generated, the ministry of Environment, Government of India has set standards for the wastewater and other wastes which are discharged into the environment. Almost all chemical industries release contaminated water, of which 17 - 20% is dye industries. In current scenario recycle is the best option than disposing. Water which is to be recycled or disposed must not contain colour as well as it must have its other physicochemical properties like pH, BOD, COD, TDS etc. in permissible limits. Untreated water of dye industries is highly coloured water due to the use of chemicals and different pigments in processes it has key parameters above specified standards. For recycle of this water, colour should be first removed and then its chemical and physical treatment is carried out to achieve parameters according to CPCB norms. In this paper we studied on the reduction of some of the key properties of dye industry waste water to the specified standards so it can be recycled to the industries. There are many methods available for colour removal from that one of method is decolourization which is achievable by one or combination of the methods like Adsorption, Filtration and Precipitation, Chemical degradation, Photo degradation and biodegradation. We used adsorption for the decolourization which is carried out by using Bentonite clay because it is easily available and its amount required for the treatment is less compared to other adsorbents. Bentonite adsorption and coagulation is employed for removing colour from synthetic dye waste water containing reactive red K \square 2G, K \square RN blue, K \square GN orange, KB \square 3G yellow. COD can be achieved in permissible limits using one or combination of the chemicals such as Activated charcoal, Bentonite clay, Ferric alum, Bleaching powder and Lime. We have used combination of above chemicals for different proportions to get better results which are shown in this paper. Advantage of using such composition is that we can also control the TDS and also good efficiency of about 55% reduction in TDS and 57% reduction in COD has been observed using the treatment we have used.

Keywords: Dye industries, Adsorption, Bentonite Clay, Ferric Alum, TDS and COD

1. INTRODUCTION

The major sources of water contamination are domestic, industrial, agricultural, thermal and radioactive waste (Gaur 1997). The industries which contribute to water pollution are pulp and paper industries, distilleries, oil refineries, pharmaceutical, textile, dyeing industry, dairy, acid pickling, power plant roller and flour mills etc. (Kudesia 1994). Effluents discharged from dyeing industries are highly coloured and toxic to aquatic life.[1] There are many parameters which are considered in determining the physicochemical properties of waste water which includes colour, odour, pH, temperature, Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), chloride and chromium (APHA 1989). There are many techniques for reduction of these properties which mainly involves Biological treatment, Catalytic oxidation, Membrane filtration, Sorption process, Coagulation, Flocculation, Ion exchange, Ozonisation, Physicochemical treatment etc.[2] There are many methods available for colour removal from that one of method is decolourization which is achievable by one or combination of the methods like Adsorption, Filtration and Precipitation, Chemical degradation, Photo degradation and biodegradation. pH can be controlled by addition of Calcium Carbonate and COD is controlled using one or combination of the chemicals such as Activated charcoal, Bentonite clay, Ferric alum, Bleaching powder and Lime. Advantage of using such composition is that TDS can also be controlled and also good efficiency is achievable.

2. EXPERIMENTATION**2.1 Materials**

For the present work, we used analytical grade chemicals such as Activated Charcoal, Ferrous Alum (NH₄Fe(SO₄)₂•12H₂O), Bentonite Clay, Bleaching powder (Ca(OCl)₂) and Lime (CaO) purchased from Desai Chemicals, Ahmedabad. All chemicals were used as received without any further purification. Dye wastewater was employed throughout the study which was obtained from Synthopharma Chemicals Ltd., GIDC Naroda.

2.2 Treatment Methods

Five different chemical treatment methods were carried out with vigorous mixing initially/after each operation.

Treatment 1: Effluent (100 mL) + Activated Charcoal (1 g)

Treatment 2: Effluent (100 mL) + Bleaching powder (1 g)

Treatment 3: Effluent (100 mL) + Lime (1 g)

Treatment 4: Effluent (100 mL) + Ferric alum (1 g)

Treatment 5: Effluent (100 mL) + Lime + Bentonite Clay (0.5 g) + Bleaching Powder + Activated Charcoal (0.5 g) (2 g total)

We took a sample of effluent and measured its physicochemical properties like pH, COD and TDS using pH meter, cod equipment and TDS Meter respectively. In first experiments, we have used activated charcoal for the treatment. We took 1g of activated charcoal in 100ml effluent and rigorous stirring was done. The mixture was then left for 24 hours. After this much time the properties of treated effluent was measured. Similarly, other treatments were done by taking bleaching powder, lime, ferric alum and mixture of lime, Bentonite clay, activated charcoal and bleaching powder respectively. For the final treatment, we increased the amount of Bentonite clay and Activated Charcoal which are good adsorbents of colour. All the experiments were carried out at room temperature.

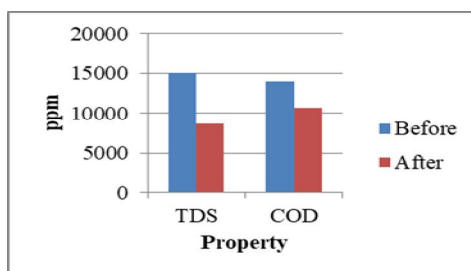
3. RESULT AND DISCUSSION

3.1. Effect of Activated Charcoal

By addition of activated charcoal it is seen that, there is very less percentage of reduction in pH whereas reduction in TDS and COD was observed about 42% and 23% respectively.

Table 1: Reduction of pH, TDS and COD by Activated Charcoal

Property	Before	After	% Reduction
pH	8.5	8	5.88
TDS	15000 ppm	8700 ppm	42.00
COD	14000 ppm	10740 ppm	23.29



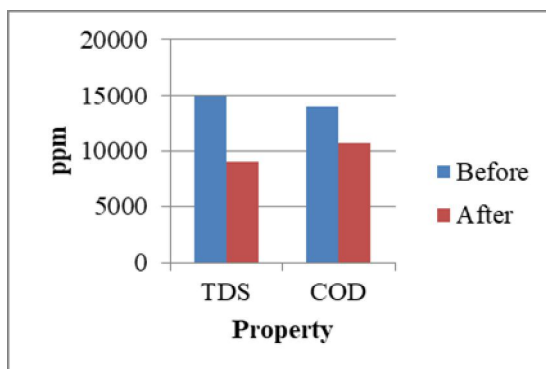
Graph-1: Comparison of initial and final TDS and COD by Activated Charcoal

3.2. Effect of Bleaching Powder

By addition of bleaching powder it is observed that there is negligible change in pH but reduction in TDS and COD was observed about 40% and 24% respectively.

Table-2: Reduction of pH, TDS and COD by Bleaching Powder

Property	Before	After	% Reduction
pH	8.5	8.4	1.18
TDS	15000 ppm	9000 ppm	40.00
COD	14000 ppm	10700 ppm	23.57



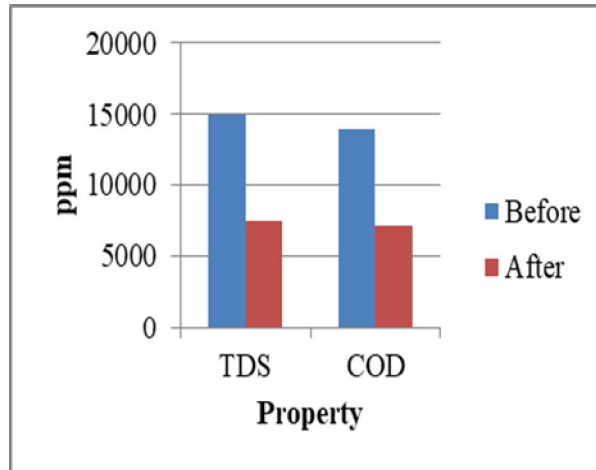
Graph-2: Comparison of initial and final TDS and COD by Bleaching Powder

3.3. Effect of Lime

By addition of lime it is observed that there is highest change in pH which is about 15% and reduction in TDS and COD was observed about 50% and 49% respectively.

Table-3: Reduction of pH, TDS and COD by Lime

Property	Before	After	% Reduction
pH	8.5	7.2	15.29
TDS	15000 ppm	7500 ppm	50.00
COD	14000 ppm	7200 ppm	48.57



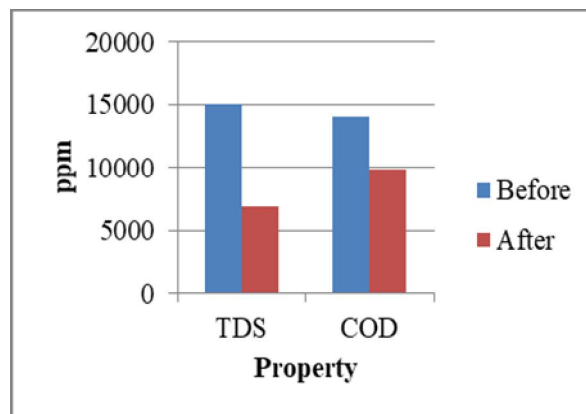
Graph-3: Comparison of initial and final TDS and COD by Lime

3.4. Effect of Ferric Alum

By addition of ferric alum it is observed that change in pH is nearly to 7.5 and about 54% reduction in TDS and 29% reduction in COD were observed respectively.

Table-4: Reduction of pH, TDS and COD by Ferric Alum

Property	Before	After	% Reduction
pH	8.5	7.4	12.94
TDS	15000 ppm	6900 ppm	54.00
COD	14000 ppm	9890 ppm	29.36



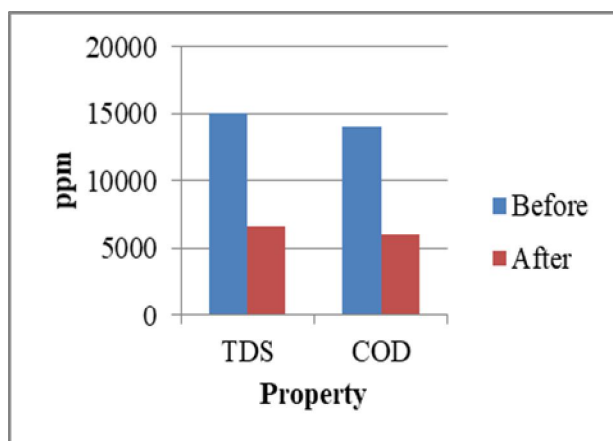
Graph-4: Comparison of initial and final TDS and COD by Ferric Alum

3.5. Effect of Lime + Bentonite Clay + Bleaching Powder + Activated Charcoal

When we added the mixture of all the chemicals we observed the maximum reduction in all the three parameters. In this method we have increased the amount of activated charcoal and Bentonite clay and because of that we obtained nearly colourless water.

Table-5: Reduction of pH, TDS and COD by Lime + Bentonite Clay + Bleaching Powder + Activated Charcoal

Property	Before	After	% Reduction
pH	8.5	7.31	14.00
TDS	15000 ppm	6700 ppm	55.33
COD	14000 ppm	6000 ppm	57.14



Graph-5: Comparison of initial and final TDS and COD by Lime + Bentonite Clay + Bleaching Powder + Activated Charcoal

4. CONCLUSION

The experimental studies approach succeeded in reduction of pH, TDS and COD using all treatments up to certain level but with the treatment no. 5, in which we have used the mixture of Lime, Bentonite Clay, Bleaching Powder and Activated Charcoal. The results indicated that reduction in COD was from 14000 ppm to 6000 ppm which was about 57% whereas reduction in TDS was from 15000 ppm to 6700 ppm which was about 55%. The pH was also observed nearly about 7.3 which is near to the neutral. Therefore, it can be concluded that treatment no. 5 is sufficient to reduce pH, TDS and COD.

5. ACKNOWLEDGEMENT

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ZERO LIQUID DISCHARGE – THE NEW AGE EFFLUENT TREATMENT TECHNOLOGY

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ABSTRACT

Industrialization over the past few decades has brought rapid development to many regions in the world today. This fact even though undeniable, has also had an adverse impact on several natural resources on Earth, particularly water. Rapid development of the industrial sector has constantly degraded the quality of water resources available in nature, especially freshwater resources. Freshwater sources account for just about 3% of the total water resources on Earth and there has been large scale scarcity of fresh water around the globe, posing a major threat to economic growth, water security, and ecosystem health. Industrial processes of the most polluting industries like Tanneries, Paper-pulp, Pharma, Dyeing, Chemicals, etc. generate wastewater with high TDS, salinity, and pH, thus have threatening the availability and value of freshwater resources. Industrial processes today reduce the availability of water for the environment or other processes since they require water as a raw material or an intermediate processing material. In addition to this these, industrial processes often contaminate nearby water resources by releasing effluents (Wastewater) that damages the local environment further, often severely polluting ground and surface waters. Since recovering and recycling of wastewater becoming a growing trend over the past two decades, several countries have begun investing in setting up Effluent Treatment Plants (ETPs) to treat the industrial wastewaters. Increased and unplanned disposal of effluents have led to heavy contamination of numerous important rivers. However, countries like India and Nigeria have experienced failed ETP projects, particularly due to improper management of funds and resources. To tackle this challenge, many governments are now aiming to push high-polluting industries towards Zero Liquid Discharge by creating regulations that require ZLD compliance.

Keywords: Water resources, Wastewater, Effluent treatment, Zero Liquid Discharge, ZLD

1. INTRODUCTION

Supplies of water are vital for agriculture, industry, recreation and human consumption. One problem that the water industry faces is disposal of concentrate from advanced water treatment processes. The public and industrial sectors consume substantial amounts of freshwater while producing vast quantities of wastewater. If inadequately treated, wastewater discharge into the aquatic environment causes severe pollution that adversely impacts aquatic ecosystems and public health. The most viable solution to this issue is recycling the wastewater generated as much as possible. Recovery and recycling of wastewater has become a growing trend due to rising water demand. It not only minimizes the volume and environmental risk of discharged wastewater, but also alleviates the pressure on ecosystems resulting from freshwater withdrawal.

Zero Liquid Discharge (ZLD) is the only option currently available in many inland regions where surface water, sewer, and deep well injection disposal are either prohibited or have caused damage to water and land resources, and effected biotic health. The strategy eliminates any liquid waste leaving the plant or facility boundary, with the majority of water being recovered for reuse. In this paper we will learn how a ZLD-system can produce a clean stream from industrial wastewater and make it suitable for reuse in the plant or can be further reduced to a solid. We will also understand the major advantages ZLD systems have over conventional ETP technologies.

2. WASTEWATER TREATMENT

Water having the highest dielectric constant is also called universal solvent because it can virtually dissolve everything in its intra-molecular space. During its passage through industrial processes (in manufacturing or utilities) it comes out as wastewater having large amounts of contamination mostly inorganic but also organic referred to as pollutants. This highly contaminated water when discharged into free flowing water bodies like lakes, rivers make the surface water polluted and unfit for human as well as plants and aquatic life.

From a typical water cycle, it is well known that the source of water is limited but consumption is increasing manifold due to increasing human lifespan and the corresponding industrialization. Over the years due to the selfish nature of human beings the industries continued to withdraw fresh water while simultaneously discharging and polluting the rivers, lakes, ponds etc.

2.1 Scenario in India

India has witnessed rapid industrialization over the past 30 years and several large scale industrial projects have generated effluents that contain either oils or grease or toxic materials (e.g., cyanide). Effluents from food and

beverage factories contain degradable organic pollutants. Since industrial wastewater contains a diversity of impurities and therefore specific treatment technology called **Effluent Treatment Plant (ETP)** is required.

The most polluting industrial sectors in India like chemicals, drugs, pharmaceutical, tannery, refineries, dairy, ready mix plants & textile, etc. have been relying on ETP to purify industrial wastewater for reuse and to release safe water to environment from the harmful effect caused by the effluent. The plant works at various levels and involves various physical, chemical, biological and membrane processes to treat wastewater from these industries. However, improper management of funds and resources has led to the failure of ETP facilities in India. ETPs in India are failing to meet the water discharge standards, thus leading to pollution of fresh water sources. This scenario is being further aggravated due to rising water scarcity in the country.

2.2 Rationale for Wastewater Reclamation and Reuse

Water reclamation is the treatment or processing of wastewater to make it reusable with definable treatment reliability and meeting water quality criteria. Water reuse is the use of treated wastewater for beneficial uses, such as agricultural irrigation and industrial boiling and cooling. In the recent light of public environmental awareness and pollution control regulations, water reclamation and reuse has assumed a more important and diversified role. The attractiveness of reuse results from several circumstances, one or more of which may be appropriate in any situation. Some of the rationale behind water reclamation and reuse are hereby highlighted below:

- Water reuse accomplishes zero liquid discharge (ZLD) mandates. Reclamation and reuse of wastewater for beneficial purposes eliminates potential pollution load to receiving water.
- Water reclamation optimizes conservation ethics. Legislative directives have asked for more wise use of resources. Extensive wastewater treatment requirements imposed for the maintenance of receiving water quality often results in the production of a product that is literally too good to throw away. This water may serve many purposes in a community.
- Water is a limited resource and where there is insufficient potable water of high quality, growth of a community may also be limited. Reclaimed water may be utilized for many of the purposes ordinarily served by the high-quality potable source, thereby permitting the high quality water to serve increasing populations.
- Reuse may result in significant economies. These economies can accrue from the postponement of the development of additional potable water supplies and/or from the lesser requirements for wastewater treatment for non-potable purposes than for discharge into fragile receiving waters. For example, the reclaimed water may be used as industrial boiler water which does not require a drinking water quality. Also, some of the nutrients in wastewater may not need to be removed at all where reuse is practiced for irrigation purpose as those nutrients have intrinsic values for agricultural plants.
- In coastal areas, recharging highly treated effluents into ground-water aquifers can provide a seawater intrusion barrier, restore depleted supplies, provide a consistent reliable source, and eliminate the need for a secondary distribution system.

3. ZERO LIQUID DISCHARGE (ZLD)

Zero Liquid Discharge (ZLD) as the name clearly indicates, is a modern engineering approach to conventional water treatment practices where the contaminants are reduced to solid waste and all water is recovered. ZLD technology is being popularly accepted due to its potential for recovering resources that are present in wastewater. Numerous global organizations have installed ZLD technologies for their waste in addition to ETPs because they can sell the solids that are produced or left over as residues after the ZLD treatment or reuse them further as a part of their industrial process. It ensures that the majority of the water is recovered for reuse.

3.1 Importance and scope in India

ZLD technologies help plants meet discharge and water reuse requirements, enabling businesses to meet stringent discharge regulations, treat and recover valuable products from waste streams and manage produced water better. Since ZLD recycles water on site, it considerably lowers water acquisition costs and risk due to fewer treatment needs. Industries are also able to improve environmental performance by meeting stringent environmental discharge standards. ZLD enables an industry to reuse wastewater as an additional resource that can be harnessed to achieve water sustainability, considerably obviating the risk of pollution associated with wastewater discharge into rivers, lakes, and streams.

India over the past few decades, has been taking aggressive actions to curb severe water pollution, even in the holy river Ganga. In the beginning, the government came out with **common effluent treatment plants (CETPs)**

to collect the polluted discharges from various industries at one point objectively to treat remove pollutants to an extent and then discharge the treated effluent into the rivers, lakes, ponds etc. Again this noble objective failed for two primary reasons:

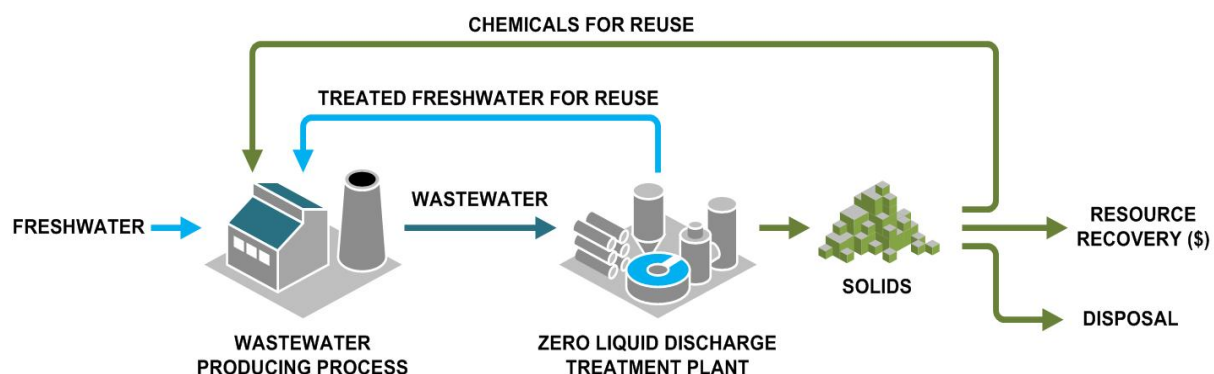
- Industries have passed the responsibility on to CETPs started sending out (discharging) severely contaminated water coupled with escalating flows.
- Administrative malfunction of CETPs management.

Finally, the apex body (related ministry/government department, pollution control boards, and equivalent body) foreseeing the future came down with a legal directive for each and every industry to install a ZLD scheme. The recent three-year target set by the Indian government, known as the “Clean Ganga” project, imposes stricter regulations on wastewater discharge to 9 State Pollution Control Boards of states along the Ganga basin and move high-polluting industries toward ZLD. The government had issued a draft policy in 2015 that requires all textile plants generating more than 25 m³ of wastewater effluent per day to install ZLD facilities.

4. PRINCIPLE AND WORKING OF ZLD

Early ZLD systems were based on stand-alone thermal processes, where wastewater was typically evaporated in a brine concentrator followed by a brine crystallizer or an evaporation pond. The condensed distillate water in ZLD systems is collected for reuse, while the produced solids are either sent to a landfill or recovered as valuable salt byproducts. Such systems, which have been in successful operation for 40 years and are still being built, require considerable energy and capital. Reverse osmosis (RO), a membrane-based technology widely applied in desalination, has been incorporated into ZLD systems to improve energy and cost efficiencies.

ZLD technology includes pre-treatment and evaporation of the industrial effluent until the dissolved solids precipitate as salts and residue. These salts are removed and dewatered. The water vapor from evaporation is condensed and returned to the process. It is the most “In demand” water treatment technology that can treat wastewater as the contaminants are concentrated.



In general, most of the ZLD systems in operation these days are based on stand-alone thermal processes, where wastewater was typically evaporated in a brine concentrator followed by a brine crystallizer or an evaporation pond. The condensed distillate water in ZLD systems is collected for reuse, while the produced solids are either sent to a landfill or recovered as valuable salt byproducts.

Normally the evaporation-crystallizing section receives the reject from a Reverse Osmosis (RO) section that concentrates dissolved solids. To prevent fouling during the reverse osmosis process, ultrafiltration is often used to eliminate suspended solids.

• Pretreatment and conditioning

Pretreatment is used to remove simple things from the wastewater stream that can be filtered or precipitated out, conditioning the water and reducing the suspended solids and materials that would otherwise scale and/or foul following treatment steps.

Typically this treatment block consists of some type of clarifier and/or a reactor to precipitate out metals, hardness, and silica. Sometimes this step requires the addition of caustic soda or lime to help with coagulation, a process where various chemicals are added to a reaction tank to remove the bulk suspended solids and other various contaminants. This process starts off with an assortment of mixing reactors, typically one or two reactors that add specific chemicals to take out all the finer particles in the water by combining them into heavier particles that settle out. The most widely used coagulants are aluminum-based such as alum and polyaluminum chloride.

Ultrafiltration (UF)

Ultrafiltration (UF) can also be used after the clarifiers instead of the gravity sand filter, or it can replace entire clarification process altogether. Membranes have become the newest technology for treatment, pumping water directly from the wastewater source through the UF (post-chlorination) and eliminating the entire clarifier/filtration train. Out of this process comes a liquid that is then filter-pressed into a solid, resulting in a solution much lower in suspended solids and without the ability to scale up concentration treatment.

• Phase-one concentration

Concentrating in the earlier stages of ZLD is usually done with membranes like reverse osmosis (RO), brine concentrators, or electro-dialysis.

Reverse Osmosis (RO)

The RO train will capture the majority of dissolved solids that flow through the process, but as mentioned in a prior article about common problems with ZLD, it's important to flow only pretreated water through the RO system, as allowing untreated water to go through the semipermeable membranes will foul them quickly. Brine concentrators, on the other hand, are also used to remove dissolved solid waste but they are usually able to handle brine with a much higher salt content than RO. They are pretty efficient for turning out a reduced-volume waste.

Electro-dialysis

Electro-dialysis can also be used in this part of the ZLD treatment system. It's a membrane process that uses positively or negatively charged ions to allow charged particles to flow through a semipermeable membrane and can be used in stages to concentrate the brine. It is often used in conjunction with RO to yield extremely high recovery rates.

• Evaporation/crystallization

After the concentration step is complete, the next step is generating a solid, which is done through thermal processes or evaporation, where you evaporate all the water off, collect it, and reuse it. Adding acid at this point will help to neutralize the solution so, when heating it, you can avoid scaling and harming the heat exchangers. De-aeration is often used at this phase to release dissolved oxygen, carbon dioxide, and other non-condensable gases.

The leftover waste then goes from an evaporator to a crystallizer, which continues to boil off all the water until all the impurities in the water crystallize and are filtered out as a solid.

• Recycled water distribution/solid waste treatment

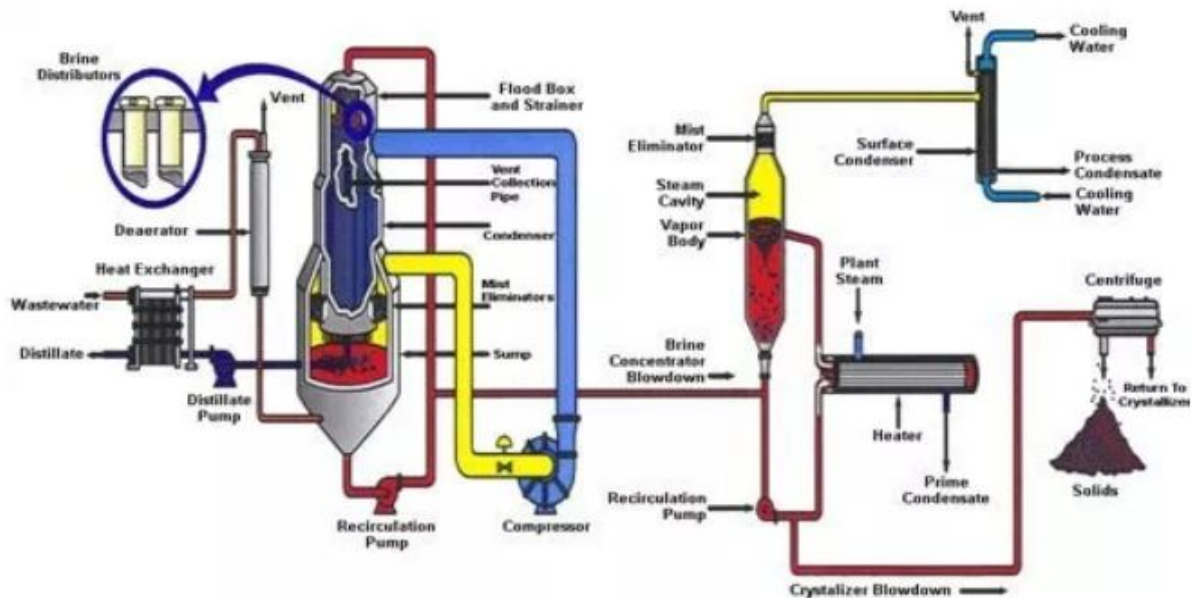
If the treated water is being reused in an industrial process, it's typically pumped into a holding tank where it can be used based on the demands of the facility. The ZLD treatment system should have purified the water enough to be reused safely in your process.

The solid waste, at this point, will enter a dewatering process that takes all the water out of the sludge with filter or belt presses, yielding a solid cake. The sludge is put onto the press and runs between two belts that squeeze the water out, and the sludge is then put into a big hopper that goes to either a landfill or a place that reuses it. The water from this process is also typically reused.

5. Important components

The most important part of ZLD is to reduce waste from source generation. For achieving this one has to go through in plant production process with influent characterization. On basis of characteristics and quantum of influent one can decide zero liquid discharge stages.

- The first part is in plant treatment or diversified usage of waste water.
- Second Part is segregation of unavoidable waste water depends on its strength.
- Third part is further sub classified in various stages
 - i. General Traditional ETP plant with efficient tertiary system
 - ii. Part of wastewater went through typical ZLD guzzlers and part typical ETP
 - iii. The whole waste water need to passes through typical ZLD guzzlers



The basic structure of a properly functioning ZLD system comprises of the following components:

- **Clarifier and/or Reactor** to precipitate out metals, hardness, and silica
- **Chemical feed** to help facilitate the precipitation, flocculation, or coagulation of any metals and suspended solids
- **Filter press** to concentrate secondary solid waste after the pre-treatment or alongside an evaporator
- **Ultrafiltration (UF)** to remove all the leftover trace amounts of suspended solids and prevent fouling, scaling, and/or corrosion down the line of treatment
- **Reverse Osmosis (RO)** to remove the bulk of dissolved solids from the water stream in the primary phases of concentration
- **Brine concentrators** to further concentrate the reject RO stream or reject from electro-dialysis to further reduce waste volume
- **Evaporator** for vaporizing access water in the final phases of waste concentration before crystallizer.
- **Crystallizer** to boil off any remaining liquid, leaving you with a dry, solid cake for disposal.

ZLD is a stage-wise scheme of gradually removing suspended impurities depending in size of-of particle using grate filters, sand filters, clarifiers, UF filters etc. removing COD , BOD & Color by chemicals, oxidation & settling, removing dissolved salts by multi-stage Reverse Osmosis units to its threshold and finally Evaporators and crystallizers to separate out all salts. Newer technologies called Forward Osmosis are being tried out for lower cost alternatives.

Cost and efficiency

ZLD systems are associated with high capital investments and even higher operating expenses. More than 90% of this operating cost is incurred during evaporation, which is a very energy intensive process. This is because, after various stages of filtration, chemical treatment, and separation of water from chemicals following Reverse Osmosis (RO), the RO Reject is first evaporated and then condensed to recover the water. In some cases however, this cost can be offset by the resource recovery i.e. salt and other chemicals which can be again reused in the process. For example, in textile industries, there is enough scope to recover salts and brine solution which can be reused in the manufacturing process and reduce the impact of treatment cost on the overall cost of production.

This mandate will drive water efficiency measures in the Indian industry. Lesser waste water means lesser treatment cost and thus improving water use efficiency will have significant benefits especially for industries like Sugar and pulp and paper industry, which have a considerably large water footprint.

Merits

Environmental experts consider ZLD to be beneficial to industrial and municipal organizations as well as the environment because no effluent, or discharge, is left over. ZLD systems are capable of purifying and recycling

virtually all of the wastewater produced and also converting wastewater from an industrial process to solids, sometimes recovering valuable resources. Targeting ZLD for an industrial process or facility holds a number of benefits like:

- Lowered waste volumes decrease the cost associated with waste management.
- Recycle water on site, lowering water acquisition costs and risk. Recycling on-site can also result in fewer treatment needs.
- Use of the most advanced wastewater treatment technologies to purify and recycle virtually all of the wastewater produced
- Some processes may recover valuable resources, for example, ammonium sulfate fertilizer or sodium chloride salt for ice melting.
- Reduces the wastewater discharge i.e. reduces water pollution
- Preferred option for industry where disposal of effluent is major bottleneck
- Separation of salts/residual solvents improve efficiency of ETP and CETP
- Reduction in water demand from the Industry frees up water for Agriculture and Domestic demands.
- Ease in getting environmental permissions
- Improved environmental performance and regulatory risk profile for future permitting.

CONCLUSION

The textile and tannery sectors in India generate the maximum amount of wastewater and have been facing a severe crunch from the government to install ZLD solutions along with conventional ETP systems as a mandate. As the severe consequences of water pollution are increasingly recognized and attract more public attention, stricter environmental regulations on wastewater discharge are expected, which will push more high-polluting industries toward ZLD. ZLD will effectively help reduce water demand from the industry and free up water for Agriculture and Domestic demands. Intensified freshwater scarcity, caused by both climate change and freshwater overexploitation, will likely facilitate ZLD implementation.

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ANALYTICAL STUDY OF CHALLENGES IN APPLICATION OF FINTECH IN BANKING SERVICES

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ABSTRACT

There has been a paradigm shift in the role no longer a financial service provider institution but now talking about customer delight...It's the time for the banks to understand the updated needs of the customer through the Artificial intelligence and big data analytics. issues like cyber security and hacking issues in the e banking transactions. Research studies observed that technology has become a tool that facilitates banks' organizational structures, business strategies, customer services and related functions. Digitalization changes face of branch banking and also it enhanced the scope of banking transactions

This paper aims to study the different types of challenges faced by the Banks in implementing the digitization in the Indian Banking Industry with the country's customer base and also understand the extent of usage of tech base services by customer and challenges faced by them. The research paper observed that key changes that banks need to make in their market approach should be focused in redesigning their process models, strategy to implement those ,developing expertise in predicting and analyzing signals of change in this disruptive environment, and becoming tactically focused on being operationally lean and agile in response to changing market and business scenario. As the findings of this research paper suggest that there are many challenges a new mindset is required in this direction. Really it will be big tough time for the traditional banks to completely transform in the current fintech based ecosystem. Banking sector has to make a lot of change in their ongoing approach for future banking of 2025.The choice banks have to make either to adopt with the fintech companies or partner with fintech companies ,while doing so bank has to keep in account the cost involved, business revenue model ,their culture and people ,cost of training ,availability of infrastructure and bandwidth to adopt that infrastructures, factor ,Scalability etc

Keywords: Digitization, Fintech, Technology, Customer, Banking Service

1. INTRODUCTION

There has been a paradigm shift in the role no longer a financial service provider institution but now talking about customer delight...It's the time for the banks to understand the updated needs of the customer through the Artificial intelligence and big data analytics

Today the technology has closely knitted with our lives. This has radically changed the way we live, work, and think. Digital has not restricted itself to a channel of banking it has emerged as banking. This huge involvement of technology is bringing the shift in banking industry from branch banking to digitization and banking services.

Legacy of traditional Banks have been disrupted with new specialized entrants and emerging business models which has erode the thin line between business and technology. Banking has moved from traditional banking services where the core task was it for lending and depositing the money and core efficiency was to creating value in Banking through growth and efficiency to the experience segmentation where a customer experience matter a lot and success and efficiency of bank lies in its ability to manifest opportunities out of the unsettling environment based on Technology and inorganic growth to create customer value will determine its success in the future. . Research studies observed that technology has become a tool that facilitates banks' organizational structures, business strategies, customer services and related functions. Digitalization changes face of branch banking and it enhanced the scope of banking transactions

Across the world, almost all banks are facing lot of challenges to find a technological solution to meet the challenges of a rapidly-changing environment.

2. OBJECTIVES OF THE RESEARCH PAPER

Digitalization demands new services new models and new approach but with this financial inclusion in mind, more and more focus on the development of small and medium enterprises how far it seems possible. The research paper aims at studying the approach of Banks and customer towards embedment of Fintech in banking sector.

In this innovative, customer centric business model, it is important to ensure regulatory compliance for effective execution of strategies in long term. The key challenge in this digital world is to ensure all customers are guarded from cybercrimes, and the most advanced cyber securities measures should be employed. The shift to digitalization will also improve the cost model and enhance the revenue of the banking industry. This will

reduce manpower and make the system automated. This paper aims to study the different types of challenges faced by the Banks in implementing the digitization in the Indian Banking Industry with the country's customer base and understand the extent of usage of tech base services by customer and challenges faced by them.

3. REVIEW OF LITERATURE

Vally & Divya (2018) has observed that transformation towards digital payments benefits in more transparency in transactions which empowers the country's economy. In recent days many changes took place in the payment system like digital wallets, UPI and BHIM apps for smooth shift to digital payments. They studied the positive impact that Digitization of payment system has bring tin the banking world. They have studied the positive impact which introduction of digital wallets, UPI and BHIM apps for smooth shift to digital payments.

David Varga (2017) research focused to bridge the gap in the current academic literature regarding the appearance of innovation-focused financial technology (fintech) companies. Their analysis provides a conceptual overview of the key value drivers behind fintech's, including the utilization of resource-based theories, business models, human-centered design and open innovation. They have identified the various key driver which are bringing the innovation in financial technology

Devulapalli & Oruganti (2017) The discussion throughout the paper revolves around the challenges that Indian banks are facing in term of e-banking, opportunity to increase awareness and measures adopted for safe and secure e-banking. The paper further tries to discuss some best e banking practices that are prevailing in the world and discuss the various challenges which the banks have to face in the midst of these opportunities. They discussed the issues like cyber security and hacking issues in the e banking transactions. They observed that technology has become a tool that facilitates banks' organizational structures, business strategies, customer services and related functions.

Nirala & Dr. Pandey (2017) The researcher in this paper identify the various drivers of Digital Banking Transformation, also studied the contribution of Indian banks towards Digital India, facilities provided by Indian banks to make India cashless, Key barriers of Digital payment and to identify the threat for Indian bank. They observed that technology has become a tool that facilitates banks' organizational structures, business strategies, customer services and related functions. Digitalization changes face of branch banking and also it enhanced the scope of banking transactions. They discussed the various challenges which are emerging in terms of Digital payment, cyber security etc.

Gomber Peter, et.al (2017) This article appraises the current state of research in digital finance and innovative business functions. In addition, it gives an outlook on possible future research directions. As a conceptual basis for reviewing this field, the Digital Finance Cube embraces three key dimensions of Digital Finance and FinTech, i.e., the respective business functions, the technologies and technological concepts applied as well as the institutions concerned. This conceptualization ropes researchers and practitioners when orientating in the areas of digital finance, allows for the arrangement of academic research relatively to each other, and enables for the revelation of the gaps in research.

Jarunee Wonglimpiyarat (2017) This paper intends to explore FinTech and its dynamic transitions in the banking industry. In particular, this study analyses the systemic innovation nature of FinTech-based innovations which today banking industry is utilizing at various level to provide better customer service and making their revenue model more robust. The relevant contribution of this research study is the development of systemic innovation model which can be used as a dynamic tool to track the progress and pattern of technology development and diffusion. It also discusses the latest financial innovation of Prompt Pay FinTech – the e-payment system in Thailand.

Christian Haddad & Lars Hornuf (2018) This paper investigates the economic and technological determinants inducing entrepreneurs to establish ventures with the reason of reinventing financial technology (fintech). It witnesses more fintech startup formations when the economy is well-developed and venture capital is readily available. Further, the number of secure Internet servers, mobile telephone subscriptions, and the available labor force has an optimistic impact on the development of this new market segment. In addendum, the more difficult it is for companies to access loans, the higher is the number of fintech startups in a country. Overall, the evidence suggests that fintech startup formation need not be left to chance, but active policies can influence the emergence of this new sector.

Giorgio Barba et.al(2018) This research paper examines the impact of Fintech on banks. Digital innovations and technology-based business models could provide new business opportunities for incumbents, by transforming how they create value and deliver products and services. Or they could disrupt the existing

structure of the financial industry, by blurring its boundaries and fostering strategic disintermediation. By providing new gateways for entrepreneurship, Fintech can ease the right of entry to financial services, fostering competition by new players. To survive, incumbent banks will have to react, face rising competitive pressure and adopt new strategies.

4. RESEARCH METHODOLOGY

4.1 To determine the current state of research pertaining to research topic we conducted an extensive literature review and to identify the challenges we collect the data through questionnaire and discussion with customers and banking employees. 120 Customers of 3 Pvt Banks & 10 Employees of 3 bank has been interview through structured questionnaire.

4.2 Limitation: This research is conducted with limited number of people and with limited geographic boundaries.

5. TRANSFORMATION IN THE OPERATING MODEL OF THE BANKS

The operating models of the bank needs restructuring or reshaping with lean channel and organization structures in place to allow for fast reprocessing. Decision and governance process need to be streamlined with a more upgraded culture or ecosystem which can support the customer experience. To meet the above an integrated IT infrastructure, need to be created and there is a need to train the manpower or talent base of the banks so that they can adopt the new model and new technologies in a better way.

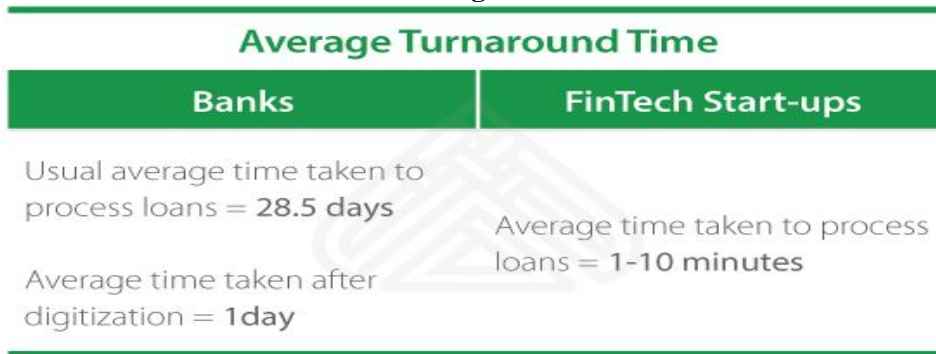
As per the experts that many Indian banks, like their Asian counterparts, are geared to use the advantage of local talent and leapfrogging technology to create forward looking digital strategies. there is a lot of space to cover on creating Omni-channel experience and enhancing processes from the customer's point of view. Customer Centricity has emerged as the new buzz word for the banking industry. Another expert believes the challenge for many banks is that they have a long - standing culture of branch- centric banking. They need to be proactive and reach out to the customer with answers through the digital channels from being branch centric to customer centric in their approach.

Some of the fintech trends that banks have implemented are given below -

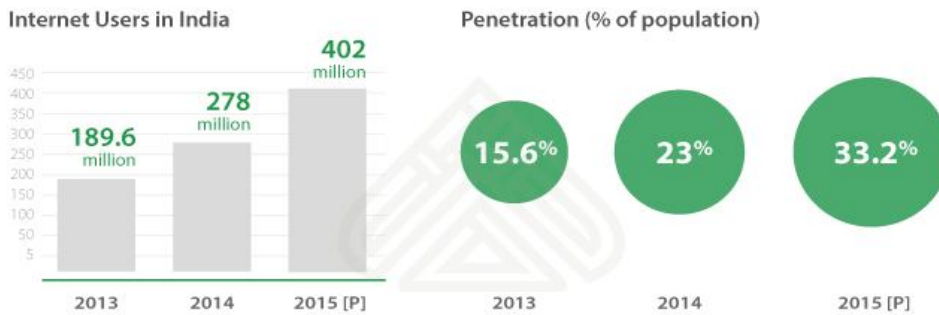
1. For effective customer interaction use of chatbots are adopted by several banks (like ICICI, HDFC). These chatbots are important interface between the customers and the banks resulted in savings of efforts and time.
2. With the help of machine learning banks are able to offer better service to customers without human intervention. With machine learnings large amount of data can be analyzed and can make predictions with accuracy and efficiency.
3. With the help of the block chain transactions can be recorded and validated by banks which does not require third party authorization. Today both commercial banks and central banks across globe are implementing new technology for issuance of digital currencies and processing of payments. This practice is going to facilitate the cross-border payments (Western Union or Swift). Banks are aiming at to implement Niti Aayog and to create India's largest blockchain network to address fraud and irregularities, to increase transparency,
4. In order to enhance the smoothness in the process workflows, banks, with the help of Artificial Intelligence, are able to identify bottlenecks in the operations in order to improve the process for better customer service. Today Every bank are using the Artificial Intelligence to know the customer behaviors which can be used to provide better services to the customers.
5. Banks with its launching pf apps has connected with its customer in a bigger way. With the touch of the button customers are well connected with all the offerings by the bank offered through the apps. Such personalized service becomes friendlier and customer centric approach towards services offered by the banks.
6. With the concept of Open banking payments, banking transactions are today more simplified and are being done in a very easy manner. Banks are becoming more open in future resulting in the smoother process of payment and other banking transactions. Banks have crossed the limits of branches and now accessible from everywhere. Virtual branches are the new emergence
7. With the help of Fintech companies, today banks are reaching out to customers (high net worth individual) with strong credit background but not using various basic banking facilities. Fintech are tapping those customers for providing them with basic training for the use basic online banking facilities and to get these customers into the mode of self service (Canara Bank played a very critical role in these respect). Various systemic innovation model which can be used as a dynamic tool to track the progress and pattern of technology development and diffusion

- 8. Today banks are extending their services not only to retail segment, but also robust services are offered to corporate banking and small and medium enterprises for better digitalized services which is one the major stable revenue segment for the banks.
- 9. Security measures are more strengthened in view of the threats to the banking sectors (hacking of the data). Preventive steps have been taken by banks in implementing various cyber security measures with encryption mode to curb hacking of the data.

Fig-1



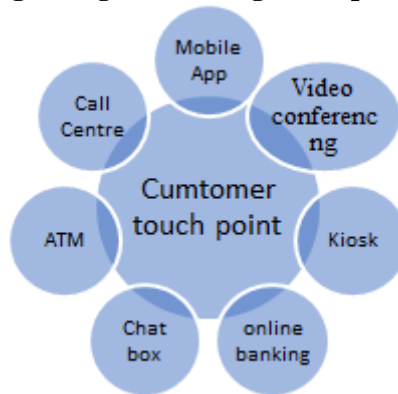
Graphic©Asia Briefing Ltd.



Source: Internet and Mobile Association of India (IAMAI)

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Fig-2: Digital Banking touch point



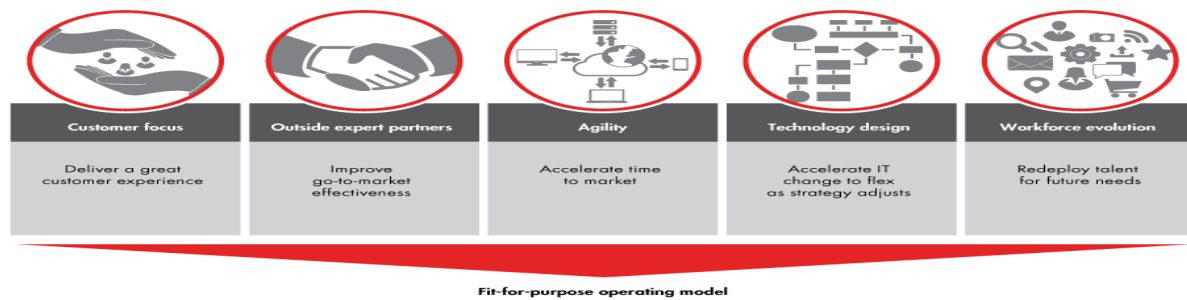
Source (Primary data and Review of Literature)

Fig-3: Enhanced presence of banks through different platforms
Changing model of banks



The way new emerging operating model will help the banks in different critical areas as per Bain and Company

Figure 3: An operating model for the future will address five critical areas



Source: Bain & Company

With favorable regulatory framework and evolving start up, India’s Fintech sector is growing exponentially. As per the NASSCOM reports, India has approximately 400 FinTech companies with an investment of around Rs. 2900 crores. This has been made possible because of the Government support and friendly regulatory framework. For example, Government of India has come out tax rebate scheme to entrepreneur for encouraging payments through digital channel (at least 50% of the payments). Again, with the introduction of India Post Payments Bank (IPPB), Government in on the verge of digital makeover of the financial sector in a big way. IPPB is also playing a pivot role in converting almost over 150000 post offices into bank branches to serve the customer in a bigger way.

HDFC banks, for example, always comes with innovative products to meet customer demand and bring new ideas for better customer service. Bank has come out with the concept ‘Bank aapki mutthi mein’ as part of the strategy for digital innovation. The bank is also holding Digital Innovation Summit to encourage creativity and innovation in Fintech segment to bring innovation in customer service. HDFC Bank has recently launched a robot known as "Humanoid" in their banking system. The robotic system will be deployed soon in various branches of the HDFC banks and these robots will act as an assistant to help the visiting customers in the branches.

With the demonetization move by the Govt of India of Rs. 500 and Rs. 1000 notes on November 8, 2016, Fintech industry got an impetus to move forward with e payments and e wallets system and there was a sudden spurt of 500% in terms of traffic in digital payments. Data revealed that that 1.7 Mn transactions were affected through e-wallet mode on the first month after the demonetization move. Approximately, 46% of the FinTech space are involved in the payment services business.

6. FINDINGS

A. Banker’s Experience

1. 87% of Banking Employees feel that fintech will add more Value based services in terms of customer experience and in ease of providing customer specific services to the customers. As this has become the need and fact that customer is wanting innovation in every service which can make it easy for them to choose the products and service as per their needs.
2. 67 % believes that simplification is the need for hour and 33 % feels that launching of new services and products is the need of the hour .Launching of new technologies and so many services and so many ways of accessing these services have made it very difficult for customer to select and access these products and service.so banker are feeling that along with launching of new innovation simplification should be the focus for the banks
3. 43% of respondents feel that application of the fintech and technology is in mature stage in terms of products and services. Launching of systemic innovation model can be used as a dynamic tool to track the progress and pattern of technology development and diffusion
4. 64% of respondent think that adding on feature will survive. Bank should focus on adding more customer centric features like banking products and services should be integrated on mobile banking and social media. Customer specific dashboard and other apps can be launched across different channels. Next Generation Core Banking Solution must be developed as a "mobile first" application while keeping in mind the security issues so in future these applications will be based on blockchain technologies.
5. Rank of Challenge which they feel in adopting to the Digital platform

Sr No	Particulars	Rank
1	Culture and people	1
2	Organizational structure and Governance	2
3	Technology Infrastructure	3
4	Cost of Implementation	4

Bankers are facing many challenges in the adoption of digital banking platforms .However they admit the fact that crossing these challenges will lead them to the new opportunities also .financial institution are moving at fast pace when it comes to the implementation of technology and adopting new process but they find it very much difficult for their own people to implement them because of different culture prevailing across the different branches of the same bank and even within one city it varies from branch to branch

The higher authorities in institution some times are under the impression that people are working the sector from last 20-25 years and they will adopt to the new technologies but it is one of the hard core fact that people belong to non-technological background and their finding it very difficult to turn up tot new technologies and also the induction providing to them for orienting toward the new technologies and for them it is also very difficult to change their long established habits and imbibing new skills in them with just some short span of training is very difficult for them.

Banks are under immense pressure respond to new compliance also while implement the latest technologies such as cyber security issues etc, transparency, integrity Again one of the biggest challenges which banks are feeling is the creation of their technological infrastructure. They have to keep in mind their revenue model as implementing the technical infrastructure cost

Lot of innovations I are coming in banking f fields such as mobile, the Internet, the cloud and security are supporting the way people work and how consumers interact with services at banks. The challenge is to make these innovations available to the customers without impacting the business models or incurring significant investment on the part of the Banking sectors .In this competitive edge the banks have to make huge investment in their information technology infrastructure while addressing to the issue like security threats Cyber rules ,transparency ,RBI and other governing bodies guidelines .Banks need to work completely upon their architecture which should support its business model and new key process .Banks for maintaining its revenue model has to work on both aspects on one side the issue is to make technological investments to launch new innovation and process improvisation and on other side bank has to make the cost under control so that revenue should not be eroded.

6. Pros and Cons of Adopting fintech in every domain of Banking sector

Pros of Adopting Fintech	Cons of Adopting Fintech
1.Better Customer Experience (Convenience) 2.Value Based services 3.simplification of services	Lack of IT infrastructure Lack of trained Manpower Pricing and Revenue Model Culture and people

Over the past decade banking institution have given their best to adopt the fintech in every key process and launching innovation on different frontier and even for many baking banks removing the complexities of old process and adopting to new technologies will lead to improvise the customer experience which in turn will give them more customer and better business growth. So the major benefits which the customer will get from the implementation of new technologies are better customer experience in terms of ease of accessibility, simplification of process and different kind of value based survived There is complete evolution in customer expectation ,regulatory requirements ,technological infrastructure ,new category of completion that all is going to bring complete change in landscape of banking industry .The Launch of digital India campaign made by the government has given a clear objective to all the baking institution to provide benefits to all customers by improving online infrastructure and better accessibility .Here the partnership between banks and fintech companies will create win win model for both the banks and fintech companies.

Banking sector has to make a lot of change in their ongoing approach for future banking of 2025.The choice banks have to make either to adopt with the fintech companies or partner with fintech companies ,while doing so bank has to keep in account the cost involved, business revenue model ,their culture and people ,cost of training ,availability of infrastructure and bandwidth to adopt that infrastructures, factor ,Scalability etc.

The entry of new banks only makes this process more complex. Today both banks and fintech players must engage as equal partners in each other’s growth and the nature partnership have also changed a lot. It is no longer mere vendor and customer relationship but more sort customer and vendor relationship.

Along the biggest challenge is these with how much uniformity this can be implanted across the banking sector. If we see due to the prevailing cultural difference across the country even for a single bank to launch the same system and process in its different branches is very much difficult.

B. Customer Experience

1. Customer Experience about Digital Banking services

Particulars	Respondents %
Mobile banking app	56%
Internet banking	48%
Online banking Portal	50%

Digital platforms have emerged as most preferred platform among the customer but still there is a huge gap to bridge because this experience is not uniform across the all segment of the customers.

Customer centricity has emerged as a buzz word in the banking industry. While analyzing the customer experience it has been observed that Mobile banking is the platform which the customer is using the maximum because of the ease and availability of mobiles. Still in India the computer is not available everywhere and accessibility is not so comfortable as compared to app.

Customers are using the mobile banking app for fund transfer, checking their balance and payment of their services

2. Purpose which they Have used technology In Banking Service

Sr No	Question	Response
1	Transferring fund anywhere in any bank account through NEFT, IMPS, RTGS	54%
2	Payment of bills	75%
3	Recharging DTH, and Data card bills etc.	52%
4	Recharging of Mobiles	53%
5	Utilization for debit and Credit card payments	75%
6	Request for blocking of cards	24%
7	Ticket booking	52%
8	Bank Balance enquiry	76%
9	Recurring Deposit and Fixed Deposit booking	24%
10	Request for New card and cheque book	42%

Services for which digital banking platform has been used more by the customers	Services based on digital platforms which have been very less utilized by the customers
Payment of utility bills, mobile bills	Transferring fund anywhere in any bank account through NEFT, IMPS, RTGS
Credit and debit card payments	DTH, and Data card bills etc.
Account balance enquiry	Recharging of DTH, mobiles etc
	blocking of these cards in case of loss or theft
	Ticket booking
	Recurring Deposit and Fixed Deposit booking
	Cheque book request

3. Challenge they faced using Digital banking

Sr No	Challenge	Response
1	Lack of Awareness	42%
2	Trust	48%
3	Find it complicated	24%

Important risks posed to the Indian banks by the fintech companies

Today banks are focusing on various avenues to reduce cost and in order to reduce complexities in operations, they are relying on the services of the fintech companies (relying heavily on outsourcing services). Usage of IT platforms are extensive in order to render better customer service, apps and new products involving wide range of data and services.

Banking sector relying on such outsourcing activities offered by the fintech companies are exposed to various security issues including internal control and governance. Thus, addressing risk management mechanism of identifying the mitigating of the critical risks impacting banking operations. Major areas of the risk with such outsourcing activities are payment, clearing and settlement. Banks should devise a strategy to address such risk before they enter into arrangement with fintech companies

Highlights of major risks –

Banks are facing risk of profitability because customers today are finding various schemes and alternatives available at various banks. This has impacted the banking sector due to fintech is providing the plethora of services in a scattered form. Lots of alternatives are available with customers with respect to various products of the banks for almost any banking service: saving, deposit. Personal and commercial loans, electronic transfer of money and so on. This has put pressure on the banks to meet profitability target — new players are able to introduce new and updated technology to deliver the service so as to meet customer expectations and their demand. For example, banks are offering various schemes to switch from saving accounts to FD or investment in mutual funds to provide lucrative return to the customers in short run. As a result, saving in to the banks accounts are mobilized for short term return to the customers.

Second most important risks banks are facing is the risk of outsourcing. These risks are generated outside the periphery of their operations since most of the activities are outsourced to the call centers or back office operations. It becomes very difficult for the banks to monitor the activities carried out at such outsourced centers and thus exposing themselves to various risks (including reputation risks). Control assurance functions need to be strengthened with risk management mechanism to identify and mitigate the risks.

Operational risk is another concern of the banks since there are interdependencies of the banks with other players like banks, fintech etc. This could lead to IT risk exposure of the banks and may create bottleneck in rendering services to the customers when such services are disrupted at other end.

Cloud sourcing' is one of the risk areas where banks share important resources software packages and analytics) in a cost-effective manner. This increases risks of the banks towards cybercrime, data security etc.

7. CONCLUSION: WHAT NEXT..... THE ROAD AHEAD

In one of the surveys conducted all global level India, ranked second in fintech industry with as many as 1218 FinTech firms operating in India thereby opening up job opportunities and creating attraction for investment. India is geared for cash less economy and the pace of technology is shaping up the digital transaction which is no longer is the monopoly of the bank. Non – banking entities are partnering with various banks to offer wide range of services to meet the customer demand. The support from the Government also serving as a boost for the digital economy.

New Technology platform like Aadhar enabled payment system is giving a new look to the retail payment system and has witnessed witnessed about nine-fold increase over the last five years.

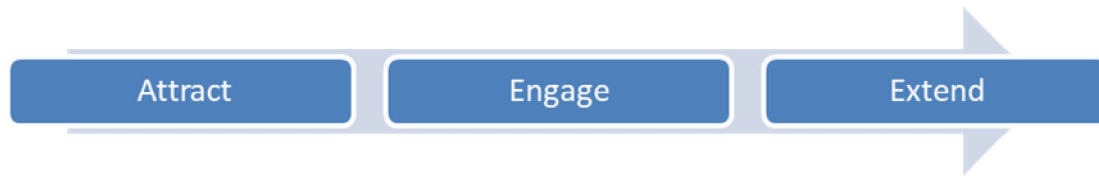
To foster financial inclusion numerous initiatives has been taken by RBI to foster growth in the financial services and banking sector.

The biggest challenge is the to have a more stringent regulatory framework for the growing fintech companies and to integrate the traditional banking system with the everchanging technology driven platform for them to compete in market with other banks. To mix the two models is a bigger challenge so as not affect the customer service. Over a few decades Banks have built the trust through customer relationships and FinTech startups have just started few years back and they need to be more patient to gain the trust of the customer over the period. Hence partnership between themselves will help to retain their customers. They should come together rather than competing with each other in order to provide effective customer service.

In the coming future banks will become more digital transparency ,25 hours availability and convenience will change the traditional banking players into the innovative fintech players. As the findings of this research paper suggest that there are many challenges a new mindset is required in this direction. Really it will be big tough time for the traditional banks to completely transform in the current fintech based ecosystem.

The identified prime applications that the customers prefer in digital banking are: 1. Transferring fund anywhere in any bank account through NEFT, IMPS, RTGS. 2. Payment of utility bills, mobile bills, DTH, and Data card bills etc. 3. Recharging of DTH, mobiles etc. 5. Credit and debit card payments as well as blocking of these cards in case of loss or theft. 6. Ticket booking 7. Account balance enquiry 8. Recurring Deposit and Fixed Deposit booking 9. Cheque book request Customers' motivation to adopt digital banking:

The need of in the banking sectors is



Prioritize making core functionality as useful, useable and understandable as possible and identify opportunities to provide advanced functionality as “enablers” that make consumers' daily financial transactions easier, faster and better Extend the experience and integrate tools and services that offer timely and relevant advice and assist customers with day-to-day financial tasks as a critical “next step” in the creation of an engaging and seamless multichannel financial hub that will become an integral part of customers' lives.

Changing dimension of competition, changing customer experience, changing technological advancements are impacting the banking industry in multifold ways than ever before. Artificial intelligence, digital transformation is providing organization access to new customer bases and route to approach new customer in many ways. Banks are now understanding the customer behaviors in better way through artificial intelligence so that they design new and innovative products for their customers which can suit their specific needs.

Banks are using technology in and out to design new products and services. This has changed the operating and process models of the bank. E branches and virtual branches will be emerging future of the banks. today banks are engaging their customers through omni channel touch points. Artificial intelligence, robot advisors, chat box, virtual banks will be the emerging reality and in this even the difference between traditional banks and modern banks have blurred a lot.

Innovation in technology is going to transform the banks and their process in drastic way. With the more and more implementation of Blockchain technology more and more transparency will be there, and integrity will come in all the transactions.

Digital disruption is all-pervasive in the present-day banking industry. The better the banks will become innovator in multifold ways the more opportunities will be there. They will be able to have a competitive advantage in terms of their products and services as said by Poornima Vasudev speed, agility and transparency has become the need for the hour. make it faster, make it agile, make it transparent.

But over and above banks have to keep in mind that in all his transformation customer should be the centrality of this digital transformation journey

Technologies like big data analytics and Artificial intelligence Big data analytics can help extend a single view to the consumer. Companies can use data from social media sites to understand their customers better. In addition to this, data available from pervious online searches and purchases can help target the right individual. key changes that banks need to make in their go-to market approach, starting with shortening their strategy cycles to months instead of years, getting better at reading signals of change in this disruptive environment, and becoming tactically focused on being operationally lean and agile in response to market condition

Initiatives by RBI

Initiatives by the RBI have focused on fostering financial inclusion. This has encouraged competition and innovation in India's growing fintech sector. The initiatives has considered both online and offline solutions to emerge and has created a safer financial system in both urban and rural areas.

Reserve Bank of India: The RBI has so far initiated the Unified Payments Interface and the Bharat Bill Payments System, P2P lending, as well as digital payments, and the use of automated algorithms to offer financial advice. RBI has granted licenses to 11 fintech entities to establish payment banks that provide savings, remittance and deposit, services.

Government Schemes: Government-led initiatives such as Digital India program, Jan Dhan Yojana, and National Payments Council of India (NPCI) have provided important enabling platforms for technology

innovators. Other initiatives include removal of surcharges on electronic transactions, tax benefits for consumers and businesses using e-payments, and changes in authentication requirements are other examples of the government's efforts to encourage the growth of a fintech ecosystem in India.

Fintech Startup Sector: This is probably the greatest empowering incentive towards the expansion of fintech ventures in India. An encouraging regulatory environment has enabled the launching of more than 125 fintech startups in 2018 alone. As mentioned earlier, several national and international banks and investment groups are also investing in India's fintech startups and funding fintech solutions.

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HARMONY IN MULTICULTURAL ENVIRONMENTS: PROBLEMS AND SOLUTIONS

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ABSTRACT

Technological advances in communication, travel and transportation have made business increasingly global. This has drastically increased cross cultural communication for people at all levels of the organization. It throws certain challenges at employees and makes it imperative for them to understand the cultural nuances to work harmoniously in the organization; creating a more comfortable and productive work place. People living in different countries have developed not only different ways to interpret events; they have different habits, values and ways of relating to one another. These differences pose as primary source of problem when people of different cultures try to communicate. The differences in our frames of reference make the task of communication a tedious one. The two problem areas around which this cross-cultural examination is organized include the problem of English as a second language for Indians and gaping cultural differences in perceptions of ways of behaving. However, the paper also investigates the problem of sub-cultures, for a diverse country like India doesn't comprise a singular monolithic cultural block with values and practices applicable to people of all sub-sects of a given culture. The study aims at understanding some of the principles, problems and implications of intercultural communication.

Keywords: Culture, Communication, Language, Perceptions, Behaviour.

In today's technology enabled world, the need for dexterity in intercultural communication and its importance doesn't require spelling out. In a rapidly shrinking world where people interact in cross-cultural environs on a daily basis, it becomes imperative to have an understanding of intercultural communication and sensitivity towards it. Precious time is lost in resolving problems arising due to cultural differences and many a time important deals go bust for little misunderstandings. For increased productivity, it then becomes imperative to minimize such problems as may arise due to cultural differences. A more homogeneous work place shall be a more harmonious one and better prepared to achieve organizational goals.

The task however, is not a simple one for culture is a much contested term. In fact, according to Raymond Williams, "Culture is one of the two or three most complicated words in the English language" (Storey, 2). Many attempts have been made to define culture but the definition derived from Anthropology shall help us put the concept into perspective: Culture is "a way of life of a group of people ...the stereotyped patterns of learning behaviour, which are handed down from one generation to the next through means of language and imitation" (Quoted in Lesikar & Flatley, 454). People living in different countries have developed not only different ways to interpret events; they have different habits, values and ways of relating to one another. These differences pose as a major source of problem when people of different cultures try to communicate. For effective intercultural communication it's important to understand the influence of culture in shaping one's identity as well as of those with whom we wish to communicate. But the problem remains, for it's more difficult to understand the impact of culture on one's own values, attitudes, and behaviour than to recognize the same in others. The complexity however, runs deeper than this. Most diverse countries like India or for that matter any large segment of people do not comprise a singular monolithic cultural block. Within one culture, there are multiple sub-cultures present which too are in a constant state of change/evolution. Many writers view culture as a hierarchy, with a national-level dominant macro culture as an umbrella over many subcultures or co cultures (Chaney & Martin 2007). Even within a sub-culture the townspeople differ from country dwellers, the rich differ from the poor, and the educated differ from the uneducated (Lesikar, 454). Some thinkers go to the extent of classifying culture into categories like Meta-culture, meso-culture, macro- culture, global culture and many more. (Ralf W Wilhelms, Mohammed K Shaki, Cheng-Fu Hsiao). Clearly the concept of culture is a highly complex one and requires mapping.

MAPPING CULTURE

Culture, as we have seen, is an all pervasive entity. It manifests in everything from our way of thinking and believing to our mannerisms and behaviour. The anthropologist Edward Hall (1959) described culture as an unseen but powerful force that holds everyone captive: "Culture is not an exotic notion studied by a group of anthropologists in the South Seas. It is a mould in which we all are cast, and it controls our lives in many unsuspected ways" (quoted by Jameson, 199). Communicating across cultural boundaries is a Herculean task almost equivalent to communicating across species. If we lack a commonality of 'code of understanding' it will become impossible to achieve any degree of intelligibility while communicating with people from different

cultures. Various researchers at different times have discussed multiple variables of culture that affect communication for instance language, time, space, perceptions, non-verbal cues, behaviour etc. For the purpose of the present study I have categorized all such variables into three broad classes. The next section looks at these 'variables' of intercultural communication moving from the more concrete problem of language to the more abstract manifestations of behaviour and cognitive processes. In closing, I propose ways to bridge the chasm of culture giving suggestions which can further be taken up for empirical research.

LANGUAGE AS A VEHICLE OF CULTURE

Language is bound by and steeped in culture. Sapir-Whorf hypothesis states that, 'the world is perceived differently by members of communities and this perception is transmitted and sustained by language.' Benjamin Lee Whorf (1956), whose work was shaped by that of the great linguist Edwin Sapir, regards language as the primary vehicle of culture. In short, the language we speak influences our experience of the world, while the evolution of language also reflects changes in the predominant modes of expression. (Tubbs and Moss, 86). The problem of understanding arises not always and necessarily because of a failure to understand grammar or vocabulary but because of a failure to understand rhetoric or point of view. In language usage, words often shape perceptions and self-concepts.

The nature of language is inherently symbolic. The words (symbols) and referents (objects in real world) are associated with each other only by convention. This makes it difficult for people to attain efficacy in communicating in a foreign or second language. Many a time, it's difficult to translate thoughts into another language for the want on an exact counterpart in the target language because languages carry with them a certain cultural baggage, that can't be explained in another language. The problem is equally relevant for second language users. English, which has nearly attained the status of the official business language (*lingua franca*) of the world, too has so many varieties and dialects that mastering it with any proficiency as an L2 is an uphill task. Language, over a period of time, comes to be enrobed in distinctly cultural expressions. Many clichés, slang expressions and euphemisms are distinctly cultural in nature, and so are the paralinguistic features which are a *sine qua non* of speech. Let's take an example; certain languages like Hindi have different second person pronouns used variously to show respect or politeness e.g. 'tu' 'tum' and 'aap'. English, on the other hand has just one - you. Also, in certain cultures this distinction is not always followed to address people, 'tu' is used to address people of all age groups. If such differentiation is used across cultures, people might take offence on otherwise an expression of endearment. In Portuguese, for instance, the expression for 'thank you' is dependent upon the gender of the speaker: women say *obrigada* whereas men say *obrigado*. An exchange in the usage may be humorous for the listener and embarrassing for the novice speaker. Therefore language can be both a unifying and a divisive agent of culture. Language is an expression of culture and people often use it as a tool for bonding and establishing kinship even at work. This aggravates the problem of attaining harmony; for in this form, language can be divisive in nature, acting as an agent for catalyzing formation of cliques and groups and limiting interaction among employees of different ethnic backgrounds.

BEHAVIOUR AS EXPRESSION OF CULTURE

Culture is learnt behaviour. Most nuances of behaviour are unwittingly picked-up as a part of learning and growing up. The etiquette, styles and mannerisms and all our non-verbal behaviour are imbibed than learnt. These ways of behaving are profoundly cultural in nature and are generally a greater source of misunderstandings than any other. Non-verbal communication systems vary from culture to culture just as verbal systems do, but often we overlook the symbolic nature of nonverbal communication (Tubbs and Moss, 323). Such lapses in usage of gestures, postures and usage and space and time can lead to serious *faux pas*. For instance, the usual way of greeting for Indians is saying *Namastey* and simultaneously folding hands together. For such people being greeted with a hug and a peck on the cheek can be scandalous and embarrassing. Similarly in many cultures the way of dressing, greeting and behaving with members of the opposite sex vary to show respect and if such manners are not followed, it may be considered disrespectful. For people who work together, understanding each other's expectations and behaving accordingly is a must to maintain work-place harmony and cordiality. Over-stepping the line can be seen as a serious breach of conduct. Most non-verbal cues are often interpreted unconsciously; therefore there are greater chances of giving offence. A fascinating aspect of intercultural communication studies is the distinction between high- and low-context cultures (Hall, 1976). Members of high-context cultures lay greater emphasis on non-verbal cues than words and are better at reading them too. For instance, Indians may seem overly animated to Americans in terms of their usage of gestures and facial expressions. Another dimension along which cultures/behaviours vary is the power-distance. In 1980, Geert Hofstede introduced a national cultural framework based on data collected in two survey rounds between 1967 and 1973 and developed a set of dimensions to characterize the concept of national culture. Power-distance Index and Collectivity are two key dimensions along which cultures differ. Cultures with high-

power distance like India consider that certain members in the society are more powerful than the others and hence treat them with desired respect. At work-place, Indians, therefore tend not to question their bosses and the bosses expect them to behave accordingly. To an American such behaviour may seem counter-productive to progress and decision making. Underlying such behavioural archetypes are certain cognitive processes that shape an individual's personality and actions.

CULTURE AS A COGNITIVE PROCESS

Culture is a powerful operating force that conditions the way we think and behave (Guffey, 72). An individual is a product of his/her environment. The psyche of a person is shaped by everything that he/she sees and experiences. The biggest impediment to effective intercultural communication is Ethnocentrism. For most individuals, their own culture, their beliefs and value-systems form the yardstick against which they measure behaviours of people from all other cultures. Thus, in most of our interactions our ethnocentric attitude interferes with our perceptions of cultural groups. These attitudes can be deeply divisive and may impede communication between members of different cultures or even sub-cultures. In a country like India, rich in its diversity, it becomes a challenge for people to accept other ways of thinking and behaving and attaining a cosmopolitan outlook. We are all prisoners of our own ideationalities (world-view). The problem is more acute for the people who for most part of their lives have had very little interaction with people from diverse ethnic backgrounds. The adaptability for such individuals is considerably less than those who have had ample exposure to the clichéd 'confluence of cultures'. This is true not only of the culture/sub-culture one belongs to but also of 'work culture'. When people conditioned to work in casual surroundings are placed in work cultures that are more formal and regimented, they may experience culture shock (Guffey, 72). When one's accepted way of thinking, believing and behaving is at war with the ways of those we have to work with, harmony is elusive. So culture as a world-view, the reality that one lives by, the cognitive processes of making sense of our surroundings and people around us, can pose as the greatest threat to intercultural communication, interpersonal cordiality and a harmonious co-existence.

BRIDGING THE CULTURAL CHASM

The world as one global village is now a reality we operate in. National and even local businesses find that their markets frequently extend across borders. To be a success in such an environment, it's important for people and companies to adapt to other cultures, understand them, and modify their own behaviour and strategies to maximize benefits. The importance of communicative competence is evident from the recruiter's list which puts communication skills at near the top of essential qualities sought after in prospective employees. There shall very soon be a time when ability to communicate in multi-ethnic contexts shall be the norm. Channelizing its communication smoothly is the goal for every organization to increase productivity, for they say that an organization is as good as the communication therein.

Taking active initiatives towards achieving harmony at the work place is the way forward to progress. Helping to create tolerance, empathy and cultural sensitivity among co-workers would minimize the frustration resulting from missed signals, muddled messages and miscommunication. What can be promoted is controlled or monitored meta-communication between employees from different backgrounds. Meta-communication (Tubbs and Moss) is communicating with the other party about the style of one's communication. Most problems occur when there's no one to help correct you or point you towards the right direction. Problems arising from language usage and behaviour can be best addressed by discussion and explanation. Yuan (1997) argues that "intercultural communication theories should be interaction based, emphasizing how individuals communicate, not how cultures communicate."

One very basic move can be to provide 'cultural training' to the employees where there are a large number of people from diverse cultural backgrounds working under one roof. The employees can be trained in understanding and adhering to the larger organizational culture. Uniformity in behaviour and expectations can take care of the day-to-day mundane problems of intercultural communication. The objective is not to culturally homogenize the work-force, for it shall be counter-productive in nature since the reason why diversity is desired at work in the first place is to have multiple perspectives, leading to better results; but to iron out the superficial oddities arising due to differences in points of view. Multiethnic work-force is a double edged sword for it may help the organisation reap the dividends of diversity but at the same time may also act as a divisive force, for there are countless differences in culture and an organizational, multi-ethnic utopia, an elusive dream and a chasm so deep that evades bridging. But what's important is that we recognize the existence of cultural differences, that we look for them, that we understand them and keep working at ways to resolve them.

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ROLE OF HR IN TALENT MANAGEMENT FOR BUILDING FUTURE ORGANIZATIONAL COMPETENCE

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ABSTRACT

Over the period of time the business environment has also evolved creating higher demand for skilled and knowledgeable employee, hence arises the requirement for high performing, high potential knowledge workers so as to achieve organizational objective in this global setup. HRM earlier focused on traditional activities of employee entry to exit and being a rigid Center of Investment less focused on Return on Investment. The situation has to evolve into an responsive Talent Management, which focuses on developing talent for future organizational leadership and competency, hence building sustainable competitive advantage. The biggest challenge faced is evolving from being cost center to being a profit center. This further redefining role of HRM in to developing model of Organizational competency management, organizational performance management and organizational leadership development understanding the future developments in the business environment. The technological development has added further to the challenges and difficulties faced. Anticipating changes and the evolution required a planned move accordingly is a key to maintain the sustainable competitive advantage. To match the pace of the globalization and the challenges posed by international companies Indian organizations will have to be creative and innovative in order to retain and attract talent, it is imperative for business organization to adapt to similar or better strategies so as to survive or beat the competition.

The research paper is supposed to understand the current talent management practices and challenges faced in the process. Also brings out role of HR in Talent Management and suggests ways to develop a strong process of Talent Management.

Keyword: Talent Management, Sustained Competitive advantage, Human resource Management

INTRODUCTION

Globalization, Technological change, Increased Competition has been posing challenge to organizations globally; Indian Organizations are also facing similar challenges. These challenges have induced the organizations to change their way of functioning. There has been continuous development in the functioning of the Organization. Every organization wants to distinguish itself from the competitor to sustain in this dynamic environment. One of the way by which an organization can make the difference through its Human resource which is unique in every organization and essential element for sustained organization growth and development. Due to which as expected, researches on **talent management** has been fast gaining its due importance at corporate level because of its strategic relevance in achievement of organizational strategic objectives.

The rapidly changing business environment and continuing insights into organizational value, organizations are thinking acutely on how organizations can realize their plan. Once the goals and objectives are defined by the organization the necessary system needs to be in place. To accomplish the set objective there has to be disciplined approach for successful implementation of strategies framed. At the same time organizations have also to cope with the changes occurring in the business environment. To withstand the above challenges organizations need to Attract, Retain and Manage talent in the organization, so as to execute plans and strategies.

HRM from its early days have been principally focused upon Recruitment, Training and Development, Employee Relations, Compensations and Benefits and Compliance. The changing business environment and perception of conviction in people competence being materialistic in achieving organization goal and objective is realized. This increases the importance of HRM to develop **future leadership and organizational competence** and actively participate in strategic framework formulation and implementation as a strategic business partner.

REVIEW OF LITERATURE

All the Organizations given from any industry present similar structure, resources, operate in similar environment, the only thing that differs is Human factor, which is integral part of every organization system and they are unique as they create value for self and organization. Human resource follows rules & regulation and policies & procedures set by organization but their actions and behaviors are governed by the policies and practices. Organizational and HRM practices are elemental to raise the motivation among the employees.

The global business environment experiencing an era of great transformation. Organizations are racing to accelerate growth in the competitive and rapidly changing world of work. These organizations face new risk of out-dated business models, traditional organizational structures and uninspired people practices that are standing in the way of successfully executing business strategies. The globalization has produced a wave of new practices in HRM which no organization can afford to ignore. It is also apparent that most of the organizations have already moved ahead and initiated the changes only others to follow (**Budhwar & Debrah 2004**). The global competition has given rise in the need for organization to thrive and grow focus on number of factors of which mastering the change, developing an apt organizational culture and internal environment in order to foster desired result (**Barry A. Friedman 2007**). It was also observed that failure to plan and implement these change strategies, resulting high turnover especially of valuable employees (**Carolyn Kristjanson Love 2000**).

To survive this competitive business environment organizations need creative and innovative skilled employees hence talented employees are the asset to the organization and should be treated appropriately (**James M.J, 2011**).

The organizations will have to be creative and innovative in framing and implementing HR strategies. Innovative HRM practices provide a sustainable competitive advantage depending on how creatively and effectively they are interpreted and executed (**Som Ashok 2007**). The organization can achieve advantage through human resources only. It is the people who can provide the competitive edge which is the reason that Human resources systems have become crucial in conduct of business operations (**Umesh R 2011**). Organization has to understand that mutually with the employees it can be competitive. They have to create an environment where individual commits self for the organization and organization in turn responds positively to such commitment. If an employee feels otherwise it may not yield positive results and organization may end up losing the talent. (**Myszak 2010**). The field of human resource management is likely to face challenges in establishing direct relationship between the human resource policies and practices which is able to attract, retain and nurture talent. (**Kaufman 2007**). They can ensure development of talent which creates value to the organization from each individual. The asset created by organization in form of the talent force will be unique and difficult to imitate. (**Brayan and joyce, 2007**).

The **McKinsey article War for talent 1998, part 2 2001 and quarterly 2007**, have been instrumental in drawing attention on talent management especially among consultants, academics and professional bodies. Lack of potential leaders is the most pressing human resource challenge organizations expect to face. In a research conducted the problems faced by most of the organization were related to lack of high-potential leadership, shortage of talent at all levels (**Right Management 2012, Manpower group 2013**). One of the clear changes due to recession is that many managers will be faced with having to manage in a tough situation, something of which they may not have any experience. There is the need for change management skills and authentic leadership (**David Birchall, Nick Holley and Benjamin Reid 2008**). The organization will have to find people who are right fit in the organization or it may have adverse effect on the performance. Hence for organization to retain and attract talent in the organization will have to be the first choice. (**Deepali Bhatnagar and Durgesh Batra 2006**). Solving talent issue is not an impossible task. But it requires an integrated, strategic approach to talent management, from planning and sourcing to training and development and retention. Insightful, integrated talent management practices can not only help an organization overcome shortage of talent, but also deliver financial results that will win the approval of all the stakeholders (**Infosys 2007**). This further brings forth the leadership role in creating value and trust among the human resource and develops a committed employee asset to sustain in the long run (**Jack W. Wiley 2009**).

TALENT MANAGEMENT EXPLAINED

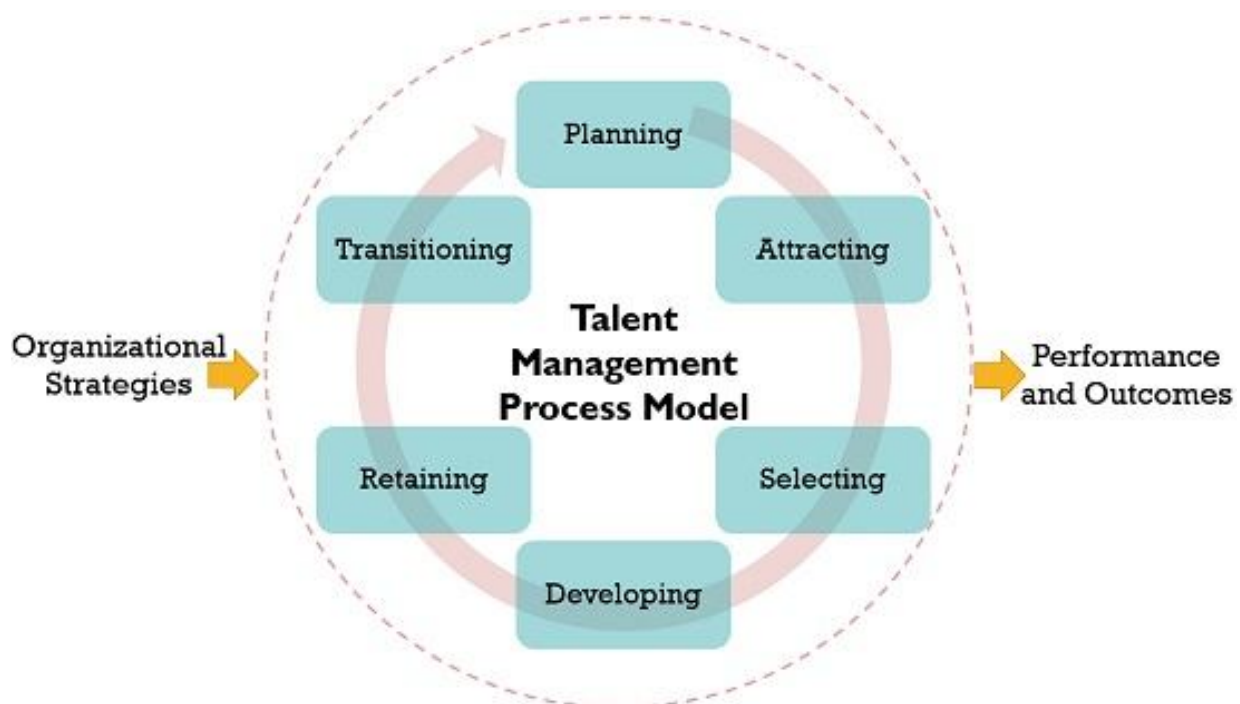
Vaiman, V., Scullion, H., & Collings, D. (2012) defined Talent Management as a organizational process that systematically identifies positions which are critical for their success and sustainable competitive advantage. It is the process of measuring contribution of individuals which is not imitable by the competitors. The study has emphasized on identification of key positions in the organization and individuals fit for the position as important aspect of strategic talent management system. The view is supported by **Nilsson, S., & Ellström, P. E. (2012)**, as talent management is the process of identifying potential, acquiring and maintaining talent which is pivotal for the organizational long term strategy. In a study by **Al Ariss, A., Cascio, W. F., & Paauwe, J. (2014)** have focused on global talent management where talent i.e. means to organizational productivity could be acquired from any part of the world.

The organizations should have clear objectives set out and well articulated for successful implementation of talent management strategy. **Bethke-Langenegger, P., Mahler, P., & Staffelbach, B. (2011)** In their research found that talent management strategies focusing succession planning only may not yield organizational

performance in short term, as it is a futuristic strategy of the organization and a traditional view of HR operation. The study also revealed that strategies focused on attraction and retention of productive employees as a more effective strategy with better outcome and value addition by HR to the organization. Organization HR policies and practices focusing on employee needs and meeting their expectations important for sustained competitive advantage.

TALENT MANAGEMENT PROCESS

Talent management refers to the anticipation of required human capital for an organization and the planning to meet those needs. Talent management is the science of using strategic HR to improve business value and to make it possible for companies and organizations to reach their goals. Everything done to recruit, retain, develop, reward and make people perform forms a part of talent management as well as strategic workforce planning. A talent-management strategy needs to link to business strategy to make sense (Vijay kumar Thota 2013). Reilly (2008) has rightly stated that the key to effective talent management is the alignment of Talent management philosophy with the organization-employee psychological contract. This can be materialized only when the goals of talent management strategy are clear to the organization, so that they act as torchbearers. Talent management requires both systems and an organizational commitment to attract, acquire, manage, and measure the talent needed to achieve a company's business objectives. If business and talent management systems are not aligned with processes, companies not only fail to maximize their benefits, they also put their goals at risk (Oracle White Paper, 2012). The impact of talent management strategies has remarkable effects on human resource perceived outcomes especially on output, efficiency and productivity of organization and employees. Profitability increases automatically whenever the employees are willing to serve with a clear vision, ideology and long term sustainability approach with their parent organization (Hanif* and Yunfei 2013).



Source: <https://businessjargons.com/talent-management.html>

CHALLENGES FACED IN MANAGING TALENT ARE AS FOLLOWING

In their study Thunnissen, M., Boselie, P., & Fruytier, B. (2013) disclose major challenge faced by talent management as per literature is putting Talent Management process to operation and achieving desired outcome. Following are the challenges faced implementing talent management process:

- Perceiving talent requirement and developing strategies to optimize talent acquisition and utilization.
- Organize and directing talent towards organizational objective
- Developing process to identify key talent and their retention
- Developing high level of employee engagement
- Developing employee motivation and commitment in organizational objective
- Developing and optimizing organizational policies and practices to match the globalized standards.

HOW HR CAN CONTRIBUTE

HRM can demonstrate its standards by maintaining and managing knowledge and knowledge workers of the organization i.e. talent management. Talent management refers to managing knowledge skills and ability of the employee by understanding the competencies held. Talent management is an ever going concept it continues to explore current competencies within the organization, and also strives to find gaps and areas of development. It tries to acquire the essential competencies so as not to compromise with the desired organization performance. Talent is considered to be the most important factor in an organization and a critical resource to achieve organizational objectives hence with growing competition; it is a never ending struggle for an organization to get right talent so as to keep the unique sustainable competitive advantage.

Following are the ways HR can promote talent management practices.

- By recruiting right candidate at right time for right position.
- By assessment of organizational competencies and cultivating them for higher results.
- Taming and aligning talent according to organization strategy and organizational culture so as to make right fitment.
- Finding talent management process gaps and taking corrective measures.
- Talent management is not short term it is with future of organization in mind.
- Accurate and fair performance evaluation.
- Anticipate, Plan and adapt to the changing business environment
- Engage employees and maintain employee relations
- Develop retention strategies

PROPOSED TALENT MANAGEMENT MODEL

Organizational Environment (Articulation of Vision/ Mission)			
Talent Attraction	Talent Maintenance		Talent Retention
	Organizational culture (Building organizational trust and commitment)	Employee management policy	
	Performance Management policy		
	Performance barriers	Effective performance need	
	Human resource development Policy		
	Organizational performance		

CONCLUSION

Talent management is a strategy to create a sustainable competitive advantage for the organizations applying it. It's time for a fundamentally new approach to talent management that takes into account the great uncertainty businesses face today. Fortunately, companies already have such a model, one that has been well honed over decades to anticipate and meet demand in uncertain environments—supply chain management Cappelli, P. (2008). Organizations need to have robust processes in terms of Management support, career development and compensation and rewards strategy which engage employees in effective and efficient manner **Alias, N. E., Noor, N., & Hassan, R. (2014).**

- Top management active support: Organization management should take interest in developing talent management strategies. There is investment required for such activity, without management support and vision for future Talent management practices could not be developed.
- Lay down comprehensive expectations: Firstly top brass of the organization will have to understand the objectives and goals clearly and the same have to be framed and articulated to every one part of the organization. Each and every individual resource should know what, when and how to contribute. There has to be clear goal alignment to have long term association with employees to make for meaningful contribution.
- Invest in technology: For an organization to be competitive now and in future use of technology is very important. As per today's business environment and immeasurable possibilities it is very important to have a

robust technology support. Organizations around the world are developing or buying technology which cuts down routine jobs and helps more focus on important matters at all levels in the organization.

- Develop organizational capability: Organizations should understand it is not just about buying technology but by developing skills and capabilities organizations can leverage technological advantage. Continuous effort is to be made to develop organizational capability critical for achieving objectives and finding gaps to avoid any obstacle in future.
- Manage and monitor performance: Organizations should manage and monitor performance habitually and systematically. Avoiding all biases accurate and fair assessment of performance management is necessary for keeping the resources motivated. Many organizations have made it in to a annual, biannual or quarterly phenomenon while it should be rigorously pursued and followed up with meaningful feedback as it is one main reason for employee resource disconnect with organization and develop intention to leave organization.
- Develop talent pool: Organizations should make an effort to develop apt talent pool to satisfy not just current requirements but keeping in mind their future requirements. If organizations lack future vision they cannot employees to align and keep short term objectives with the organizations

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AN INVESTIGATION OF COMPUTER ATTITUDE OF SECONDARY SCHOOL TEACHERS IN RELATION TO GENDER, EXPERIENCE AND EDUCATIONAL QUALIFICATIONS**Niraj Dilip Sharma**

INTRODUCTION

Computer is the outcome of technological innovation. A technological innovation has become a common place phenomenon and is frequently taken for granted by contemporary society. A computer is a general purpose device that can be programmed to carry out a finite set of arithmetic or logical operations only. A computer is a general- purpose machine for storing and manipulating information. Attitudes are of chief importance not only for person's character formation but for his mental health and achievement as normal. Like other aspect of personality, attitudes are acquired, not innate. The success of any initiatives to implement technology in an educational program depends strongly upon the support and attitudes of teachers involved. It has been suggested that if teachers believed or perceived proposed computer programs as fulfilling neither their own or their students' needs, they are not likely to attempt to introduce technology into their teaching and learning.

NEED AND JUSTIFICATION OF THE STUDY

As computers are becoming very important part of human life therefore it becomes obvious that how the field of education could be untouched. Computer education is now a compulsory part in the syllabus at every level of education. The National Policy on Education (NPE), 1986, has provided for environment awareness, science and technology education to include in the syllabus for secondary education. Though the teacher is an integral part of teaching-learning process, so teachers' attitude towards computer becomes more important. Ultimately it is the teacher who will teach the class. If teacher has positive attitude towards use of computer in education then he will feel comfortable and interested in the use of computers in education.

STATEMENT OF THE PROBLEM

While studying the present study the investigator decided to investigate the computer attitude of secondary school teachers in relation to gender, experience and educational qualifications. Consequently, the study might be stated as **"An investigation of Computer Attitude of Secondary School Teachers in Relation to Gender, Experience and Educational Qualifications"**

OBJECTIVES OF THE STUDY

Following are the objectives of the study:

1. To study the attitude towards computer of the secondary school teachers.
2. To study the attitude towards computer of the secondary school teachers with respect to gender.
3. To study the attitude towards computer of the secondary school teachers with respect to experience.
4. To study the attitude towards computer of the secondary school teachers with respect to educational qualifications.

HYPOTHESES OF THE STUDY

In order to achieve the above objectives following hypotheses have been formulated. There were following hypotheses in the study.

1. There is significant difference in computer attitude of secondary school teachers with respect to gender.
2. There is significant difference in computer attitude of government secondary school teachers with respect to gender.
3. There is significant difference in computer attitude of aided secondary school teachers with respect to gender.
4. There is significant difference in computer attitude of private secondary school teachers with respect to gender.
5. There is significant difference in computer attitude of secondary school teachers with respect to experience.
6. There is significant difference in computer attitude of government secondary school teachers with respect to experience.
7. There is significant difference in computer attitude of aided secondary school teachers with respect to experience.

8. There is significant difference in computer attitude of private secondary school teachers with respect to experience.
9. There is significant difference in computer attitude of secondary school teachers between highly experienced male and less experienced male.
10. There is significant difference in computer attitude of secondary school teachers between highly experienced female and less experienced female.
11. There is significant difference in computer attitude of secondary school teachers with respect to educational qualifications.
12. There is significant difference in computer attitude of government secondary school teachers with respect to educational qualifications.
13. There is significant difference in computer attitude of aided secondary school teachers with respect to educational qualifications.
14. There is significant difference in computer attitude of private secondary school teachers with respect to educational qualifications.
15. There is significant difference in computer attitude of secondary school teachers between doctorate male and graduate male.
16. There is significant difference in computer attitude of secondary school teachers between doctorate female and graduate female.
17. There is significant difference in computer attitude of secondary school teachers between graduate with less experience and graduate with high experience.
18. There is significant difference in computer attitude of secondary school teachers between doctorate with less experience and doctorate with high experience.

DELIMITATIONS OF THE STUDY

The study was limited to:

- I. The study is delimited to teachers teaching from grade nine to twelve.
- II. The study is delimited to secondary school teachers of Lucknow Division only. Lucknow Division comprised of six districts namely Sitapur, Raibareli, Unnao, Hardoi, Lakhimpur Kheeri and Lucknow.

METHODOLOGY

The present piece of work is a type of descriptive research using quantitative approach. In which survey method of research has been used.

RESEARCH DESIGN

In the present study the simple normative survey has been used. The survey method collects data from a somewhat large number of cases at a specific time. It deals with the generalized statistics that result when data are distracted from a number of individual cases. It is basically cross-sectional.

POPULATION

All the secondary school teachers of Lucknow Division constituted the population of the study. The investigator has taken six districts from Lucknow Division which is as follow: - Sitapur, Raibareli, Unnao, Hardoi, Lakhimpur Kheeri and Lucknow.

SAMPLE OF THE STUDY

In the present study the strata of the population is based upon the type of schools and gender of the secondary school teachers, yielding six types of strata-Male teachers from Government secondary schools, Female teachers from Government secondary schools, Male teachers from Aided Secondary Schools, Female teachers from Aided Secondary Schools and Male teachers from Private Secondary Schools, Female teachers from Private Secondary Schools.

Table

Sr. No.	Name Of The Districts	Govt. Sec. Schools		Aided Sec. Schools		Pvt. Sec. Schools		Total		Grand Total
		No. Of Teachers Administered And Responses Found		No. Of Teachers Administered And Responses Found		No. Of Teachers Administered And Responses Found		Male	Female	
		Male	Female	Male	Female	Male	Female			
1.	Hardoi	14	15	14	14	14	14	42	43	85
2.	Lakhimpur	13	14	14	14	14	15	41	43	84
3.	Lucknow	14	13	14	14	15	14	43	41	84
4.	Raibareilli	14	14	13	15	14	14	41	43	84
5.	Sitapur	13	15	14	13	14	13	41	41	82
6.	Unnao	14	14	14	14	14	14	42	42	84
Total		82	85	83	84	85	84	250	253	503

STRUCTURE OF SAMPLE

Table shows that teachers from government secondary schools including 82 male and 85 female teachers were selected. From aided secondary schools including 83 male and 84 female teachers were selected. Likewise, from private secondary schools including 85 male and 84 female teachers were selected. In all, there were 250 male and 253 female secondary school teachers, thus 503 teachers in all. Table further indicates that for the Hardoi district 85 secondary school teachers including 42 male and 43 female teachers were selected. For the Lakhimpur- Kheri district 84 secondary school teachers including 41 male 43 female teachers were selected. For the Lucknow district 84 secondary school teachers including 43 male 41 female teachers were selected. For the Raibareili district 84 secondary school teachers including 41 male 43 female teachers were selected. For the Sitapur district 82 secondary school teachers including 41 male 41 female teachers were selected. For the Unnao district 84 secondary school teachers including 42 male 42 female teachers were selected.

VARIABLES IN THE STUDY

Following are the dependent and independent variables taken in the present Study:

Independent variable- Gender, Experience and Educational Qualifications Dependent Variables- Computer attitude

TOOL OF THE STUDY

In the absence of any standard attitude scale the investigator has developed an attitude scale namely "Computer Attitude Scale for Secondary School Teachers."

ANALYSIS OF THE DATA

Quantitative analysis was done on the basis of responses received from the secondary school teachers on the Computer Attitude Scale for Secondary School Teachers. T- Test was used to analyse the data regarding the responses of teachers. To calculate, "t" the investigator calculated mean and standard deviation.

FINDINGS OF THE STUDY

The study was conducted to investigate the computer attitude of the secondary school teachers in relation to gender, experience and educational qualifications. The findings of the present investigation have presented here according to the hypotheses.

- Both male and female secondary school teachers have moderately positive attitude towards computer.
- Both male and female secondary school teachers seemed to have moderately positive attitude towards computer.
- Both male and female secondary school teachers seemed to have moderately positive attitude towards computer.
- Both male and female secondary school teachers seemed to have moderately positive attitude towards computer.
- Highly experienced secondary school teachers seemed to have slightly positive computer attitude and less experienced secondary school teachers seemed to reflect highly positive attitude towards computer.
- Highly experienced secondary school teachers have slightly positive computer attitude and less

experienced secondary school teachers reflects highly positive attitude towards computer.

7. Highly experienced secondary school teachers have moderately positive computer attitude and less experienced secondary school teachers reflects highly positive attitude towards computer.
8. Highly experienced secondary school teachers have moderately positive computer attitude and less experienced secondary school teachers reflects highly positive attitude towards computer.
9. Highly experienced male teachers of secondary schools have slightly positive computer attitude whereas less experienced male teachers of secondary schools reflects highly positive computer attitude.
10. Highly experienced female teachers of secondary schools have moderately positive computer attitude whereas less experienced female teachers of secondary schools reflects highly positive computer attitude.
11. All the groups of educational qualifications reflects moderately positive attitude towards computer.
12. Doctorate teachers reflects highly positive attitude towards the computer.
13. All the groups reflects moderately positive attitude towards computer.
14. Post-Graduate secondary school teachers have moderately positive computer attitude on the other hand doctorate secondary school teachers have highly positive computer attitude.
15. Both the group of secondary school teachers reflects moderately positive computer attitude.
16. Post-graduates with less experience secondary school teachers have highly positive computer attitude on the other hand post-graduates with high experience secondary school teachers have slightly positive computer attitude.
17. Doctorate with less experience secondary school teachers have highly positive computer attitude on the other hand doctorate with high experience secondary school teachers have moderately positive computer attitude.

LIMITATION OF THE STUDY

The limitations of the study are as follows:

- i. This study did not classified urban and rural schools of the Lucknow Division.
- ii. The conclusions of the study can only be generalized for Lucknow Division.

EDUCATIONAL IMPLICATIONS OF THE STUDY

The present study has attempted to study the computer attitude of secondary school teachers in relation to gender experience and educational qualifications. A few decade earlier, major attention was paid towards the understanding of teachers. But now-a-days the situation has changed considerably. Now student is the centre of the educational process. Therefore, lacks of the attention to the studies related to the teachers are being undertaken. The educationists and psychologists have now pointed out that the study of teachers is also very important, otherwise the attempt to educate students well may fail miserably which will in turn not be conducive towards the proper development of the computer education also. The present study is a humble attempt towards the upliftment of the status of the secondary education. However, a number of implications are drawn from the analysis, comparisons and findings of the present investigative study.

This study will be helpful in investigating the computer attitude of secondary school teachers in relation to gender, experience and educational qualifications. Findings of the present study report that the ideal method for developing teachers' positive attitude for computer use would be to provide them with training and support to work successfully with computers. If anxiety is reduced and self- efficacy level is increased, teachers will be benefitted from their computer training and subsequently can be expected to increase their commitment to and use of computers in education. So, teachers must be trained effectively about the use of computer, which will be fruitful in their professional life. The results also showed that simply introducing computer technology resources does not guarantee teachers' use of these in practice. The provision of training is seen as a key factor in both changing attitudes and encouraging teachers in incorporating technology into their instruction.

Handler (1993) found that attitude towards computer usage were becoming more favourable as computers became more available in schools and colleges. Computer availability in the secondary schools is of utmost importance, without which no secondary school teacher can be able to increase his/her level of computer attitude. The governing bodies of secondary schools may monitor the computer facilities of the schools. To develop strongly positive computer attitude, teachers need to be introduced to computer technologies

systematically and be engaged in activities that will provide them with positive experiences with regard to computer use. For this in-service training engaging teachers in computers may be helpful. Information and communication technology must be integrated into secondary education programme. Thus, secondary school teachers are expected to possess both skills in the use of computer technologies and positive belief in their capacity to integrate them into their teaching.

Clearly the results of this study have implications for both education and teaching, as Post-Graduate as for further research. Given the shift in attitudes by females from negative to positive, educators should recognize that females, as Post-Graduate as males, are suited for a full range of technology courses. Because females have a similar regard for the contribution of technology to productivity improvement and are comfortable with technology as men, they should be encouraged to pursue technology in teaching. In employment situations, managers should be encouraged to use both males and females teachers for technology assignments and teachers training activities. Their positive attitudes and comfort levels with technology may make women especially adept at creative applications of technology.

The findings of the study will further help the organizations, policy makers or managers to understand their teachers' computer attitude individually as well as collectively. This will enable them to modify or change their approach in dealing with teachers in the implementation of any computer program or in preparing the dimensions of any in-service training.

The tool "Computer Attitude Scale for Secondary School Teachers" constructed during the course of this study will be of immense use to educational purposes and research workers.

Inclusion of different ages or experience levels would be insightful. Replication in the work education world may be particularly helpful in determining whether biases exist because of perceptions about gender and the use of technology.

Thus, the findings of the present study will help governments, managers and social workers towards the understanding of the teachers' computer attitude which in turn will reduce difficulties of the implementation of the computer education at secondary level. Thus a forward looking and well balanced computer educational program may be developed for the secondary level.

SUGGESTIONS

Suggestions for Teachers

The following are the suggestions for teachers:

1. Teachers' interest towards computer may be developed through a relevant computer course.
2. Teachers may be encouraged to pursue any pre-service or in-service computer course.

Suggestions for Policy Makers

The following are the suggestions for policy makers:

1. Good infrastructure, like electricity supply, a techno-savvy teacher, some computer sets may be provided for computer education. Infrastructure for computer education should be made stronger.
2. A proper computer course may be provided to all government, aided or private secondary school teachers.
3. More finance may be provided for computer education. More focus may be given to the computer education in the educational budget.
4. Continuous monitoring must be done to make sure that certified or trained teachers are teaching at school.
5. A good in-service and pre-service computer training program may be useful for the secondary school teachers.
6. Policy makers may be careful to provide at least one computer in each school.

Suggestions for Further Studies

The following are suggestions for further research:

1. This study was confined only to the Lucknow Division. Therefore, the study cannot claim to have comprehensiveness and its findings may not be universally applicable. It is, therefore, necessary to cross validate the reported results from other parts of the state and country.
2. The present study has been conducted on 503 secondary school teachers only. Therefore, it is suggested that

this study may be conducted on a larger sample from the similar population somewhere else.

3. In the present study “Computer Attitude Scale for Secondary School Teachers” with 47 statements in three different areas, viz., items containing positive and negative statements about the value of computer technology, the impact of computer technology on teachers and teachers’ comfort level with computer technology have been used. However, an attitude scale with more areas and items may also be constructed and used for the purpose.
4. Further researches on the computer attitude at different levels can also be conducted.

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Bateson, C. D.,(2006), ‘Doing Business after the Fall: The Virtue of Moral Hypocrisy’, *Journal of Business Ethics*, 66: 321 – 335

• **Multiple author journal article:**

Khan, M. R., Islam, A. F. M. M., & Das, D. (1886). A Factor Analytic Study on the Validity of a Union Commitment Scale. *Journal of Applied Psychology*, 12(1), 129-136.

Liu, W.B, Wongcha A, & Peng, K.C. (2012), “Adopting Super-Efficiency And Tobit Model On Analyzing the Efficiency of Teacher’s Colleges In Thailand”, *International Journal on New Trends In Education and Their Implications*, Vol.3.3, 108 – 114.

- **Text Book:**

Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2007). *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies* (3rd ed.). New York: McGraw-Hill.

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