GRADE CARD APPROACH TO ASSESS SOCIO-ECONOMIC STATUS IN MUSTOOR SUB-WATERSHED, CHIKBALLAPUR TALUK, KARNATAKA

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ABSTRACT

This paper presents case study on Socio Economic Status of Mustoor sub watershed using Udai Pareek revised scale. As it is the only method, which assesses the socio-economic status of rural area in India. Considering the nine factors that exactly reflect the social and economic status of the families. In this socio-economic scale income is excluded as people will not be comfortable in sharing their income. Hence it is reliable and more accurate method as compared to the other SES methods. It helps in estimating and grading of the social and economic status of the people residing in the sub watershed. Grades for the watershed is assigned based on the maximum population percentage class.

Keywords: *SES study, Socio-economic status, Socio economic study, rural area, Socio economic. Udai Pareek revised scale.*

INTRODUCTION

The economic and social status of any family plays a major role in understanding the lifestyle and healthy condition of families in India. Influence of Socioeconomic status is vast on lifestyle of families and on various available health facilities, it would also aid in enhancing the quality of life to fight against hydrological calamities like draught and floods. Many researchers have given their methods for calculating the economic and social conditions of individuals or their families. Psychologists developed SES scales especially in the western world. SES can help the decision makers to understand the actual scenarios of people living in the society to fight the natural calamities financially and socially.

In Indian studies, based on per capita monthly income B. G. Prasad has given a scale to determine the economic and social status in 1961 and later revised in the year 1968 and year 1970 and has been used extensively. For urban communities, it is also widely used to determine the economic and social status of families or individuals. Income, education, and occupation are the three variables used in the Kuppu swamy scale to determine the economic and social status of the families or individuals. Later it was revised adopting income per capita per month, education, and occupation of head of the family. Modified B. G. Prasad and Kuppu swamy scale are suitable for urban areas only. Tulikasingh et. al., (2017).

To understand the affordability of amenities and services related to health, the capacity of the families to purchase without any stress etc., the stratification of socioeconomic is must. Hence, all the communities-based studies emphasize on socio economic study. The Socio-economic status (SES) Plays a vital role in understanding the health of the families, and actual scenario of families that influences the decision making towards healthcare facility affordability, acceptance and proper utilization of the facilities made available for the people in society. Dr. Chinta Ankitha et. al., (2016).

SES adopts the major factors concerning in life of a person, to understand the social class that are complex in nature. The application of the study and its reliability and validation of the SES is very high. Dr. Kusum Lata Gaur (2013)

In this case study on Socio Economic Status of Mustoor sub-watershed using Udai Pareek revised scale is adopted. As it is the only method, which assesses the socio-economic status SES of rural areas in India. adopting the nine practical factors that plays a role in day-to-day life like., education, occupation, social participation, caste, farm power, land, material possession, family type and type of house. Hence, this exactly reflect the social and economic status of the families.

Study Area

Mustoor sub watershed was chosen as the study area, it is treated under Integrated Watershed Management Programme. Mustoor

sub watershed is in Chikaballapura District in the Chikaballapura Taluk. The geographical Location lies between north latitudes 13.4324° N, and east longitudes 77.7280° E (survey of India Topo-sheet SOI No - 48/N/1). The following prominent villages were identified: Harobande, Avalagurki, Dibburu, Kadadibburu, Lingshettypura, Golluchinappanahalli, Kavarnahalli, Guvalakkanahalli, Manchanabele, Gundlagurki, Mustoor. The sample survey for socio-economic study was done. The survey with the questionnaire was done for a total of 799 families in the sub watershed as shown in Table 1.

METHODS

In this case study Udai Pareek revised scale is used as it attempts to judge the socio-economic status of the families residing in the sub watershed. Udai Pareek method is the only method which accurately assess the socio-economic condition of the rural population. This scale has nine factors which assess the socio-economic status of the individual viz., Education, occupation, social participation, caste, farm power, land, material possession, family type and house. The required information was obtained through survey and were filled in the form for determining the Score for individual parameters as suggested by Udai Pareek Scale, the total score is summed up and interpreted in terms of the socio-economic class. As rightly assumed in this method it was experienced that people were uncomfortable in discussing their family income with the surveyor.

Udai Pareek method is the only method that doesn't stress upon the income of a family, so the data collected with the scale may be more valid.

Table 1: Sampling Population		
Village	Census 2011 Population Data	5% of population
Harobande	1881	94
Avalagurki	2073	104
Dibburu	1815	91
Kadadibburu	405	20
Lingshettypura	436	22
Golluchinappanahalli	589	29
Kavarnahalli	725	36
Guvalakkanahalli	822	41
Manchanabele	3555	178
Gundlagurki	1317	66
Mustoor	2354	118
	Total	799

Table 2: Factors and Points Representation								
Points	0	1	2	3	4	5	6	7
Education	Illiterate	can only read	can read and write	completed primary education	Middle school	completed High school	Graduate	Graduate and above
Occupation	unemployed	Laborer	Caste Occupation	Business	Independent Profession	Cultivation	Service	
Social Participation	None	Member of 1 Organization	Member Of >1 Organization	Office holder in organization	Wide public leader			
Caste		Scheduled caste	Lower caste	Artisan caste	Agriculture caste	Prestige caste	Dominant caste	

Farm Power		No Draught Animal	1-2 draught animals		3 – 4 draught animals		5-6 draught animals	
Land	No land	<1 acre	1 - 5 acre	5 – 10 acres	10 – 15 acres	15 – 20 acres	>20 acre	
Material possessions	Bullock cart	cycle	radio	chairs	mobile phone	television	Refrigerators	
Family type		single	joint	size up to 5 / other distinctive factors	extended				
House	No House	Hut	Kutcha House	mixed house	pucca house	Mansion		

The extensive literature survey when done projected the advantages and uniqueness of Udai Pareek Socio Economic Scale. This method projects the reliability of social and economic status of families. Hence through Literature, adoption of Udai Pareek Socio economic scale was finalized.
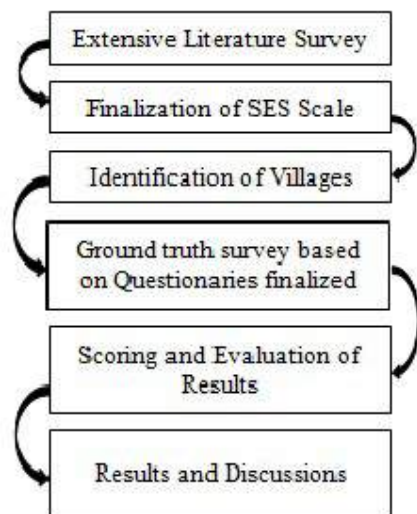

Figure 1: The strategic Execution process

Table 3: Adopted Format for Socio Economic survey using Udai Pareek revised scale						
Socio Economic survey						
Name:			Age			
Occupation:			Family Income Per Month:			
Education			Land			
components	Score	Applicable	components	Score	Applicable	
Illitrate	0		No Land	0		
can read only	1		< 1 acre	1		
can read and write	2		1 - 5 acre	2		
Primary	3		5 - 10 acre	3		
Middle	4		10 - 15 acre	4		
High school	5		15 - 20 acre	5		
Graduate	6		> 20 acre	6		

and Above	7				
Occupation			Material Possessions		
components	Score	Applicable	components	Score	Applicable
None	0		Bullock cart	0	
Labourer	1		Cycle	1	
Caste occupation	2		Radio	2	
Business	3		Chairs	3	
Independent Profession	4		Mobile phone	4	
Cultivation	5		Television	5	
Service	6		Refrigerators	6	
Social Participation			Family Type		
components	Score	Applicable	components	Score	Applicable
None	0		Single	0	
Member of 1 org.	1		Joint	1	
Member of > 1 org.	2		Extended	3	
office holder in org.	3		Size upto 5	2	
wide public leader	4		any other distinctive	2	
Caste			House		
components	Score				

identification of villages in that sub watershed was done using census 2011 and grampanchayath office the data was mismatching hence the online source of information was considered and finalized for sampling selection. The total sampling population of selected villages are shown in Table 2.

Ground truthing was done on these identified villages visiting the sample population finalized earlier. The questionnaire survey as suggested by Udai Pareek Socio Economic Scale were adopted as shown in Table 2.

The scores were given based on observation and survey information collected on spot. grading of points is done as per the specifications above and at last the sum of all parameters highest scores yields the scores 0 to 46. Based on the scores obtained the families are classified as upper, upper middle, middle, lower middle, and lower class and graded as A, B, C, D, E respectively. The parameters and their values in the form of points are displayed in the adopted survey format represented in Table 3.

RESULTS

As per the baseline report of watershed department based on IWMP Report on mustoor sub watershed: The total population of the sub watershed is 35445 of which 17549 comprises of male and 17877 females in the study area. SC population is 9935 (28%), ST 2442 (6.88%), others 21609 (65.12%). Literacy rate in the sub watershed is 68%, 75% of male and 60% of female. Main occupation of 80% families is agriculture and about 19.6% landless depend on farm labor. A very small families are engaged in sheep/goat raring and other pretty business.

Questionnaire based study on socio economic status revealed the following results.

Table 3: Socio-Economic Status statistics of selected samples.

Class description	Grade	No. of samples	Percentage (%)
Upper Class	A	88	11
Upper Middle Class	B	136	17
Middle Class	C	384	48
Lower Middle Class	D	120	15
Lower Class	E	72	9

After the mathematical calculation considering all the points of all parameters like education, occupation, participation socially, caste, power of owning farm animals, land, possession of material, Type of family and house. 88 samples (11%) of all the villages out of 799 samplings have shown Upper class category.136 samples out of 799 (17%) have shown the socio-economic status of Upper Middle Class, 384 out of 799 (48) have shown Middle class, 120 out of 799 (15%) have shown Lower middle class and 72 (9%) samples have shown Lower class.

samples is done from the observation the major population i.e., 48% is of middle-class family hence, this sub watershed can be graded as "C" under Socio-Economic Conditions for the selected samples.

This study also helps in lifting of identified sector lying in lower class through various initiatives and setting up of self-help groups/ Community programs for economical growth of that sector.

The simple grading method when adopted in watershed Socio economic analysis gives us the scope to understand the pitfall and work towards enhancing the lifestyle of any sector.

CONCLUSION

When the statistical analysis for all the selected

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ASSESSMENT OF AIR QUALITY IN THE PREMISES OF SELECTED TRAFFIC AREAS IN BANGALORE CITY

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ABSTRACT

Air pollution is one of the major issue in the world. The main objective of this study was to analyse the concentration of air pollutants and compared with the Air Quality standards, around the selected areas of Bangalore city. The study conducted the investigation with reference to major pollutants like PM2.5 and PM10, CO respectively. In the study, the selected areas based on traffic volume, they are Hebbal, Tin Factory, Marathahalli and Doddaballapur. During the time of study the readings were recorded for about two to three weeks of different stations. The study observed that the pollutants at the different stations were varying gradually. The obtained results were compared with the standards of Air Quality. The Air Quality in Doddaballapur is good, Marathahalli is moderate, Hebbal and Tin Factory are unhealthy. The study developed an Air filter model, to control the pollutants in the most affecting areas

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Keywords: Air Pollutants PM2.5 and PM10, CO, Traffic volume..

INTRODUCTION

The degradation of air quality is a major environmental problem that affects many urban and industrial sites and the surrounding regions. There certainly exists a close relation between poor air and poor health, as pollution of air results in breathing difficulties, increased incidence of Asthma, Cancer and even death. Heavy industrialization and increased transportation have polluted the atmospheric air to such an extent that it is slowly losing its self-cleaning capacity. Deteriorating air quality is posing serious threats, of changing, even the composition of atmosphere. Indian metro politancities like Delhi, Mumbai, Kolkata, etc. have high emission of air pollutants, which is degrading the ambient air quality day by day. The degradation of air quality is a major environmental problem that affects many urban and industrial sites and the surrounding regions worldwide. Air pollution can reach levels, where it significantly influences human health, diminishes crop yield, and destroys infrastructure and patrimony. The phenomena involved in air pollution are complex. Once emitted into the atmosphere, primary pollutants are transported by wind, turbulence and diffusion, which can undergo chemical reaction, change phase and finally are removed from the atmosphere by dry and wet deposition. Health and environmental impact of secondary pollutants, i.e., those formed in the atmosphere can be more severe than their emitted precursor.

The increase of traffic flow in cities causes traffic congestion and accidents as well as air pollution. Traffic problems have attracted the interest of many researchers from the perspective of theory and engineering. A model is based on the relationship between traffic flow and vehicle exhaust emission under a certain level of road capacity constraints. In the study, suggested the model that sucks the smoke and send it to the container that contains adsorbents (charcoal and glass wool) which has the capacity to adsorb the smoke. Practically, it every time that smoke blows from your car's exhaust pipe, so there is no denying that vehicles are major contributors to air pollution.

Materials and Methodology
A. Study area

For a present study Bangalore is considered. Because Bangalore is a rapidly growing with increase in pollution. Bangalore is located in Southern India on a Deccan Plateau, at a height over 900m (3000ft)above sea level. It is positioned at 12.97° N 77.56° E and cover an area of 2190 square kilometer (850 sq mi). The selected study areas are Hebbal, Tin Factory, Marathahalli and Doddaballapur.

Hebbal is an Assembly Constituency area in Bangalore, Karnataka, India, which was once indicative of the north endpoint of the city. Though originally famous for Hebbal Lake, it

is now better known for the serpentine maze of flyovers that network the Outer Ring Road and Bellary Road on NH7. The flyover spans a length of 5.23 kilometres (3.2 mi) over all the loops combined.

The Tin Factory junction is a road junction in Bangalore, India. Located near Krishnarajapuram railway station on Old Madras Road, the junction witnesses high traffic congestion and is one of the worst traffic bottlenecks in the city. The junction connects the Outer Ring Road IT cluster of Mahadevapura– Marathahalli– Bellandur with

areas along the National Highway 44 such as Hebbal.

Marathahalli is an eastern suburb of Bangalore city in Karnataka state of India. The locality is named after the Marut fighter aircraft developed at a HAL facility nearby.

Doddaballapur is a City municipal council in Bangalore Rural district in the state of Karnataka, India. Dodda means "big" in the native Kannada it is an industrial city which houses several multiple national companies it lies 40 km away from Bangalore.
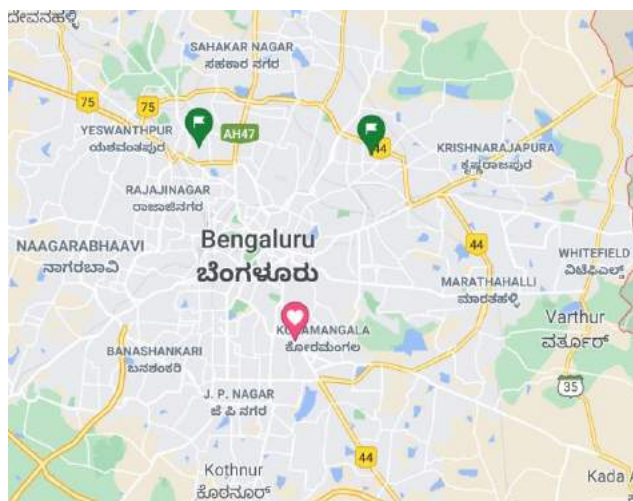
B. Sampling station:
4samplinglocationsareselectedformonitoringofPM2.5,PM 10 and carbon monoxide. The location is selected based are traffic density over place that 1 is commercial, 2 is

Industrial and commercial, 3 is traffic and lastly 4 is Residential with medium traffic volume, the sampling sites are listed below in table.

Table 1. Sampling Stations

Sl No	Selected Stations	Types of Zones
1	Hebbal	Commercial
2	Tin Factory	Industrial and Commercial
3	Marathahalli	Traffic
4	Doddaballapur	Residential

C. Parameters considered:
The parameters considered for the study are Particulate matter PM 2.5, PM 10 and Carbonmonoxide.

D. Implementation:

The model is made up of wooden material. Exhaust fans which are placed in the box helps us to suck the enough smoke from the roads. In the study used Charcoal and Glass wool as adsorbents, there are wide range of adsorbents which can be used. In the model making process the batteries have been used

to conduct the electricity but to save the electricity the solar panels can also be used for the construction of big model. So, it can be called eco-friendly. Vacuum suckers can also be used to suck the smoke from the roads. The use of mixture of two or more adsorbents together can give a good result.

Now the model undergoes testing, so that the CO readings properly and placed at a convenient place to carry out the experiment. Along with that the traffic count is also recorded. Now the vehicle emission is allowed to pass through the inlet and of the model and CO readings and particulate matter readings (PM 2.5 and PM10) are noted down. Once the readings are obtained now the adsorbent materials as discussed above

are placed and the outlet readings are also noted down.

The materials used for making the air filter model are as follows,

- Wood
- Exhaust fans
- Battery
- Adsorbents The adsorbents usedare:
- Charcoal
- Glasswool

RESULTS AND DISCUSSION

The result obtained from the present study shows that PM 10 and PM 2.5 are moderate in the selected stations

Table 2. Pollutants

Sl No	Locations	Pollutants					
		PM 2.5 µg/m³		PM10 µg/m³		CO ppm	
		WD	WE	WD	WE	WD	WE
1	Hebbal	36	35	104	84	6	4
2	Tin Factory	38	36	111	108	11	10
3	Marathahalli	36	33	97	84	6	5
4	Doddaballapur	21	18	54	51	3	2

CO-Carbon monoxide, WD-Week Day, WE-Week End day

- The pollutants PM 2.5 is moderate, and PM 10 is moderatein both weekday and weekend in Hebbal.
- The pollutants PM 2.5 is moderate, and PM 10 is moderatein both weekday and weekend in TinFactory.

- The pollutants PM 2.5 is moderate, and PM 10 is moderatein both weekday and weekend in Marathahalli.
The pollutants PM 2.5 is moderate, and PM 10 is moderatein both weekday and weekend in Doddaballapur
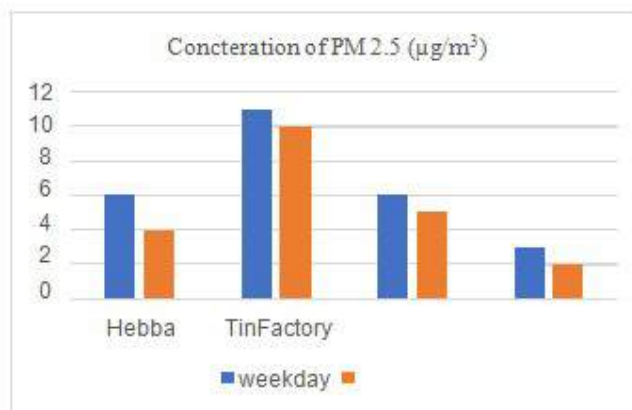
Figure 1. Concentration of pollutant PM 2.5
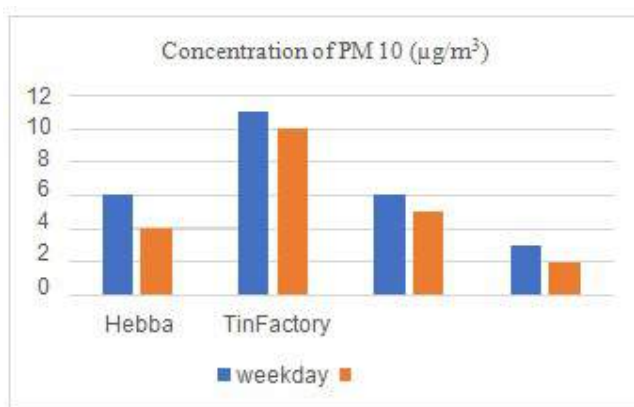
Figure 2. Concentration of pollutant PM 10
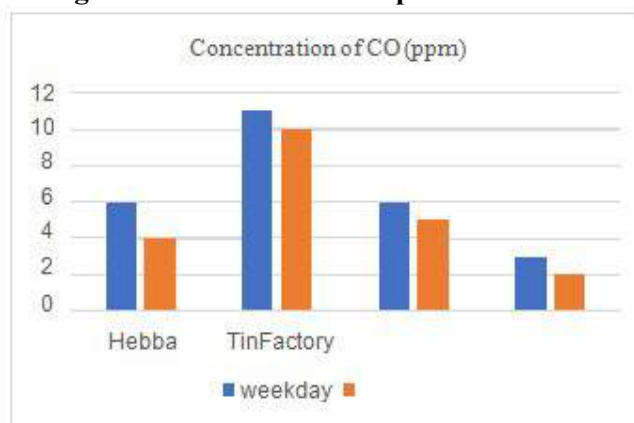
Figure 3. Concentration of pollutant CO

Results from testing through Air Filter Model,

The test was carried out by using different source and adsorbent to analyze the emission of carbon monoxide (CO). The obtained results are based on the amount of CO adsorbed on the adsorbents

Table 3. Result from Air Filter Model

Sl. No	Source	Materials	Initial (ppm)	Final (ppm)	Difference	Result in %
1.	Bike Emission	Charco al and Glass Wool	854	144	710	83.13 %

CONCLUSION

The study conducted the investigation with reference to major pollutants like PM2.5 and PM10, CO respectively. In the study, the selected areas based on traffic volume, they are Hebbal, Tin Factory, Marathahalli and Doddaballapur. During the time of study the readings were recorded for about two to three weeks of different stations. The study observed that the pollutants at the different stations were varying gradually. The obtained results were compared with the standards of Air Quality. The Air Quality in Doddaballapur is good, Marathahalli is moderate, Hebbal and Tin Factory are unhealthy. The study developed an Air filter model, to control the pollutants in the most affecting areas..

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PERSUASIVE MOBILE APP FOR DOMESTIC NON- BIO WASTE

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ABSTRACT

This paper provides a systematic review of a waste management with the main aim of developing an app to connect the households, commercials activities and recycling unit for disposal of non-bio waste and also to facilitate the basic level of waste service to all on the basis of questionnaire based survey. This survey could be conducted on a household basis, commercial establishment basis or even on an industrial basis. The questions are framed in such a way to collect information about the options of disposing off the non- bio waste, the average year of using an non- bio product after re-using, obsolescence rate of different non-bio waste appliances . This information have led us to understand most of the people upgrade to newer, better electronics devices but often fail to recycle the existing gadgets in an environment-friendly manner. However it is essential to dispose of old tech responsibly hence we started developing an app called E-WASTE. App users can conveniently dispose of old electronic items after registering to the app by providing their personnel details. Users can get quotes for their products by uploading pictures they can either request a pick-up or drop items off at collection points. Based on our results this app leads to prevent the improper disposal of non- bio waste directly to the environment and to enhance the environmental protection by provide a higher quality and safe services to citizens.

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Keywords: *Mobile app, Non- bio waste management, Questionnaire based survey, Waste service.*

INTRODUCTION

A Non-Bio waste can be defined as a kind of substance which cannot be broken down by natural organisms and acts as a source of pollution. Unlike biodegradable wastes, non-biodegradable cannot be easily handled. Non-biodegradable wastes are those who cannot be decomposed or dissolved by natural agents.

The traditional methods of managing non-biodegradable waste are outlined below:

(1) Reuse: If the waste has reuse potential, then that should be explored before it gets disposed of. This can be accomplished through fixing items that are broken but still usable, repurposing things like old jars or other containers or up cycling old clothing into new clothing.

(2) Recycling: If the item can't easily be reused in it's form, then recycling should be considered next. Can the item be taken apart or have it's form changed and then recreated into the same product again (e.g. paper recycled into paper or paper board, metal recycled into metal, etc.). If that is possible than this should be explored prior to disposal.

(3) Disposal: If the item cannot be reused or recycled, then it should be disposed of

properly. This means knowing if it contains hazardous materials and making sure they are managed safely so as not to pollute or if it's traditional solid waste, getting it to a disposal facility for proper management. There are two traditional methods of disposal: landfilling and waste-to-energy/incineration. Landfilling is a method where the material is buried in a specially designed system of 'cells' which make sure the waste stays in place and any potential pollution is managed so it doesn't get into the broader environment. Waste-to-energy/Incineration is the process where waste is burned. Waste-to-energy is a form of incineration where the heat produced by burning trash is tied into a power production facility and is used to generate electricity.

Harmful Effects of Non-Biodegradable wastes

➢ Extreme use of non-biodegradable wastes, for example chemical pesticides (DDT) and fertilizers make the soil more acidic or alkaline thus affecting the fertility of the soil.

➢ These materials can also be washed away from the fields into the closed water bodies thereby disturbing aquatic

life and endorsing algal blooms. This occurrence is termed as eutrophication. Toxic substances like DDT when come into any food chain, being non-biodegradable, they keep on collecting progressively at each trophic level. Since humans occupy the highest trophic level in any food chain, the maximum concentration of these chemicals can be found in human bodies. This occurrence is termed as biological magnification.

Objectives

➢ To collect non bio waste which act as a valuable tool for recycling units by integrating with software application (mobile app) in the battle for environmental protection, waste prevention, recycling, etc.
➢ To create an app to connect households, commercial activities and recycling unit for disposal of non bio waste.
➢ To facilitate the provision of at least a basic level of waste service to all.
➢ To implement basic refuse removal policy for indigent households.
➢ To allow the users send dry waste in one of four categories: paper, metal, E-waste and plastic.
➢ To protect the health and wellbeing of people by providing an affordable waste collection service

Methods

➢ This section describes the methods we employed in our study. Here, we show the persuasive app developing criteria and coding.
➢ First, we used various search terms including "non bio waste management", "waste disposal", and "waste recycling", to search for apps on the App Store and Google Play that is related to the subject matter.
➢ Based on the research we concluded to design a app which is user-friendly for the common people
  • App works based on the
    ✓ User
      a. Registration
      b. Sign In
➢ Take the photo of the waste

➢ Select the type of waste
➢ Give the address
➢ Submit
➢ Recycle unit
➢ Accepts the request
➢ Gives the time slot in which the waste is collected
➢ Collects waste
➢ Lastly the processing and recycling of non bio waste will be done by the recycling unit.

Conduction of Survey
Questionnaire Based Survey

In which estimating the waste is a questionnaire based survey. The survey could be conducted on a household basis, commercial establishment basis or even on an industrial basis. The questions are framed in such a way to collect information about the options of disposing off the electrical appliances, plastics, metals and paper.

STAGE 1: Collecting the data of non bio domestic waste in Bengaluru city.

STAGE 2: The data can be classified based on the type of source of generations
  • Household or domestic
  • Institutions
  • Corporations

STAGE 3: Analyze the current management of non bio waste in the city through the collected data.

STAGE 1: Collecting the data of E-waste in Bengaluru city.
  • In which survey is conducted on selected houses, institutions and corporates in Bangalore.
  • The questions are prepared to collect the information about E-waste.
  • Pre-test experiment is done after the preparation of questions.
  • In which pre-test experiment whatever questions are missing or extra questions are added.

Questions prepared :

1) Do you know about non bio domestic waste?
2) Quantity of plastic you have in your home?

3) Quantity of metal you have in your home?
4) Quantity of paper you have in your home?
5) Quantity of E-waste you have in your home?

6) How long you keep this waste in your home?
7) How do you dispose all this waste?
8) After knowing non bio domestic waste, will you control it?

STAGE 2: The data can be classified based on the type of source of generations
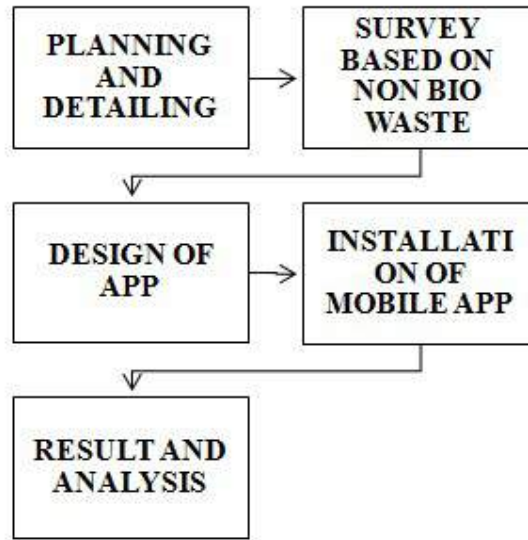
FIG 1: THE STRATERGIC PLANNING PROCESS

Analysis of Apps

The goal of coding the apps is to evaluate the number and type of persuasive strategies employed in designing persuasive apps for waste management. We coded the appsusing the Persuasive System Design (PSD) model described. We chose thismodel because it is a widely accepted framework for deconstructing persuasive systems.Specifically, we used the persuasive strategies of the primary task support category tocode the apps since they are the commonly employed strategies that directly aid inachieving the desired behavior.

The primary task support strategies aid in

Fig 2 : App logo

Table 1: DATA COLLECTION OF NON-BIO WASTE IN HOUSEHOLD CHARECTERISTICS.

<u>**LOCATION**</u>: **KAMMAGONDANAHALLI,12TH WARD BENGALURU**

Place	Family members	Plastic (kg)	Metal (kg)	E-waste (Kg)	Aware of Non-bio domestic Waste
#1054,8th cross	4	3	0	5	NO
#1054,8th cross	3	2	1	5	NO
#1050,8th cross	4	4	1	6	NO
#1050,8th cross	2	2	0	3	NO
#1049,8th cross	2	2	1	4	NO
#1049,8th cross	2	2	0	4	NO

#1049,8th cross	3	2	0	4	NO
#1049,8th cross	2	2	0	4	NO
#1048,8th cross	2	2	0	3	NO
#1048,8th cross	4	4	0	5	NO
#1048,8th cross	3	2	0	5	YES
#1048,8th cross	3	3	1	4	YES
#50,8th cross	2	2	0	3	NO
#50,8th cross	5	3	1	6	YES
#50,8th cross	4	3	1	4	NO
#1025,8th cross	2	1	0	3	NO
#1025,8th cross	3	2	0	4	YES
#1025,8th cross	3	3	0	3	YES
#1026,8th cross	3	2	0	4	NO
#1026,8th cross	3	2	0	3	NO
#1026,8th cross	3	2	0	5	YES
#1027,8th cross	3	3	0	4	NO
#1027,8th cross	3	2	0	4	YES
#1027,8th	4	2	0	5	NO

cross					
#1028,8th cross	2	2	0	4	NO
#1028,8th cross	4	3	0	5	YES
#1028,8th cross	2	2	0	4	YES
#1028,8th cross	4	2	1	6	YES
#1029,8th cross	4	3	1	6	NO
#1029,8th cross	4	4	0	5	YES
#1029,8th cross	3	2	0	4	NO
TOTAL:	739	534	54	1144	YES=65
					NO=137

Total	Family Members	Plastic	Metal	E-Waste	Aware Of E-Waste
202	739	534	54	1144	YES= 65
					NO=1 37

Fig 3: Aware of E-waste in Household characteristics (Graph)

DISCUSSION

Based on the results of a comprehensive assessment it was found that the waste recycling and disposal is an increasingly pressing issue for the preservation of the Earth natural environmentWe argue that, among many factors, a lack of user centered design in waste recycling support tools can be one of the causes. For such reason, we approach the design of a new waste recycling support application, the "E- WASTE", by merging behavioral studies and common features of existing mobile apps with a code sign methodology.

CONCLUSION

➢ The domestic non bio-waste should not to be given to the scrap dealers. It should be given to authorized non bio-waste recyclers.

➢ Improper non bio-waste disposal leads to environmental pollution.

➢ Awareness should be created in the people.

➢ Technology in non bio-waste disposal needs to be improved and make use of it.

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UTILIZATION OF TEMPLE WASTE TO PRODUCE BIO-FERTILIZER

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ABSTRACT

In this paper we have approached a way to use the temple waste to convert it into a organic material. The waste of temple is collected and is kept for composting. The moisture content, pH, electrical conductivity, energy sources such as Carbon, Nitrogen, Phosphorous, Potassium content and C:N of the compost prepared using bacterial cultures were given for testing after two different periods that is 15 days and 30 days. Flowers have applications in many industries like perfumes, cosmetics, food, liquor and textile industries. So we have approached to use the temple waste as a organic fertilizer which contains flowers dry leaves leaf cups. The management of these temple waste maybe a conversion into different value-added products like a compost, bio fuels, biogas, and biogas for electricity generation. After the samples are given for testing the values of NPK ratios of the sample 1 and sample 2 were found to be 0.078-19-180 and 0.082- 27-255respectively.

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INTRODUCTION

Environment is defined as the sum total of all the conditions and circumstances and the living and non-living things around an organism, which affects its life.

Human and environment are closely interwoven with each other, to maintain a balance or equilibrium in nature. With increase in population and development, there is a tremendous increase in the pollution levels which leads to environment degradation.

The primary causes of environment degradation are exploitation of natural resources, industrialization, and urbanization. Pollution of all sort like air, water, land along with solid waste and its disposal eventually degrade the environment as well as humanhealth. . In India, religion is a path of life. It is an intrinsic element of the entire Indian culture.

People worship God and are accustomed to go to the temples offering flowers, fruits, coconuts and sweets. The bulk of the flowers and leaves of different plants, coconuts shells, milk and curd are piled up and then disposed off exclusively in water bodies. The municipalities are responsible for management of solid wastes in the locality. But due to lack of financial resources, organization and complex structures they have been failing in handling of solid wastes. Being an offering to God, flowers do not find its way to be conventional waste disposal system.

Mainly temple waste consists of organic waste like flowers, leaves, coconut shells, fruits, which find their way ultimately into bins or some water bodies and thereby result in the pollution and hygiene problems. Therefore, the present paper has reviewed various methods reported for the utilization and value addition of temple waste in various sectors

Objective

- Collect biodegradable waste and non-biodegradable waste from temples.
- To manage the temple waste mainly biodegradable fraction of solid waste in enriching the nutrition values of organic fertilizer.
- Convert waste flowers, leaves and banana into fertilizer in a short period of time

Method

Vermicomposting is the scientific method of making compost, by using earthworms. They are commonly found in living in soil, feeding on biomass and excreting it in a digested form. Vermi culture means "worm-farming" earthworms feed on the organic waste materials and give out excreta in the form of vermicasts that are rich in nitrates and minerals such as phosphorous, magnesium, calcium and

potassium. These are used as fertilizers and enhance soilquality.

The Study area of our Project is Kattigenahalli, and the Temple is Shanimahathma Temple and Shree Shanaishchara Temple. The waste were collected from these two temples and the sample is prepared. We had prepared four pots of Samples. The pots were prepared by layers of soil and waste. Three layer of soil and three layers of waste each of 5 cm each. Similarly, four pots were prepared. Two pots were kept under direct sunlight and the other two pots were kept under normal room temperature for 15 days. The pots are kept undisturbed until the time period is over.

After this time period of 15 days the samples were given for testing. The parameters which was found was Moisture content, NPK values, Color, C:N ratio, and pH content. After the test results are obtained we have to analyze the values of the samples, so that we can come to a conclusion whether the sample can be used as a bio-fertilizer.

A basic flowchart that shows the method used is:
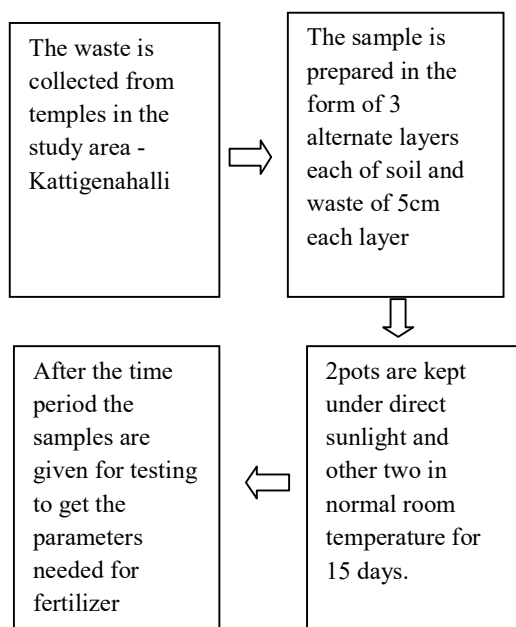
Results

Based on the test results obtained after testing the samples, the required essential nutrients were present in the given sample. The test results obtained are given below:

Based on the test results obtained after testing the samples, the required essential nutrients were present in the given sample. The test results obtained are given below:

Pot 1:

Table 1: Light Brown in Colour and Less Moist in Condition

Condition of Sample	GOOD	
PARAMETERS	UNITS	RESULTS
pH (1:2 Suspension)	---------------	6.30
Moisture content	%	13.0
C:N Ratio	---------------	22.69
Nitrogen as N	%	0.078
Phosphorus as P_2O_5	mg/kg	19.0
Potassium as K_2O	mg/kg	180.0

Pot 2:

Table 2: Light Red in Colour and Moist in Condition.

Condition of Sample	GOOD	
PARAMETERS	UNITS	RESULTS
pH (1:2 Suspension)	---------------	7.39
Moisture content	%	24.5
C:N Ratio	---------------	21.83
Nitrogen as N	%	0.082
Phosphorus as P_2O_5	mg/kg	27.0
Potassium as K_2O	mg/kg	255.0

DISCUSSION

Based on the analyzes we did through this project we found that the NPK values are very much necessary for a bio fertilizer. So the values we obtained from the test samples after testing showed that the pot kept under normal room temperature showed more results than the pots kept under direct sunlight. The moisture level, potassium value, and ph showed values that could be used as a fertilizer.

Nitrogen the N in NPK : Nitrogen is used by the plant to produce leafy growth and formation of stems and branches. Plants most in need of nitrogen include grasses and leafy vegetables such as cabbage and spinach.

Basically, the more leaf a plant produces, the higher its nitrogen requirement.

Phosphorus the P in NPK : Phosphorus is essential for seed germination and root development. It is needed particularly by young plants forming their root systems and by fruit and seed crops. Root vegetables such as carrots, swedes and turnips obviously need plentiful phosphorus to develop well.

Potassium the K in NPK : Potassium has the chemical symbol K from its Latin name kalium. It promotes flower and fruit production and is vital for maintaining growth and helping plants resist disease.It's used in the process of building starches and sugars so is needed in vegetables and fruits. Carrots, parsnips, potatoes, tomatoes and apples all need plenty of potassium to crop well.

CONCLUSION

The results obtained shows that the sample that was prepared can be used as a Bio-fertilizer. The values obtained showed good results of Moisture content, pH , NPK values, which makes a good bio-fertilizer. A bio-fertilizer is main component in agriculture or plantation because it naturally takes the nutrients from the fertilizer. By using chemical fertilizer the plantation might give out immediate results but unfortunately it isn't healthy. Nowadays, people get ill due to food poison and of consuming unhealthy items. By using this fertilizer all the materials used are natural and organic and thus does not create any harm to people consuming it.

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ANALYSIS TIME AND COST OVERRUN FOR CONSTRUCTION PROJECT

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ABSTRACT

The construction sector is large, volatile and requires high investment. The construction industry has major impact on economy of the country and political environment. In many construction projects, project managers and contractors find difficulties like poor planning of project, poor material, labor shortages, insufficient number of equipment, increased cost of material, unexpected weather changes, these factors result into cost and time overruns conflicts in project. This study is carried out to find out the critical factors which cause the delay and cost increase in Indian construction scenario using the statistical analysis tool. The ranking of the factors will be useful for mitigating and increasing the efficacy of the industry. Then a questionnaire survey is done to find the major causes of delay faced by Client, Contractor, and Consultant, miscellaneous. Using RII the delay and cost overrun factors were ranked based upon their impact on the project delay and cost overrun. Respondents have classified into three profiles namely client, contractor and consultant. The responses which we have received from the survey were put through correlation analysis which we have run through the SPSS in order to identify the impact of one category over the other. From correlation we came to know the factors which comes under one category is affecting by other factors which falls under other categories So, by controlling these factors may implement good results to avoid the delay and cost overrun in the projects.

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Keywords: *Delay analysis technique, causes of delay, tools to evaluate delay in construction, delay control measure.*

INTRODUCTION

Construction is one of the major industries in India which contributes about 7% of GDP by giving employment to the organized and unorganized sector of economy. The country's infrastructure fillips the economic viability and sustainability. The construction sector is large, volatile and requires high investment. The construction industry has major impact on economy of the country and political environment. In many construction projects, project managers and contractors find difficulties like poor planning of project, poor material, labor shortages, insufficient number of equipment, increased cost of material these factors result into cost and time overruns, conflicts in project Infrastructure projects in India are infamous for the project delays and cost overrun, which is the common and major problem over the construction sector worldwide. According to the Ministry of Statistics and Project Implementation's (MSOPI) annual report for the year 2017-2018, there is cost overrun for one lakh crore rupees for railway projects and Rs. 6,372 crores cost overrun for road transportation and runways

whereas the cost overrun stands Rs. 12,490 crores for infrastructure projects. These projects delays defer the growth of Indian economy and increases the debt for government, which indirectly results in rise in taxation and reducing the living standard of the People. Moreover, most of the infrastructure projects are funded from tax payer's money. Thereby the failure not only results in intended use of provisions by public on a given time but also results in economic drawdown of the nation. Similarly, cost overruns in public sector projects seem to reduce competitiveness of the economy This statement can be illustrated with the construction of Bogibeel bridge over the river Brahmaputra which reduces the travel time and distance from 4hrs to 30minutes and 500kms to 100kms respectively. The project got delayed by 16years, which stalls the growth in eastern part of India. By the construction of this bridge will improve the transportation of goods and foster the industrial development in the East India and also improves in swifter movement of troops and military tanks during war like situation. This in turn improves the security and quality of living standards of the

locality. Deficiencies in project planning, use of inappropriate procurement contracts and faulty contract management contribute to delays in project implementation. Construction- related commodities costs are expected to continue to increase in the future and these increases will be directly result in higher construction costs. The rate of rise in the prices is unlikely to slow down. Labor costs are also increasing and there is currently a shortage of high end skilled labor/experienced workforce in key city locations. This is likely to have a sizeable impact on tender prices and lead-in times, potentially requiring the use of less skilled labor teams to deliver fast-track projects. The impact could be a reduction in quality. As a result of the current levels of material and labor cost inflation and the buoyant market conditions, contractors are increasing their average margins by between 5% and 7%. These increases are reflected in higher tender prices, particularly on key landmark developments, although on smaller projects contractors are more likely to absorb the increased costs to remain competitive. Hence it is of great importance to identify the causes of schedule and cost overrun of construction project, and to control, monitor such factors effectively and efficiently, so the project undertaken can be completed within stipulated time and in budgeted cost.

Research need:

The construction projects face delays along with the increase in contract price, sometimes results in dispute among the parties. In India most of the infrastructureprojects are facing delays due to various reasons, which freezes the money in the project and also makes it not usable for public who are the tax payers.

Research Aim:

This study is carried out to find out the critical factors which cause the delay and cost increase in Indian construction scenario using the statistical analysis tool. The ranking of the factors will be useful for mitigating and increasing the efficacy of the industry.

Research objective:

• Finding out the major factor affecting the project resulting in delay and increase in cost by questionnaire survey.

• Analyzing the collected data using the statistical tool and converting it into useful information.

• Ascertaining them in the ascending order based on the severity on the delay and cost overrun.

• Finding the correlation between the factors, thereby we can foresee the price escalation and reduce the risk of delay.

Delay:

"Delay is defined as the time extension beyond the scheduled completion period specified in the contract or beyond the date that parties agreed upon for delivery of project". It can also be defined as "late completion of works as compared to the planned schedule or contract schedule." Time overrun is the difference between the estimated project duration and the actual time taken to complete the project. Delays are incidents that impact a project's progress and procrastinate project activities, incidents may include weather delays, unavailability of resources, delays in submission of drawings and RFI's etc., Delays are classified based on their impact on completion time of project and also on the penalty. They are: Non-critical delays: Delays that affects completion time is considered as non-critical delay and has no adverse effect on the completion time of the given project as per the contract.
Excusable delays: Delay caused due to unexpected and uncontrolled activities are called excusable delays. These delays can't be controlled or predicted hence no one can be held responsible. Non-Excusable delays: These delays are caused due to negligence/ignorance of the contractor and hence it is the responsibility of the contractor. Customer is entitled for the remuneration and can claim the damage.

Compensable and Non-compensable delay:

Excusable delays are compensable and hence the contractor can claim for compensation including extension of time and also in terms of monetary value. Whereas the non-

compensable delays attract penalty for the contractor.

If the same type of delay occurs repeatedly, either alone or consequently, which has impact on completion of the project then concurrent delay occurs. This is represented in table

Delays that occur concurrently	Entitlement to the contractor
Excusable and non-excusable	Only time extension granted
Excusable with compensation and excusable without compensation	Entitled to time extension but not for the damages.
Two excusable with compensation	Entitled for both time extension and damages.

Cost overrun:

Cost is the budgeted expenditure for which the contractor has agreed to finish the work or project within the specified time to the client. The difference between the actual or estimated cost of the project from the actual budgeted cost at the starting time of project is called as cost overrun. Actual cost is the accounted cost actually spent, determined at the time of completion of the project. Estimated cost is the budgeted cost or forecasted costs at the time of proposal of the project. The cost of project is categorized as: Direct cost:This cost is directly employed for the execution of the activities which include labor cost, material cost and machinery cost. This cost increases as the crashing of activities takes place. Hence it is indirectly related to the delay and has cost implications.

Indirect cost: The cost involved in establishment of organization, administration, overheads and contingencies comes under indirect cost. It remains constant all over the project irrespective of the delay of completion of time. This cost cannot be identified with the performance of the activity. In other words, all cost other than direct costs are covered under indirect cost.

Methodology:

These are two types of information sources
Primary: Information gathering where the analyst collects the information by face to face interviews or discussions with members, questionnaire and also can be gathered through phone interviews, email exchange, trials and meetings.

Secondary : Information accessible from sources gathered by researches, survey officials and not for particular exploration issues under control. The major sources are internet materials, media reports, exploration papers and diaries.

This research could be divided into two types of methodologies

Quantitative methods:

Quantitative research method can be identified as collection of information as explanation of phenomena which can be analyzed numerically based in mathematical ways. The results are presented by using statistics, table and graphs. However, large scale of units is required to provide information in breadth and it is considered as shallow method of study of concept. This study consists of two phases of assessments. In first phase, the data are collected from secondary sources. While in second phase, close ended questions are circulated to the industry people for continuing the collection of secondary data. The aim is to test the hypotheses and make predictions to generate results which confirms or refuse the hypotheses.

Qualitative method:

Qualitative research method helps us to understand, makes sense of what the actual ground reality is. Instead of generating numerical data which will later be interpreted using statistical tools and hypotheses.

Qualitative research method gives us a descriptive narrative of setting or practice with the help of case studies and observations. These practices turn the scenario into a series of representations consisting of interview, conversation, notes, photographs, memos and audio recordings. It's more suitable to provide details which help us understand viewpoints of the research population and its context.

The Adopted Research Method:

Considering the ease with which data can be collected and analyzed, quantitative method is opted for the research. Statistical test will be run on the data collected to test the hypotheses.

Descriptive analyses will be performed on the attributes using the data collected in the survey. Descriptive analysis is an important measure for ranking the attribute in terms of their criticality as perceived by the respondents. Relative Importance Index (RII) will be adopted for analyzing the responses and it will be useful to highlight the relative importance of attributes as perceived by the respondents. To study the degree of agreement between two parties' sets of ranking, the Pearson's rank correlation coefficient will be used in this research study.

Literature review → Factors causing delay and cost → Categorizing the delay into groups → Preparation of questionnaire survey in Google Forms → Analysis of response obtained from the survey using RII and Pearson's → Ranking of delay factors. → Identifying the correlation between the factors using Pearson's rank correlation. → Identifying the major causes of delay and cost overrun from ranking and correlation.

Questionnarie survey

For this research, a questionnaire survey method has been adopted to find the impact of critical Factors that lead to delay on resource related I the Indian construction industry drawing from various international researchers. A questionnaire survey was Conducted of construction professionals consisting of project managers, consultants, contractor, clients representatives and construction managers. Heterogeneity of respondents is a imp criteria in capturing the impact of various attribute on

construction delay. This also helps for the analysis of such data using SPSS Software.

Preparation of questionnaire:

Identification of critical attributes for the study and Preparation of questionnaire is a crucial step for the successes of research. The questionnaire is divided Into 2 parts. The first part of the questionnaire collects the background information of the responds The second part consist of key delays and Cost overrun attributes which were identify under 4 category namely client related, consultant related

Contractor related, and miscellaneous. A five point liker scale (1 poor impact,2 low impact, 3 medium impact, 4 high impact, 5 severe impact)was adopted the respondents were request to rank the importance and impact of particular attribute on delay and cost
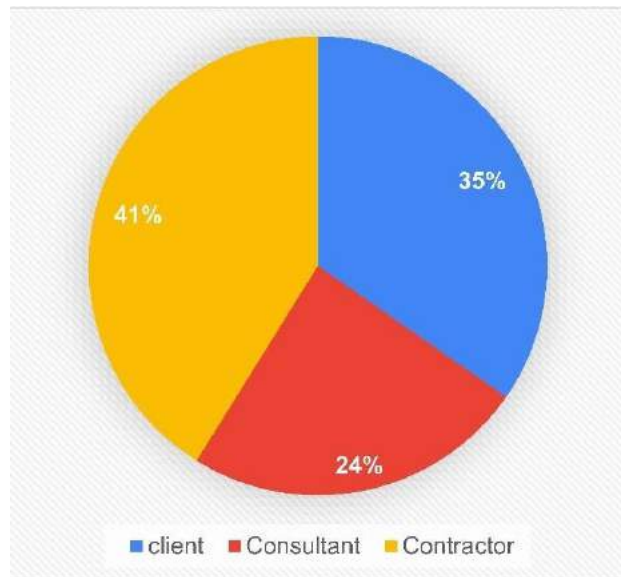
FIG 1 Respondent's demographic

Categories of factors causing Delay and cost overrun

CONTRACTOR CATEGORY	
1.	Non-compliance of safety practices leading to accidents.
2.	Timely unavailability and failure of Plant and machinery.
3.	Monopolistic pricing by vendors of equipment services.
4.	cost incurred for rehabilitation measures.
5.	Under estimation of original cost.
7.	Resource scarcity.
8.	Lack of technology.
9.	Rework due to error in design, execution or due to non-conformance to quality.
10.	Low productivity of labour and equipment.
11.	Poor site management (leading to wastages of materials and man hours).
12.	Lack of skilled labor and operator.
13.	Omission and error in bill of quantities.

14.	Unavailability of land for material storage and precast yard.
CLIENT CATEGORY	
1.	Land acquisition.
2.	Delay in permit, approvals and inspection.
3.	Ambiguous contractual clauses.
4.	Law & order problems.
5.	Delay in payments.
6.	Geological surprises (such as aquifers, swampy land, rock strata, glaciers etc..,) unforeseen ground conditions.
7.	Litigations, conflicts and disputes.
8.	Delay in handing over the site.
CONSULTANTS CATEGORY	
1.	Delay in finalizing the detailed drawings.
2.	Inaccurate site investigation.
3.	Slow decision making.
4.	Lack of communication between the parties.
MISCELLANEOUS CATEGORY	
1.	Political intervention
2.	High Inflation, Interest rate and Insurance.
3.	Price fluctuations.
4.	Amendment in Government Taxation Scheme.
5.	Change in Government Regulation and Laws.
6.	Force Majeure.

Calculations of relative importance index (rii):

Many researchers are having a opinion that mean and standard deviation of each individual attribute is not a suitable measure to assess overall rankings as they do not reflect any relationship between them and hence used RII which can be calculated using the following equation

RII (Relative Important Index) = $\Sigma W/A*N$
Where W= weight given to each attribute by respondent A= Highest weight, N= Total number of respondents

The attributes are arranged in ascending order of ranks, attribute with highest RII or rank 1 indicates that it has the maximum impact on the delay while the attribute with lowest rank indicates that it has the least impact on factors causing delay and cost overrun. However, the

RII doesn't talk about the relationship between   the various attributes.

RANK OF CAUSES BASED ON THE RII	RANK
Delay in Payments.	1
Land Acquisition	2
Delay in finalizing the Detailed Drawings	3
Poor Site Management.	4
Delay in handing over the site.	5
Rework due to error in Design, Execution or due to Non-Conformance to Quality.	6
Change of Scope and Specifications	7
Litigation's, Conflicts and Disputes.	8
Delay in acquiring Permit, Approvals and Inspection.	9
Low Productivity of labor and equipment.	10
Lack of Communication between the parties.	11
Law & Order problem.	12
Political Intervention	13
Lack of Skilled labor and operator.	14
Non-Compliance of Safety practices leading to accidents.	15
High Inflation, Interest rate and Insurance.	16
Price fluctuations	17
Monopolistic Pricing by vendors of equipment services.	18
Inaccurate Site Investigation.	19
Amendment in Government Taxation Scheme	20
Change in Government Regulation and Laws.	21
Lack of Technology.	22
Omission and Error in Bill of Quantities	23
Ambiguous Contractual Clauses.	24
Unavailability of Land for material storage and precast yard.	25
Force majeure	26

Geological Surprises and Unforeseen Ground Conditions.	27
Timely unavailability and failure of Plant and machinery.	28
Cost incurred for Rehabilitation measures.	29

Pearson's Correlation:

The Pearson's correlation is the test statistics that calculate the statistical association between two continuous variables. This is known as the best way to calculate the relation between interest variables since this is based on the covariance method. Thisprovides information on the association's extent, or correlation, as well as the relationship path On each representative of a sample, multiple quantitative variables are often calculated. If we consider a couple of such variables, it is often of interest to determine whether there is a relationship between the two; i.e. to see whether they are correlated.

We may categorize the form of correlation by considering what happens to the other variable when one variable increases

•   Positive correlation – the other variable has a tendency to also increase;

•   Negative correlation – the other variable has a tendency to decrease;

•   No correlation – the other variable does not tend to either increase or decrease.

correlation test helps us answer few very important questions like, is there a statistically significant correlation between delay & cost overrun with the factors identified? Is there a statistical connection between them

SPSS Statistical Tool:

SPSS Statistics is a software package used for interactive or batched, statistical analysis. Long produced by SPSS Inc., it was acquired by IBM in 2009. The current versions are named IBM SPSS Statistics. Originally it is an acronym of Statistical Package for the Social Science but now it stands for Statistical Product and Service Solutions One of the most popular statistical packages which can perform highly complex data manipulation and analysis with simple instructions.

SPSS is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners and others. In addition to statistical analysis, data management (case selection, file reshaping, creating derived data) and data documentation (a metadata dictionary is stored in the datafile) are features of the base software. Statistics included in the base software
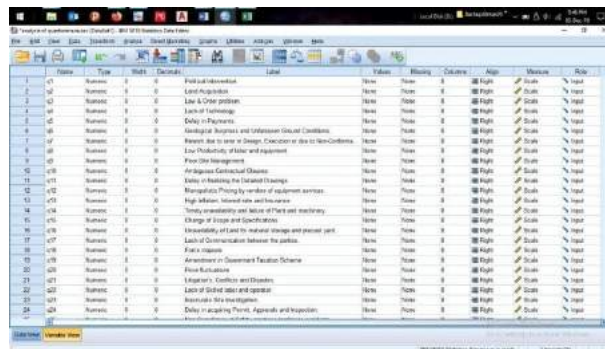
Fig 2; Variable View

Figure 2 shows the Variable view in SPSS tool where we enter the questionnaire under the label column. The type of measurement we adopted in the questionnaire is "Scale" which is opted in the measurement column
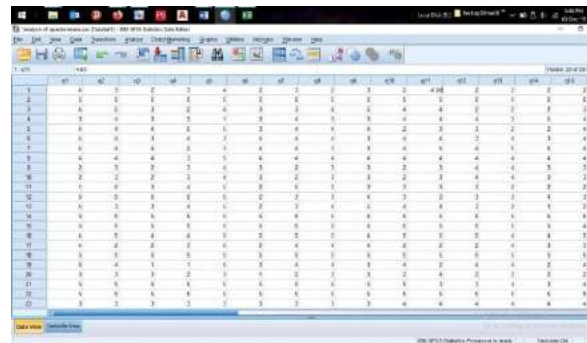
Fig 3;Data View

The data view tab in SPSS tool is shown in Figure3. in which we can import the responses gathered from the google form to the tool.
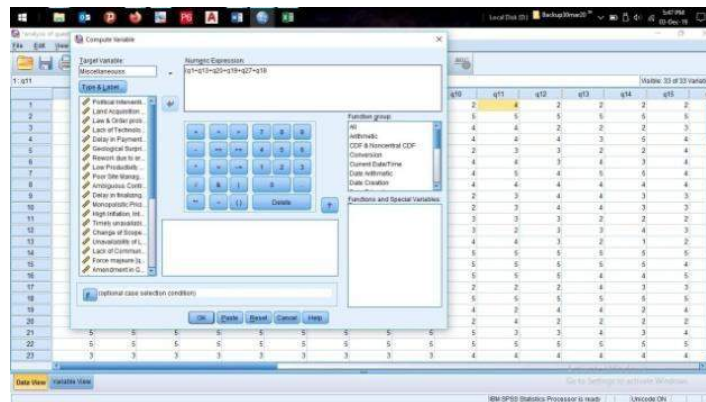
Fig 4; Average Rating of Responses

Figure 4. gives the picture of calculating the average rating of responses based on the respective categories. This will be useful for finding out the correlation between the categories of causes
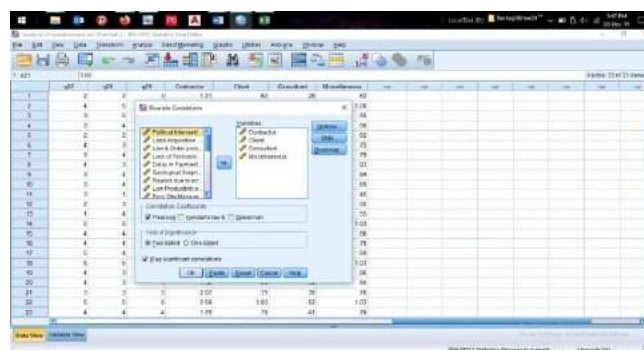
Figure5; Pearson Correlation

Figure5 Illustrate the Pearson correlation in SPSS tool. The dialog box consists of variable content for which correlation has to be found out. In this project we consider about the correlation between contractor, consultant, client and miscellaneous categories

Results and Discussion
Pearson correlation test results:

The statistical analyses of the severity and frequency Reponses indicate that the data has good compactness and homogeneity. It also

shows that the participants are highly agreed on the impact and frequency of the top affecting   factors. As shown in figure 6

Correlations

		Contractor	Client	Consultant	Miscellaneous
Contractor	Pearson Correlation	1	.693**	.683**	.778**
	Sig. (2-tailed)		.000	.000	.000
	N	125	125	125	125
Client	Pearson Correlation	.693**	1	.577**	.549**
	Sig. (2-tailed)	.000		.000	.000
	N	125	125	125	125
Consultant	Pearson Correlation	.683**	.577**	1	.575**
	Sig. (2-tailed)	.000	.000		.000
	N	125	125	125	125
Miscellaneous	Pearson Correlation	.778**	.549**	.575**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	125	125	125	125

**. Correlation is significant at the 0.01 level (2-tailed).

Figure6; Pearson Correlation Results (SPSS Tool)

- Pearson's test indicates that there is a great influence on contractors work due to indirect factors. i.e. to say factors categorized under OTHERs are affecting the contractor, by Pearson correlation test we infer that contractor and other factors are closely related (correlation value: 0.778).

 E.g.: let us consider political intervention under other category is affecting law and order problem in contractor category

- Pearson's test indicates that there is a great influence on client work due to indirect factors. i.e. to say factors categorized under contractor are affecting the contractor, by Pearson correlation test we infer that client and contractor factors are closely related (correlation value: 0.693).

E.g.: let us consider delay in handing over the site under client is affecting delay in acquiring permit, approvals, inspection in contractor category

- Pearson's test indicates that there is a great influence on consultant work due to indirect factors. i.e. to say factors categorized under contractor are affecting the contractor, by Pearson correlation test we infer that client and contractor factors are closely related (correlation value: 0.683.

E.g.: let us consider delay in finalizing the detailed drawings under consultant is affecting

delay in execution or due to non-performance to quality in contractor category.

CONCLUSION

- Thus, from above study we have identified the factors affecting for delay and cost overrun analyzed are substantiated them from the results of responses.
- Using RII the delay and cost overrun factors were ranked based upon their impact on the project delay and cost overrun. Respondents have classified into three profiles namely client, contractor and consultant.
- The responses which we have received from the survey were put through correlation analysis which we have run through the SPSS in order to identify the impact of one category over the other.
- According to results which we have got the major factor is delay in payment which comes under client category which defers the contractor's procurement and construction activity. Like this the factors are analyzed and factors are correlated.
- From correlation we came to know the factors which comes under one category is affecting by other factors which falls under other categories.
- So, by controlling these factors may implement good results to avoid the delay and cost overrun in the projects

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GEOMETRIC DESIGN AND QUANTITY TAKEOFF OF THE PROJECT ROAD BY USE OF CIVIL 3D

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Abstract

Road network plays a vital part in India's economy. The road network in our nation is considered as a significant factor to the nation's development, social joining and security needs of the country. The Government of India energizes foreign investments in highway projects to fetch out high standards and quality. The traffic volume conveyed by the state highways nearly surpasses the designed traffic volume, and henceforth the necessary speed cannot be achieved. In this manner extending of highways gets fundamental. The increment in population is additionally to be considered and consequently arrangement for future broadening is to be given. This dissertation presents the geometric design for broadening of SH-95 is carried out utilizing Autodesk Civil 3D software according to IRC rules. This design consists of horizontal alignment, vertical profiling and computation of earthwork quantities throughout the stretch of the project road, according to the existing topographic data. The radius of the curve has been increased to form a smooth curve. Also, the vertical profile has been designed based on the permissible gradient and sight distances. From this, convenience of more traffic volume and increment of design speed seems to be reachable.

Keywords: *Autodesk Civil 3D,Geometric Design, Road Alignment.*

INTRODUCTION

In olden days generally we are concerned with the structural design because the traffic volume was very less, the speed was very less and other vehicles with very small speed were moving on the road, so geometric design was not important in that time. But with the passage of time traffic volume increased, second thing is the speed of the vehicles increased, so for the safety and a smooth flow of the traffic the need was felt for the accurate design of geometry of highways. So with the time there was a shift from the structural design to the geometric design and now the geometric design is much more important from the point of view of the safe passage as well as for smooth passage of road users. A structural design is important from the point of the life of the road but here in case of geometric design it is directly related to the loss of life, loss of economy, Because if accidents occur the financial losses will be there and loss of lifeas well. Therefore just to reduce the financial losses as well as the losses of life, this geometric design is very important.

Autodesk Civil 3D

The Autodesk Civil 3D is a BIM solution for civil engineering design and documentation. Civil 3D is extremely helpful software for civil engineers, drafters, designers who are working on transportation, land development and water projects. With the associate of Autodesk Civil 3D, project representation, examination and planning become very simple.

People who are at present utilizing Autodesk or plan on learning Autodesk will acquire a few advantages of utilizing Autodesk Civil 3D. Autodesk Civil 3D was initially made to be an extra for Autodesk anyway as its prominence and request developed, it had been additionally advanced and formed into a total item based on the Autodesk stage

OBJECTIVES

- To carry out the geometric design of 10 Km stretch of SH-95 (Hoskote to Malur) from two lane to four lane road according to IRC rules.
- Designing of flexible pavement as per IRC:37-2018 method
- Quantity extraction in selected stretch using Civil 3D

Study area location

The project region is situated in Bangalore region of Hoskote taluk from Hoskote to Malur. Project area explore through plain

terrain and rolling terrain. Existing investigation region comprises of asphalt road.Existing road is a 2- lane undivided carriageway with Unpaved shoulders on both sides.In this project a road length of 10 Km of SH-95 from Km 6+800 to Km 16+800 has been studied, analyzed and also the geometric design as per four lane standards using Autodesk Civil 3D software has been executed.
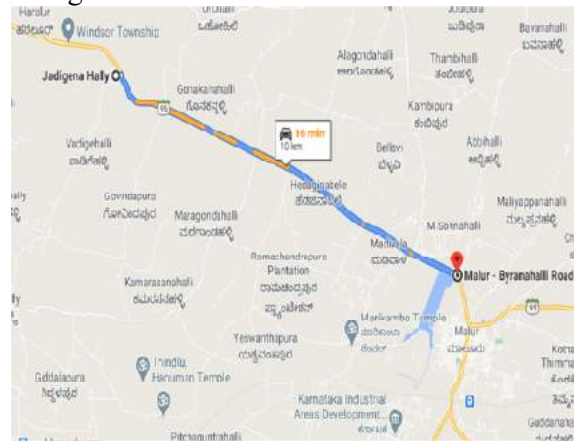
Figure 1: Location map of the Project road

METHODOLOGY

- Topographic survey- This will include existing features, the elevations of the ground and any utilities that might be present on the surface.
- Traffic survey and analysis- This step comprises of collection of data connected to traffic studies, axle load survey and subgrade CBR values from the field. From the information acquired, flexible pavement will be designed with the assistant of rules referenced in IRC: 37-2018. Then analyze the pavement utilizing software IITPAVE.
- Roadway design- The further step is to propose design of road alignment elements such as Horizontal Alignment, Vertical Alignment etc. by use of Autodesk Civil 3D software.

Highway Project

Public work department, Government of Karnataka, has appointed Winsun Global Tech as consultants for carrying out Feasibility Study, survey and preparation of Detailed Project Report, for Widening and strengthening /Reconstruction of Existing Pavement from two lane to four Lane(SH-95 from Hoskote to Malur). Length of project road is 10 km.

DATA COLLECTION

- Topographic survey: The profile survey was done for 10 km (from 6.8 km to 18 km) at an interval of 30m along the alignment(longitudinally) and 3m interval up to 20m across the road on either side(transverse). This consists of X, Y, Z. co-ordinates.
- Traffic Volume Count Survey: The classified traffic volume count is carried out at location along the project corridor. This traffic volume count survey has been carried out for 3 continuous days 24 hours.
- Axle load Survey: The wheel load surveys were carried out using a portable wheel weighing equipment with a capacity of 20 tones.

Design of flexible pavement as per IRC: 37-2018

Table 1: Design Parameters of Pavement Design

Sl. No.	Design Parameters	Location near jadigenahalli
1	4 days soaked CBR	10%
2	Construction Period	2 Years
3	Design Lane	4 Lane
4	Design life (n)	20 Years
5	Growth rate ®	5%
6	Traffic (CVPD)	1490
7	VDF (D)	6
8	Lane Distribution Factor (F)	0.75

Calculation of Design Traffic
- ✓ Design Traffic for 20 years
- ✓ Number of Commercial Vehicle For Four lane of road=P =1490
- ✓ $A = P(1+r)^x = 1642$ CVPD
- ✓ Annual growth rate of commercial Vehicles r = 5%
- ✓ Vehicle Damage factor D = 6
- ✓ $$N = \frac{365*\left[(1+r)^n - 1\right]}{r} * A * D * F$$
- ✓ N = 89 msa

Table 2: Pavement compositions

Pavement layers	Designed Crust
BC	45
DBM	100
WMM	250
GSB	200
Total	595

Total station

Total Station is a tool that we use for surveying to take distance, angle, and elevation measurements. The total station is used to find the existing condition of land. This will include existing features, the elevation of the ground and any utilities that might be present on the surface. We are finding out the difference in height between two point horizontal and vertical measu combine them and create a fu to show the exact conditior surface.

The survey file used for geometry of road in the softw total station is as follows:

Table 3: The Format of survey file used in designing

Points No	Easting (m)	Northing (m)	Elevation (m)
1	804312.451	1446860.898	881.603
2	804211	1447012.393	880.495
3	804223.335	1447004.965	880.897
4	804220.095	1447007.953	880.896
5	804222.371	1447004.31	880.978

Design Standards adopted

Sl. No	Items	Standards
1	Design Speed	80 kmph
2	Cross sectional requirements (Rural Section)	
	a) Right of way (ROW)	40m
	b) Width of Carriageway on both sides of median (2-lane Carriageway with each lane 3.5m)	7.0m (3.5*2)
	c) Minimum width of median	1.2 m
	d) Paved shoulder width	1.5m
	e) Earthen shoulder width	2.0 m
	f) shyness	0.25m
3	Horizontal Radius of Curvature	
	a) Desirable minimum Radius	400m
	b) Absolute minimum radius	250m
	c) Desirable minimum radius requiring no superelevation	2000m
	d) Desirable minimum radius requiring superelevation	250m
4	Camber / cross fall	
	a) Carriageway including paved shoulder	2.5%
	b) Earthen shoulders	3.0%
5	Superelevation	
	a) Desirable	5.0%
	b) Maximum	7.0%
6	Stopping Sight Distance	
	a) Desirable	260m
	b) Minimum	130m
7	Vertical Alignment	
	a) Minimum length of vertical curve	50m
8	K value	
	a) Minimum K for SSD	32.6
	b) Minimum k for PSD	60
	c) Minimum K for HSD	25.3

Roadway Design on Autodesk Civil 3D
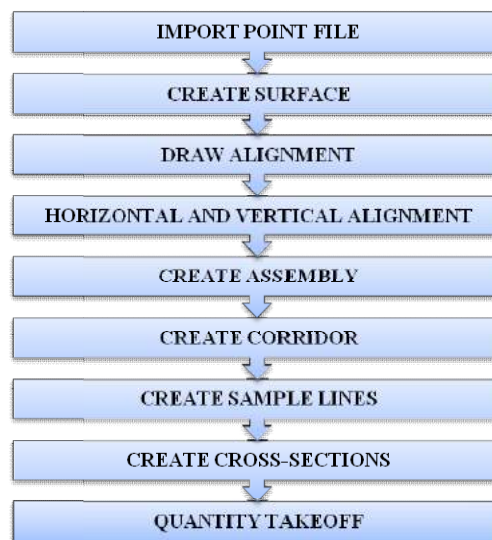
Figure 2: Flow Chart of Autodesk Civil 3D

The first step in the Autodesk Civil 3D software is importing the data which is collected from the total station survey. The survey data is first copied to the excel sheet and then imported to the software. A Surface is nothing but the digital representation of Project area. To proceed further with the road design procedure the project area should be identified first on the drawing.After creating the surface, further step in the Civil 3D software is alignment creation.Further we need to have the assemblies and subassemblies because we know where the alignment starts and where it ends. But we have not defined how many lanes, what is the slope of the lanes? What the thickness of each pavement layer? So all these information will be included in this step. In the next step we need to create a corridor for our road. After creating the corridor we will be able to calculate the earthwork needed for our road.To create the cross sections the software needs sample lines from the corridor. The

sample lines represent where we want to have a sections for the highway. And also sample lines are used for other calculations like earthwork.

The beneath figures shows the design procedure
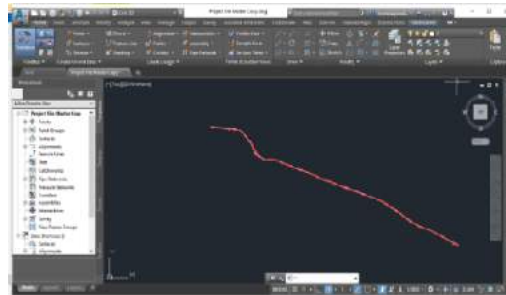
Figure 3: Import Point File
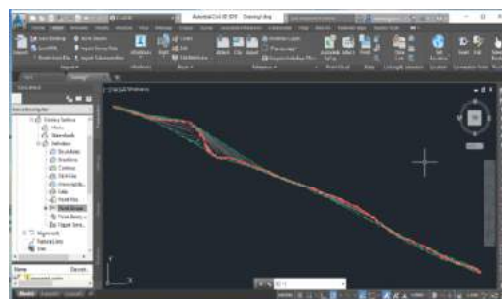
Figure 4: Surface Creation
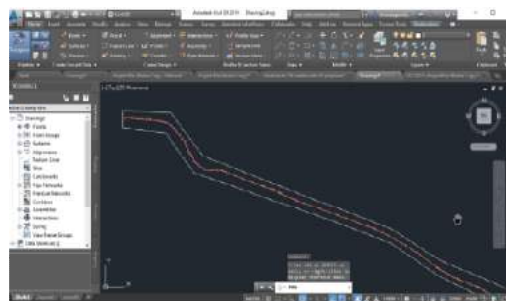
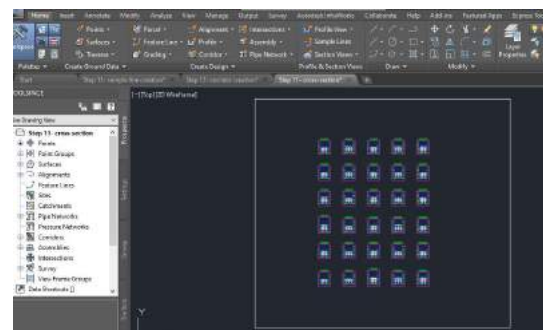**Figure 5: Horizontal Alignment Creation**
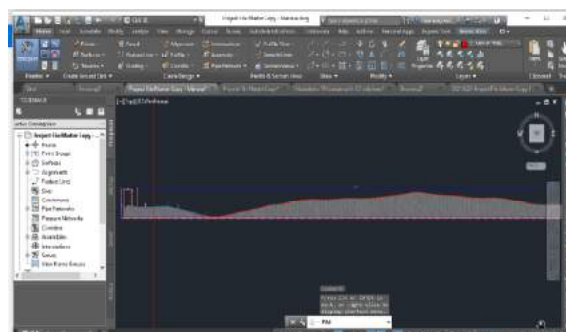
Figure 6: Vertical Profile creation
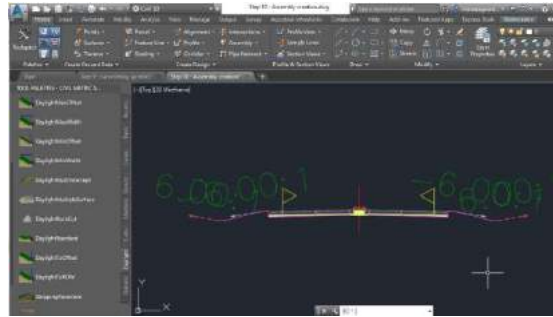
Figure 7: Assembly creation
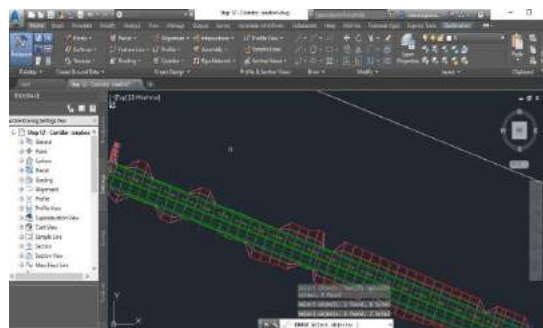
Figure 8: Corridor Creation
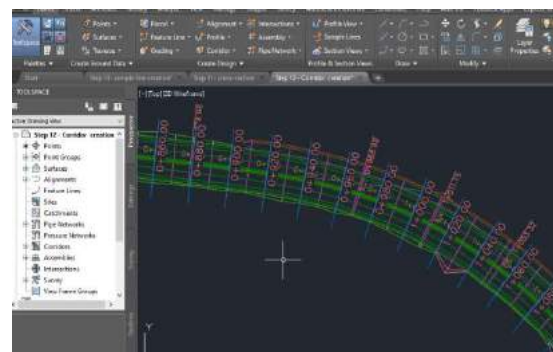
Figure 9: Sample line Creation

Figure 10: Road Cross-sections
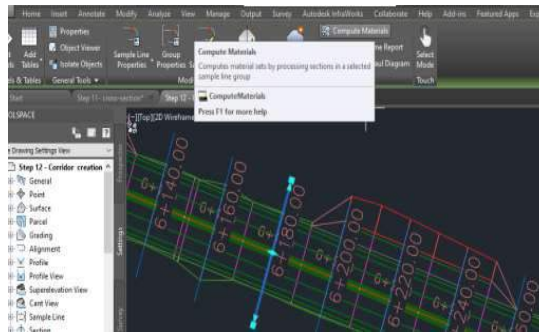
Figure 11: Quantity Takeoff

RESULTS AND DISCUSSIONS

Drawings are the outcomesacquired for the proposed road and successively tabular column are created automatically with details.

We will get the details of formation level, cross sections, and curve details along with the details of earthwork quantity for the project road.

CONCLUSIONS

- Geometric design for the widening of SH-95 from 2-lane to 4-lane has been carried out utilizing Autodesk Civil 3D software according to IRC rules.
- A pavement Crust thickness of 595 mm is adopted based on projected traffic – 89 MSA and subgrade soil strength CBR- 10%.
- Earthwork quantityis extracted for the selected stretch of Project road by using Civil 3D.

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APPLICATION OF A QUINTIC SPLINE FUNCTION OF CONTINUITY CLASS C2 FOR SOLVING CAUCHY INITIAL VALUE PROBLEM

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ABSTRACT

Here we have considered a quintic spline function which is obtained for (0, 1, 4) lacunary interpolation problem. In the present paper we have shown that this quintic spline function can be used to solve Cauchy Initial Value problem. Here we have shown the application of this spline function.

1. INTRODUCTION

This paper is an extension of our latest work (Singh Kulbhushan 2019) [12]. In that we found a special quintic spline function for (0, 1, 4) lacunary Interpolation problem, where firstly we have shown that this spline function exists uniquely later we found the error bounds to show the convergence of this function.

Actual idea of this type of problem was initiated by Micula [3] for finding the approximate solution of nonlinear second order differential equations through splines. There he used a spline function to obtain the approximate solution of Cauchy's problem.

$$(1.1) \quad \begin{cases} y'' = f(x, y, y'), x \in [0,1] \\ y(0) = y_0, y'(0) = y_0' \end{cases}$$

We use the following results, which have been obtained in our latest work [12].

Theorem of Unique Existence

Given Δ and the real numbers y_k, y_k', $y_k^{(4)}$, k= 0,1, …,n ; y_0'', y_n'' ; there exists a unique spline function s_Δ (x)$\in S_{n,5}^{*(2)}$ such that

$$(1.2) \quad s_\Delta^{(p)}(x_k) = y_k^{(p)}, \ k = 0,1, …, n; p = 0, 1, 4,$$

$$(1.3) \quad s_\Delta''(x_0) = y_0'' , \quad s_\Delta''(x_n) = y_n''$$

Theorem of Convergence

Let $f(x) \in C^5(I)$. Then for the unique spline function $s_\Delta(x)$ mentioned in above theorem, with y_k, y_k' etc. being associated with the function f(x), that is $y_k = f(x_k)$, $y_k' = f'(x_k)$ etc.; we have for $x \in [x_k, x_{k+1}]$, k = 0, 1, … , n –1,

$$(1.4) \quad \left| s_\Delta^{(p)}(x) - f^{(p)} \right| \le C_{\Delta,p} \ h^{5-p} \ \omega_5(h), \ p = 0, 1, …, 5.$$

Here $h_k = h$ for all k = 0, 1… n –1 and denote the modulus of continuity of $f(x) \in C^5(I)$ by $\omega_5(h)$. The coefficients $C_{\Delta,p}$ are different constants.

Now we use the above mentioned spline function to obtain an approximate solution of Cauchy's initial value problem given by (1.1)

Let y(x) be the true solution of the Cauchy's problem (1.1) and let $\overline{s}(x)$ be the spline function approximating the solution y(x). Then we study how smooth $\overline{s}(x)$ produces an approximation to y(x). For similar study kindly refer (Singh et. al 2014) [10].

2. Preliminaries.

This section contains some assumptions regarding the function f(x, y, y') in the differential equation (1.1) and definition of the approximate value given by T. Fawzy [5] and also the error estimates of these approximate values to the exact values. We assume that f[x, y(x),y'(x)]$\in C^r[0,1]$ and that it satisfies the Lipschitz condition

(2.1) $| f^{(q)}(x, y_1, y_1') - f^{(q)}(x, y_2, y_2') | \leq k\{ |y_1 - y_2| + |y_1' - y_2'| \}$

for all $x \in [0,1]$ and all real numbers y_1, y_2, Here k is some Lipschitz constant and $q = 0, 1, \ldots, r$. These conditions ensure the existence of unique solution of the problem (1.1)

Let y (x) be the true solution of (1.1) with given initial value $\bar{y}^q = y^{(q)}(x_k)$, $q = 0, 1, \ldots, r$. Then T. Fawzy [5] has defined the approximate values $\acute{y}_k^{(q)}$ to the true values $y_k^{(q)}$ as follows:

$$\bar{y}_0 =$$
$$y_0, \quad \bar{y}_0' = y_0', \bar{y}_0^{(q+2)} = f^{(q)}(x_0, y_0, y_0'),$$

$$\bar{y}_{k+1} = \bar{y}_k + h\bar{y}_k' + \int_{x_k}^{x+1} \int_{x_k}^{t} f[u, y_k^*(u),$$
$y_k^{**}(u)]$ du dt,

$$\bar{y}_{k+1}' = \bar{y}_k' + \int_{x_k}^{x_{k+1}} f[t, y_k^*(t), y_k^{**}$$
(t)]dt ;

$$\bar{y}_{k+1}^{(q+2)} = f^{(q)}(x_{k+1}, \bar{y}_{k+1} + \bar{y}_{k+1}'), q$$
$= 0 (1) r$, $k = 0 (1) m - 1$,

where

$x_k = k/m$, $x_m = 1$, $h = 1/m$

and

$$y_k^*(x) = \sum_{j=0}^{r+2}\{(\bar{y}_{k^{(j)}}/j!)(x - x_k)^j\}, x_k \leq x \leq x_{k+1},$$

$$y_k^*{}'(x) = \sum_{j=0}^{r+2}\{(\bar{y}_{k^{(j+1)}}/j!)(x - x_k)^j\},$$

$$y_k^{**}{}'(x) = \bar{y}_k' + \int_{x_k}^{x} f[t, y_k^*(t), y_k^*{}'(t)]dt$$

As to the speed of convergence of these approximate value, T. Fawzy [6] has

obtained the estimates

(2.2) $| y_{k+1}^{(j)} - \bar{y}_{k+1}^{(j)} | \leq c_j h^{r+2} \omega_{r+2}(h), j = 0$
(1) n – 2, k = 0 (1) n – 1.

For the value $\bar{y}_1$ and $\bar{y}_1'$ even sharper estimates

$$| y_1 - \bar{y}_1| \leq c_0 h^{r+4} \omega_{r+2}(h), | y_1' - \bar{y}_1'|$$
$\leq c_1 h^{r+3} \omega_{r+2}(h)$

are valid. In (2.2) c_j's denote different constants and

$$\omega_{r+2}(h) = \sup_{|x-x_i| \leq h} | y^{(r+2)}(x) - y^{(r+2)}$$
$(x_1) |$

is the modulus of continuity.

3. Spline Function Interpolants

In this section we give the definition and construction of lacunary spline

interpolants which approximate the solution of the differential equation (1.1).

We have

Theorem 3.1

Given Δ and the real numbers $\bar{y}_k, \bar{y}_k', \acute{y}_{k+1}^{(4)}$, k = 0 (1) n; $\bar{y}_k'', \bar{y}_n''$; there exists

unique $\bar{s}_\Delta(x) \in S_{n,5}^{(2)}$ such that

(3.1) $\bar{s}_\Delta^{(p)}(x_k) = \bar{y}_{k^{(p)}}$,   k = 0 (1) n;   p = 0, 1, 4;

(3.2) $\bar{s}_\Delta''(x_0) = \bar{y}_0''$, $\bar{s}_\Delta''(x_n) = \bar{y}_n''$

Proof

For the explicit form we have

$$\bar{s}_\Delta(x) = \begin{cases} \bar{s}_0(x) & \text{when } x \in [x_0, x_1] \\ \bar{s}_k(x) & \text{when } x \in [x_k, x_{k+1}], k = 1(1)n-2 \\ \bar{s}_{n-1}(x) & \text{when } x \in [x_{n-1}, x_n]; \end{cases}$$

where

$$\bar{s}_0(x) = \bar{y}_0 + (x - x_0)\bar{y}_0' + (x - x_0)^2/2!\bar{y}_0'' + (x - x_0)^3/3!\bar{a}_{0.3} +$$
$$+ (x - x_0)^4/4!\bar{y}_0^{(4)} + (x - x_0)^5/5!\bar{a}_{0.5} + (x - x_0)^6/6!\bar{a}_{0.6}$$

$$\bar{s}_k(x) = \bar{y}_k + (x - x_k)\bar{y}_k' + (x - x_k)^2/2!\bar{a}_{k.2} + (x - x_k)^3/3!\bar{a}_{k.3} +$$
$$+ (x - x_k)^4/4!\bar{y}_k^{(4)} + (x - x_k)^5/5!\bar{a}_{k.5}$$

$$\bar{s}_{n-1}(x) = \bar{y}_{n-1} + (x - x_{n-1})y_{n-1}' + (x - x_{n-1})^2/2!a_{n-1} + (x - x_{n-1})^3/3!a_{n-1}$$
$$+ (x - x_{n-1})^4/4!\acute{y}_{n-1}^{(4)}$$
$$+ (x - x_{n-1})^5/5!a_{n-1} + (x - x_{n-1})^6/6!a_{n-1}$$

Using these equations we can obtain the values of the coefficients $\bar{a}_{0,3}$, $\bar{a}_{0,5}$, $\bar{a}_{0,6}$, $\bar{a}_{k,2}$, $\bar{a}_{k,3}, \bar{a}_{k,5}$, $\bar{a}_{n-1,2}$, $\bar{a}_{n-1,3}$, $\bar{a}_{n-1,5}$, $\bar{a}_{n-1,6}$

4. Theorems of Convergence for $\bar{s}_\Delta(x)$

Let $s_\Delta(x)$ be the spline function of Section 1 corresponding to the

approximate values y_k and let $\bar{s}_\Delta(x)$ be the spline function of Section 2

corresponding to the exact solution of $\bar{y}_k$ of (1.1). Then we have

Theorem 4.1

(4.1) $\left| s_0^{(q)}(x) - \bar{s}_0^{(q)}(x) \right| \leq c$ $h^{7-q}\omega_5(h)$, $q = 0\ (1)\ 6$,

(4.2) $| s_k^{(q)}(x) - \bar{s}_{k^{(q)}}(x) | \leq c\ h^{5-q}\omega_5(h)$, $q = 0\ (1)\ 5$,

(4.3) $| s_{n-1}^{(q)}(x) - \bar{s}_{n-1^{(q)}}(x) | \leq c$ $h^{5-q}\omega_5(h)$, $q = 0\ (1)\ 6$.

Here and onward c will denote different constant independent of h.

Proof

We have

$s_0(x) - \bar{s}_0(x) = (x-x_0)^3/3! \left(a_{0,3} - \bar{a}_{0,3}\right) + (x-x_0)^4/4! \left(y_0^{(4)} - \bar{y}_0^{(4)}\right) +$

$+ (x-x_0)^5/5!\ (a_{0,5} - \bar{a}_{0,5}) + (x-x_0)^6/6!\ (a_{0,6} - \bar{a}_{0,6})$.

Now

$a_{0k,3} - \bar{a}_{0,3} = 18\ h^{-3}\ (y_1 - \bar{y}_1) - 4\ h^{-2}\ (y_1' - \bar{y}_1') + h/60\left(y_1^{(4)} - \bar{y}_1^{(4)}\right)$.

Using (1.3) we get

$| a_{0,3} - \bar{a}_{0,3} | \leq c\ h^7\omega_5(h) + c\ h^4\omega_5(h) + c\ h^6\omega_5(h)$ $\leq c\ h^4\omega_5(h)$.

On the same lines

$| a_{0,5} - \bar{a}_{0,5} | \leq c\ h^2\omega_5(h)$

and

$| a_{0,6} - \bar{a}_{0,6} | \leq c\ h\ \omega_5(h)$.

Hence

$| s_0(x) - \bar{s}_0(x) | \leq c\ h^7\omega_5(h)$.

By successive differentiation, we have (4.1). To prove (4.2) we consider

$s_k(x) - \bar{s}_k(x) = (y_k - \bar{y}_k) + (x - x_k)(y_k' - \bar{y}_k') + (x - x_k)^2/2!\ (a_{k,2} - \bar{a}_{k,2}) +$

$+ (x - x_k)^3/3!\ (a_{k,3} - \bar{a}_{k,3}) + (x - x_k)^4/4!\left(y_k^{(4)} - \bar{y}_k^{(4)}\right) +$

$+ (x- x_k)^5/5!\ (a_{k,5} - \bar{a}_{k,5})$.

Here

$| a_{k,2} - \bar{a}_{k,2} | \leq ch^3\omega_5(h)$,

$| a_{k,3} - \bar{a}_{k,3} | \leq ch^2\omega_5(h)$,

$| a_{k,5} - \bar{a}_{k,5} | \leq ch^4\omega_5(h)$

So $| s_k(x) - \bar{s}_k(x) | \leq ch^5\omega_5(h)$.

Again, the method of successive differentiation yields (4.2). Equation (4.3) can

be obtained in the same way.

Theorem 4.2

Let y(x) be the exact solution of Cauchy's problem (1.1) and $\bar{s}_\Delta(x)$ be the spline

function of section 2. Then

(4.4) $| y^{(q)}(x) - \acute{s}_\Delta^{(q)}(x) | \leq c\ h^{5-q}\omega_5(h)$, $q = 0(1)5$.

Proof

$| y^{(q)}(x) - \acute{s}_\Delta^{(q)}(x) | = | y^{(q)}(x) - \bar{s}_{\Delta^{(q)}}(x) + \bar{s}_{\Delta^{(q)}}(x) - \bar{s}_{\Delta^{(q)}}(x) |$

$\leq | y^{(q)}(x) - \bar{s}_{\Delta^{(q)}}(x) | + | \bar{s}_{\Delta^{(q)}}(x) - \bar{s}_{\Delta^{(q)}}(x) |$

$\leq c\ h^{5-q}\omega_5(h)$, $q = 0(1)5$,

using equation 1.4 and Theorem 4.1.

Theorem 4.3

Let $\bar{s}_\Delta(x)$ be the spline function given in Theorem 2.1. Then

(4.5) $| \bar{s}_\Delta''(x) - f(x, \bar{s}_\Delta(x), \bar{s}_\Delta'(x)) | \leq ch^3\omega_5(h)$.

Proof

$\bar{s}_\Delta''(x) - f(x, \bar{s}_\Delta(x), \bar{s}_\Delta'(x)) = \bar{s}_\Delta''(x) - y''(x) + y''(x) - f(x, \bar{s}_\Delta(x), \bar{s}_\Delta'(x))$

$= [\bar{s}_\Delta''(x) - y''(x)] + [f(x, y(x), y'(x)) - f(x, \bar{s}_\Delta''(x), (x), \bar{s}_\Delta'(x)))]$.

Therefore

$|\bar{s}_\Delta''(x) - f((x), \bar{s}_\Delta(x), \bar{s}_\Delta'(x)| \leq |\bar{s}_\Delta''(x) - y''(x)| + |f(x,y(x),y'(x)) - f(x, \bar{s}_\Delta(x), \bar{s}_\Delta'(x))|$

$\leq | \bar{s}_\Delta''(x) - y''(x) | + K\ [\ |y(x) - s_\Delta(x)| + | y'(x) - \bar{s}_\Delta'(x) |]$.

by using Lipschitz condition (2.1).

Now, applying Theorem 4.2 for q = 0,1,2 Theorem 4.3 is proved.

RESULTS AND DISCUSSION

We have shown that the spline function exists uniquely

Given Δ and the real numbers $\bar{y}_k, \bar{y}_k', \acute{y}_{k+1}^{(4)}$, k = 0 (1) n; $\bar{y}_k'', \bar{y}_n''$; there exists

unique $\bar{s}_\Delta(x) \in S_{n,5}^{(2)}$ such that

$$\bar{s}_\Delta^{(p)}(x_k) = \bar{y}_{k^{(p)}}, \quad k = 0 \ (1) \ n; \quad p = 0, 1, 4;$$

$$\bar{s}_\Delta''(x_0) = \bar{y}_0'', \qquad \bar{s}_\Delta''(x_n) = \bar{y}_n''$$

Later it has also been shown that this spline function is convergent.

Let y(x) be the exact solution of Cauchy's problem (1.1) and $\bar{s}_\Delta(x)$ be the above spline function then

$$| y^{(q)}(x) - \acute{s}_\Delta^{(q)}(x) | \le c \ h^{5-q} \omega_5(h), \ q = 0(1)5.$$

Scope and Applications

The numerical approach applied here is very much useful in various other fields by Kekana et. al [13] and [15]. Wherever differential equations are involved for modeling real life situations these functions can give easy and fast solutions as in Kumar et. al. [12] and Agrawal et. al [16].

CONCLUSION

A (0, 1, 4) lacunary interpolation problem is considered here for which a five   degree spline function satisfying the given interpolatory conditions exists uniquely. The function thus obtained is then shown convergent. In the present paper, we have shown that this spline function can be used to solve the Cauchy initial value problem. This paper shows the application of spline function for solving Cauchy's Initial Value Problem. On the basis of this present paper and other research materials available [11],[12] and[14] our next communications will be on further applications of spline functions.

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APPRAISAL OF IMPACT OF DELAYS IN PROJECT DELIVERY IN CONSTRUCTION INDUSTRY

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ABSTRACT

In India, delay in construction is increasing critically which results in requirement of more time and cost for the completion of the construction project. This paper mainly aims to find out the important factors causing delays in Indian construction projects. From the literature review 37 causes of delays are categorized into 8 different groups such as Owner, Contractor, Consultant, Designer, Labour, Material, Equipment and External Related Factors. Further, from the data obtained a questionnaire survey is carried out through google forms and sent to various stakeholders such as project engineers, site supervisors, contractors, consultants and academicians. Fifty responses were collected from them and analysed using Relative Rank Index (RRI) and ten major critical factors are identified. These factors include rework due to errors in design, low productivity, delay in payments, delay in material delivery, litigation and disputes etc. Then a case study of a residential building is carried out in MS Project regarding time overruns and eventually recommendations are given to avoid delays in construction project.

Keywords: Cost overrun, Delay analysis, Microsoft project (MSP), Relative rank index (RRI), Time overrun

INTRODUCTION

The construction industry is a biggest sector which plays a pivotal role in monetary improvement of the country. However, numerous projects are experiencing critical delays which is leading to cost and time over-run.Construction delay is applied as far as your quality, cost, security and time due to the achievement of the task. The construction sector is enormous, unpredictable and will require huge capital. Development of the construction industry is a significant component for developing nations. By this, we can suggest more amount in the national budget is been linked to construction sector. The most important reason behind the increase in the price of construction materials is due to government present in that place. On the opposite hand, there are delays in payment, changes in the contract, problems due to shortage of economy, buying of good quality materials,changes in the agreement, shortage of people, deficiency in equipment, lack of vision, mistakes in designs. Disputes caused by the labours and strikes was the most important reason for the delay in few construction projects. In construction sector, the delay can be defined as requirement of more time for the construction or delivery of the project over the date which has been agreed for the completion by a set of contracts and end date of the contract. Delays are usually unpredictable which may arise due to involvement of performances of stakeholders, availability of resources, environmental changes, and relationships among the stakeholders and other parties. A delay in almost every project is caused by the owner or contractor or other numerous reasons.Completion of the project on the given time saves lot of money which is a great sign of efficiency and an efficient project

management, however, it is not happening nowadays. In order to encounter the delays, we can use project management which helps us in reducing the delays.

Project Management

Project management is the art of planning and executing the projects with in scheduled cost and time using the available resources effectively. Project management consists of 5 phases

1. Project initiation- this includes documentation, formation of project team, set up project office.
2. Project planning- this includes creation of task list, making of budget, risk management plan, communications plan, making of project schedule, assigning tasks.
3. Project execution- this includes task management, schedule management, cost management, quality management, resource management
4. Project monitoring and control-this includes reporting and monitoring the process
5. Project closure-this includes confirmation of completion, review documentation, transfer deliverables etc

Objectives

➢ To recognize different reasons for the delays.
➢ To decide the fundamental construction delays of project.
➢ To consider and comprehend results of delay on the construction project arising during the execution stage.

➢ To understand delay factors and steps to limit the delay and their effects in the construction projects.
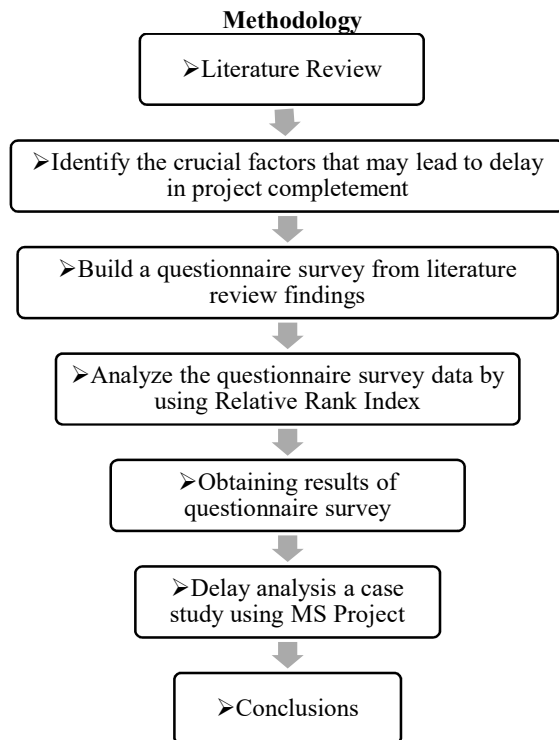
Methodology

Figure 1: Work Methodology Flow Chart

Types of delays

It is much necessary to know and understand the types or classifications in which delay falls into before examining construction delays. For the further mitigation attempt and to convert it in to a merit, a clear knowledge of types of delays is fundamental. The delays can be arranged in to 4 ways:

 a. Critical delays or noncritical delays
 b. Excusable delays or non-excusable delays
  1. Excusable delays with repayment
  2. Excusable delays without repayment
  3. Non-excusable delays
 c. Compensable delays or non-compensable delays
 d. Concurrent delays or non-concurrent delays

Effects of delays

 1. Requirement of more time
 2. Low profit to the contractor
 3. Loss and damage to company's reputation
 4. Loss of income for investor due to requirement of more time for completion of the project
 5. Dispute, Litigation or Arbitration between the stakeholders
 6. Abandonment of the project

Microsoft Project Software

M S Project may be a project management tool or software developed and sold by Microsoft, which helps a project manager in expanding the purpose, tracking progress, setting or allocating assets to tasks, analyzing

workloads, and balancing the budget. Project creates accounts supported resource cost and assignment work. As resources are allocated to the task and therefore the project calculates the utility adequate to the work time increases the speed, tends wind up to the task step then to any summary tasks step and eventually to the project level. Resource definitions (Equipment, materials, and labour) are often shared between projects working a balanced resource pond. Each resource can have its calendar, which defines what time and days is resource present. Resource prices are wont to compute resource assignment prices. Each resource is often assigned to several tasks in collective projects and every task are often allocated numerous resources. The implementation of the scheduled work supported the resource accessibility as defined within the resource calendars. All resources are often defined in Price, Work, and Material. Therefore, it cannot evaluate what percentage completed products are often collected with a given budget of raw materials. This makes Microsoft Project inapposite for resolve problems of available materials unnatural production. The appliance exhibits critical path schedules, and event chain and important chain methodology third-party plugging also are available. Schedules are often resource balanced, and task networks are seen through in Gantt chart. Also, Microsoft Project can determine differing sectors of the users. These unique classes of users can have varying access stages to projects, other data, and views. Modifying of aspects in Microsoft Project like views, tables, calendars, fields, and filters are collected in an enterprise global which is reachable by all users.

Terminology in MSP
Calendar:
Calendar will display companies working and non-working days. In MSP, calendar is used to for assigning, and scheduling by keeping in mind about non-working days. MSP consists of three types of calendars
24 hrs-usually for machineries
Night shift-software department
Standard- 8 hrs.

Baseline:
Baseline is a gathering of almost 20 essential reference focuses (in five classes: start dates, time required, finish dates, work, and quotes) that we can set to record the first venture plan when that arrangement is finished and refined.

Critical path:
Critical path means it is a series of associated works which directly alters the project completion date. If there are any tasks in this path then entire project is delayed.

Work breakdown structure:
WBS is important which breaks downscope of work into easily manageable things. The main objects of WBS are to make plan more efficient, to complete plan on fixed time and with fixed cost, to finish the planned work with quality and satisfy the needs of stakeholder, to make

planning consistent, to provide effective project execution.

Float:
Float is the measure of time that an assignment in a venture organization can be postponed without causing a late to resulting undertakings and task finishing date. Buoy assists with inspecting project timetables and work out how long separate undertakings can slip without influencing the general course of events or conveyance date.

Predecessor and successor:
Predecessor can be defined as a beginning task which control the start date or end date of the upcoming successor task. The successor is task which start and end dates are guarded by predecessor task.

Advantages of Microsoft Project
➢ Customer support
➢ Integration
➢ Dependability
➢ Flexibility

Disadvantages of Microsoft Project
➢ File compatibility issues
➢ Cost constraints
➢ Requires training

Questionnaire Survey
Many questions were prepared in and shared to different professionals like contractors, engineers, site supervisors, professors etc. and got their responses through google forms.Questions have been passed to 70 professionals and have received 50 responses**.**

Collection of data
The questionnaire is designed by the suggestion of the expertise and distributed to 72 professionals including consultants, clients and contractors using a software called as Google forms which is available in google. Total 50 have replied to the survey in that 10 are

S.No	Notation	Importance of Criteria	Conversion of notation into Numerical Value
1	IR	Irrelevant	0
2	VLI	Very Low Importance	1
3	LI	Low Importance	2
4	MI	Medium Importance	3
5	I	Important	4
6	VI	Very Important	5

contractors,23 are consultants and engineers,16 are clients and 1 is from lecturer. All these data are used for the overall analysis of the project.

Calculation and analysis
   1. **Statistical package for the social sciences**

It is a set of programs which is combined in a single software. The main aim of this software is to analyze the scientific data.

The advantages of Using SPSS for Survey Data:
   1. Exporting overview information to SPSS makes the process of controlling, pulling and examining information simple and clean
   2. The information of any overview gathered through a survey can be traded to SPSS for detailed examination.
   3. Its accentuation on analyzing statistical data, it is an exceptional tool for controlling and interpreting survey information.
   4. SPSS will import chosen title, variable names, value labels and variable sorts was set up automatically, implying that minimum legwork is required from specialists.

Frequency table:
It is a conveyance table gives a preview perspective on the attribution of an informational collection. It permits to perceive how scores are distributed across the entire arrangement of scores.

Figure 2- Sample of frequency table

Delay in progress payment by owner

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.0	1	2.0	2.0	2.0
	3.0	12	24.0	24.0	26.0
	4.0	26	52.0	52.0	78.0
	5.0	11	22.0	22.0	100.0
	Total	50	100.0	100.0	

   2. **Relative Rank Index(RRI)**
Relative Rank Index method is used to determine the relative importance of different causes of delays.A six-point Likert scale can used for the present study and RRI is calculated using the formulae given below.

RRI= (1/n N) *($\sum_{i=1}^{n} li * xi$)
N: The total number of responses
n: The maximum Likert scale
i: 1, 2…. N
xi: The frequency of the ith response.
li: Likert scale (IR is the least important and VI is the most
important)

 Table 1- Relative rank index

Summary of the results

The information which is gathered by literature review and examination of the equivalent is summed up in Table 2,and the results of the Relative rank index describes the impact of delay in the construction projects according to literature survey which is executed. Every causes are allocated ranks dependent on the worth of relative rank index. From the ranking, we will actually want to see most significant components which create the setbacks and impact the most on the construction projects.

Based on the ranking from the Table 2, we can observe that the RRI of Delay in progress payment by owner and mistakes in design documents have the same RRI of 0.656667 that means both those causes are equally important for the cause of the delay. Similarly, unqualified workforce and Unavailability of utilities (water, electricity etc) have the same RRI of 0.64.

Table-2: Details of RII and Ranks of Causes by All Respondents

Causes of delays	RRI	RANK
Owner contributed factors		
Delay in progress payment by owner	0.656667	4
Changes by owner during execution	0.61	21
Delay in revising and approving of design documents by owner	0.756667	1
Delays in providing of materials by owner	0.596667	27
Poor communication and co-ordination with others	0.586667	31
Slow making of decisions by owner	0.62	18
Cancelation of the whole project	0.623333	16
Contractor contributed factors		
Difficulty in providing money to project	0.636667	13
Changes of work during execution	0.603333	26
Conflicts between contractor and other parties	0.58	33
Poor site management and supervision by contractor	0.643333	9
Ineffective planning and scheduling of contractor	0.733333	2
Consultant contributed factors		
Improper construction method by consultant	0.666667	3

Causes of delays	RRI	RANK
Delay in checking the documents	0.596667	28
Delays of major changes	0.616667	19
Less communication with others	0.563333	35
Dispute between consultant designer	0.646667	7
Designer contributed factors		
Mistakes in design documents	0.656667	5
Delays in giving documents	0.58	34
Missing details in drawing	0.613333	20
Insufficient collection of data and preliminary survey before starting design	0.626667	15
Not understanding properly the requirements of owner	0.606667	22
Material contributed factors		
Change in types of materials	0.62	17
Delay in material delivery	0.65	6
Stored material is damaged	0.606667	23
Delay in making of special construction materials	0.586667	32
Late in ordering of materials	0.606667	24
Equipment contributed factors		
Breakdowns in equipments	0.606667	25
Low skills to operate the equipment	0.593333	29
Less efficiency,productivity of equipment's	0.556667	36
Labour contributed factors		
Less labour in construction	0.633333	14
Unqualified labours	0.64	11
Low productivity of labour	0.643333	10
Personal problems of labour	0.526667	37
External factors		
Unfavourable climatic conditions	0.646667	8

Unavailability of utilities like electricity, water, etc	0.64	12
Effect of social, cultural and political factors	0.593333	30

From the calculation of RRI, the ten most important delays are

1. **Delay in revising and approving of design documents by owner(RRI0.756667)**

This is the most important factor which effect for the cause of delaying in the project. The blue prints and floor plans of the project needs to be approved by the owner and if the owner doesn't approve the designs on time, and if there are too many changes given to the architect then a lot of time is lost. Receiving late approvals on time can lead to the delay in the project completion.

2. **Ineffective planning and scheduling of contractor (RRI 0.733333)**

Project planning is about choosing the effective methodologies to attain project goals. While project scheduling is listing of activities and assigning tasks to get them completed on time by allocating appropriate resources. Effective project planning and scheduling is a critical factor in time management.

3. **Improper construction method (RRI 0.666667)**

Proper development strategy incredibly affects the usefulness and nature of the venture, and their determination is the significant choice for the appropriate improvement of a development task and it is one of the primary elements influencing the effectiveness of the undertaking.

4. **Delay in progress payment by owner (RRI 0.656667)**

The delay in paying construction contractors has a negative effect in delivery the project on scheduled time. If the owner of the project doesn't provide sufficient funds on time to the contractor the it may lead to the time over run and also may lead to the abandonment of the project.

5. **Mistakes in design documents (RRI 0.656667)**

If the mistakes in the design documents are not rectified at the early stage, then it will lead to the demolition of the building and reconstruction of the building which will take more time for the execution of the project.

6. **Delay in material delivery (RRI 0.65)**

The common construction materials are cement, aggregates, steel, bricks etc if these materials are not arrived to the site on time, then there will be a lot of delay in the completion of the project.

7. **Dispute between consultant designer (RRI 0.646667)**

All the parties such as owners, consultants and the consultants must have good coordination between them if not consultants may delay to prepare designs which will also delay in the project delivery.

8. **Unfavourableclimatic conditions (RRI 0.646667)**

Unfavourable climatic conditions such as rain, snowfall, storms, cyclones play an important role in the completion of project on time. If there is a heavy rain fall or cyclone then the project needs to be stopped for a certain period of time and then to be resumed.

9. **Poor site management and supervision by contractor (RRI 0.643333)**

Contractors needs to complete the tasks as per planned schedule, and all the works carried out at the site must be supervised effectively otherwise it will lead to dismantle and redoing the work in some of the cases which may cause delay in the project.

10. **Low productivity of labour (RRI 0.643333)**

If the labour present in the site is not efficient to do a particular job or takes more time to do a specific task then we call it as low productivity of the labour. If the productivity of the labour is not good then it will lead to the delay in the project completion drastically.

Case study

Residential Building of G+2 is taken for the case study and the data collected from the site is been analysed using MSP. The case study is been studied in 3 stages as follows
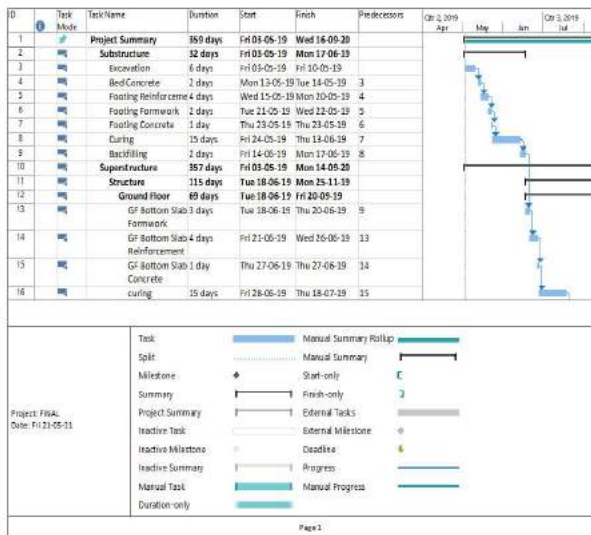
Stage1 Without any delays
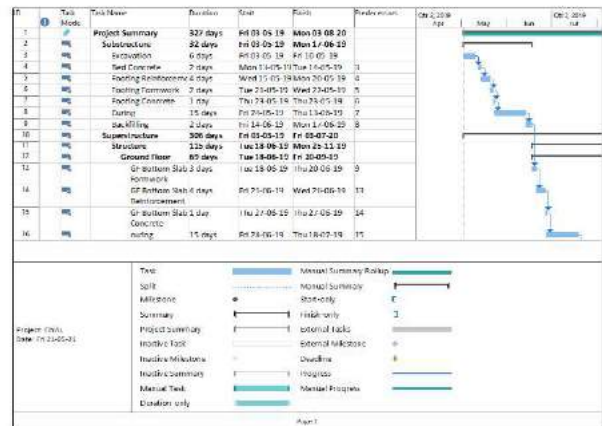
Figure 3: GANTT Chart View of the project without any delays

The G+2 residential building project was started on 03-05-2019 and scheduled to be completed on 03-08-2020 which takes a duration of 327days to complete the project as per the schedule.
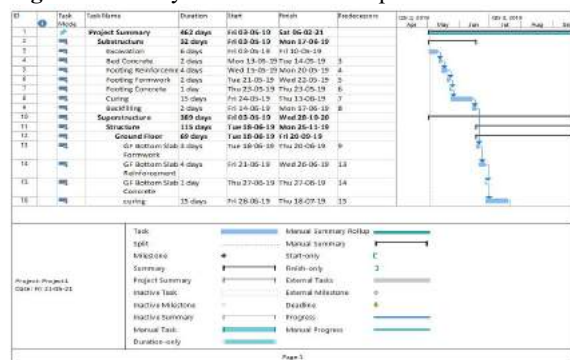
Stage 2 With delays caused due to heavy rainfall

Figure 4: GANTT Chart View of the project with delays caused due to heavy rainfall

The project duration considering the effect of rainfall is increased from 327days to 359 days therefore the delayed finish date of the project was 16-09-2020. The number of days required extra by considering this effect is 32days.

Stage 3 With delays caused due to the pandemic

Figure 5: GANTT Chart View of project with delays caused due to pandemic

Due to the effect of pandemic covid-19 the government of India imposed a lockdown. The project duration considering the effect pandemic is increased from 359days from 462 days therefore the delayed finish date of the project was 06-02-2021. The number of days required extra by considering this effect is 103days.

CONCLUSION

The main aim of the study was to find out the cause that have a adverse impact on the performance of completion of construction projects.

A case study was carried out by collecting the data from the site and been executed in MS project software. From the case study two major important factors which affected the project completion on time is heavy rain fall and lockdown imposed by the government due to the pandemic covid-19.

An extensive literature review was carried out to choose the causes which make the delay in construction. From the study thirty-seven causes of delays were selected. The study shows 10 major causes out of 37 which has highest Relative rank index. These 10 causes are

1. Delay in revising and approving of design documents by owner
2. Ineffective planning and scheduling of contractor
3. Improper construction method
4. Delay in progress payment by owner
5. Mistakes in design documents
6. Delay in material delivery
7. Dispute between consultant designer
8. Unfavorable climatic conditions
9. Poor site management and supervision by contractor
10. Low productivity of labor

Delays can't be wiped out completely be that as it may will be diminished to bigger degree by taking consideration at development stage. Also, delays will be diminished once the underlying root causes are encountered.

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ASSESSMENT OF LAKE EUTROPHICATION: A CASE STUDY IN KATTIGENAHALLI LAKE, BENGALURU

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ABSTRACT

The water quality of the lakes can be degraded due to the discharge of wastewater sources, such as municipal sewage agricultural runoff and industrial wastewater. This study summarizes the sources and the mechanisms that will leads to the eutrophication in lakes. The water quality analysis is carried out to determine the water quality index and trophic status index to evaluate the level of eutrophication of lake. Kattigenahalli lake located at Bengaluru, Karnataka was used as a case study. 10 sampling stations were identified and the samples were collected in all the sampling stations and the water quality parameters: Temperature, pH, EC and Dissolved oxygen were determined in the field and also water samples were carried to laboratory for analyzing remaining water quality parameters. The experimental data indicate that the Kattigenahalli lake is moderately polluted due to continuous discharge of the municipal wastewater from 3 inlet points and from the agricultural runoff. Based on the Carlson's TSI calculation the Kattigenahalli Lake has been classified as eutrophic. Thus certain precautionary and constructive steps are mandatory to avoid further eutrophication of lakes.

Keywords: Water quality, river pollution control and remediation.

Introduction

Water is one in all the foremost necessary natural resources on the market to humans. Knowing the worth of water. In nutritious health, the requirement to conserve water bodies particularly H_2O bodies still exists it was consummated within the whole world. International clean water isthat the foremost acceptable human resource and thus the world is called "Blue Planet" because water covers regarding seventy one percent of the surface, however majority of the water is salty. But 3 percent of water is clean and majority of the water isin ice caps, glaciers, and groundwater. Most of the remainder is the lakes, streams and soil wet. The world water state of affairs is minatory. Water quality is vital not just for drinking and domesticfunctions however conjointly for business, agriculture and commercial use. Water availableness is vital , considering the event of recent homes communities and even these days, the emergence of public installation systems is tied on to growth of suburbs.

Water is on the market in giant quantities underground and however but 1 Chronicles in it's pure water. Most of the planet is calculable at 1.4 billion cube-shaped

kilometers (326 million cube- shaped miles) seawater or frozen ice and ice cubes. water contains regarding 35 g / litre (4.5 ounces per gallon) of mineral or dissolved salt. This makes him unprepared for drinking and most industrial or agricultural use. In several areas, however, tide availableness is reduced due to the ascension of urban and industrial development and also the space within which they operate Pollution issues. Asian country faces a significant shortage of natural resources, particularly water with a read to growth and economic development. Most fresh bodies round the world pollution, so reducing water carriers.

The life depends on water and is gift in nature in many species like ocean, lake, river, rain, clouds, snow and fog etc. thanks to human growth, agricultural development, urbanization and industrial development have exacerbated high pollution problem with reducing access to drink. several elements of the planet face such shortages water. Most of the sewer water is drop directly into rivers, lakes and estuaries while not treatment. Lakes are a vital part of the layer that's not solely a supply of precious water, but to provide appropriate surround for plants and animals, balanced hydrological

cycles, low climate influences, increasing the sweetness of the planet and increasing the numerous opportunities for recreation for humans. A a pool could be a place of varied sizes crammed with water, found in an exceedingly hole encircled by the planet, with none stream or alternative store that serves to feed or discharge the pool. The pools lie on the bottom and don't seem to be a part of the ocean, and therefore they're totally different from lakes, and conjointly larger and deeper than lakes, or nonexistent official or scientificexplanations. Lakes is compared to rivers or streams, which regularly flow freely. Most lakes are fed and discharged by rivers and streams. Natural lakes are typically found within the mountains areas, cracks, and areas with continuous glaciation. Some lakes are found in endorheic pits or close to the movement of ripe rivers. In some elements of the planet, there are several lakes owing to the flow of water patterns remaining from the last geological period. All lakes are temporary additionally to geological time estimates, as they're going to fill a touch with plenty or drain the basin containing them.Lake eutrophication is enrichment of nutrients, along with component and phosphorus, which is able to end in a series of abnormal theme responses. The water quality of the lakes can be degraded due to the discharge of wastewater sources, such as municipal sewage agricultural runoff and industrial wastewater Lake eutrophication can increase flora biomass and decreases water transparency.

Study Area

Kattigenahalli,Bangalore Urban is a Locality in Bangalore City in Karnataka State, India. It is belongs to Bangalore Division. Yelahanka, Venkatala,Sathnur Village and Hunasamaranahalli area unit the neighbourhoods of Kattigenahalli.Bangalore, Vijayapura ,Chikkaballapur , Malur are the nearby Cities to Kattigenahalli. The Kempegowda International landing field is 18Km away and it will be reached via National Highway-44.

Kattigenahalli is gaining demand in residential sector and there is substantial infrastructure development over recent years including Malls, Hotels, Cinema Theatres, schools and colleges. etc. The Population of the locality is increasing because of the migrants from various parts of the country. Hence, becoming burden on the water supply and also there is an increase in generation of sewagequantity. Kattigenahalli Lake, is that the lake set in Yelahanka zone in north urban center, spreads across a region of twenty acres. it's set at latitude of 13°6'52"-N and longitude of 77°37'43"-E encompasses a drainage basin of twenty acres 10 guntas, Scope of development for pumping, overhead tank, irrigation line, natural land. The sewage from nearby areas are discharged directly is polluting the Kattigenahalli lake.
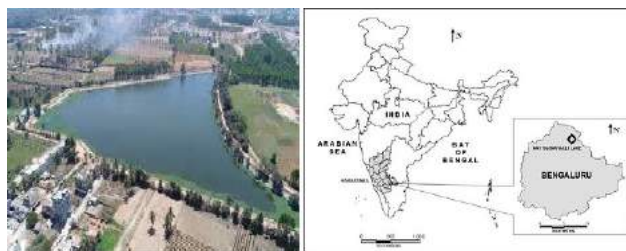

Fig. 1 Location of the Study Area

MATERIALS AND METHODOLOGY

The type of investigation, purpose of the study, and anticipated variation in chemical quality determine to a large degree the location of the lake water sampling site and the frequency of sample collection. Drying time is very important because pollution has a huge impact on the receiving lake due to the flow of dry weather. 10 sampling stations were selected based on point source contamination. Samples were collected using the grab sample collection method. The location description of the sample stations is described in Table. 1 and Figure 2.During the present study the physical, chemicalparameters of water analyzedsample were analyzed in the laboratory using the guidelines from the standard methods for the examination of water and wastewater, published by the American Public Health Association. To determinewater quality index we tend to select CCME (CANADIAN COUNCIL OF MISTERS OF ENVIRONMENT) technique of water quality index. To measure TSI of Kattigenahallilake, Carlson's Trophic Status Indexmethod is selected for the present study.

Table 1: Codes of sampling stations atKattigenahallilake

| Code	Sampling points	Longitude	Latitude
S1	Surface water of Lake	77.6209177	13.115616
S2	Surface water of Lake	77.627574	13.116181
S3	Surface water of Lake	77.626825	13.116064
S4	Surface water of Lake	77.62718	13.115914
S5	Surface water of Lake	77.627467	13.115635
S6	Surface water of Lake	77.627783	13.114747
S7	Surface water of Lake	77.627775	13.113144
I1	Sewage Inlet 1	77.628017	13.152930
I2	Sewage Inlet 2	77.630347	13.115000
I3	Sewage Inlet 3	77.629387	15.115470
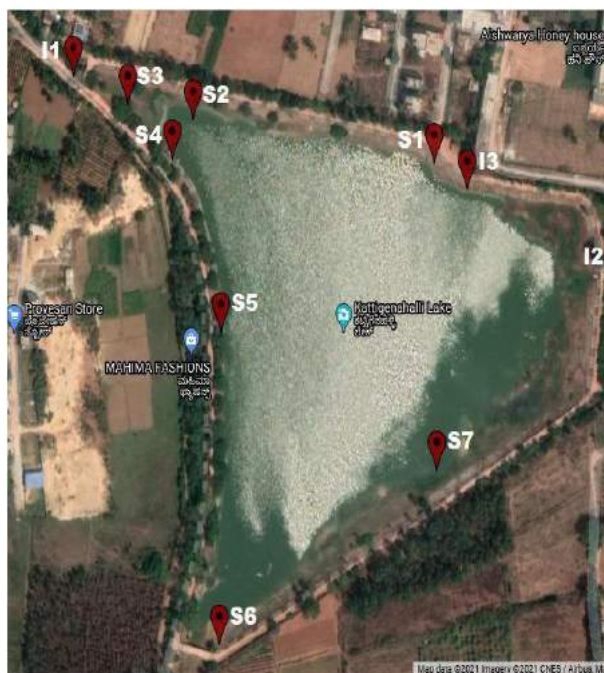
Fig2.Map of Sampling stations atKattigenahalli lake

RESULTS

The reported effects on physico-chemical properties are influenced by rainfall changes and seasonal variations in hydrology. It has been found that the influx of clean water changes the quality of water in the area by continuous discharge of pollutants into the lake. Table 2 shows the water quality parameters of the Kattigenahallilake.

Table 2: Water Quality Parameters of the Samples collected at the Study Area

Parameters	S1	S2	S3	S4	S5
pH	7.65	7.78	7.81	7.34	7.47
Temp ° C	29	29	30	28	28
EC, µS/cm	752	773	997	712	725
TDS, mg/L,	320	342	431	295	307
D.O mg/L,	5.6	5.1	4.9	5.2	5.6
Transparency, m,	0.71	0.68	0.54	0.73	0.69
Chloride, mg/L,	199.33	195.4	212.2	188.3	179.4
T. Hardness, mg/L,	171.76	264.8	244.4	163.6	204
Sodium (Na), mg/L,	17	19	23	17	16
Potassium(K), mg/L,	0.743	0.513	0.289	0.652	0.42
Sulphate (SO$_4$), mg/L,	0.159	0.174	0.21	0.192	0.14
Phosphate (PO$_4$), mg/L,	21	23	26	24	24
Magnesium, mg/L,	43.04	54.88	91.6	67.52	77.52
Calcium, mg/L,	128.72	209.92	152.8	96.08	126.48
Nitrate (NO$_3$), mg/L,	1.8	1.4	2.2	1.1	1.1
Turbidity, NTU,	21.3	22.61	25.14	20.36	19.97
Alkalinity, mg/L,	268	274	274	198	215
C.O.D,mg/L,	11.3	12.12	12.41	12	10.95
BOD$_5$, mg/L,	3.4	3.7	3.8	3.6	3.3
Chlorophyll A, mg/L	5.78	6.18	7.14	4.91	4.61

Parameters	S6	S7	I1	I2	I3
pH	7.39	7.5	7.9	8.08	8.03
Temp ° C	28	27	30	31	32
EC, µS/cm	768	331	348	1206	1268
TDS, mg/L,	331	348	501	515	538
D.O mg/L,	5.4	5.7	3.2	2.8	3.1
Transparency, m,	0.78	0.63	0.25	0.22	0.23
Chloride, mg/L,	183.1	176.6	298.2	347	324.58
T. Hardness, mg/L,	211.56	224.17	204.2	203.9	224.36
Sodium (Na), mg/L,	15	16	25	25	26
Potassium(K), mg/L,	0.344	0.67	0.792	0.811	0.769
Sulphate (SO$_4$), mg/L,	0.154	0.14	0.265	0.369	0.382
Phosphate (PO$_4$), mg/L,	22	27	30	31	34
Magnesium, mg/L,	63.04	34.88	71.6	87.52	87.52
Calcium, mg/L,	148.52	189.29	132.6	116.38	136.84
Nitrate (NO$_3$), mg/L,	0.9	1.5	3.1	3.4	3.7
Turbidity, NTU,	20.79	19.31	37.22	44.5	43.77
Alkalinity, mg/L,	205	241	359	394	385
C.O.D,mg/L,	11.85	10.47	18.1	18.86	18.2
BOD$_5$, mg/L,	3.5	3.2	6.3	6.9	6.3
Chlorophyll A, mg/L	4.53	6.54	6.89	10.89	10.76

DISCUSSIONS

Water Quality Analysis

pH

The pH value represents the acidic and alkalinity value of the water. The lake water maximum value (8.1) is observed in (I2), and the minimum value (7.3) is observed in (S5). The pH values show that water is suitable for drinking but it should be treated before use.

Temperature

TheTemperatureoflake waterisconsidered asimportant factorinqualityanalysisofwater.The lake water maximum

value (32) is observed in stations point I3 and theminimumvalue (27)instationpoint S7.Thetemperature valueisinversely proportionaltodissolved oxygen,asthetemperatureincreasethedissolvedoxygendecreases.

Electrical Conductivity (EC)

The EC is an index to represent the total concentration of soluble saltsin water. In lake water maximum value (1268 μs/L) is observed in station I1 and minimumvalue(712μs/L)observedinstationS4.ElectricalConductivityofLakewatershowsthat wateris suitable for both drinking and irrigation purposes. The range is within 53.76μs/L to 104.35μs/L.

Total Dissolved Solids (TDS)

A complete blend of soluble solvents or ions in a water body has been found to be a useful parameter in defining the size of a chemical as a solid. Water with complete melted solids has shown a lot of ionic concentrations that are not low in potency and can cause undesirable physico-chemical reactions in consumers. The increase in the number of TDSs reflects pollution from external sources and negatively affects the quality of the water supply. The TDS content in the study area observed in the lake water is higher at I3 and lower in S4.

Total Alkalinity

Alkalinity is the ratio of any acid reduction solution or "buffer". The first source of carbonate and bicarbonate ions in water is carbon dioxide dissolved in rainwater, which, when absorbed into the soil, decomposes excess carbon dioxide. Carbonated water dissolves carbonate minerals, as they pass through soil and rocks, providing bicarbonates. In lake water the total alkalinity is high at I2 (394mg / L) and minimum at S4 (198 mg / L). The recommended alkalinity limit for drinking water is 200 mg / L, otherwise the taste is bad. This indicates that water is within the desired range of Alkalinity.

Chloride (Cl)

The most important source of chloride in natural water is due to the discharge of sewage and itplaysa vital rolein photophosphorylation reaction in autotrophs.The chloride concentrationbetween4-10ppmindicatespurityofwater.Highchlorideconcentrationindicatestheimpactbyhumanactivitiessuchasroadsalting,agriculturalrunoff,andsewageeffluent.Chloridesinlakewater atmaximumisat I2 (347mg/L)andminimuminS7(176.6mg/L).Thedesirablelimitforchlorideis 250mg/L.

Total Hardness (TH)

Hardnessisanimportantcriterionfordeterminingtheusabilityofwaterfordrinking,domesticandmanyindustrialpurposes.Thetotalhardnessinlakewaterrangedfromminimum163.6 mg/L(S4)tomaximumof264.8mg/Lin(S2).InlakewaterTH rangeishigher as248.5mg/L.Thesourcesofhardnessinthecurrentresearchstudymaybedueweatheringoflimestone,sedimentaryrockandcalciumbearingmineralsandgroundwaterqualityisaffectedbychemicals andsewageeffluents.

Sodium

Sodium is a highly soluble chemical element and is found naturally in groundwater. All groundwater contains some sodium because most rocks and soil contain sodium compounds where sodium is easily dissolved. In lake water the concentration of sodium ranges from a minimum of 25 mg / L in I2 to maximum 26 mg / L in I3. Sodium levels in **the** current study can be caused by erosion of salts and rock-carrying minerals, surface infiltration of sewage or pollution by sewage.

Potassium

Potassium is an essential element in humans and is seldom, if ever, found in drinking water atlevels that could be a concern for healthy humans. In lake water the concentration of potassium is maximum at (0.811 mg/L) I2 and minimum at (0.289 mg/L) S3. The higher potassium concentration is observed in thestudyareaisduetothe applicationofexcessivefertilizers.

Sulphate

Sulphate concentration is attributed to the wide application of soil conditioners. In view of thestabilityofthedissociatesulphateioninmostenvironments whereitoccurs,andalsoduetohighsolubilityofthesulphatesofthecommoncationssuchascalcium,magnesiumandsodium ,highconcentration of sulphate may be expected. In the study area Concentration of sulphate in lakewatermaximumat (0.382 mg/L)I3andminimumat (0.192 mg/L) S4.Themainsourcesofsulphatesingroundwatersamplesmaygenerate fromthe dissolutionofminerals,suchasgypsumandanhydrites.

Phosphate

Phosphates are present in natural waters and in their concentration do not pose any threats to humans. However, excessive contamination of water subjects from agricultural fertilizers has begun, and the removal of pollutants can promote excess algae or plant growth. Phosphates act as a component of plant growth and its high concentration and is an indicator of eutrophy. In lake water the phosphate is high in (34 mg / L) I3 and low in (21 mg / L) S1. Sources may be caused by anthropogenic activities especially in the application of fertilizers and organic rot during the study.

Nitrate

Nitrate (NO_3) is a naturally occurring form of nitrogen found in soil. Nitrogen is important for life. Due to its high mobility, nitrate can also seep into groundwater. If humans or animals drink high levels of nitrate, they can cause methemoglobinemia, and the disease is more common in children, although nitrates are naturally occurring in certain groundwater, in many cases with high levels of human activity. In the lake water distances of up to I3 and lower to S2. Many vegetable crops need a lot of nitrates to support a high yield. The recommended nitrate limit for drinking water is 45 mg / l.

Dissolved Oxygen

DOanalysismeasurestheamountofgaseousoxygen(O_2)dissolvedinanaqueoussolution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapidmovement) and as a waste product of photosynthesis. Adequate dissolved oxygen is necessaryfor goodwaterquality.InlakewatertheconcentrationofDO is maximumatS1 and minimumatI2.

BOD

(BOD)isanindexoforganicpollutiontomeasuretheamountofDOrequiredbymicrobialcommunityindecomposingtheorganicmatterpresentinawatersample by aerobic biochemical action. The high BOD is an indication of organic pollution. Inthe presentstudyBOD value wasminimumatS7andmaximumatI2.

Transparency

Water resistance is related to the depth at which light will penetrate the water. The transfer of light from the body of water is very important because the sun is the first source of energy for all living things. Light is needed for photosynthesis, the process of which produces oxygen and food for consumers. It is common practice for biologists to view the depth of the euphotic area as 2.7 times (the limit of visibility. As light enters the water, it decreases and converts to its spectral composition. of dissolved organisms.ThetransparencymaximumatS6andminimumin I2.

Calcium

Calcium in lakes plays an important role in combating acid rain. Calcium is also an essential nutrient for all plant and animal species while other species, including freshwater mussels, crayfish, and Daphnia, need more calcium. Rivers usually contain 1-2 ppm calcium, but in lemon areas rivers can contain up to 100 ppm calcium pressures. per liter, sometimes more. Calcium content maximum in S2 and minimum in S4

Magnesium

Hard Water Solidity Calcium Magnesium Mining Scale. Water is described as "solid" high in dissolved minerals, especially calcium and magnesium. Solid water is not a health hazard, but is a nuisance due to the mineral composition of the ingredients and the non-abrasive soap and / or soap performance. The concentration of Mg in the lake water has exceeded the recommended range (150 mg / L, according to GCS limits (1993/149) and SAS (1993/701). in its natural sources.The magnesium ratio is maximum in S3 and minimum in S7.

Turbidity

High temperatures can significantly reduce the quality of lakes and streams, adversely affectingtourism. It can increase the cost of water treatment through drinking and food processing. Systems that use filters without regular or direct filtering must follow state parameters, which must include malfunctions not exceeding 5 NTU. Many drinking water resources strive to reach levels as low as

0.1 NTU. European standards for instability say it should not exceed 4 NTU. High humidity in I2 and low in S7.

COD

High COD levels mean a large number of organic matter in the sample, which will reduce dissolved oxygen levels (DO). Decreases in DO can lead to anaerobic conditions, which are undesirable for higher aquatic life forms. COD is one of the most widely used parameters in the study of pollution. The average COD values for indoor wastewater are between 400-600 mg / l. A low DO level indicates contamination in the lake water. Therefore, higher COD values are also expected. COD is higher in I2 and lower in S7.

Chlorophyll A

Water with high levels of nutrients from fertilizers. Chlorophyll-a is tested in ponds to determine how much algae are present in the pond. however, the water is not so warm, which limits the growth of algal. The second way to measure chlorophyll-a is to use data from satellite images. Color intensity in satellite images is related to the concentration of chlorophyll-a in water. Itis high in I2 and low in S6.

Water Quality Index

Water quality index (WQI) is defined as the rating reflecting the composite influence of a number of water quality parameters. It also provides a convenient means of summarizing complete water quality data. Water quality index developed for the surface water samples does not indicate a wide variation from station to station.

The scope of the study was to assess the WQI in order to evaluate the water quality of the area for public use, irrigation and other purposes. According to the NSF, surface water quality of overall Kattigenahalli lake, was mainly assessed as bad quality since the value was between 35 to 45 and shown in table 3.

Table 3: WQI and TSI of samples in the study area

Code	WQI	Quality	TSI	Attributes
S1	44	Bad	54	Eutrophic
S2	43	Bad	54	Eutrophic
S3	42	Bad	57	Eutrophic
S4	44	Bad	54	Eutrophic
S5	44	Bad	54	Eutrophic
S6	44	Bad	53	Eutrophic
S7	45	Bad	56	Eutrophic
I1	35	Bad	-	-
I2	38	Bad	-	-
I3	36	Bad	-	-

Trophic State Index

The trophic state index (TSI) of a lake is the average of the TSI for phosphorus, the TSI for chlorophyll-a and the TSI for secchi depth; therefore, it can be thought of as the lake condition. Phosphorus, Chlorophyll-a (algae concentration) and Secchi depth are related. When phosphorus increases, that means there is more food available for algae, so algal concentrations increase. When algal concentrations increase, the water becomes less transparent and the Secchi depth decreases.On the

Carlson's scale if TSI is < 30 represents oligotrophy, from 30 to 50 represents mesotrophy, from 50 to 70 eutrophyand > 80 hyper eutrophy. Henceas per the Carlson's scale TSI as shown in Table 3.The average TSI value is found to be 54. 57 and Hence, the Kattigenahalli Lake has been classified as eutrophic.

Scientific Remediation of Kattigenahallilake

Minimize adding nutrients

Since phosphorus is a real cause of eutrophication in many Minnesota lakes, reducing the addition of phosphorus to a lake is the most effective way to reduce eutrophication. Phosphorus can enter the pond through poorly regulated or ineffective septic systems, phosphorus detergents, phosphorus lawn fertilizers, agriculture and animal feeders. To find the source of eutrophication in a particular lake, complete a true-world study with a sea-level collection. True soil research involves studying the penetration of a pond and identifying any sources of phosphorus near them that add nutrients to the river and eventually the lake. The ocean lineup includes a small boat ride around the entire lake, taking a picture of each parcel and exploring land management practices. Lake parcels can be summed up in percent; for example, 60% of parcels have suitable coastal areas and 40% of donots. Bringing awarenessamong the people to limit addition of phosphorus to a lake will be a very good remedial measure.

Reducingsediment addition

When erosion occurs, the soil will enter the lake. additional particles of soil create waterlogging and eventually decompose at a much lower cost in the lake making it mucky and slightly stable. The soil collectively contains nutrients such as phosphorus and gas which can cause explosions. In the study of the realities of the world and in coastal ecosystems, identifying areas where erosion occurs and take steps to stabilize the state. The best strengthening process would be a bath of native plants; however, on a very scary coast where plants cannot establish a merger can further apply data to shoreline buffers and restorations.

CONCLUSION

The major source of pollution in the Kattigenahalli lake was the sewage from the Kattigenahalli that entered the lakes without any prior treatment. Also, agricultural runoff, washing and cleaning activities of people contributes. The experimental data indicate that the lake is moderately polluted and certain precautionary and constructive steps may avoid further eutrophication of lakes. Based on the experimental results obtained, the following conclusions have been drawn. 1. From the results obtained, it can be concluded that the lake is polluted due to continuous discharge of municipal wastewater and from the agricultural runoff.

2. Based on the water quality index calculation the water quality of Kattigenahalli Lake has been classified as bad.

3. Based on the Carlson's TSI calculation the Kattigenahalli Lake has been classified as eutrophic.

4. Due to the surplus algal growth, aesthetic appearance of the Kattigenahalli lake is hampered.

5. Due to the growth of the weeds, which leads the water holding capacity of the lake decreased.

6. The periodical survey of the lake is to be done to find out the water quality and abatement programs to check further deterioration of water quality.

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OPTIMUM FREQUENCY DETERMINATION FOR PUBLIC TRANSPORTATION

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ABSTRACT

The frequency setting model, a non-deterministic polynomial optimization, is designed to reduce user and operator costs. Inorderto reduce the total operating costs of the public transportation system and a mathematical programming technique using Visual Basic Algorithm (VBA) is utilized. The top level specifies the overall cost of the system, which must be kept as low as possible while taking operational and user limitations into account, while the lowest level specifies assignment to public transportation planning.The deviation of the observed passenger load is minimized at the maximum load point from the ideal load level of the vehicle.

Keywords: Frequency, User and Operator Costs, Visual Basic Algorithm and assignment.

INTRODUCTION

Cities throughout the world are plagued by extended journey times, traffic jams, pollution, road accidents, and other issues. In India, the bus transit system has always been the primary mode of public transportation for those cannot afford more expensive modes of transportation. In recent years there has been a significant shift towards private and other flexible modes such as para-transit and mobile application-based cabs, resulting in the decline of public bus services in major cities[1][2][3]. The use of public transportation often requires considerable time outside the vehicle, including walking to and from the transit stations, waiting for service at the stops, and optional switches to other modes or routes. Generally public transport users take a long period outside the vehicle, including walking to and from transit terminals, waiting for service at stops and switching optionally to other means or routes. Inorder to optimise the efficiency of the bus servicean enhanced model by means of preventive operational control in real time, taking into account a complex relationship between random passenger demand, stochastic driving conditions, segments of vehicles and limiting load capacity and a variety of operating control systems, such as Automated Vehicle Positioning (AVL) and Automation Passenger Counting (APC), have recently been employed to enhance the efficiency of the bus service [4][5][6][7]. Bus operators often operate buses with different frequencies depending on passenger demand, circumstances of traffic. The key stage in the design of bus transport is the optimal frequency setting in the network, which incorporates passenger hourly rates at bus stops, OD and bus stop-to-stop data [8]. Setting the crowding limit assures attractiveness of service and improves user comfort and convenience.However, apart

from the crowding level; in the context of India's urban bus service passenger waiting time and the likelihood of getting a seat when making the journey is one of the significant user level considerations [9][10][11][12] and should be taken into account when deciding the optimal frequency for a bus route.Bus operators have limited resources and must prioritize minimizing fleet size ensuring complete round trip for each service cycle.While developing strategies to improve transit system efficiency, passenger demand on a single bus route is considered in terms of waiting time, vehicle time, and vehicle crowding time.An upgraded model by means of preventative operational control is examined in order to optimise bus service efficiency in real time taking into account a complex relationship between random passenger demand, stochastic driving conditions, segments of vehicles and limiting load capacity[13]. In recent studies, in order to decrease losses in the public transportation system, the average cost of fuel utilised, the fixed wage of employees, and the cost of vehicle service [14][15] are all examined. The optimum size of the bus would be considered on the network, taking into consideration the decision variables for the model would be the frequency of each path. The various constraints such as on-board level of crowding,waiting time threshold for travellers,minimum criterion for availability of seats,kilometres per passenger per vehicle,minimum passenger for each ride,maximum cost of service per passenger,minimum rate of recovery of costs, maximum number of passengers lost during the operating time and minimum threshold level of crowding were induced to determine the frequency of the vehicle[16]. The overall bus service expenses are reduced against constraints such as passenger waiting time, trip duration, number of transfers, overall travel

time delay, total subsidy, fleet size, minimum and maximum travel, vehicle capacity, and passenger loads. According to recent research, the average cost of access time is around 1.6 - 2.5 (2 for simplicity), while the average cost of waiting time is 2.4 - 3 times the cost of travel time perceived by passengers in the vehicle, and standing time of in-vehicle transportation is valued around 1.5 times more than travel time in the vehicle [17]. The cost of travel time is also often interpreted as the sum of various cost categories depending on operation, access and egress time costs, waiting time costs, travel time costs in the bus and transfer costs [18][19][20]. In addition, fleet size and unfavourable operating conditions such as bus bunching can also be regulated by setting suitable headway from the perspective of user and operator [21][22][23][24].

Objectives

The model addresses the problem using a mixture of optimization and simulation methods. This technique allows for the analysis of the relationship between supply and demand, ensuring the consistency of flows and frequencies in each iteration of the algorithm. The cost connection between the user and the operator is created by the simulation model.A bi-level variant of the Transit Network Design (TND) optimizes the user and operator cost at the top level, and transit assignment with capacity constraints at the bottom level [25] [26].The overall cost of bus service fluctuates with service headway and crowding. The mannequin proposed in this paper solves the optimization hassle for headways at an optimum social and operating cost for bus transit system.Finallycost comparison of various service variations along a bus route considering societal costs which is deterministic in nature. Thus, the goals are:

i. Development of bus frequency model for a given time period.

ii. A model-based tool for cost analysis along a bus route for several service variants.

Methodology

Frequency Setting specifies the number of trips per hour required to meet passenger demand for a specific route. A frequency optimization model for an isolated bus route for each direction was developed where each individual passenger travel time is presumed to be knownfor an optimal scenario[27][28][29]. The statistical optimization derives the optimum frequency by optimising the social value of the bus service by mutually minimising the expense of user and operatorover a fixed service period. The cost of the user is calculated from the generalised cost of multiple user time impedance variables and the cost of the operator is determined from the fixed and operating cost of the bus service[30][31][32].
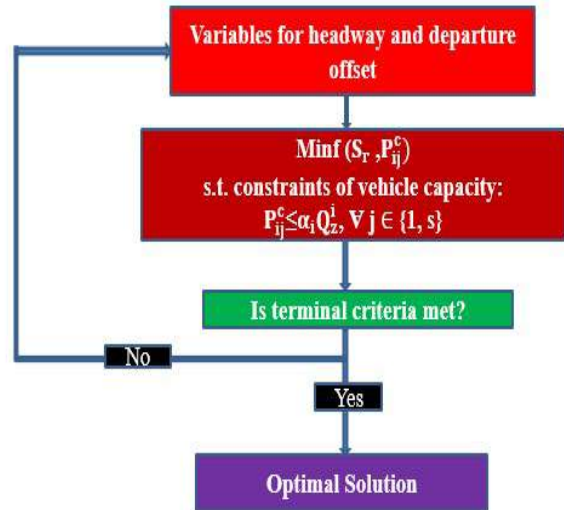

Figure 1: Algorithm for Frequency

Where i=1,2,3,4……vtotal number of dispatched vehicles,

j = 1,2,3,4……s number of stations for buses,

P = Period of time,

Q_z^i = Capacity of seating of bus type z

α_i = Crowding Level

f= Frequency

S_r = Load Factor

P_{ij}^c = Total number of passengers

The emphasis of this work will be on one of the four distinct methods referred to as "Method 2"and for the randomly arriving passengers expected waiting time is given by Ceder [33].It is the derived frequency (f) from the maximum passenger-load point which is given in equation (1) and defined (standard) ideal occupancy (load factor), for each time period, usually one hour which is given as;

$$f = \max \left(\frac{P_{mj}}{\alpha}, f_{min} \right) \qquad (1)$$

Where f_{min} is the minimum frequency (standard) required equation (1) assumes a uniform sequence of passenger arrivals at the maximum load point. In addition, P_{mj} is the observed maximum load reflecting the average number of travellers, over a given time span H, which begins at the maximum load point and crosses the maximum load segment. The even-headway function decreases the capacity of the scheduler to handle variations demand over a specified time span. The objective function

considers the user costs and the operator costs, subject to various constraints as follows:

1. A restriction on route frequency(f);$f_k^{min} < f_k^{route} < f_k^{max}$ that takes into account the maximum and minimum permissible frequency of operation on route k where $f_{up}=d_{own}$.

2. The constraint of fleet size is planned to ensure optimum operation does not surpass the maximum number of $f_{max\ fleet\ size}$ buses available and the permitted service frequency where $\sum f_k^{route} \le f_k^{max}$.

In this investigation the user cost and operator cost are taken into account in the expense structure as overall cost [34] which is given in equation (2).A mathematical programming approach based on the Visual Basic Algorithm (VBA) is used to obtain the frequency for various crowding levels.

Overall Cost (C_o) = Operator Cost (C_{oc})+ User Cost (C_{uc}) (2)

Operator Cost = Fuel Consumption Cost + Maintenance Cost +Vehicle Depreciation Cost + Crew Cost+ Operator Penalty Cost   (3)

User Cost=Total waiting time Cost +Travel Time Standing Cost +Travel Time Seating Cost +Passenger In convenience Cost(4)

Case Study

In this segment, in the city of Bangalore, India, a real bus line, used as a numerical illustration for the implementation of the proposed bus frequency formulation. A survey was performed along the routes 290E,285,401,401A, and 402 D to obtain travel demand details during peak hours.Inorder to determine bus frequency of a route, passenger load profile rule-based method and overall expenditures is employed.

Data Collection

In this situation, a study was carried out to collect information about the demand of the line during peak hours. The table shows the running time and distance between subsequent stops. The prospective passenger demand O-D matrix for various lines is calculated using the collected demand data which is shown in the fig 2-6. Fig 7 – 11 shows that there is no flat fare and as a result, the strategies and fare problems are framed as optimal models with the goal of maximizing the total of benefits of users and operators.
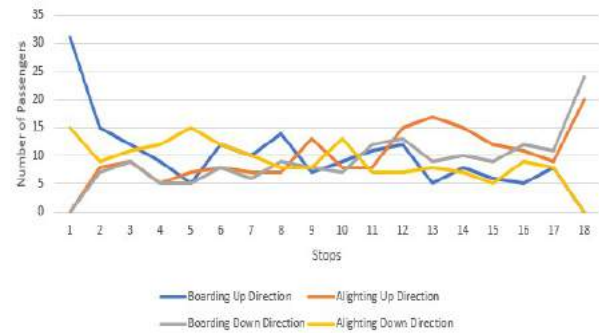
Figure 2: Boarding and Alighting for 285 route
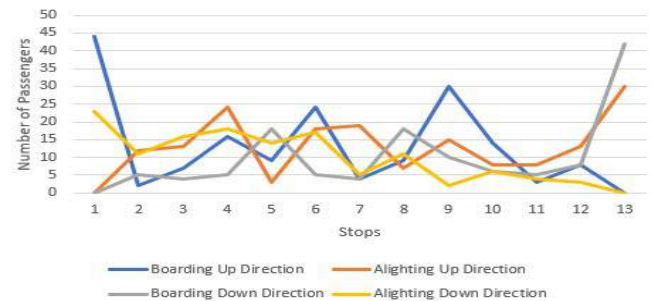
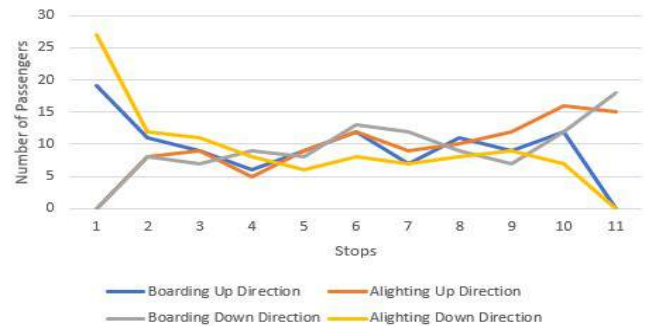**Figure 3:**Boarding and Alighting for 290 E route

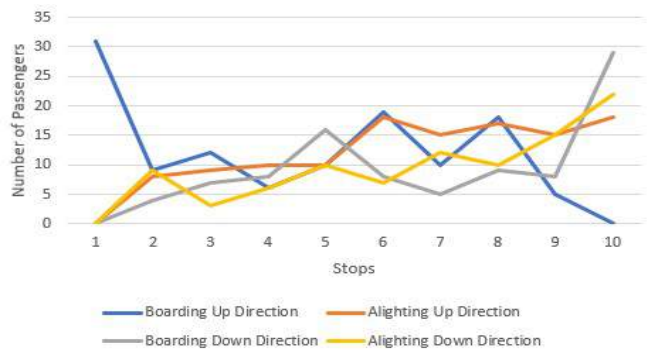**Figure 4:**Boarding and Alighting for 401 route
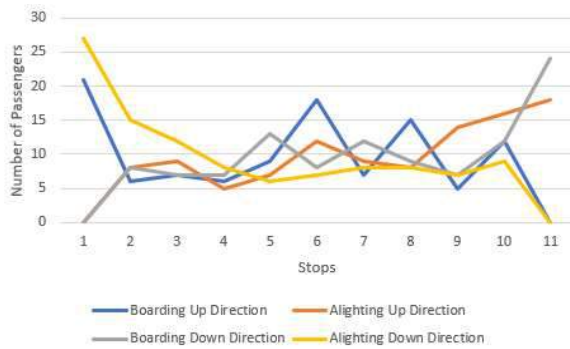

Figure 5: Boarding and Alighting for 401A route

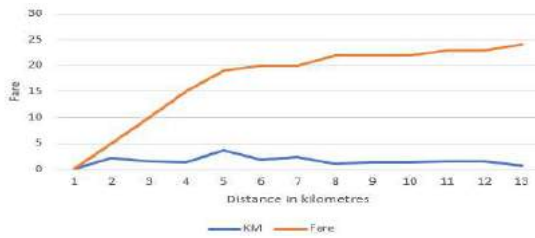**Figure 6:**Boarding and Alighting for 402 D route

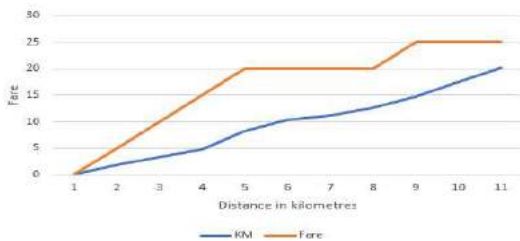**Figure 7:**290 E Bus Route Fare/kilometre

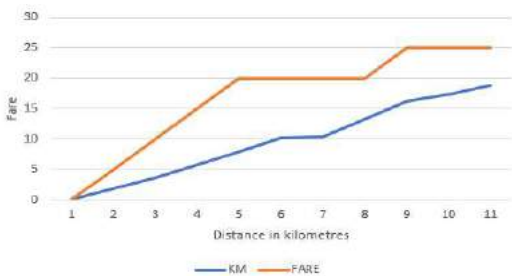**Figure 8:**401 Bus Route Fare/kilometre

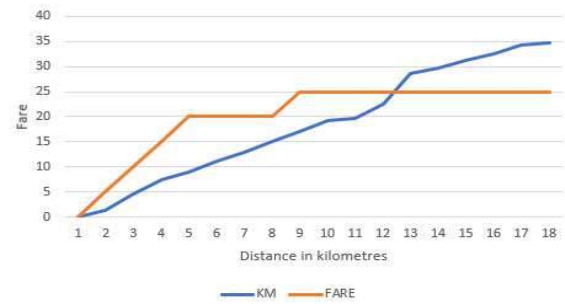**Figure 9:**402 D Bus Route Fare/kilometre

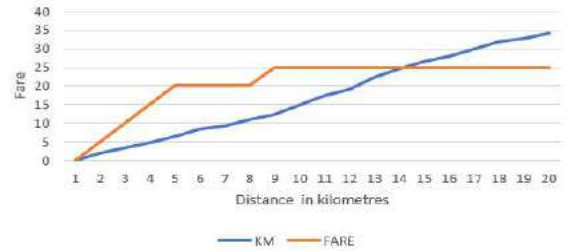**Figure 10:**285 Bus Route Fare/kilometre

Figure 11:401 A Bus Route Fare/kilometre

Sensitivity Analysis:

The overallcost variations surrounding the ideal solution must be examined in detail to determine the total cost change with frequency. Inorder to discover how the model responds to changes in the values of various headways and crowding level, a sensitivity analysis is conducted. There is no straightforward interaction between the parameters and sometimes the cost of user and operation per hour for certain headways is lower compared to headways that are immediately higher due to the lower number of passengers lost at the same number of dispatches. The user cost is decreased as the headway is increased for various crowding level.

The operator cost is increased as the crowding level is increased for various headways. The overall Cost is decreased as the headway is increased and the load factor remains constant.
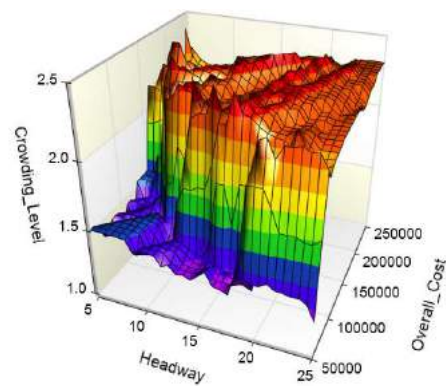

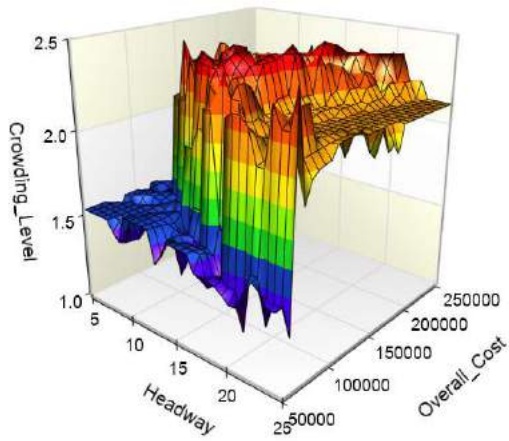**Figure 12:**Overall Cost for 285 route in Up Direction
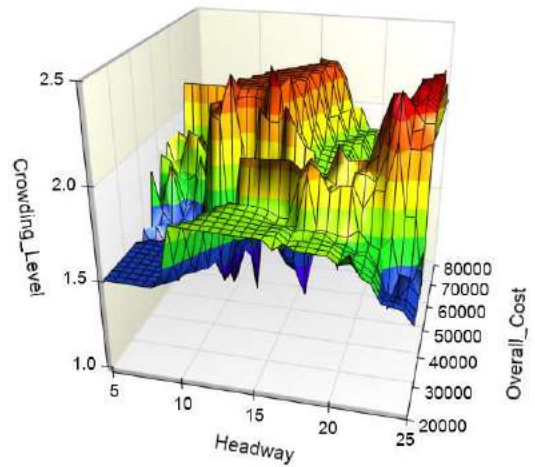
Figure13: Overall Cost for 285 route in Down   Direction
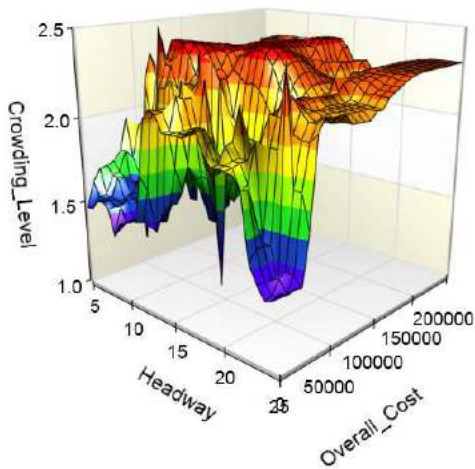

Figure16: Overall Cost for 401 route in Up Direction

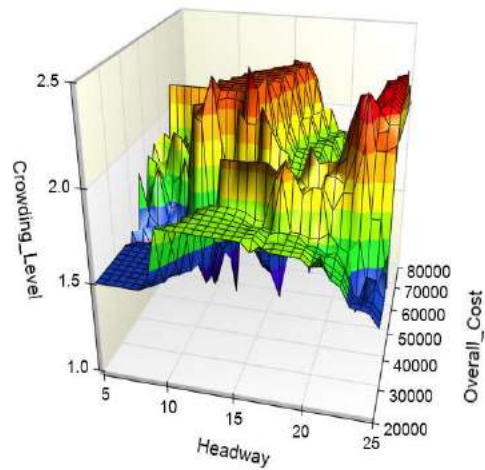**Figure14:**Overall Cost for 290E route in Up Direction

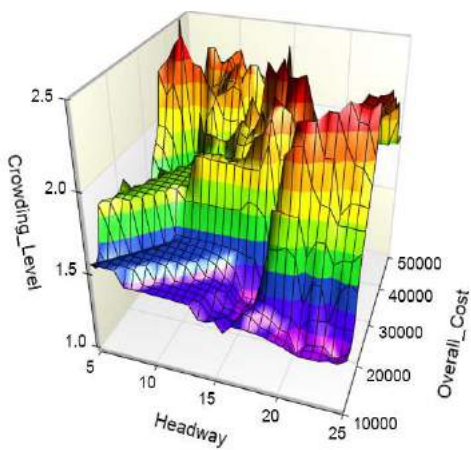**Figure17:**Overall Cost for 401 route in Down Direction

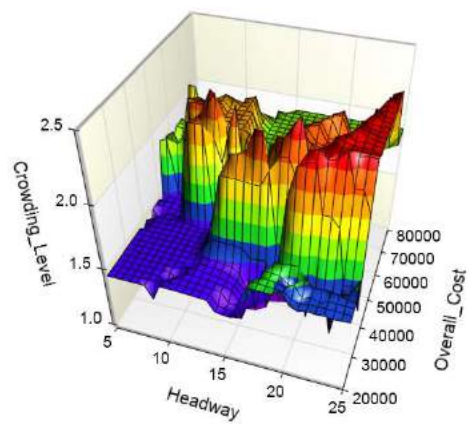**Figure15:**Overall   Cost   for   290E   route   in   Down Direction
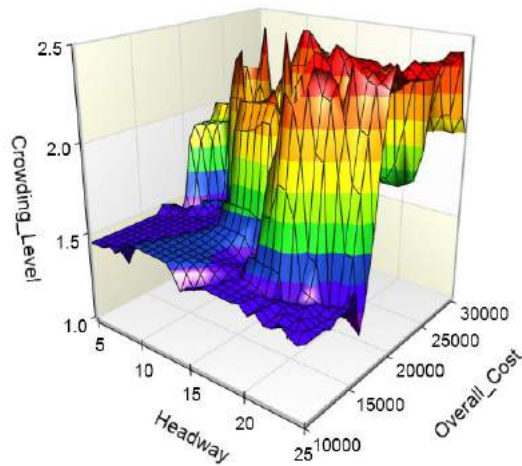

Figure18: Overall Cost for 401 A route in Up Direction

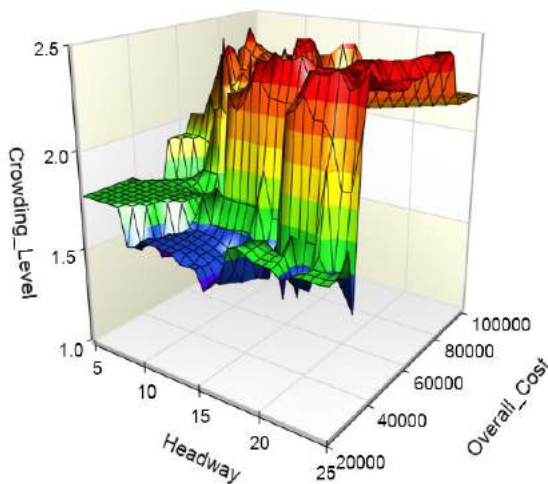**Figure19:**Overall Cost for 401 A route in Down Direction

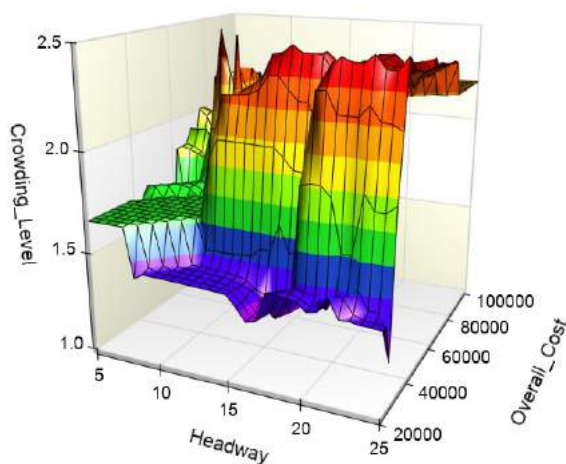**Figure20:**Overall Cost for 402 D route in Up Direction

Figure21: Overall Cost for 402 D route in Down Direction

CONCLUSIONS:

This paper focuses on passenger demand-driven operating solutions for a bus route. A model with capacity limits was used in the assignment of public transportation. It also examined the cost of a bus route to aid operators with the identification of the optimum level of service. The demand function is based on the fact that it reflects the characteristic of crowding.

The ideal results show that an optimal mix of operational methods merged with a varied frequency has the greatest potential for enhancing overall social welfare.Thus, the optimal frequency is determined minimising the social cost and evaluating all potential headway combinations fulfilling user and operator level constraints.

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DESIGN OF HIGH SPEED SYSTEM FOR POSITION AND SPEED CONTROL OF BLDC MOTOR IN MISSILE APPLICATION

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ABSTRACT

Brushless DC (BLDC) motor is primary component for accurate missile control. The object can be targeted accurately by correcting the angle of BLDC motor with high speed. The angle can be corrected based on the rotation of BLDC motor which can be sensed by quadrature encoder. Hence high speed decoder logic is necessary to control the speed and position of the BLDC motor with high accuracy. Thus, the decoder logic is proposed to control the speed and position of the BLDC motor with the support of ADSP, DRV8320 and hex-bridge. The speed of the BLDC motor control operation is improved by PWM approach and power consumption is maintained low by PID which is implemented on ADSP. Speed and position of the motor is controlled in run time through GUI based on the direction of the BLDC motor. The direction of the BLDC motor is detected by quadrature encoder which is inbuilt in BLDC motor. However the glitches are presented in the motor which is reduced by debouncer logic. Such a way BLDC motor speed and position is controlled through GUI with the delay of 1.39% and accuracy of 99.9%. The proposed method implemented on FPGA Spartan-6 based XC6SLX16 device. The simulation and synthesis results shows that, the proposed method provides the better controlling of speed by reducing the delay compared to the state of art approaches.

I. INTRODUCTION

Brushless DC motors are utilized in a wide range of applications because they combine the benefits of both DC and induction motors, such as reduced noise, long lifetime and good weight/size to power ratio, high efficiency, high dynamic response, wide speed range and capacity to tolerate vibrations and shock will improve the drive's stability [1]. Researchers use various simulations to analyze the behavior and functioning of the arrangement in order to improve the motor's speed management and starting torque. The researchers are tuning PID controllers by utilizing iterations, PSO algorithms, Fuzzy logic controllers and traditional methods such as hysteresis control, variable dc link control and PWM control [7].

Modern motion control relies entirely on encoder inputs with great precision and resolution, as well as quick signal processing. The manufacturing of hardware components, the latency of communication between distributed encoders and the central controller are essential factors of motion control. A hardware integrated circuit connects the rotary quadrature encoder to the controller. The delay caused by the signals passing through these many components can have an impact on the system's ability to operate in real time. By using decoder logic for quadrature encoders, the software implementation of the entire encoder interfacing system and the controller on a single integrated circuit, i.e., FPGA, can eliminate this latency[4]. It can increase the real-time operation capability and gives an edge over conventional motion control system for bulk reduction, ease of control and scalability.

Many research have been presented on speed control of BLDC motor using Quadrature encoder. With the help of a bidirectional switch, a quadrature encoder is employed to control the speed. The signal is applied at the up counter-bus midpoint to accomplish this. It turns off the encoder and starts the counter counting up. The switching frequency is twice that of the input signal in this case. As a result, the Quadrature encoder must have a short delay. This strategy has a drawback that the quadrature encoder should have a low latency. It signifies that the switching frequency is more than twice as high as the supply frequency [6]. A new controlling technology known as FPGA based frequency fold-back approach is developed to overcome this problem. In this procedure, the glitch signal was perceived and measured at the DC-bus decoders. The DC-bus glitch-current may be computed effectively and without loss by measuring this signal. Due to the fact that the DC-bus glitch current is not readily quantifiable. However, the main disadvantage of this technique is that it reduces the

output speed of the motor by managing the power used by the FPGA.

Using the FPGA environment is another novel technique to reduce power consumption. However, the RMS and peak currents of the diode were ineffectual in lowering stresses in BLDC motors. Currents flowing across the input terminals cause the stresses to be formed. In the typical fold-back approach to acquire the glitch value set point based on the BLDCs 3-rating, the proportional-integral (PI) based control mechanism is applied. Although this method is simple to apply, it presents problems with the hardware that must be checked in the field [8].

To address these issues, the designers purposefully lowered the speed of the BLDCs [9]. When considering the DC-bus glitches in the signal, the drives output frequency must be regulated in such a way that the decoders' overstressing problem is reduced. However, this procedure does not alleviate the pressures that are inherent in many VFD components, particularly terminal pieces and input diodes. Another effective approach for protection of BLDC speed is presented. The protection can reduce the stresses presented in various components of BLDC across the advanced encoders and counters side respectively. In this method the output power can be effectively controlled by mitigation of output frequency. Also the output power can be controlled by reducing the

glitch amplitudes of QAC system as an effective alternative to the regular reduction of DC-bus-signal glitch. The major drawback of this approach is that, it does not reduces the stresses above the BLDC motor that is more occurrence of torque glitches in the motor; this problem generated if the BLDC motor operated at various ranges of speed through the different frequencies respectively [11].

Hence the effective high speed decoder logic is proposed for better controlling of speed by reducing the delay compared to the state of art approaches which is essential in positioning the missiles towards the target.

II. Decoder logic for BLDC motor control

Modern motion control is entirely based on high-precision and high-resolution encoder inputs, as well as rapid signal processing. Motion control relies on the fabrication of hardware components and the latency of communication between distributed encoders and the central controller. The rotary quadrature encoder is connected to the controller through a hardware integrated circuit. The signals flowing through many components which generates a delay and can affect the system's capacity to operate in real time. Hence many approaches have been incorporated to provide the better performance. Most of the research focused to control the direction of the motor using the decoder logic. One of the approach is depicted in Fig 1.
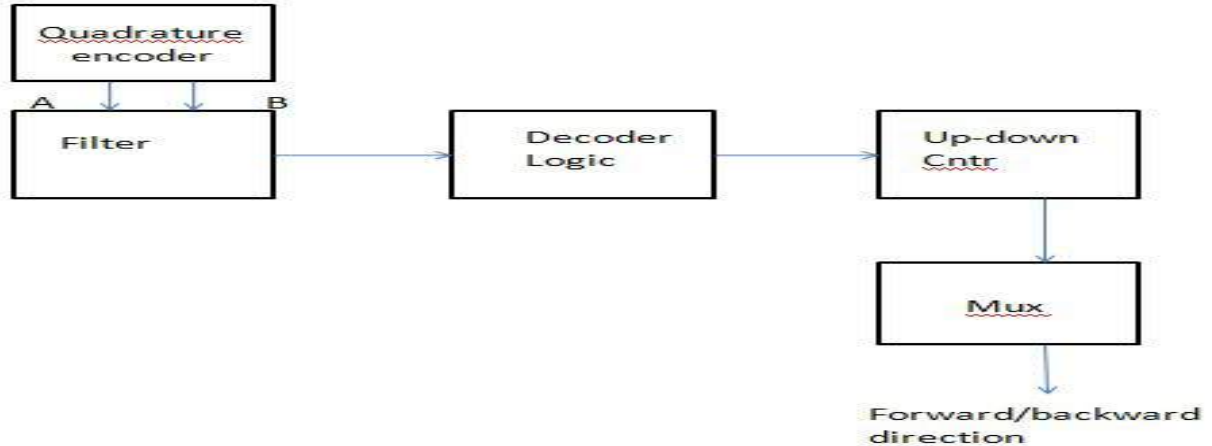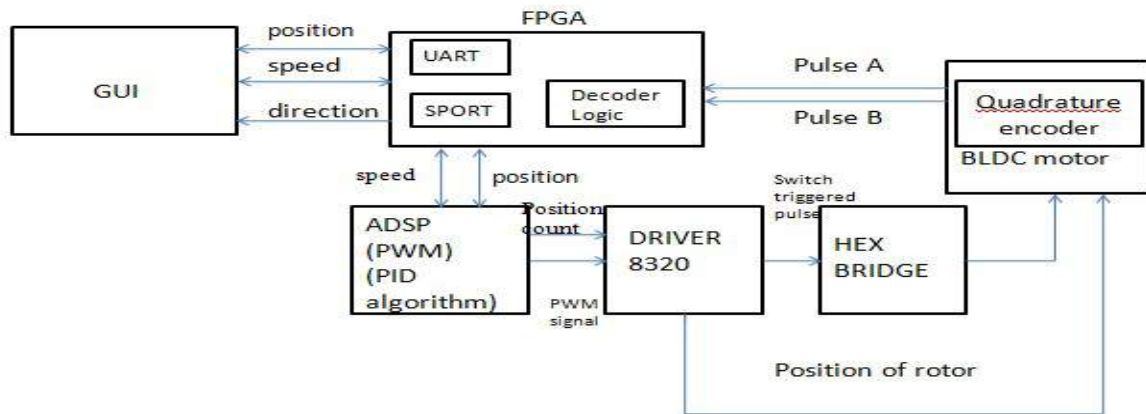

Fig 1. Existing decoder logic for BLDC motor direction control

Fig 2. High speed decoder logic for BLDC motor control

Hence a decoder design is proposed to control the speed and position of the BLDC motor with the support of ADSP, DRV8320 and hex-bridgeto provide better performance which is shown in Fig 2. Here a graphical user interface is designed to send speed control commands and receive information about the position and direction of the BLDC motor. Decoder logic receives commands from GUI and generates the displacement and speed signal and send them to ADSP. ADSP generates the pulse width modulated signal to control the speed based on the signal received from decoder logic. The position count value provided by the ADSP interms of 1º = 465 pulses. Based on the PWM pulse and position count from the ADSP, the driver and hex bridge drive the BLDC motor. The motor begins to rotate and generates pulses. The pulses A & B generated from the inbuilt quadrature encoder based on motor rotation and send for verification of position, direction and speed of motor through decoder logic which is implemented on FPGA.

ADSP

Pulse-width modulation (PWM) or duty-cycle variation methods are often used to control the speed of DC motors. The duty cycle is defined as the fraction of digital 'high' to digital 'low' plus digital 'high' pulse-width during a PWM period. To begin, the entire PWM (99 percent) has been maintained dependent on speed. The duty cycle has to be lowered once the pulses reached 460. The motor is in reverse and the direction oscillates when it hits 465 pulses. As a result, before reaching 450 pulses, PWM must modify the speed.

The ADSP memory interface communication protocol ensures that the BLDC motor's rotor rotates appropriately with the Quadrature encoder's outputs which determines the motor speed. PWM is a technique for altering the output levels of an applied signal. The desired speed is maintained with the help of a speed controller. It controls the duty cycle of the PWM pulses, which is proportional to the signal amplitude required to maintain the desired speed.

Pulse Width Modulation (APWM) based on ADSP is an effective approach to alter the amount of power delivered to the load. The APWM method minimizes harmonics and allows for smooth speed fluctuations without reducing starting torque. The APWM method of controlling the speed of a BLDC motor is a hybrid and advanced method. The operating power to the motors is turned on and off in the APWM technique to regulate the current to the motor. The ratio of 'on' to 'off' time is known as the duty cycle. The motor speed is determined by the duty cycle. To reach the required speed, the duty cycle can be modified.

Because the frequency is kept constant while the on-off period is changed, the duty cycle of APWM is determined by the pulse width. As a result, the power grows with the duty cycle in APWM. The analysis is carried out using a load cell, a current sensor and a signal sensor. This sensor is used to calculate the system's torque and power in a variety of conditions, including load and without load.As a result, the APWM duty cycle can be used to effectively control the BLDC motor's speed. The ADSP, on the other hand, may control the BLDC motor's position by connecting to the Hex bridge via the DRV8320.

DRIVER8320

The Driver8320 receives the control signal from the ADSP as an input. The integrated gate driver for three-phase application is the DRV8320 family of devices which is shown in Fig 3. It includes three half-bridge gate drivers, each of which can control both high-side and low-side switching devices such as diodes, transistors, and MOSFETs in Hex Bridge which is shown in Fig 4. The DRV8320 uses an inbuilt charge pump for high-side switching devices and a linear regulator for low-side switching devices to provide the correct gate drive signal. Peak gate drive currents of up to 1 amp source and 2 amps are supported by the smart gate drive architecture.The DRV8320 can run on a single power source and accepts input voltages ranging from 6 to 60 V

for the gate driver and 4 to 60 V for the optional buck regulator. Simple interface to controller circuits is possible with the 6x, 3x, 1x, and independent input PWM modes.The gate driver and device configuration settings can be highly customized using the SPI or hardware (H/W) interface.

By shutting down much of the internal circuitry, a low-power sleep mode is given to achieve low quiescent current consumption. Under signal lockout, charge pump fault, MOSFET over current, switching devices short circuit, gate driver fault and over temperature are all protected by internal protective features. For SPI device versions connected over the Hex Bridge, fault conditions are signalled on the nFAULT pin with details through the device registers.
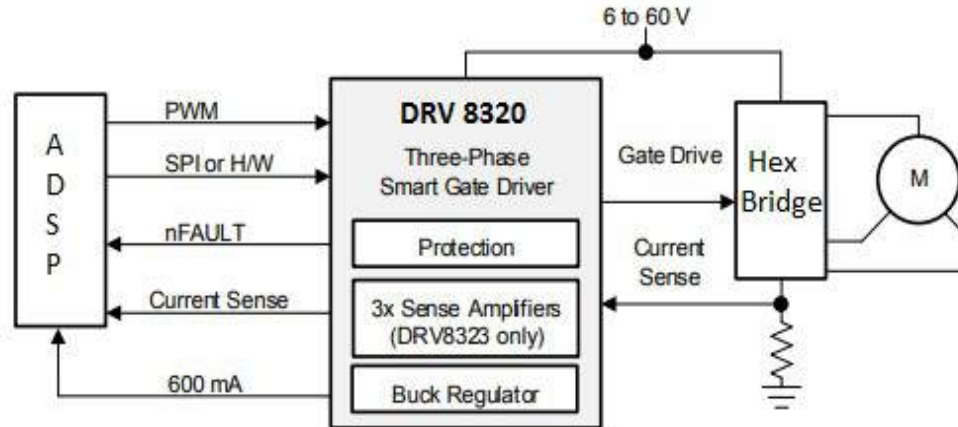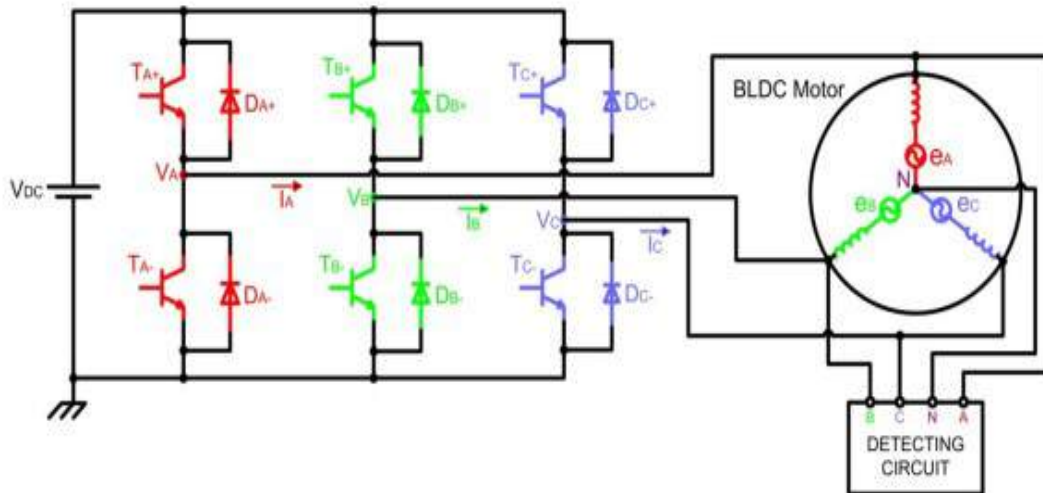

Fig 3. Driver 8320

Fig 4.Hex bridge

The BLDC motor operates on the basis of feedback from the internal shaft and rotor. Unlike brushed DC motors, which require a commutator and brushes to sustain feedback, brushless DC motors use feedback sensors to determine rotor position. Hall sensors and optical encoders are the most prevalent sensors. When a current carrying conductor is exposed to a magnetic field, charge carriers experience a force dependent on the signal created across the conductor's two sides.The signal created across the two sides of the conductor changes when the direction of the magnetic field changes [6].

The Hall Effect sensors provide a HIGH or LOW level signal whenever the rotor magnetic poles pass near the Hall Sensor, which can be utilized to calculate the shaft position. The back EMF of a three-phase BLDC motor is trapezoidal and there is a phase difference. This phase difference was used to start the motor spinning from user-defined places. The phase difference is additionally controlled by the Quadrature encoder outputs for effective position control and the speed is finally controlled in parallel with position by the Quadrature encoder based APWM mechanism.
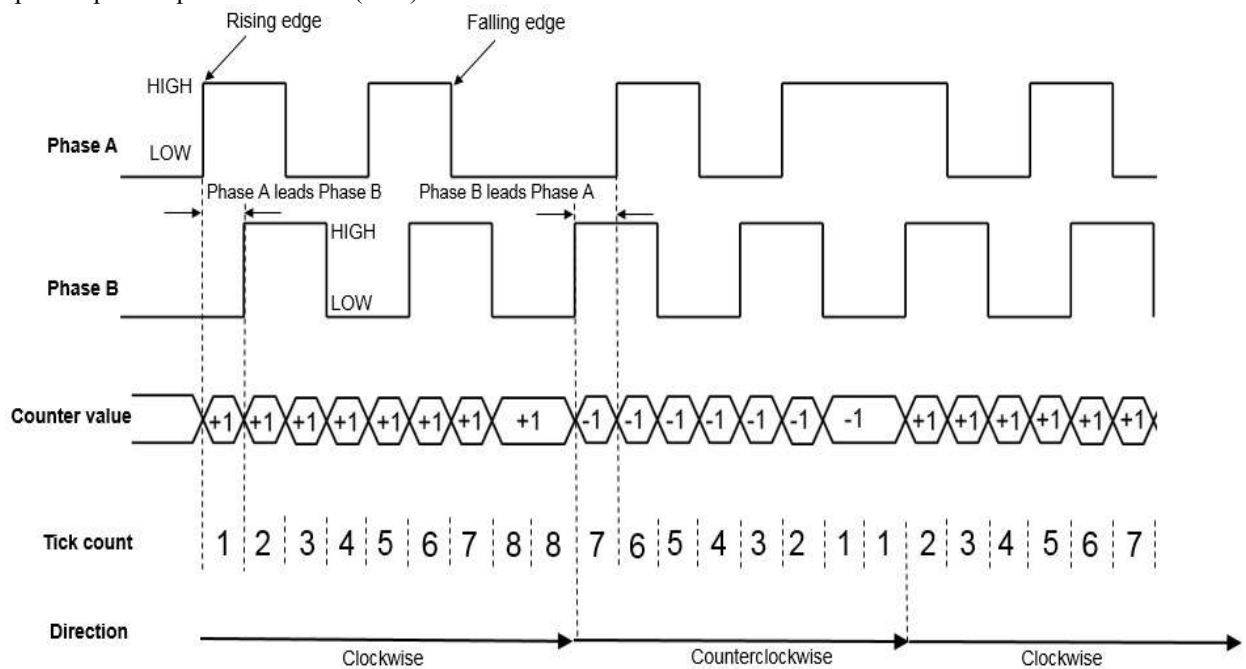
Quadrature encoder

A Quadrature encoder is a type of position sensor which is employed for determining the position of a shaft. It generates an electrical signal, analog or digital, consistent with the rotational movement. There are many various kinds of rotary encoders which are classified by either output signal or sensing technology.

This Quadrature encoder is additionally referred to as rotary encoder or relative rotary encoder and its output is a series of square wave pulses. A Quadrature encoder is an incremental encoder with 2 out-of-phase output channels used in many general automation applications where sensing the direction of movement is required. Each channel provides a specific number of equally spaced pulses per revolution (PPR) and the

direction of motion are detected by the phase relationship of one channel leading or trailing the other channel.

The code disk inside a Quadrature encoder contains two tracks usually denoted Channel A and Channel B. These tracks or channels are coded ninety electrical degrees out of phase, as indicated in the image below, and this is the key design element that will provide the Quadrature encoder and its functionality. In applications where direction sensing is required, a controller can determine direction of movement based on the phase relationship between Channels A and B. When the encoder is rotating in a clockwise direction its signal will show Channel A leading Channel B, and the reverse will happen when the Quadrature encoder rotates counterclockwise.

Fig 5. Timing diagram of quadrature encoder for direction detection of BLDC motor

Quadrature encoder is designed by utilizing the concept of finite state machine. The position of the motor is detected based on A & B pulses and state transition diagram is shown in Fig 6.Depending on state machine either increment or decrement the position will be done.
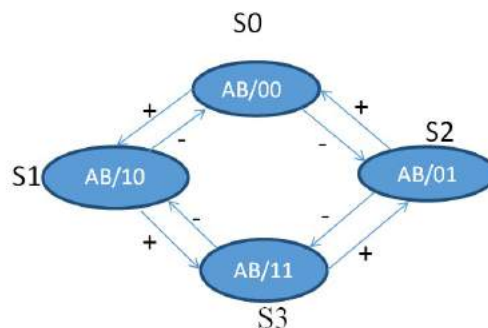
Fig 6. State transition for quadrature decoder logic

There is an incremental encoder (quadrature encoder) attached at the end of the each motor which needs to be interfaced with the ACU unit for position feedback. Pulse per revolution from each encoder channel A and B is 128 and with quadrature logic (A 90º phase offset w.r.to B) total state change or count registered as (128*4) =512 per revolutionparameters of incremental encoder.BLDC motor have high noise.Due to high current flow in Phases A, B and C if we get glitch it takes as count(false count). Debounce logic is used to avoid that false count.

III. Results and discussion of decoder logic
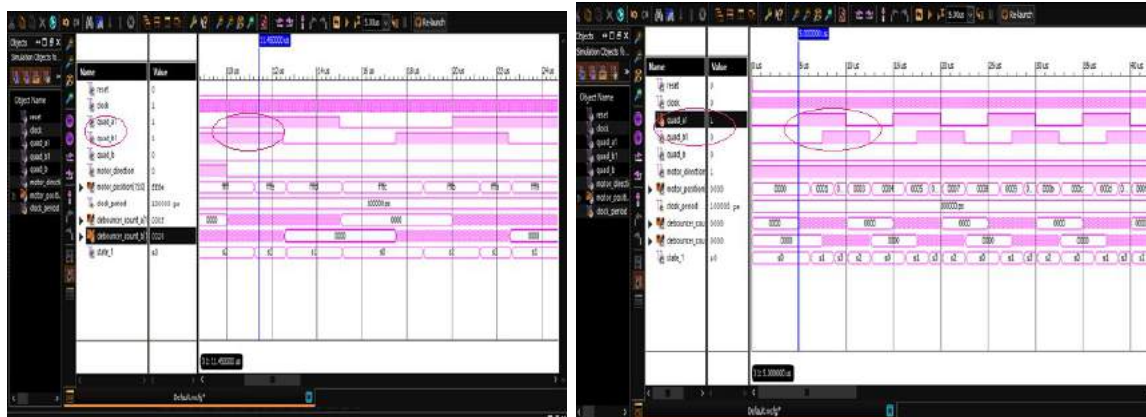
(a) Forward direction   (b) Reverse direction

Fig 7.Direction detection of BLDC motor using quadrature decoder

The decoder logic is designed using Xilinx ISE software on FPGA Spartan-6 based XC6SLX16 device to control the speed and directionof BLDC motor. The resultsshow that the detailed analysis of proposed design with respect to the input. The functionality of decoder logic is verified for different input combination through simulation result. The direction of BLDC motor is detected based on the quad_a and quad_b signal. If quad_b is leading by quad_a then motor rotates in reverse direction and vice versa in forward direction which is depicted in Fig7(a) & (b).

The speed of the BLDC motor is measured using displacement of the motor in unit time.It is verified by comparing the previous position with present position which is shown in Fig 8.
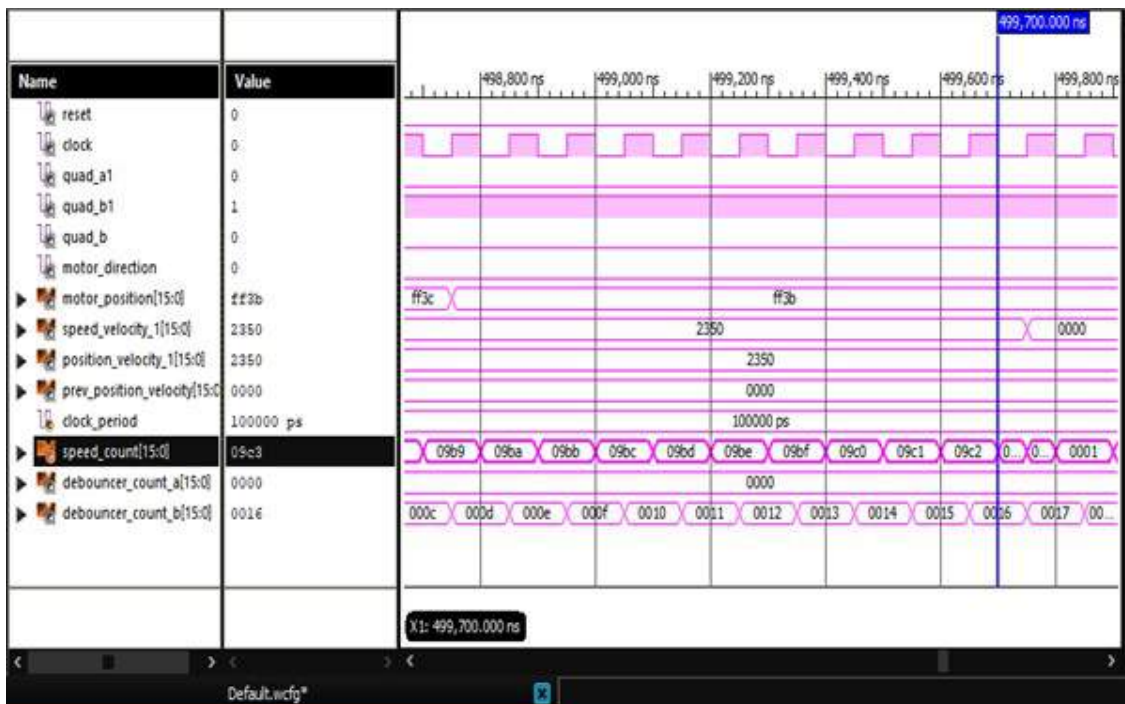
Fig 8. Speed of BLDC motor

The clock period of XC6SLX16 device is 5MHz(200nsec). The speed count is 2500 (09C3) based on above mentioned simulation result.

Speed updating time = 200*2500=500μs

Hence the speed to be updated for every 500μs.

The synthesis resultreported about the utilization of area with respect to the programmable logic blocks (PLBs) and look up tables (LUT), time summary with respect to various path delays and power summary.Table 1 represents that summary report by using the Xilinx ISE software. From the above table observed that dealy of 3.607ns and power consumption is 0.021W and used LUTS are 52. It indicates that less delay required for the proposed design. However more LUTs are utilized as compared with the conventional design. Since the conventional design detected the direction of BLDC motor alone. But present design controlled the speed by the position count and identified the direction. Hence the number of LUT increased for proposed design.

Table 1. Comparison of power, area and performance with conventional decoder design

Parameters	Reference[6]	Present work
Delay(ns)	4.76	3.607
Power Consumption(W)	0.02	0.021
No. of LUTS	24	52

The speed and position control system for four BLDC motor is depicted in Fig 8.
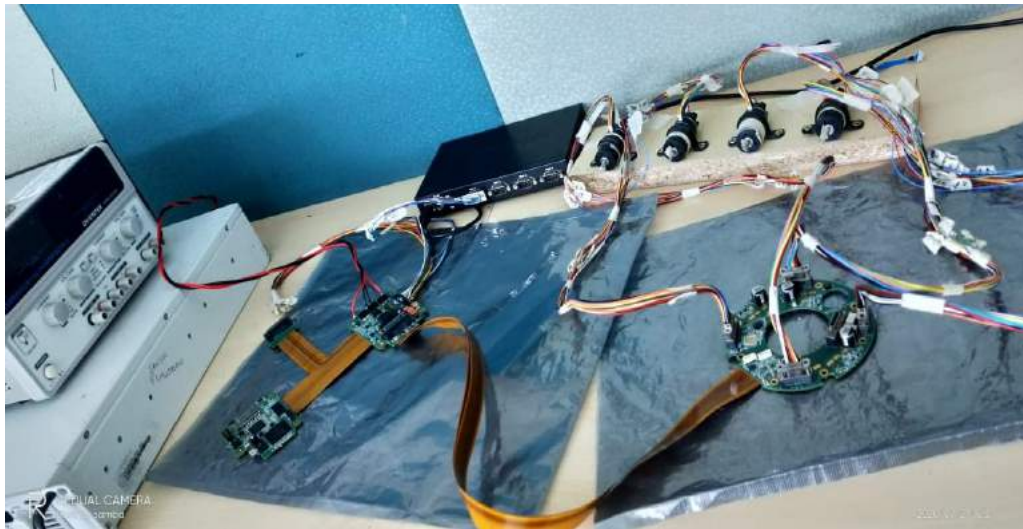
Fig8. Speed and position control system for BLDC motor
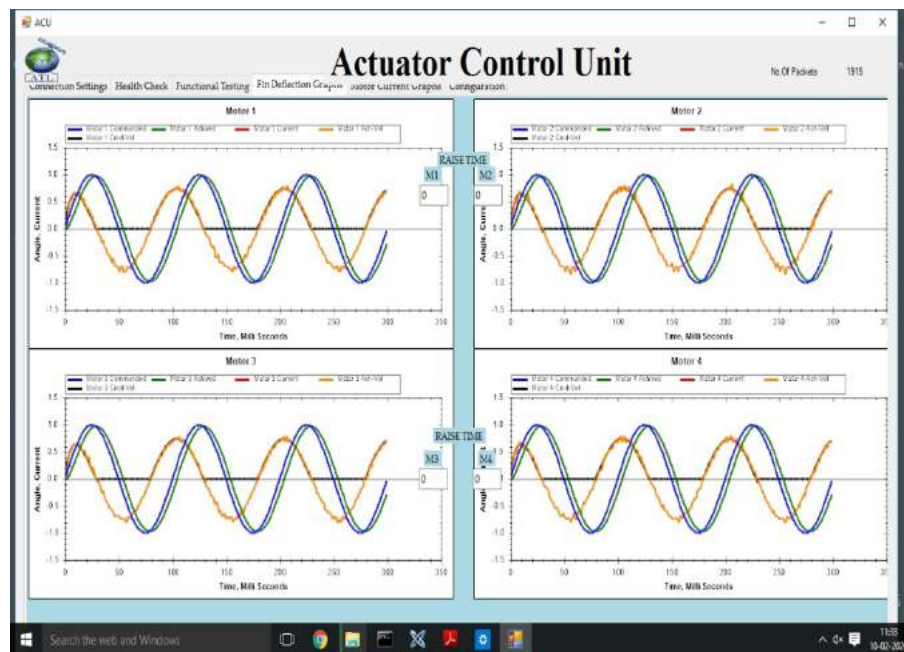
Fig9. Actuator control unit output of four BLDC motor

The GUI has Actuator control unit (ACU) window which represents the four BLDC motors respectively and the speed of motor in Radians. Here, Blue line represents the position, black line represents the speed velocity, green line represents the achieved position and finally orange line represents the achieved velocity respectively.Hence the accuracy of speed control is measured 99.9% based on the ACU

CONCLUSION

Thus, BLDC motor is controlled in terms of speed, position and direction with the delay reduction of 1.39% by PWM method.Two more functionalities also included i.e., controlling speed and position detection of BLDC motor.The proposed method implemented on FPGA Spartan-6 based XC6SLX16 device through the Xilinx environment with the accuracy of 99.9%, high speed and low power consumption.In future it can be extended to implement the parallel individual control of four BLDC motors using modified finite state diagram operation.

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ASSESSMENT OF PHYSICO-CHEMICAL CHARACTERS IN GROUND WATER OF KARUR BLOCK AREA, TAMILNADU, INDIA

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ABSTRACT

In the present study, the physico-chemical characteristics of groundwater water in Karur district was selected as the reference site. The concentration of water quality parameters like temperature, pH, dissolved oxygen, chloride, sulphate, nitrate, fluoride, total hardness, total alkalinity, electrical conductivity, biological oxygen demand (BOD) and chemical oxygen demand (COD) were done triplicate in the laboratory as per the standard methods. The results of the physico-chemical examination of this could be helpful in the management of its water quality. The correlation analysis on water quality parameters revealed that most of the parameters are correlated with each other Person's Correlation matrix. It is observed that some of the parameters do not have significant correlation between them indicating the different origin source of mild contamination. The analysis reveals that the ground water of the area needs some degree of treatment before consumption. The data obtained in this villages could be used as a baseline and reference point when assessing further changes caused by nature or man in these villages, since there has not been published information of data on these important villages from Karur district.

Keywords: Physicochemical parameters, Biological Oxygen Demand and Chemical Oxygen Demand.

INTRODUCTION

Water plays vital role in human life. It is extremely essential for survival of all living organisms. Clean and safe drinking water is important for the overall health and wellbeing; therefore, access to safe potable drinking water is one of the basic amenities of humankind, especially in rural areas. Groundwater is ultimate, most suitable fresh water resource with nearly balanced concentration of the salts for human consumption. Over burden by means of population pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate place enhance, the infiltration of harmful compounds to the groundwater (Pandey *et al.*, 2008). The quality of water is of vital concern for the mankind since it is directly linked with human welfare. There are several states in India where more than 90% populations are dependent on groundwater for drinking and other purpose (Ramachandraiah, 2004; Tank and Singh, 2010). The uncontrolled disposal of industrial and urban wastes and the use of chemical substances in agriculture (fertilizers, herbicides and pesticides) are the primary causes of groundwater contamination (Ullah *et al.*, 2009). During last decade, this is observed that groundwater get polluted drastically because of increased human activities.

Consequently, number of cases of water borne diseases has been seen that is a cause of health hazards. Hence, the present study was therefore undertaken with a view to provide much needed information on the water quality parameters The specific objectives of the study were to assess physical and chemical properties of groundwater in Karur district, Tamil Nadu was selected as the reference site.

MATERIALS AND METHODS

Study Area :

Karur is the textile and dyeing industry rich area in this state of Tamilnadu. It has been classified into unions and blocks, Karur block is one of them which has historical importance of temples, rivers and blessed with fertile agricultural lands. The Main sources of water is the river Amaravathi which is nowadays polluted by the said Industries. Karur includes 53 panchayat villages exactly, out of which, nearly 10 villages are focused for our investigation of surface and ground water and represent in table 1. Figure 1 shows the location of sample collection. The water sample used in this study was collected during pre-monsoon (March 1 and May 31) period at 2019. The collected samples were protected from direct sunlight and immediately transported to the laboratory for analysis.

Plate.1: Water samples

Table 1 Selected villages in Karur block area, Karur district

S. No	Place
1	Nanniyur
2	Thalappatti
3	Emur
4	Thaanthoni malai
5	Puliyur
6	Melappalayam
7	Vaangal
8	Manavadi
9	Aathum
10	Somur
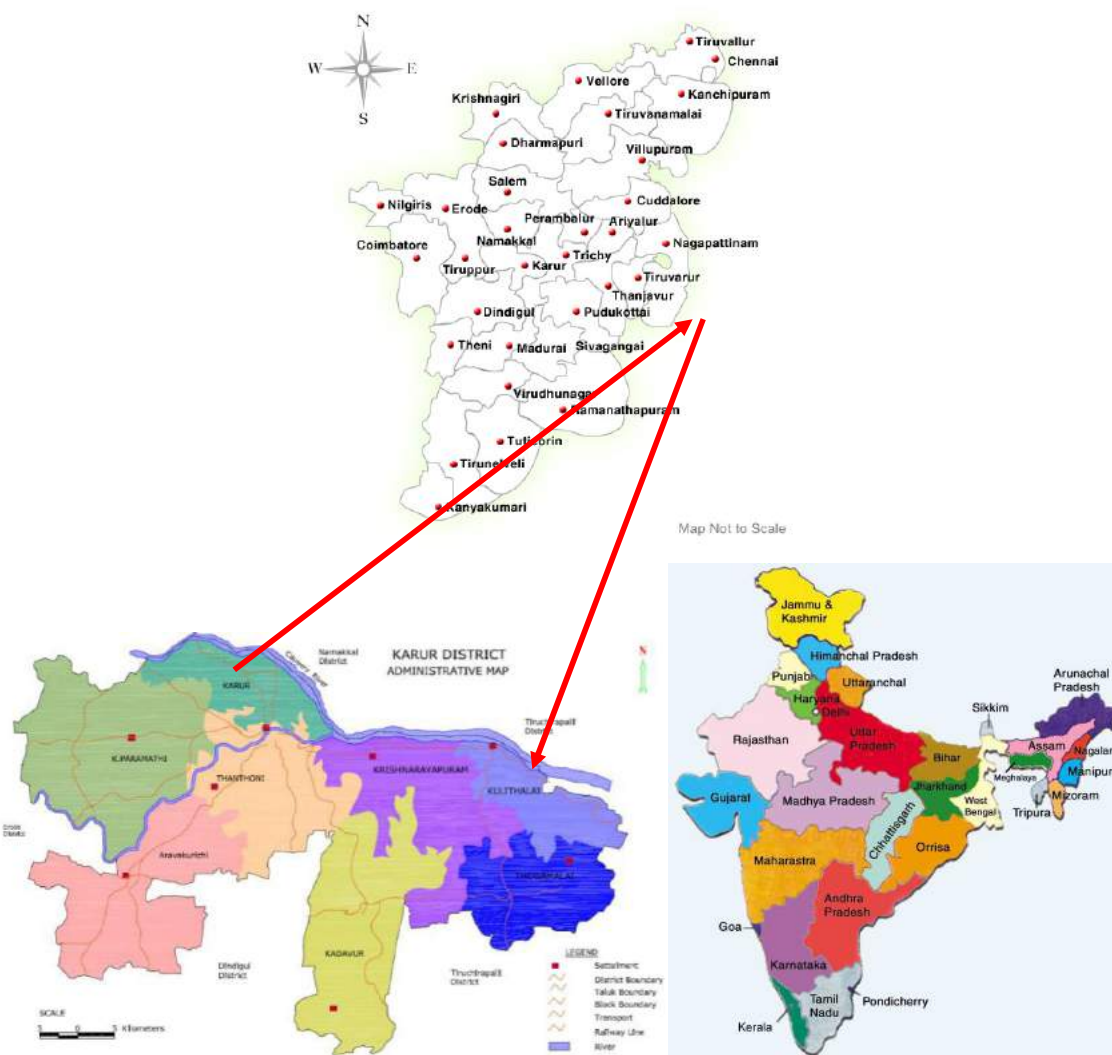
Figure 1 Location of sample collection

Physico-chemical parameters

The methods used for the analysis of various physic-chemical parameters were the same as given in Standard Methods for the Examination of water (APHA, 1985, 1989, 1998, Golterman *et al.,* (1969) and National Environmental Engineering Research Institute (NEERI, 1986).

Colour and odour: The colour is examined by visually and odour of the water is investigated by sensibly.

RESULTS AND DISCUSSION

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physic-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Water does content different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, color, odour, pH, turbidity, TDS etc, while chemical tests should be perform for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters. For obtaining more and more quality and purity water, it should be tested for its trace metal, heavy metal contents and organic i.e. pesticide residue. It is obvious that drinking water should pass these entire tests and it should content required amount of mineral level. Only in the developed countries all these criteria's are strictly monitored. Due to very low concentration of heavy metal and organic pesticide impurities present in water it need highly sophisticated

analytical instruments and well trained manpower. Following different physic chemical parameters are tested regularly for monitoring quality of water Data on the range of like pH, temperature, electrical conductivity, total hardness, total alkalinity, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), chloride, sulphate, etc., are given in the Table 1 and 2.

Temperature, Hydrogen ion concentration (pH) and Electrical conductivity

The temperature of 10 village's groundwater ranged from a minimum of Nanniyur village groundwater 28.50 °C to a maximum Aathum village 34.12 °C. (Table 1) shows the variation in temperature of groundwater. The pH of 10 villages groundwater ranged from a minimum of Thaanthoni malai village groundwater 7.20 to a maximum Thalappatti and Somur village 8.00 (Table 1) shows the variation in pH of groundwater. The temperature of 10 village's groundwater ranged from a minimum of Thaanthoni malai village groundwater 0.38 mmhos/l to a maximum Thalappatti village groundwater 1.32 mmhos/l. (Table 1) shows the variation in temperature of groundwater.

Temperature is an important limiting factor, which regulates the biogeochemical activities in the aquatic environment. Generally water temperature correspond with air temperature indicating that the samples collected from shallow zones has a direct relevance with air temperature, shallow water reacts quickly with changes in atmospheric temperature (Rajkumar *et al.,* 2011). Temperature controls behavioral characteristics of organisms, solubility of gases and salts in water (Vincy *et al*., 2012).

pH of water is an important environmental factor, the fluctuation of pH is linked with chemical changes, species composition and life processes. It is generally considered as an index for suitability of the environment (Rani *et al*., 2012). The highest value of electrical conductivity may be due to the Industrial Effluent because it contained many chemicals, salts and dissolved solids (Mishra and Saksena, 1993). Higher EC indicates the presence of high amount of dissolved inorganic substances in ionized form (Murhekar, 2011). Domestic Effluent also showed moderate to high value of EC. Electrical Conductance in monsoon was found below detection limit because it is distilled water and in distilled water presence of ions and chemicals is in minute quantity so; EC is found below the detection limit.

Total solids (TS), Total dissolved solids (TDS) and Total suspended solids (TSS)

The total solids (TS) of 10 village's groundwater ranged from a minimum of Thaanthoni malai village groundwater 140.72 mg/l to maximum Somur village groundwater 910.46 mg/l. Total dissolved solids (TDS) of 10 village's groundwater ranged from a minimum of Thaanthoni malai village groundwater 374.73 mg/l to maximum Somur village groundwater 889.05 mg/l. Total suspended solids (TSS) of 10 village's groundwater ranged from a minimum of Manavadi village groundwater 6.09 mg/l to maximum Somur village groundwater 51.41 mg/l. (Table 2) shows the variation in TS, TDS and TSS of groundwater.

The value of dissolved oxygen is remarkable in determining the water quality criteria of an aquatic ecosystem. The Dissolved oxygen is regulator of metabolic activities of organisms and thus governs metabolisms of the biological community as a whole and also acts as an indicator of trophic status of the water body (Saksena and Kaushik, 1994). This could also be because of freshwater mixing from river and low metabolic rate of organisms. Similar observation were drawn by Sahu *et al*., (2000). Dissolved oxygen is regulator of metabolic activities of organisms and thus governs metabolisms of the biological community as a whole and also acts as indicator of trophic status of the water body (Saksena and Kaushik, 1994).

Total Hardness (TH), Dissolved oxygen (DO), Alkalinity, Chloride (Cl) and Sodium (Na)

The Total Hardness of 10 village's groundwater ranged from a minimum of Manavadi village groundwater 220.30 mg/l to a maximum Somur village groundwater 380.78 mg/l. (Table 2) shows the variation in Total Hardness of groundwater. The Dissolved oxygen (DO) of 10 village's groundwater ranged from a minimum of Manavadi village groundwater 4.20 mg/l to a maximum Emur village groundwater 9.10 mg/l. (Table 2) shows the variation in Dissolved oxygen (DO) of groundwater. The alkalinity of 10 village's groundwater ranged from a minimum of Manavadi village groundwater 15.20 mg/l to a maximum Somur village groundwater 198.45 mg/l. (Table 2) shows the variation in Alkalinity of groundwater. The Chloride of 10 village's groundwater ranged from a minimum of Thaanthoni malai village groundwater 174.18 mg/l to a maximum Thalappatti village groundwater 386.41 mg/l. (Table 2) shows the variation in Chloride of groundwater. The Sodium of 10 village's groundwater ranged from a minimum of Thaanthoni malai village groundwater 57.05 mg/l to a maximum Somur village groundwater 274.74 mg/l. (Table 2) shows the variation in Sodium of groundwater.

Hardness is the parameter of water quality used to describe the effect of dissolved minerals (mostly Ca and Mg), determining suitability of water for domestic, industrial and drinking purpose attributed to presence of bicarbonates, sulphates, chloride and nitrates of calcium and magnesium. Present finding is in agreement with Mohan Raj *et al*. (2013). High values of hardness are probably due to regular addition

of large quantities of detergents used by the nearby residential localities into lakes which drains into estuaries.

The alkalinity of water is its capacity to neutralize acids. Alkalinity of water is a measure of weak acid present in it and of the cations balanced against them (Singh *et al.*, 2010). Total alkalinity is the total concentration of bases in water usually bicarbonates and carbonates (Ouyang *et al.*, 2006). Total alkalinity depends on the concentration of the substance which would raise the pH of the water. High levels of alkalinity indicate the presence of strongly alkaline industrial waste water and sewage in the estuary (Safari *et al.*, 2012). The degradation of plants, living organism and organic waste in the estuary might also be one of the reasons for increase in carbonate and bicarbonate levels, shows an increase in alkalinity value (Wang *et al.*, 2006). Our result agrees with the earlier report (Mohan Raj *et al.*, 2013).

Biological oxygen demand (BOD) and Chemical oxygen demand (COD)

Biological oxygen demand of 10 village's groundwater ranged from a minimum of Manavadi village groundwater 5.27 mg/l to maximum Somur village groundwater 12.30 mg/l. (Table 2) shows the variation in Biological oxygen demand of groundwater. Chemical oxygen demand of 10 village's groundwater ranged from a minimum of Manavadi village groundwater 6.75 mg/l to maximum Thalappatti village groundwater 13.65 mg/l. Table 2) shows the variation in Chemical oxygen demand of groundwater.

Chemical Oxygen Demand (COD) is a measure of pollution in aquatic ecosystems. It estimates carbonaceous factor of organic matter. Biological Oxygen Demant (BOD) is the amount of oxygen required by the living organisms engaged in the utilization and ultimate destruction or stabilization of organic water. It is a very important indicator of the pollution status of a water body. In the conducted experiments, BOD was high in Domestic and Industrial Effluent due to high organic load and excessive growth of total microorganisms (Kandhasamy and Santhaguru, 1994). This may be as a result of escape of organic matter (organic) into the river mostly from faecal waste deposition by the surrounding urban area and human settlements. Control Sample revealed BOD value below detection limit, because it was distilled water and had no organic load. Highest COD values were found in Domestic Effluent which may be due to the incessant inflow of sewages from urban areas (Mishra *et al.*, 1990).

Krishna Kumar Yadav *et al.* (2012) carried out to assess the status of the groundwater in Agra city .The range of physicochemical parameters like pH (7.2-7.7), EC (1580-5200 mmhos), TDS (1020-4950 mg/l), Turbidity (1.1-31.4 NTU), Total Alkalinity (330-525 mg/l), Total hardness 240-1425 mg/l), Chloride (295-1140 mg/l), Calcium (72-436 mg/l), Magnesium 14.6-151.2 mg/l), Sodium (126.5-1254.9 mg/l) and Potassium (1.9-60.6 mg/l) were found to be higher than the natural background level of groundwater. This indicates the groundwater pollution in selected water samples from 12 sampling sites from Feb. to May 2011 of Agra city. The results considered that the groundwater of the study area in general cannot be considered as good quality.

Correlation matrix

Statistical analysis was performed on the physico-chemical parameters detect the relationship and differences between the groundwater samples. The correlation coefficients(r) are presented in the form of matrix among various water quality parameters was calculated and the values of the correlation coefficients were given in the Table 3. Pearson's correlation analysis measures the closeness of the relationship between two variables at a time. The values of correlation coefficient nearer to +1 or –1, shows the probability of relationship between the variables x and y. This analysis attempts to establish the nature of the linear relationship between the variables and thereby provides a mechanism for prediction (Mulla et al., 2007; Kumar et al., 2005; P. Lilly Florence et al., 2012). The value of relationship takes values ranging from -1 to +1, where +1 represents an absolute perfect positive linear relationship, 0 represents no linear relationship, whereas -1 represents an absolute inverse relationship between the bivariates. The sign in front of the correlation coefficient value determines the direction of the relationship. Pearson correlation coefficients were computed in order to understand the association and relationship of different physical and chemical parameters. Therefore, in recent years an easier and simpler approach based on statistical correlation, has been developed using mathematical relationship for comparison of physico-chemical parameters. Extensive research has been carried out on statistical analysis to assess the surface water quality (Joshi et al., 2009). During the investigation find-out significant positive correlation between pH, EC, TS, TDS, TSS, HCO_3 Total alkalinity, TH, DO, BOD, COD, Na and Cl were recorded and negative correlation between COD and CO_3 that means where COD increase then CO_3 will be also decrease.

Table.1: Physical characters of water sample during pre-monsoon period at 2019

S. No	Place	Clarity	Nature of sample	Colour	Odour	Taste	pH	Temperature (^{o}C)	Electrical conductivity (mmhos/l)
1	**Nanniyur**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.30	28.50	0.45
2	**Thalappatti**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	8.00	30.12	1.32
3	**Emur**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.50	32.14	0.48
4	**Thaanthoni malai**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.20	28.75	0.38
5	**Puliyur**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.50	33.25	0.49
6	**Melappalayam**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.90	31.45	0.54
7	**Vaangal**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.50	30.67	0.47
8	**Manavadi**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.40	29.54	0.45
9	**Aathum**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	7.60	34.12	0.47
10	**Somur**	Transparent	Liquid	Colourless	No Characteristic	No Characteristic	8.00	30.22	1.27
*WHO (2011) Std.		Transparent	Liquid	Colourless	No Characteristic	No Characteristic	6.5-8.5	25.6	0.52

Table.2: Chemical characters of water sample during pre-monsoon period at 2019

S. No	Place	TS (mg/L)	TDS (mg/L)	TSS (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	Total alkalinity (mg/L)	Total Hardness (mg/L)	Dissolved oxygen (mg/L)	BOD (mg/L)	COD (mg/L)	Na (mg/L)	Cl (mg/L)
1	**Nanniyur**	420.18	390.92	29.26	2.17	15.15	120.74	265.74	4.8	6.23	8.52	98.35	182.86
2	**Thalappatti**	901.38	845.13	56.25	1.65	274.08	180.65	350.45	8.2	11.32	13.65	265.07	386.41
3	**Emur**	670.59	642.85	27.74	2.18	147.19	140.65	280.8	9.1	10.25	11.32	165.74	242.39
4	**Thaanthoni malai**	410.72	374.73	35.99	3.15	248.04	110.4	235.42	4.2	7.4	8.3	57.05	174.18

5	Puliyur	651.38	618.07	33.31	1.76	119.73	146.23	279.21	5.4	9.53	10.2	149.83	219.74
6	Melappalayam	865.63	812.74	52.89	2.86	325.52	170.24	325.74	7.02	10.78	11.45	250.46	365.5
7	Vaangal	620.48	596.04	24.44	2.18	85.01	152.04	255.74	6.32	8.6	9.23	157.18	237.05
8	Manavadi	425.04	418.95	6.09	2.94	65.43	15.2	220.3	4.2	5.27	6.75	140.72	195.07
9	Aathum	738.32	714.32	24	1.55	272.35	158.23	265.3	6.85	8.45	9.76	152.18	241.01
10	Somur	940.46	889.05	51.41	4.74	335.04	198.45	380.78	8.62	12.3	11.2	274.74	379.42
	*WHO (2011) Std.		500	500	-	1500	150	300	6	10	10	200	250

TDS=Total dissolved solids, TSS=Total solid substances

Table.3: Correlation coefficient (r) values between the Physico-chemical parameters (n = 10)

Parameters	pH	Tem.	EC	TS	TDS	TSS	CO_3	HCO_3	Total alkalinity	TH	DO	BOD	COD	Na	Cl
pH	1														
Tem.	0.229	1													
EC	0.821	-0.136	1												
TS	0.960	0.423	0.738	1											
TDS	0.957	0.452	0.724	0.998	1										
TSS	0.735	-0.050	0.694	0.741	0.702	1									
CO_3	0.226	-0.436	0.325	0.145	0.134	0.241	1								
HCO_3	0.702	0.230	0.540	0.749	0.733	0.730	0.365	1							
Total alkalinity	0.685	0.347	0.559	0.813	0.795	0.798	0.031	0.621	1						
TH	0.912	0.084	0.863	0.899	0.881	0.865	0.347	0.668	0.798	1					
DO	0.744	0.380	0.615	0.832	0.837	0.533	0.080	0.524	0.721	0.755	1				

BOD	0.840	0.349	0.700	0.925	0.913	0.813	0.213	0.713	0.866	0.895	0.856	1			
COD	0.808	0.312	0.700	0.866	0.851	0.813	-0.120	0.601	0.815	0.836	0.834	0.902	1		
Na	0.983	0.206	0.794	0.931	0.931	0.669	0.254	0.606	0.615	0.890	0.759	0.822	0.777	1	
Cl	0.984	0.118	0.824	0.939	0.928	0.811	0.279	0.734	0.700	0.928	0.742	0.858	0.830	0.968	1

Correlation coefficient is a measure of relationship between two variables, it ranges 0 to +1 or 0 to -1. Size of correlation coefficient 0.9 to 1.0 (or) -0.9 to -1.0 in this range very strong correlation, 0.7 to 0.9 (or) -0.7 to -0.9 in this range strong correlation, 0.5 to 0.7 (or) -0.5 to -0.7 in this range moderate correlation, 0.3 to 0.5 (or) -0.3 to -0.5 in this range low correlation while 0.0 to 0.3 (or) 0.0 -0.3 in this range very low correlation and 0.0 is no correlation in this range was used as present aim of study.

CONCLUSION

The results of the physico-chemical examination of this could be helpful in the management of its water quality. The correlation analysis on water quality parameters revealed that most of the parameters are correlated with each other Person's Correlation matrix. It is observed that some of the parameters do not have significant correlation between them indicating the different origin source of mild contamination. The analysis reveals that the ground water of the area needs some degree of treatment before consumption. The data obtained in this villages could be used as a baseline and reference point when assessing further changes caused by nature or man in these villages, since there has not been published information of data on these important villages from Karur district.

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APPLYING ARTIFICIAL INTELLIGENCE TO KNOWLEDGE MANAGEMENT

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ABSTRACT

Knowledge management is a critical focus area of the organization because of its effectiveness. It is an integrated approach for creation, sharing and upgrading information assets like experiences of individuals and groups. Knowledge identification is a challenging task and in our approach, we have applied clustering and genetic algorithm for identification and extraction. This will provide as an effective and an efficient way of identification of knowledge in an organization. It also describes the experience in designing and deploying knowledge management strategies and processes within an organization.

INTRODUCTION

Knowledge management (KM) provides a mechanism for managing the knowledge that incorporates in the enterprise [3]. The concept of KM comes from the realization and it's utilization with the tremendous value of knowledge for the corporate enterprise. In large organizations knowledge management [1] [2] plays a key role in acquiring and deploying new technology trend for process improvement. There are problems linked with tracing the knowledge assets [4] [2] and make utilize of them with internal triangle i.e. in an time bond, quality and cost-effective manner. The organization needs to have a common vocabulary, to be able to identify knowledge that can be shared [5]. The knowledge assets should be reused. This paper presents critical success factor of a knowledge management system [2].

CHALLENGES IN KNOWLEDGE MANAGEMENT

Knowledge management process as a concept along with framework will make the system cohesive and effective. Different stages of knowledge management framework are:

1.   Identification of the Knowledge

2.   Creation of the Knowledge

3.   Knowledge integration & distribution

4.   Upgrading knowledge

5.   Verifying effectiveness and efficient action

Knowledge management can be simplified as process of capturing and accumulating individual knowledge organization [8] wide and making available to all group members. This will start a knowledge loop rich with experience and experiment. Not only success but failures are captured as part of knowledge.

Knowledge sharing is used for innovative, faster reach to market and to build the competency of the work force. It also imbibes the team work culture. Implementation process of Knowledge Management comprises of following steps:

1. Conceptualize the domain

2. Have the infrastructure in place

3. Define the role

4. Management principle

5. Check effectiveness and Corrective action

6. Reward and recognition

Figure 1 Knowledge Management deployment process flow

Figure 1 shows how KM process that can be deployed in a software organization. Initially, we need to identify the domain area for KM. A suitable content management tool (interwoven, share point portal, etc) can be evaluated for content taxonomy. This infrastructure will help in KM creation stage. Along with the infrastructure we need to define role for reviewer, approver, user, and administrator. A structured workflow will be put in place to support content flow for all defined role. The administrator/apex committee has to constantly monitor and evaluate the effectiveness and efficiency. Reward and recognition will increase participation of different role players [2].

The process of knowledge management follows the following steps:

- Enhancing a sharing culture

- Creating the faith in the movement

- Build and sustain momentum

- Implement IT infrastructure

- Ensure quality of content

- Measure Utilization factor

- Scale up to the Organization

In any organization the KM cycle will face different level of challenges. This is shown in Figure 2.
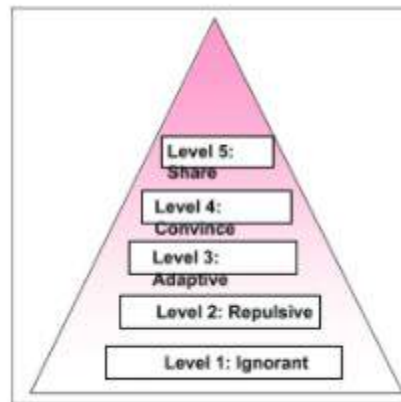
Figure 2: **Difficulty level in Knowledge Management**

In the KM initiation process the first level is ignorance. People at this level are not aware the benefit of knowledge and resist knowledge sharing. In the next stage they will be repulsive to accept the knowledge sharing idea. The organization should take care of these two difficulties and make them aware of "reinventing the wheel" concept. This will lead to adapt and convince the elite group to start sharing knowledge with peers.

IMPLEMENTATION OF CLUSTERING AND GENETIC ALGORITHM -IDENTIFICATION OF KNOWLEDGE

Knowledge identification can be categorized by virtue of content, type and application wise. The more and better classification will increase the granularity of knowledge management. This can be defined as knowledge taxonomy. The better the granularity of knowledge management more effective it will be in decision making. In our approach, we will be using

clustering to identify the data and categories the data into different clusters. The database has the enterprise information stored in it. The knowledge extraction from the database is important to support in decision making. Thus the knowledge base is extracted from the database.
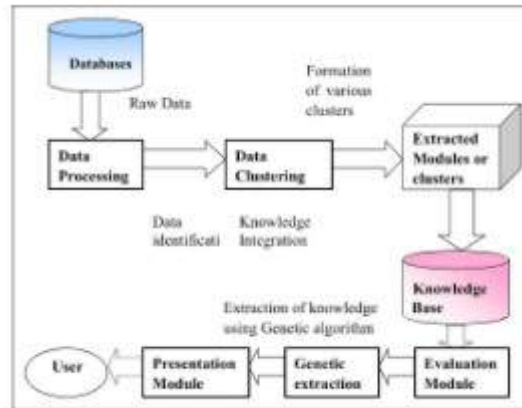

Figure 3 Knowledge Management procedures

The knowledge management procedure is described in Figure 3. The information contained in the database is clustered in different objects. The data in one cluster are similar to each other. The data needs to be searched from the knowledge base so that the collected knowledge can support the users. We have used genetic algorithm to extract data from the knowledge base. Genetic algorithm has an added advantage of robustness over his cousins.

Applying Clustering on data

Clustering is a nonlinear activity that generates data around a stimulus word. It may be a class or an individual activity. Therefore, a cluster is a collection of things as objects or as data which are "similar "between them. The clusters also are "non-similar" with the objects of other cluster. There is no "best" criterion of clustering but it depends on the user to apply clustering in such a way that the result suits their needs. In our approach, in the proposed system, the clustering Fuzzy C-means (FCM) algorithm is used [7] to perform the collection of data. This clustering algorithm is mostly used in case of overlapping of data in more than one cluster. GA is a generate-and-test population-based search stochastic method to solve the tough problems [11]. FCM is method of clustering which allows the data to belong to more than one class. The objective function is following:

$$J_c = \sum_{i=1}^{N} \sum_{j=1}^{t} u_{ij}^c \left\| x_i - t_j \right\|^2, \quad 1 \le c < \infty$$

Where c is any real number greater than one, and degree of membership of xi in the tj cluster is $^C_{ij}$, tj is the center of the cluster. The more the data near to the center it belongs to that cluster. The overlapping is based on the membership function of xi.

$$t_j = \sum_{i=1}^{N} u_{ij}^c . x_i \Big/ \sum_{i=1}^{N} u_{ij}^c$$

The FCM algorithm is applied to form the clusters of data according to the similarity in data. The membership function and the Centerior are calculated from the above formulas [2A].

KNOWLEDGE INTEGRATION

Knowledge integration will support in the decision making. We have proposed the integration of the knowledge using genetic algorithm. Genetic algorithm will categorize the data in accordance with the domain.

Genetic algorithm – Extraction of data

Genetic Algorithms (GAs) is inspired by the concepts of evolution and natural selection. In nature, the population of a species evolves according to principles of natural selection, of the "Survival of the fittest". Accordingly, the characteristics of an individual which is fit (good) are most likely to be passed to the next generation than the characteristics of an unfit individual. Genetic Algorithm attempts to simulate the natures' theory. The algorithm takes the population and does the evolution on it; it gives back optimal solution after the series of run and 100 of generations. Genetic algorithm is the most widely used random search technique.

. A genetic algorithm [10] is optimization search techniques useful in a number of practical problems where elements in a given set of population are randomly combined until we get a population of encoded solutions. We have a fitness function that evaluates the optimality of each solution the termination criteria is satisfied. Population is evolved iteratively in order to improve the quality of the

population. Initially the population is generated and with each generation a new set of solutions is generated by applying the three basic operators. The process is done by three important operators' i.e selection, crossover and mutation. Crossover is one of the most important operators of GA as it explores new search space by recombining existing elements of the space [10,11]. Mutation introduces new search elements that were not found in existing solutions.

Genetic Algorithm surpasses the traditional methods because of its robustness. GA is fundamentally different as compared to its traditional cousins. GA search from a population of points and not a single point. It uses probabilistic transition and not deterministic rules.

Chromosome

The chromosome represents information about solution [9]. The chromosome is a set of binary string. Each bit will present characteristics of the solution.
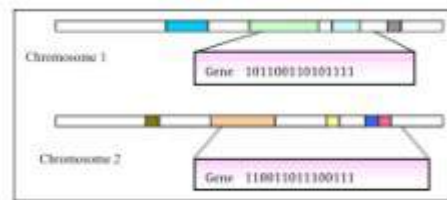

Figure 4 Chromosome

To use a genetic algorithm the solutions must be encoded in a structure of the problem that can be stored in the computer. This object is a genome (or chromosome). There are a number of operators that are performed on the initial population. The life cycle of the genetic algorithm is the initial random population is generated depending on the user requirement. Then the fitness function for each is generated the more the "fitness" value the more it is suitable for existence. The chromosome with a high fitness value will pass to the next generation. There are a number of operators that are used to pass the fit solution to pass to next generation.

Crossover

Crossover selects genes from parent chromosome and creates a new offspring. The simplest way to perform crossover is to select a point and cross the bits in two chromosomes. The Crossover can be complicated and that depends on the encoding of the chromosome.
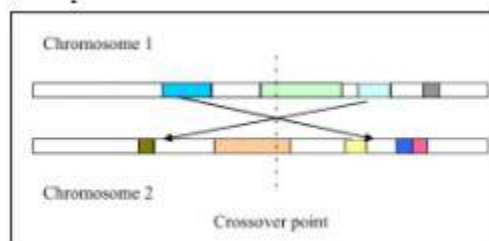
Figure 5 Crossover operation

Mutation

Mutation is performed after the crossover so that the chances of getting stuck in the local optimum are

reduced. Mutation is performed by randomly selecting a bit and changing the bit. This will change the population and there are less chances of getting stuck in local optimum.
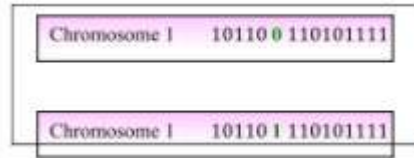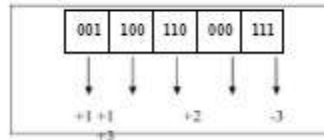

Figure 6 Mutation operation

Mutation changes randomly the new offspring. On the other hand the rate of mutation should be low. If the mutation probability is more than the whole population will change. Mutation could be changing the genes [9].

Now if the data set is as follows, then the calculated sum of debit and credit will represent the fit value of solution.

So d= +1+1+2-3+3 = +4

So the sample data with more value is more suitable as compared to the one with less value.

KNOWLEDGE MANAGEMENT PROCEDURE STEPS

The steps that need to be followed for knowledge management are as follows:

1. Information in database
2. Perform clustering on information
3. Fuzzy C mean algorithm implemented
4. Knowledge base (Clusters)
5. Extraction of data using Genetic Algorithm
6. More Fit value is suitable solution

The above are the steps that need to be followed in order to make the knowledge effective. In our approach, we have implemented these steps. The five numbered clusters with high probability. The results were generated at 198th iteration as compared to the 212th iteration.

The description of the process of knowledge management is as follows:

Promote a sharing culture

Each of the organization has inherent problem of knowledge encapsulation. The organization has to promote for knowledge sharing.

Evangelize the movement

We need to form a knowledge committee in which people from different segments should be the member. There should be review meetings and knowledge seminar scheduled every fortnight. This has to be pushed constantly by the apex committee members. The apex members should be from the middle management group.

Build and sustain momentum

The senior members of the top management should put enough effort in terms of time and resources for KM culture.

Deploy IT infrastructure

A content publishing tool should be put in place for automating the knowledge sharing. There are off- the-shelves tools available in the market like (interwoven, vignette, etc). These tools have defined workflow for

capturing, maintaining, approving and publishing the contents[10].

Ensure quality of content

A review and approval needs to be done by the apex committee to check the contents before publishing. The committee should also look into the associated IPR issues.

Measure Utilization factor

Awards and rewards scheme should be in places for publishing any knowledge content as well as at the time of reuse also. These can be captured through the number of access to the published content.

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Thanks to and proud of nonika bajaj, rakesh agarwal of their progress in the last decade

CONCLUSIONS

Knowledge Management is a critical activity in an organization especially in software organization. The effectiveness relates to the expressive power and re-usability [5] in context of software reuse [6] perspective. The Knowledge management system should be built upon the technologies existing in different endpoints by providing the communications infrastructure [3][4] which is needed to connect the servers reliably and securely. By managing processes [4] using taxonomy services and content- based routing the effectiveness and content-rich knowledge base is established. This approach will help the decision makers and will support the knowledge management. The analysis and development of the prototype may be used for further various types of GAs available for implementation.

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DETERMINATION OF BIOACTIVE CONSTITUENTS IN *TRICHOPUS ZEYLANICUS* SSP. TRAVANCORICUS BURKILL EX K. NARAYANAN LEAF AND STEM EXTRACTS BY USING GC-MS TECHNIQUE

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ABSTRACT

Trichopus zeylanicus ssp travancoricus Burkill ex K. Narayanan is a herb which belongs to the family Trichopodaceae locally known as Arogyapachai. It is accounted as one of the chief ethnomedichal plants. The present study focused to analyse the bioactive components present in the leaves and stem of T. zylanicus ssp travancoricus by using GC-MS. Thirteen and ten compounds were identified from the ethanol extracts of T. zeylanicus ssp travancoricus leaf and stem respectively. Undecane (19.65%), n-Hexadecanoic acid (8.54%), phytol (8.48%), Hexadecanoic acid, methyl ester (7.24%), Neophytadiene (7.01%)3-Azabicyclo [3.2.2] nonane (6.28%), Methyl stearate (4.71) and Decane, 1,9-bis[(trimethylsilyl]oxy] (3.64%) were identified as major bioactive constituents of T. zeylanicus ssp travancoricus leaf. Similarly, n-Hexadecanoic acid (32.29%), 1,3-propanediol-2-(hydroxymethyl).2-nitro (24.42%), carbamic acid, monoammonium salt (12.08%), phthalic acid, butyl undecyl ester (7.46%), Octadecanoicacid (5.17%) and 13 octadecenal, (z)-were found as major bioactive components of T. zeylanicus ssp travancoricus stem. The obtained bioactive components were reported as potentially active in various medicinal treatments and can be used for the treatment of various diseases.

Keywords: Arogyapachai, Kani, Undecane, Phytol, Octadecanoic acid

INTRODUCTION

For thousands of years traditional herbal medicines have cured many diseases due to their special healing efficacy. It has gradually attracted interest and acceptance by the general public as efficient and cost effective medicine besides being locally available and safe [1]. Plants contain different phytochemicals, known as secondary metabolities. Phytochemicals are helpful in the treatment of definite disorders by the individual, additive or synergic acts to recover health [2,3]. Phytochemicals are vital in pharmaceutical industry for development of new drugs and preparation of therapeutic agents [4].

Plants as sources of bioactive compounds persist to play a main role in the protection of human health. Plants have the ability to synthesize a wide variety of bioactive compounds that are used to perform important biological functions. Bioactive compounds such as flavonoids, tannins, saponins, alkaloids and terpenoids have several biological properties which include antioxidant, antiinflammatory, antidiarrheal, antiulcer and anticancer activities, among others [5]. Bioactive compounds are naturally synthesized in the plant body and any part of the plant body may contain active components. Extraction and characterization of several active phytocompounds from these green factories have given birth to some high activity profile drugs [6].

Trichopus zeylanicus ssp. *Travancoricus* Burkill ex K. Narayanan is a rhizomatous herb which belongs to the family Trichopodaceae locally known as Arogyapachai (Tamil) and Arogyapacha (Malayalam) and literally known as the green that gives strength. In India, the species have reported as endemic to the Southern Western Ghats with a restricted distribution of Agasthyamalai Biosphere Reserve. It is reported as one of the important ethnomedicinal plants which grow near to the wet banks of streams and rivulets of the dense forest. The Kani tribe of Agasthyamalai has introduced various uses of this wild plant to the present medical world. They also claim that one who consumes the fruits of Arogyapachai regularly, will remain healthy, agile and disease resistant [7]. The powdered leaves of *T. zeylanicus* ssp. *travancoricus* along with stem bark of *Mangiferaindica* was used to treat venereal diseases [8]. The indigenous tribal community in Agastya hills traditionally uses this plant as an instant energy booster that combat fatigue [9]. *T. zeylanicus* ssp *travancorius* also possess several pharmacological activities and medicinal properties such as choleretic, aphrodisiac, hepatoprotective, mast cell stabilization [10-12] adaptoagenic[13]cardioprotective[14] anxiolytic and antidepressant activity hepatoprotective activity, immunomodulatory activity and antiulcer activity [15-17]. The chemical investigation of aerial part, fresh leaves, dried leaves and fruits were already carried out by some investigators [18-20]. It is an important ethnomedicinal herb, so far, no study has been carried out on phytochemical analysis of stem of *T. zeylanicus*

ssp *travancoricus*. With this research reivew, the present study was carried out to identity the bioactive components present in the ethanol extracts of the leaves and stem of *Trichopus zeylanicus* ssp. *travancoricus*.

Materials and Methods

Plant collection and identification

The fresh plant of *Trichopus zeylanicus* ssp *travancoricus*Burkill ex K. Narayanan (hereafter TZT) were collected from Mankkamalai, Petchiparai, Kanyakumari District, Southern Western Ghats, Tamil Nadu. The specimens collected were identified with the local flora and authenticated by Botanical survey of India, Southern circle, Coimbatore. The voucher specimen of TZT (EPH: 411) was submitted in the Herbarium of Ethnopharmacology unit, Research Department of Botany, V.O. Chidambaram college, Tuticorin.

Preparation of plant extract

The leaf and stem were air-dried at room temperature and pulverized into powder in a mechanical grinder. Needed quantity of powder was weighed. This was transferred to stoppered flask and treated with ethanol. This is done until the powder is fully immersed. For the first 6 hours, the flask was shaken every hour. Then it was kept aside. This was again shaken after 24 hours. This process was repeated for 3 days. Then the extract was filtered. The extract was collected. This was evaporated to dryness. This was done by using a vaccum distillation unit. The ultimate residue thus attained was then focused to GC-MS analysis.

GC-MS analysis

The Shimadzu GC-MS QP 2020 was used in the analysis employed a fused silica column, packed with SH-Rxi-% silMS(30m × 0.25 mm ID × 250μm df) and the components were separated utilizing Helium as carrier gas at a constant flow of 1 ml/min. The injector temperature was set at 280°C during the chromatographic run. The 1 μL of extract sample injected into the instrument the oven temperature was as follows: 40°C (2 min); followed by 280°C at the rate of 10°C min^{-1} and 280°C, where it was held for 3 min. The mass detector conditions were: transfer line temperature 280°C, ion source temperature 230°C and ionization mode electron impact at 70eV, a scan time 0.2 sec and scan interval of 0.1 sec. The fragments from 40 to 550 Da. The spectrums of the components were compared with the database of spectrum of known components stored in the GC-MS NIST (2017) library.

RESULTS AND DISCUSSION

A total of 13 compounds were identified from the GC-MS analysis of ethanol extracts of TZT leaves exhibiting various phytochemical activities. The chromatogram is presented in Fig. 1 while the chemical constituents with their retention time (RT), molecular formula (MF), molecular weight (MW), concentration (%) and structure of compounds are presented in Table 1.

Fig. 1 GC-MS chromatogram of TZT leaf

Table 1: Bioactive compounds found in ethanol extract of TZT leaf

S. No.	R.T	Name of the Compound	M.F	M.W	Peak Area %	Structure
1	3.616	Undecane	$C_{11}H_{24}$	156	19.65	
2	8.750	Phenol, 2,6-bis(1,1-dimethylethyl)-	$C_{14}H_{22}O$	206	3.46	
3	9.761	Chloroacetic acid, 4-pentadecyl ester	$C_{17}H_{33}ClO_2$	304	2.53	
4	12.616	Neophytadiene	$C_{20}H_{38}$	278	7.01	
5	7.01	3-Azabicyclo[3.2.2]nonane	$C_8H_{15}N$	125	2.58	
6	13.160	3-Azabicyclo[3.2.2]nonane	$C_8H_{15}N$	125	3.78	
7	13.595	Benzene, (1-methyldodecyl)-	$C_{19}H_{32}$	260	1.90	
8	13.731	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	7.24	
9	14.187	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	8.53	
10	16.278	Phytol	$C_{20}H_{40}O$	296	8.48	
11	16.496	Methyl stearate	$C_{19}H_{38}O_2$	298	4.71	
12	21.854	Decane, 1,9-bis[(trimethylsilyl)oxy]-	$C_{16}H_{38}O_2Si_2$	318	3.64	
13	22.164	Azetidine, 1-methyl-3,3-dipentyl-	C_4H_9N	71.12	3.63	
14	23.454	dl-Alanyl-l-alanine	$C_6H_{12}N_2O_3$	160	1.51	

The prevailing compounds were undecane (19.65%), n-Hexadecanoic acid (8.53 %), Phytol (8.48 %), Hexadecanoic acid, methyl ester (7.24 %), Neophytadiene (7.01 %) , 3-Azabicyclo [3.2.2] nonane (6.28 %), Methyl stearate (4.71 %), Decane, 1,9-bis [(trimethylsily)oxy] (3.64%), Azetidine-1.methyl-3-3-dipentyl (3.63 %), phenol, 2,6-bis(1,1-dimethylethyl)(3.46 %) and chloroacetic acid, 4-pentadecyl ester (2.53 %). Ten compounds were identified in TZT stem by GC-MS analysis (Fig. 2). The active principles with their retention time (RT), molecular formula (MF), Molecular Weight (MW), concentration (%) and structure of compounds are presented in Table 2.
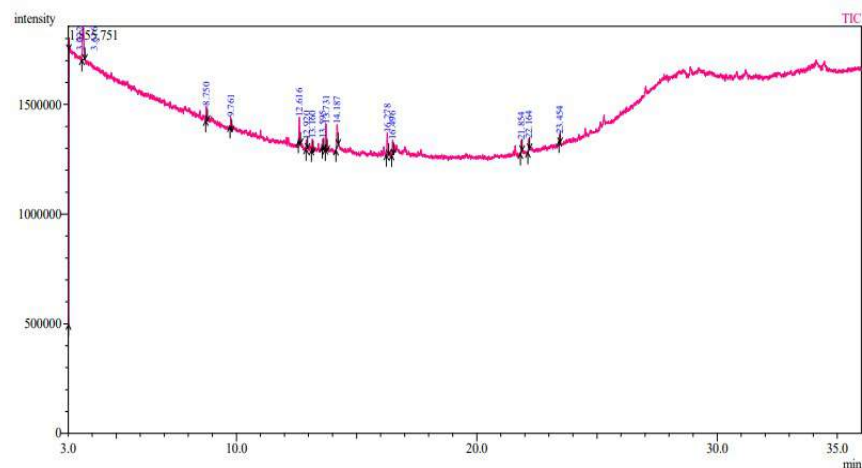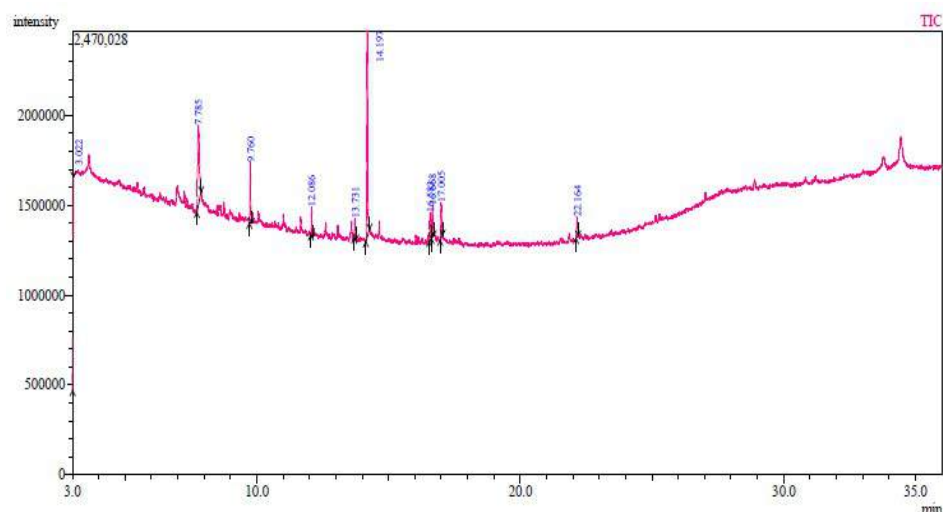
Fig. 2: GC-MS chromatogram of TZT stem

Table 2: Bioactive compounds found in ethanol extract of TZT stem

S. No.	R. Time	Name of the Compound	Molecular Formula	Molecular Weight	Peak Area %	Structure
1.	3.022	Carbamic acid, monoammonium salt	$CH_6N_2O_2$	78	12.08	
2.	7.785	1,3-Propanediol, 2-(hydroxymethyl)-2-nitro-	$C_4H_9NO_5$	151	24.42	
3.	9.760	Phthalic acid, butyl undecyl ester	$C_{23}H_{36}O_4$	376	7.46	
4.	12.086	1-Nonadecene	$C_{19}H_{38}$	266	3.35	
5.	13.731	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	2.51	
6.	14.197	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	32.39	
7.	16.583	10(E),12(Z)-Conjugated linoleic acid	$C_{18}H_{32}O_2$	280	4.45	
8.	16.668	13-Octadecenal, (Z)-	$C_{18}H_{34}O$	266	4.90	
9.	17.005	Octadecanoic acid	$C_{18}H_{36}O_2$	284	5.17	
10.	22.164	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl	$C_{19}H_{38}O_4$	330	3.26	

The major compounds were n-Hexadecanoic acid (32.39 %), 1,3-propanediol, 2-(hydroxymethyl)-2-nitro(24.42%), carbamic acid, monoammonium salt (12.08 %), phthalic acid, butyl undecyl ester (7.46 %), octadecanoic acid (5.17 %), 13-octadecenal, (z)-(4.90 %), 10(E), 12(Z)-conjugated linoleic acid (4.45 %). 1-Nonadecene (3.35%), Hexadecanoic acid, 2-hydroxyl-(hydroxymethl) ethyl (3.26)% and Hexadecanoic acid, methyl ester (2.51%).

Tables 3 and 4 listed the major phytocompounds and its reported biological activities of TZT leaves and stem. Most of the phytoconstituents have been found to show interesting biological activity against certain illnesses and/or pathogens. For instance, the anti-inflammatory (31) antioxidant, hypocholesterolemic (32), antibacterial (33) activities reported for n-Hexadecanoic acid. Similarly, Hexadecanoic acid, methyl ester reported for antibacterial, antifungal (30) antioxidant, hypocholesterolemic, antiandrogenic and hemolytic (26) may suggest the rationale for the traditional use of the species. n-Hexadecanoic acid and Hexadecanoic acid, methyl ester were reported in TZT leaves and stem. Each compound identified has their exceptional character to treat a variety of diseases. Thus, the present and previous studies have been identified and reported for the biological activities of the plant.

Table 3:   Reported biological activities of phytocompounds in the ethanol extract of TZT leaf

S. No.	Name of the Compound	Compound Nature	Biological Activity
1	Undecane	Alkane hydrocarbon	Antimicrobial agent [21] antiallergic, antiinflammatory[22]
2	Phenol, 2,6-bis(1,1-dimethylethyl)-	Phenolic compound	Antifungal activity, [23] Antipathogenic agent [24]
3	Chloroacetic acid, 4-pentadecyl ester	Ester compound	Acidifier, Acidulant, Arachidonic acid-Inhibitor [25], Urinary-acidulant, Urine-acidifier [26]
4	Neophytadiene	Sesquiterpene	Carminative, Gastrin inhibitor, Antiulcerative, Histamine release inhibitor, Antiprotozoal, Anti parasitic [27] Antipyretic, Analgesic, Antiinflammatory, Antioxidant, Antimicrobial (28)
5	3-Azabicyclo[3.2.2]nonane	Amino compound	Antiplasmodial, Cytotoxicity [29]
6	Benzene, (1-methyldodecyl)-	Aromatic hydro carbon	No activity
7	Hexadecanoic acid, methyl ester	Palmitic acid, methyl ester	Antibacterial, Antifungal [30] Antioxidant, hypocholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, Favor [26]
8	n-Hexadecanoic acid	Palmitic acid	Antiinflammatory, [31] Antioxidant, Hypocholesterolenic, Anti androgenic, Flvor, Nematicide, Hemolytic, 5-Alpha reductase inhibitor, [32] Antibacterial potent mosquito larvicide [33]
9	Phytol	Diterpene	Lipid metabolism regulator, AntiparasiticAntitelmintic, Antiprotozoas (Leishmania), Histamine release inhibitor Spasmolytic [27], Antimicrobial, Antiinflammatory, Anticancer, Diuretic [34,35]
10	Methyl stearate	Fathyacid aldehyde	GABA amino transferase inhibitor, Antiinflammatory, Intestinal lipidmetabolism regulator, Gastrin inhibitor,

S. No.	Name of the Compound	Compound Nature	Biological Activity
			Antihelmintic (Nematodes) Antinociceptive[27] Catechol-O-Methyl Transferase inhibitors Methyl-Guanidine inhibitor [26]
11	Decane, 1,9-bis[(trimethylsilyl)oxy]-	Alkane	No activity
12	Azetidine, 1-methyl-3,3-dipentyl-	Saturated heterocyclic organic compound	No activity
13	dl-Alanyl-l-alanine	Dipeptide	Antitumor, Cytotoxic, Anticancer, Anticarcinomic, Anti-LDL, Antioxidant [26]

Table 4:   Reported biological activities of phytocompounds in the ethanol extract of TZT stem

S. No	Name of the Compound	Compound Nature	Activity
1.	Carbamic acid, monoammonium salt	Ammonium carbamate	No Activity
2.	1,3-Propanediol, 2-(hydroxymethyl)-2-nitro-	Nitro compound	Antimicrobial [36]
3.	Phthalic acid, butyl undecyl ester	Plasticizer compound	Antimicrobial, antifouling [34]
4.	1-Nonadecene	Alkane	Antituberculosis, anticancer, antioxidant [26], antimicrobial [37], antifungal [38]
5.	Hexadecanoic acid, methyl ester	Palmitic acid, methyl ester	See above
6.	n-Hexadecanoic acid	Palmitic acid	See above
7.	10(E),12(Z)-Conjugated linoleic acid	Linoleic acid	Anticancer, AntiTennis-Elbow, Antidote, Ergogenic, Epitheliogenic, Trypsin-Enhancer [26]
8.	13-Octadecenal, (Z)-	Fathyacid aldehyde	Antimicrobial, Antioxidant, anticancer, Hypercholesterolemic, Antiulcerogenic, Lubricant, Nematicide, Antiinflammatory, Antiandrogenic and other activities [26].
9.	Octadecanoic acid	Stearic acid	Antimicrobial, Antiinflammatory, Anticancer [26].
10.	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl	2-Palmitoylglycerol	Antioxidant, Antibacterial and Antiinflammatory [26]

CONCLUSION

The present study revealed that the ethanol extracts of *Trichopus zeylanicus* ssp *travanconicus* of GC-MS analysis proves the presence of numerous active phytoconstituents responsible for various pharmaceutical activities and justifies the medicinal use of this plant in ethnomedicine. Hence, the presence of phytochemicals is responsible for their therapeutic effects. Further investigation is required for possible development of novel drug using some of the bioactive compounds found in *Trichopus zeylanicus* ssp *travancoricus*.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

All the authors contributed for the design of the study. KMSM and VRM sourced the plant materials, while KMSM dried and extracted the plant material. All the authors contributed in the

phytochemical analysis of the plant material: S.S and VRM contributed in the GC-MS evaluation of the plant sample and in the interpretation of the results PST collected the literature sources. All the authors contributed in preparing the manuscript. All the authors read and approved the manuscript.

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EFFECTS OF POLYMER TREATMENT ON THE MECHANICAL PROPERTIES AND DURABILITY OF RECYCLED CONCRETE AGGREGATE

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ABSTRACT

The recycling of concrete aggregates is an important way to contribute to a sustainable approach in the construction industry. One of the problems faced in the construction industry is the demolition waste. Recycling the construction and demolition waste is a feasible solution to alleviate the impact demolition waste has on the environment and land resources. This study focused on the impact polymer treatment of the recycled coarse aggregates has on the mechanical properties and durability of the recycled concrete aggregate. It was observed from the study that an optimum content of 0.6% of polymer solution would yield the maximum compression and tensile strength of 75 MPa and 2.85 MPa, respectively. The use of polymer treatment on recycled concrete aggregates improved its water absorption capacity with the ability to absorb 6% of the water compared to less than 1% that of non-treated natural concrete. The durability of a polymer treated recycled aggregate is studied by means of carbonization.

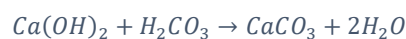*Keywords: Polymer treatment, demolition waste, carbonation resistance, sustainability,*

1. INTRODUCTION

The shortage of natural aggregate resources has caused it to be regarded as a scarce resource in most countries, thus the use of construction demolition excavation waste is an alternative for sustainability (Tsi& Chang, 2012). In a study conducted by (Wang, et al., 2014), the construction waste produced by China in 2016 was more than 3.5 billion tons with an efficiency utilization rate of approximately 5% which amounts to 200 million tons of new construction waste per year. (Ahmed & Lim, 2021) demonstrated the environmental impact that concrete waste has when stacked in land resources. They showed that not only does the concrete waste take up useful land resources, but they also contribute to global warming due to their carbon footprint. Thus, an environmentally friendly and sustainable approach has become a necessity in the construction industry. Sustainability is an environmentally friendly approach that focuses on the preservation of the environment (Atmajayanti, et al., 2018). Sustainability in the construction industry can be achieved through the re-use and recycling of waste concrete aggregates. Based on studies previously conducted by (Hoffmann, et al., 2012), recycled concrete aggregates show weaker properties compared to natural aggregate concrete. Recycled aggregates have also been characterized by their high-water absorption ability, high porosity and lower strength compared to natural aggregates (Martinez, et al., 2018). However, (Kong, et al., 2010), demonstrated in a study they conducted that the properties of recycled concrete aggregate can be improved through the mixing process by identifying the right type of a mix design. The durability of concrete structures has been demonstrated by (Zhu, et al., 2019) to be effectively measured through carbonation resistance ability. The chemical reaction that takes place between calcium hydroxide and carbon dioxide during the carbonization
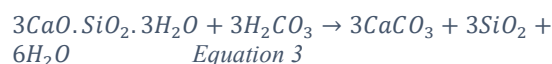
of concrete is shown in Equation 1 up to Equation 4 (Silva, et al., 2014).

$$CO_2 + H_2O \rightarrow H_2CO_3$$
$$\text{Equation 1}$$

$$Ca(OH)_2 + H_2CO_3 \rightarrow CaCO_3 + 2H_2O$$
$$\text{Equation 2}$$

$$3CaO.SiO_2.3H_2O + 3H_2CO_3 \rightarrow 3CaCO_3 + 3SiO_2 + 6H_2O \quad \text{Equation 3}$$
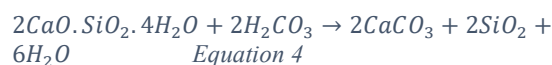
$$2CaO.SiO_2.4H_2O + 2H_2CO_3 \rightarrow 2CaCO_3 + 2SiO_2 + 6H_2O \quad \text{Equation 4}$$

This study seeks to observe the mechanical properties of a recycled concrete aggregate that has been treated with a polymer solution. The aim of this study is to establish the best conditions for an efficient and sustainable polymer mix that will improve the physical and mechanical properties of recycled concrete aggregate to be close and comparable to that of natural aggregates. (Junak&Sicakova, 2017) demonstrated that surface treatment on medium quality recycled concrete aggregate may reduce its water absorption capability. They modified the surface properties of the recycled concrete aggregate using geo-polymer materials based on fly ash resulting in an increased density and compressive strength of the sample. The physical properties of recycled concrete aggregates have been shown by (Spaeth &Tegguer, 2013) to depend on the quality and amount of the adhered mortar. They also demonstrated that the amount of adhered mortar is influenced by the crushing procedure and production process shown in Figure 1 below of the aggregate being recycled. The porosity of mortar depends on the water-cement ratio of the recycled concrete (Evangelista & Brito, 2010).
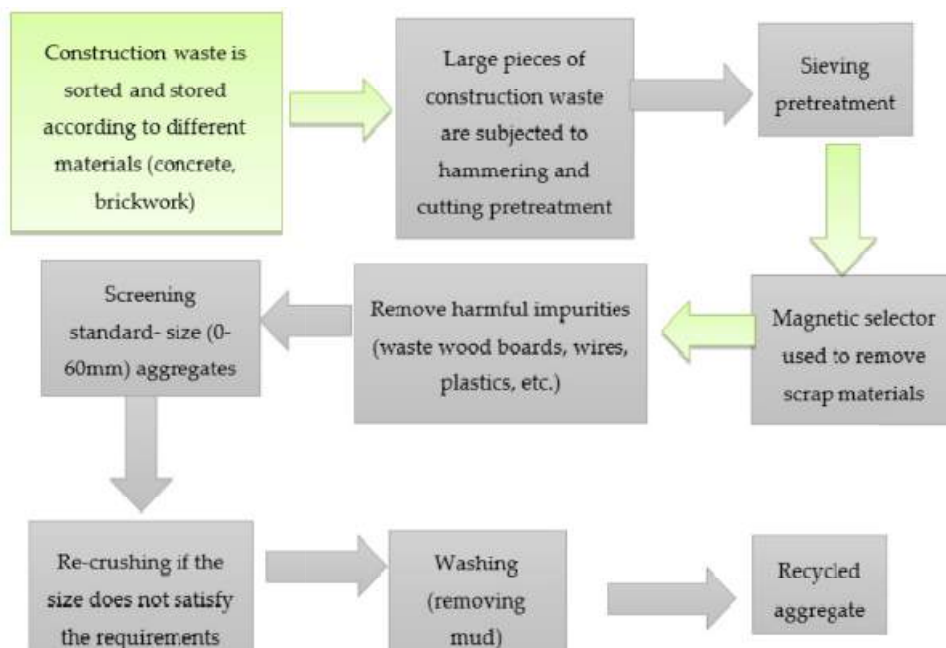
Figure 1: Production of recycled aggregates (Senaratne, et al., 2016)

The mechanical properties of concrete that

$$f'_c = \frac{P}{A}$$

Equation 5

$$f_{ct} = \frac{2P}{\pi Ld}$$

Equation 6

$$E = \frac{S_2 - S_1}{\epsilon_S - 0.00005}$$

Equation 7

where:

f'_c= Compressive strength (MPa)

P= Maximum load (N)

A= Specimen area (mm^2)

f_{ct}= Split tensile strength (MPa)

L= Specimen length (mm)

D= Specimen diameter

E= Modulus of elasticity (MPa)

S_1= Stress when the load reaches 40% of the maximum load (MPa)

S_2= Stress when the contraction reaches 0.00005

ϵ_1= Strain corresponding to the stress S_1 (MPa)

2. Materials and Experiments

The experiments were conducted to verify the workability of the concrete samples based on a slump test method (Atmajayanti, et al., 2018). In a study carried out by (Grdic, et al., 2010), they showed that to achieve the same performance as natural aggregate concretes, recycled concrete aggregates require 0.15-0.37% more water. The materials used for this study

include Portland cement, fine aggregate sand, coarse aggregate, polypropylene and water. During this experiment, proportions of 50% and 100% of recycled concrete aggregates were used within the concrete mix. Before treating recycled concrete aggregates with the polymer polypropylene, a water absorption test of natural and recycled aggregates was conducted. (Djerbi, 2012) demonstrated that recycled concrete aggregates had a longer time of saturation of about 48 hours. The aim of the experiment seeks to establish the mechanical properties of the recycled concrete aggregate that has been treated with polymer material. These properties include the compressive strength, tensile strength, the flexural strength as well as the stress and strain relationship. The flexural strength of concrete is an important parameter that shows the strength index of concrete. It has been demonstrated by (Ismail, et al., 2017) to be affected by the flexural strength of its constituent aggregate and cement mortar.

Experiment 1: Determining compressive and tensile strength.

Preparation of samples

Two samples of natural and recycled aggregates were used during this experiment. Recycled aggregates were crushed from ordinary concrete and are as shown in Figure 2 below. Natural aggregates of density 2.8 g/cm^3 was used during this experiment. The water to cement ratio of the selected ordinary concrete is 0.48 hence the amount of water to be used for the recycled concrete aggregate according to. (Grdic, et al., 2010) is 173. The proportions of the mixture are as shown on Table 1 below.

Table 1: The mix design composition of used ordinary concrete

Mix Ingredients (kg/m³)	Ordinary Concrete	Recycled Concrete
Coarse aggregate, 12-20mm	740	740
Sand	365	
Cement	300	
Water	144	173
Water to cement ratio	0.48	

The characteristics of conventional concrete aggregates from a study conducted by (Spaeth &Tegguer, 2013) is as shown on Table 2 below.

Table 2: Mechanical properties of natural concrete after 28 days and 90 days (Spaeth &Tegguer, 2013)

Mechanical properties	28 days	90 days
Module of elasticity, E (GPa)	22.2 ± 0.4	23.8 ± 0.5
Compressive strength f_c (MPa)	58.6 ±2.6	70.2 ± 1.2

The samples were first subjected to a water absorption test. This test seeks to identify the amount of water that each sample can absorb in a period of 48 hours. The samples of natural aggregates (NA), recycled aggregates (RA) and polymer treated aggregates (PRA) were all totally immersed in separate containers with 2 000ml of water for 48 hours. The volume of water in each container is drawn using a capillary tube and measured. The following equation 8 is used to calculate the water absorption rate of each sample.

$$w = \frac{v_i - v_f}{v_i} * 100\%$$

Equation 8

Where:

w= water absorption rate

V_i= initial water volume in ml

V_f= volume of water measured after 48 hours

Figure 2: Recycled concrete aggregate

Table 3:

Properties	Natural Concrete	Recycled Concrete
Maximum grain size (mm)	9.5	9.5
Density (kg/m^3)	2662	2178
Attached mortar content (%)	-	44.3

Polymer Treatment

Polymer treatments were conducted in a controlled laboratory environment. Surface treatment was conducted on recycled concrete aggregate using Sikagard 800G which is a polymer type solution. The recycled aggregate sample was soaked in the polymer solution for 8 minutes, then the samples are dried at laboratory temperatures of 23 ± 2 °C and about 45% relative humidity for 24 hours. After drying the samples were then placed in an oven set to 60 ± 5°C for the next 24 hours. The surface treatment on the recycled concrete aggregate does not affect the density of concrete. The concrete mixing procedure used during this study made use of a compressive packing model that was demonstrated by (Amario, et al., 2017). A compression and tensile strength test were conducted on the samples treated with sikagard 800G and containing 50% and 100% of recycled aggregates as shown in Figure 3 and Figure 4 below (Standards, 2011).

Figure 3: Compressive test

Figure 4: Tensile strength

Experiment 2: Flexural strength test

This experiment aims to determine the flexural strength of natural concrete, concrete with recycled coarse aggregates as well as polymer treated recycled concrete.

Apparatus

The following apparatus were used for the flexural strength test:

i. **Beam mould-** the beam used for this experiment was of size 100*100*500mm.

ii. **Flexural test machine**- the test machine used was provided with two steel rollers of 35mm in diameter, on which the test sample will be supported. The centre-to-centre distance of the two rollers is 400mm. The load was applied through two similar rollers and was divided equally between the two loading rollers as is shown on Figure 5 below.
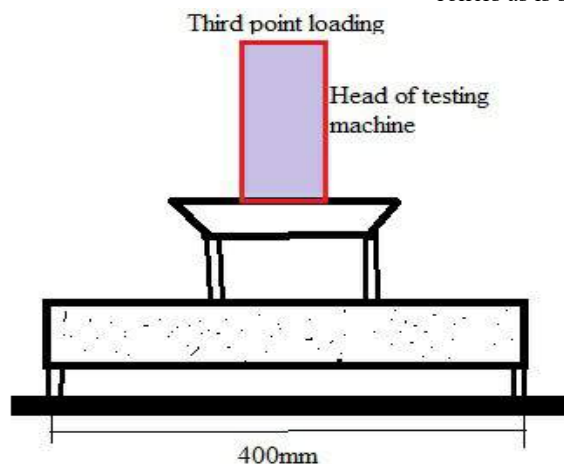
Figure 5: Flexural test setup

iii. **Tamping bar-**a tamping bar of length 400mm with a tamping section of 25*25mm was used.

Experiment 3: Durability

Carbonation Resistance

The chemical reaction of carbon dioxide in the air and calcium hydroxide in concrete is referred to as carbonization. In a study conducted by (Silva, et al., 2014), carbonation causes concrete to shrink thereby leading to cracks. In this experiment samples were infused with a measured volume of air saturated with carbon dioxide in a closed cubicle. The setup was left isolated for a period of 20 days. The amount of carbon dioxide left in the cubicle was retrieved and measured.

3. RESULTS

The water absorption ability of natural aggregates (NA) was lowest at 0.8% followed by the recycled aggregate (RA) at 4.2% and the polymer treated recycled aggregate (PRA) had the highest water absorption ability of 5%. These results are similar to the findings by (Spaeth &Tegguer, 2013).
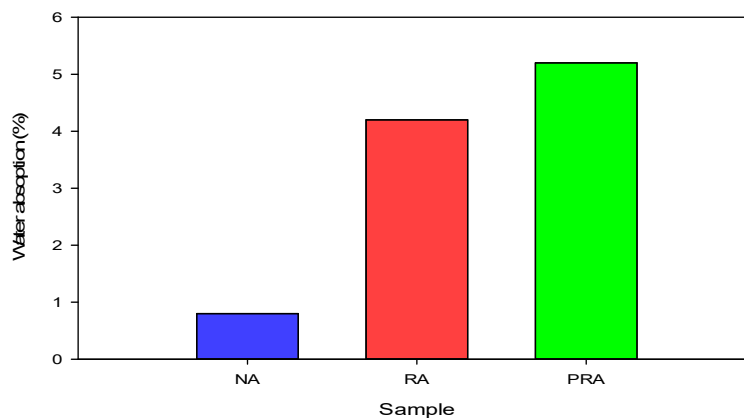
Figure 6: Water absorption

Compressive Strength

The results obtained from the compressive test shown in Figure 6 below indicate that the compressive strength of 50% recycled aggregate increases in the range between 0-12% that of 100% recycled aggregate. This is similar to the results that were obtained by (Choi & Yun, 2012) and this can be as a result of the high water-absorption capacity of the recycled concrete aggregate.
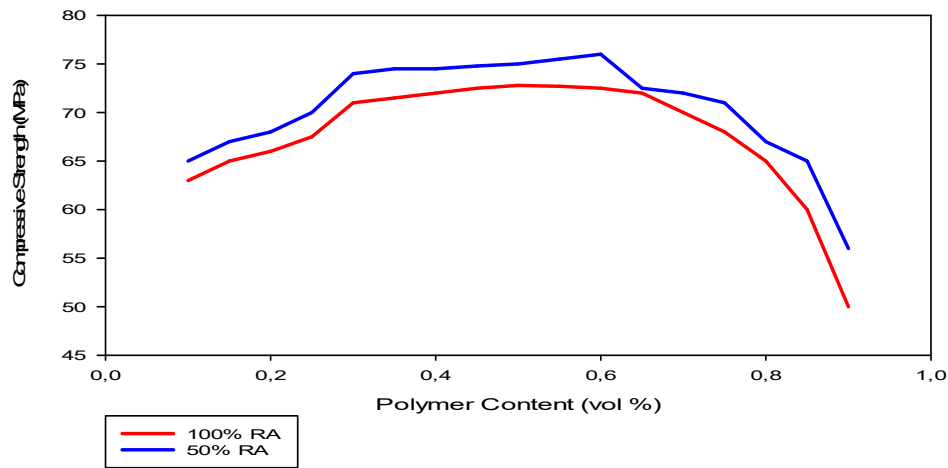
Figure 7:Effect of polymer treatment on Compressive strength

Tensile Strength

The tensile strength test experiment was done using 50% and 100% of recycled coarse aggregate. The volume of the polymer solution was varied between 0 and 1%. The outcome shown in Figure 8 below show that at 50% recycle aggregate had higher tensile strength compared to the sample with 100%. These results are consistent to the findings by (Hanumesh, et al., 2018) and (Akca, et al., 2015) who discovered that the tensile strength of a matrix decreases with an increase in the recycled aggregate content.
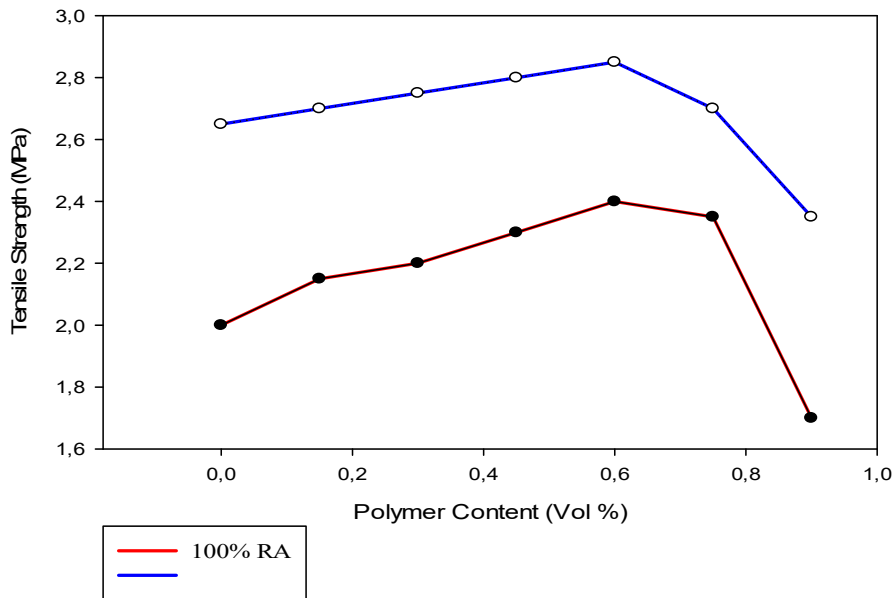
Figure 8: Tensile strength
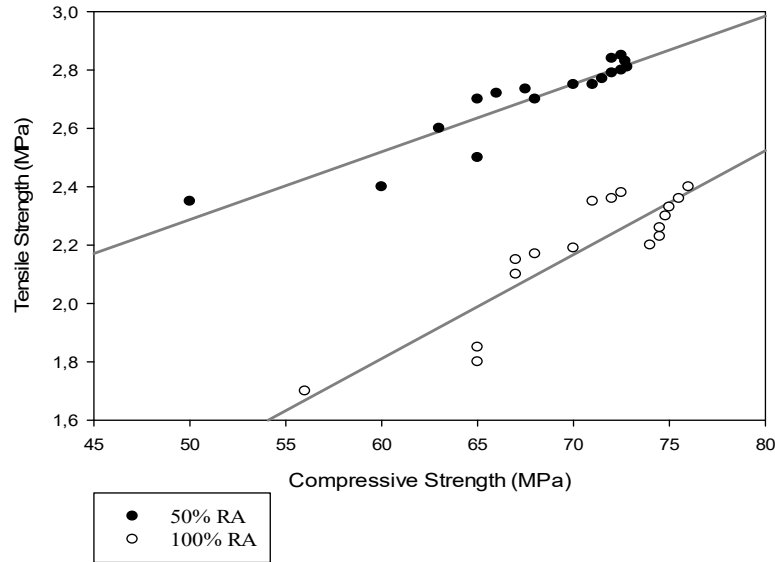
Figure 9: Relationship between tensile strength and compressive strength

Flexural Strength

The flexural strength as investigated in experiment 2 showed that the strength for the sample that had 100% recycled aggregate was approximately 12% lower than that which had 50%. These results are consistent with the findings by (Nepomuceno, et al., 2018), who discovered that recycled aggregate concrete contains impurities such as glass, bricks, and wastepaper, which weaken the bond between the cement mortar and the recycled aggregate concrete, thereby reducing the flexural strength.
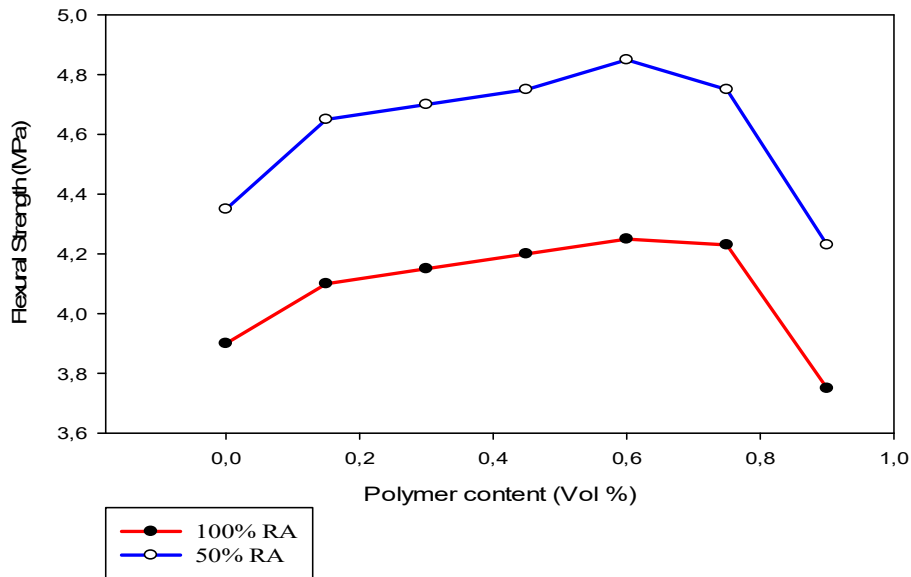
Figure 10: Effect of polymer content on the flexural strength of concrete

Durability

The polymer treated sample with 100% recycled aggregate had a lower carbonation depth compared to the one with 50% recycled aggregate. 100% RA is more carbonation resistant hence more durable.
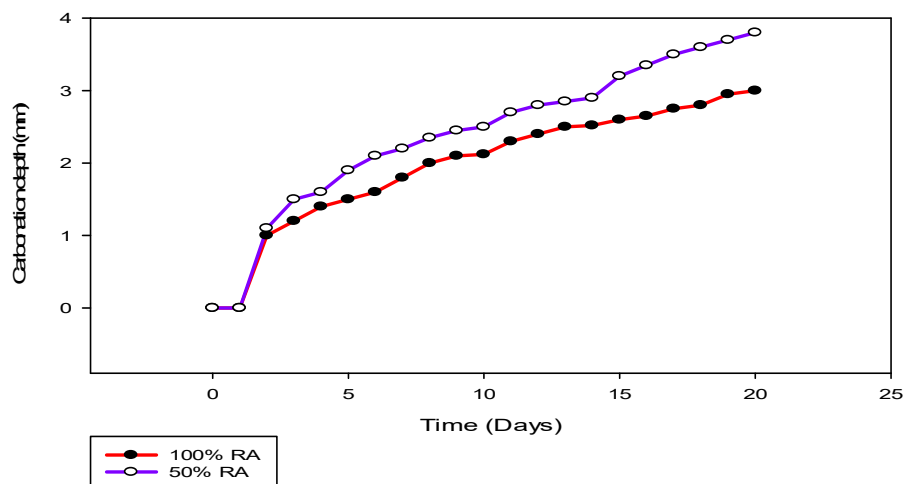
Figure 11:

DISCUSSION AND CONCLUSION

Tensile strength increases gradually from 2.6MPa for 50% RA and 2MPa for 100% RA, at 0.6% volume content of polymer solution, the two samples had the highest tensile strength of 2.85MPa for 50% recycled concrete and 2.3MPa for 100% recycled concrete. The tensile strength then decreases in value as the polymer volume is increased beyond 0.63% (to tensile strength of 2.4MPa and 1.65MPa for 50% and 100% respectively). The compressive strength for 50% and 100% RA is below 65MPa for polymer volume < 0.2 %. The compressive strength on the other hand of 50% recycled aggregate increases in the range between 0-12% that of 100% recycled aggregate yielding maximum compression strength at 0.6 (+/-) 0.05% polymer volume concentrations. As the polymer content volume exceeds the 0.6%, the values for compression strength decreases to values below that of 0.2% polymer content.The flexural strength for 50% and 100% RA is 4.4MPa and 3.9MPa respectively at 0.2% polymer content. The RA yields the maximum flexural loading at 0.6% polymer volume. The flexural loading strength starts to decrease beyond 0.6% to typical values of 4.2MPa and 3.7MPa respectively for 1% polymer volume content. 100% RA is more carbonation resistant than 50% RA; therefore 100% RA is more durable on any construction work.

The optimum polymer volume content is about 0.6% to yield the maximum compression, tensile and flexural loading strength. If the removal of impurities like glass, wood, plaque and silt is not effectively and efficiently done, this will result on reduced strength (compression, tension and flexural loading). When the volume of polymer is increased to 1% the yield strength is always less than those of 0.2% polymer volume content. Therefore from the above, balance between durability and strength must be found, maintained and be used one structural members. Also the results indicate that the use of 100% recycled

concrete results in a decrease in both tensile and compressive strengths.

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STUDY ON CONCRETE WITH REPLACEMENT OF FINE AGGREGATES BY VERMICULITE AND CEMENT BY SILICA FUME

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ABSTRACT

This paper aimed to compare the mechanical aspects of light weight concrete of M30 concrete with and without silica fume as replacement to cement by 10% along with sand as partial replacement of 0%,5%,10%,15%,20%and 25%variations of vermiculite. Specimens are tested for compressive strength using 10cm X 10cmX10cm cubes for 7, 14, and 28 days flexural strength was determined by using 10cmX10cmX50cm prisms at 28 days and split tensile strength is determined using 15cm diameter and 30cm height cylinder specimens at 28 days The test show that it is possible to produce a natural light weight concrete with increase in mechanical properties using vermiculite and silica fume.

Keywords: *Fine Aggregates, coarse aggregates vermiculite Silica Fume.*

INTRODUCTION

There is rapid rise in construction field which provokes new innovation in concrete with unfamiliar materials to subsiding the dead weight of structural elements by replacing light weight aggregates. Light weight concrete is typically obtained by embodying light weight aggregate such as Pumice, expanded clay, scoria, Perlite, pellite, Dolamite,Vermiculite etc. The unit weight of aggregate less than 1120kg/m3 are extensively used as light weight likewise in some cases 90 to 900kg/m^3 are also provided. The bulk weight of vermiculite ranges from 60 to 130kg/m^3. The concrete with unit weight below 1800kg/m^3 are premeditated as light weight concrete. The variation of density of vermiculite concretes are from range of 400 to 900kg/m^3.

As correlated to traditional concrete light weight concrete shows objective aspects for both mechanical and durability. Example low density, thermal insulation, permeability, sound insulation, reduction in dead weight. Due to above properties the significant demand of light weight concrete is duly rising up, which makes reduction of cross sections of structural elements.

Lightweight concrete preserves its enormous voids without formation of laitance sheets or cement films when used. This research study was based on the performance of aerated lightweight concrete.

However, sufficient water cement ratio is essential to produce ample cohesion in middle of cement and water. Deficient water may develop lack of cohesion among particles, which duly reduce the strength of concrete. Moreover redundant water can cause cement to weaken the bond with aggregate which may develop laitance layers. Consequently decline the strength of concrete.

LITERATURE REVIEW

S.JyothiManjula, G.VijayMano, J.SundarPrabu, M.Prabanjan S.Pradeep (2018)This paper presents the experimental investigation of light weight self compacting concrete.(LWSCC) for M30 grade of concrete using pumice stone, expanded perlite, exfoliated vermiculite test were conducted on hardened concrete for compressive, split tensile, flexural, and impact and also on fresh concrete for Slump test, flow test, vee-bee consistometer, compaction factor tests were done. Further self-compacting concrete for M30 the proportion of coarse aggregate is replaced by pumice stone, vermiculate and perlite at vartions of 2.5%, 5%, 7.5%, 10%, 12.5% and 15%it was found that the light weight aggregate replacement for coarse aggregate with percentage like 2.5% to 15%.from 2.5% to 7.5 % replacement given good results. But beyond 7.5%. Has reduced the mechanical properties when compared with conventional concrete.

M.V.S.S. Sastry, P.Ashveen Kumar,.K.Jagannadha Rao (2018) In this experimental study, the mechanical properties of M20 grade concrete with different percentages at a range of 0-100% at an increment of 20% as partially replacement with vermiculite to the total weight of fine aggregate along

with mineral admixtures like Ultra fine Fly ash (UFA) and micro silica (SF) is replaced with cement by various percentages i.e., from 5-15%, and Micro silica (SF) at 5%, 10% and 15% by weight of cement. The compressive strength at all ages is decreasing due to the replacement of Exfoliated Vermiculite (EV), but an economical design was obtained with 20% replacement to sand.

T.Subramani, M.Meghnathan. S.Priyanka(2017) This paper presents investigation on Fiber Reinforced High Strength Concrete. Using recycled aggregate for 20% and40% replacement of coarse aggregate for M30 grade of concrete with replacement of natural sand with vermiculite mineral with varying percentages. And 1% steel fibers is also used and compared with conventional concrete casted using plastic fibers. all the specimens are tested for 28 days using cubes andcylinders and tested for compressive strength,split tensile strength and workability. Investigation resulted that strength of vermiculite concrete although decreased but was increased using super plasticizer and usage of vermiculite had given less density proving to be suitable for light weight structures.

A.V.V.Sairam,K. Sailaja (2017) This paper presents Mechanical Properties onM35 grade concrete mix for varying percentages with 5%,10%15%20% 25% and 30% replacement with vermiculite to fine aggregate along with fly ash to replace cement with varying percentages of10%15% and20%and silica fume as additive to cement with varying percentages of 5%7.5%10% and12.5%with constant water cement ratio of 0.42 and it was found that10% of silicafume and 15% flyash and 5%vermiculite has given optimum increase in compressive strength whereas10%silicafume and 10%flyash with 5%vermiculite has given increase in split tensile strength compare to concrete with no vermiculite.

Ramapradheep. G.S, M.Sivaraja(2017) This paper presents Experimental investigation on self compacting self curing concrete using light weight aggregate for M40 grade using 5%,10% LECA as and 5%,10% replacement to fine aggregate and test was conducted using cubes and cylinders the workability and mechanical properties improved for 10% LECA and 10% vermiculate as a partial replacement of fine aggregate .

Thangam.D,Geetha.V(2017) This paper presents Experimental investigation on self curing concrete for M20 grade using vermiculite and GGBFS 50% of ggbfs as replacement to cement and vermiculite with diff variations of 20%,40%,60% and80% with fine aggregate and it was found that 20% replacement with fine aggregate and 50% ggbfs replacement to cement used for casting of self curing

concrete has given good strength. With usage of poly ethylene glycol as self curing agent.

S.Syed Abdul Rahman,Gijo.K.Babu(2016) the paper presents about M30 grade of concrete to know variation in density of concrete with and without vermiculite. For constant water cement ratio of 0.40 for different variation 0%,5% and10% of replacement of natural sand with vermiculite powder and it was found that there is decrease in strength with increase in vermiculite but decrease in density from 2486 to 2167 kgs/m^3 with proves that use of vermiculite decrease the self weight ofconcrete with slight decrease in compressive strength.

M.R.Divya.,Prof.M.Rajalingam,Dr.SunilaaGeorge(2016) This paper presents study of M30 grade concrete mechanical properties experimental set up were done by replacing fine aggregate with vermiculite passing through 2.36mm sieve by 40%,50%and60%by weight it was found that concrete mix with replacement with 40% vermiculite has given increase in compressive strength, split tensile strength and flexural strength alternately indicates use of high percentage of vermiculite that is beyond 40% as replacement to fine aggregate reduce the strength

RESULTS AND DISCUSSIONS

The object is to find the Mechanical properties of M30 mix. Compressive Strength (CS), Flexural Strength(FS), SplitTensile Strength(TS)

Quantities of cement, water, sand, and aggregate per cubic meter of concrete in dry Table I consists of twelve different samples with OPC, sand, aggregate with varying silica fume, water and vermiculite.samples1-6are mix proportion without silica fume and 7-12 are with silicafume.

M30 mix proportion: 1: 1.42: 1.66 **S1, S2, S3, S4, S5 and S6 without silicafume S7, S8, S9, S10, S11 and S12 with silicafume**

Basic proportions of material:

sample	Cement (kg's)	Silica fume (kg's)	Fine agg. (kg's)	Ver min. (kg's)	Coarse agg. (kg's)	Water content (ltr's)	W/C ratio
1	21	0	30	0	35	9.634	0.4
2	21	0	28.5	1.5	35	9.634	0.4
3	21	0	27	3	35	9.634	0.4
4	21	0	25.5	4.5	35	9.634	0.4

5	21	0	24	6	35	9.634	0.4
6	21	0	22.5	7.5	35	9.634	0.4
7	18.9	2.1	30	0	35	9.634	0.4
8	18.9	2.1	28.5	1.5	35	9.634	0.4
9	18.9	2.1	27	3	35	9.634	0.4
10	18.9	2.1	25.5	4.5	35	9.634	0.4
11	18.9	2.1	24	6	35	9.634	0.4
12	18.9	2.1	22.5	7.5	35	9.634	0.4

CS for 7days, 14days and 28 days has found for M30 mix concrete with and without silica fume as replacement to cement by 10% along with sand as partial replacement of 0%, 5%and 10% variations of vermiculites similarly flexural strength and split tensile strength for 28 days is also determined specimens used are.10cmx10cmx10cm cubes, for compressive strength flexural strength for 28days has been found using 10cmx10cmx50cm prisms, split tensile strength for 28days has been found using 15cm diameter and 30cm height cylinder.

COMPRESSIVE STRENGTH FOR 28 DAYS:

Without replacement of silica fume

Top-right continuation table:

Sample	Weight(Kg)	Avg Weight(Kg)	Force(kN)	Area(m2 m2)	Strength(N/m2 mm2)	Avg Strength
	2.24	26	217.5	10000	21.75	08
5	2.19		190	10000	19	
	2.21	2.20	180	10000	18	18.18
	2.22		175.5	10000	17.55	
6	2.12		130	10000	13	
	2.11	2.09	120	10000	12	12
	2.05		110	10000	11	

Sample	Weight (Kg)	Avg Weight(Kg)	Force(kN)	Area (m2 m2)	Strength(N/m2 mm2)	Avg Strength(N/m2 mm2)
7	2.28		480	10000	48	
	2.29	2.29	520	10000	52	50.33
	2.31		510	10000	51	
8	2.27		480	10000	48	
	2.26	2.26	440	10000	44	46.33
	2.25		470	10000	47	
9	2.23		340	10000	34	
	2.22	2.21	380	10000	38	35.66
	2.19		350	10000	35	
10	2.18		260	10000	26	
	2.17	2.166	280	10000	28	27.18
	2.15		275.5	10000	27.55	
1	2.14		220	10000	22	
	2.15		200	10000	20	

Bottom-left table:

Sample	Weight(Kg)	Avg Weight(Kg)	Force(kN)	Area(m2 m2)	Strength(N/m2 mm2)	Avg Strength(N/mm2)
1	2.45		300	10000	37	
	2.42	2.43	320	10000	38	37
	2.43		320	10000	36	
2	2.39		300	10000	30	
	2.4	2.39	290	10000	29	30
	2.38		310	10000	31	
3	2.32		270	10000	27	
	2.315	2.325	275	10000	27.5	26.83
	2.34		260	10000	26	
4	2.29		225	10000	22.5	
	2.26	2.	220	10000	22	22.

1	2.155	2.148	217.5	10000	21.75	21.25
	2.13		130	10000	13	
1 2	2.11	2.12	130	10000	13	13.18
	2.12		135.5	10000	13.55	

Graphical representation of compressive strength

FLEXURAL STRENGTH FOR 28 DAYS:

Without replacement of silica fume

Sample	Force(kN)	Area(m m ^{2})	Strength(N/mm ^{2}) 3/2*(P*L/ B*D^2)	Avg Strength(N/ mm ^{2})
1	18	1334	13.49	
	17.5	1334	13.12	
	18.5	1334	13.86	13.49
2	16.5	1334	12.36	
	16	1334	11.99	
	16.3	1334	12.21	12.18
3	15	1334	11.24	
	15.5	1334	11.61	
	15.6	1334	11.69	11.51

4	14.5	1334	10.87	
	14	1334	10.49	
	14.6	1334	10.94	10.76
5	13.3	1334	9.97	
	12.9	1334	9.67	
	13.5	1334	10.11	9.91
6	11.8	1334	8.8	
	11.5	1334	8.62	
	11.6	1334	8.69	8.70

With replacement of silica fume

Sample	Force(kN)	Area(m m ^{2})	Strength(N/mm2) 3/2*(P*L/ B*D2)	Avg Strength(N/ mm ^{2})
7	24.5	1334	18.36	
	25.5	1334	19.11	
	25	1334	18.74	18.736
8	22.5	1334	16.86	
	24.5	1334	18.36	
	23	1334	17.24	17.486
9	20	1334	16.49	
	19	1334	14.24	
	20.5	1334	15.367	15.36
10	16.5	1334	12.36	
	16	1334	11.99	
	16.8	1334	12.59	12.31
11	14	1334	10.49	
	14	1334	10.49	
	14.5	1334	10.869	10.616

	12.5	1334	9.37	
	13	1334	9.74	
12	13.1	1334	9.82	9.643

Sample	Force(kN)	Area(mm^2) Π*L*D/2	Strength(N/mm^2)	Avg Strength(N/mm^2)
7	225	70686	3.18	3.11
	220	70686	3.11	
	215	70686	3.04	
8	200	70686	2.83	2.71
	190	70686	2.69	
	185	70686	2.61	
9	170	70686	2.40	2.42
	175	70686	2.47	
	170	70686	2.40	
10	150	70686	2.12	2.19
	155	70686	2.19	
	160	70686	2.26	
11	130	70686	1.84	1.82
	125	70686	1.76	
	132	70686	1.86	
12	100	70686	1.414	1.473
	110	70686	1.55	
	103	70686	1.457	

Graphical representation of flexure strength for 28 days:
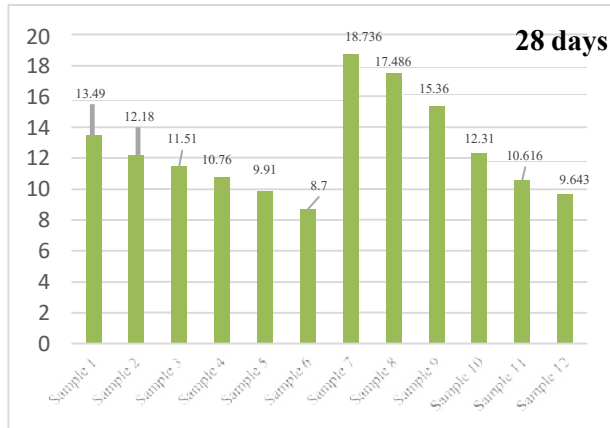
SPLIT TENSILE STRENGTH FOR 28 DAYS:

Without replacement of silica fume

Sample	Force(kN)	Area(mm^2) Π*L*D/2	Strength(N/mm^2)	Avg Strength(N/mm^2)
1	190	70686	2.68	2.621
	185	70686	2.61	
	182	70686	2.574	
2	175	70686	2.47	2.41
	167.5	70686	2.37	
	170	70686	2.40	
3	165	70686	2.33	2.29
	160	70686	2.26	
	162.5	70686	2.29	
4	155	70686	2.19	2.07
	145	70686	2.05	
	140	70686	1.98	
5	130	70686	1.839	1.779
	125	70686	1.768	
	122.5	70686	1.73	
6	85	70686	1.20	1.256
	90	70686	1.27	
	92.5	70686	1.30	

With replacement of silica fume

CONCLUSIONS

For compressive strength of 7 days, with 5% of vermiculite and 10% of silica fume sample replacement to fine aggregate and cement developed good strength provided with less weight compared to normal concrete.

In compressive strength for 14 days, the 5% of vermiculite and10% of silica fume sample were observed as the sample has good strength and with less weight compared to normal concrete.

In compressive strength for 28 days, the 5% of vermiculite and10% of silica fume sample were observed as the sample has good strength and with less weight compared to normal concrete.

In split tensile strength test for 28 days, the 5% of vermiculite and 10% of silica fume were observed as the sample has good strength and with less weight compared to normal concrete.

And in flexure strength test for 28 days, the 5% of vermiculite and 10% of silica fume sample were observed as the sample has good strength and with less weight compared to normal concrete.

Finally by completing this project, this project concludes that the 5% of vermiculite and 10% of silica fume sample were observed as the sample has good strength and with less weight compared to normal concrete.

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AGROFORESTRY MANAGEMENT: A MECHANISM FOR EMPOWERING THE RURAL WOMENOF ODISHA

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ABSTRACT

Gender dimension of agroforestry reveals that globally nearly half of the human population is directly dependent on natural resources for its livelihood, and mostly indigenous and rural women depend directly on biodiversity to fulfil their daily subsistence needs. Untill1970, women's were largely absent in farming, animal husbandry and forestry research. Initially, very little attention was paid to 'women' or 'gender in the relationship with forestry, and the term 'gender' is narrowly interpreted as meaning women or differences between women and men; research focuses on the collection of sex-disaggregated data without any attention to the gendered relations of power. Advocates of poor women, such as Vandana Shiva from India and WangariMaathai from Kenya, interpreted dependence differently contending that rural women were particularly knowledgeable stewards of nature" and especially vulnerable to resources degradation (Maathai 2010, Shiva1988). Women began to appear as stewards of nature or forest heroines in the development and environment literature, though the view of poor women as orest foes did not entirely disappear (Arora– Jonsson, 2011). The current paper investigates whether women's engagement in agroforestry management has contributed to empowering them. The research is being conducted in the Nuapada district of Odisha, where agriculture and forest economy are the primary sources of income for the population. Besides, in the Nuapada district, most of the population comprises the tribal population, i.e. 33.8 per cent. The great majority of them are underprivileged, and their empowerment is vital to bringing about a significant conversion in their lives. Furthermore, the paper focuses on women's livelihood options, access to banks, savings, markets, land ownership, food security, voting rights, and the shifts in bargaining power inside and beyond the family.

Key words: Agroforestry, Management,Empowerment,Environment,Stewards

INTRODUCTION:

Gender equality and women's empowerment are two primary global goals widely underlined in achieving Sustainable Development Goal 2030. Women's engagement is essential, as their involvement in policy initiatives is intended to sustainable women's empowerment, but this does not automatically indicate more gender equality unless the structural underpinning of gender inequality stays unaltered. Many researchers and authors have consistently stated that women in agricultural activities are undervalued, almost always unnoticeable in data systems because land operations are the benchmarks by which census enumeration

systems categorize farmers, have less access to productive resource rights, to financial institutions and irrigation sources, so on and are not taken into account for decision-making. Even though more than 70% of rural women workers in developing countries such as India are engaged in agricultural work, according to 2017-18 data published by the government's National Sample Survey Office, they are not recognized as employed labour. Despite this, only around 13% of women own land (OXFAM India, 2013). Their role as

agricultural workers is limited due to the position of family labourers who work on the farm and their regular household duties. According to the UN Food and Agriculture Organization, equal access to agricultural producing resources is essential to enhance development. Women with equal access to productive resources can boost agricultural productivity by around 30% and increase agricultural productivity in developing nations by 4%, leading to a 12-17% decrease in hunger, or about 100 million fewer people (Munshi 2017). The patriarchal tradition and hegemonic gender indoctrination have rendered women's roles in agriculture unacknowledged. Thus, this research aims to determine if agroforestry management assists in closing the gender gap and providing women with possibilities for economic and social empowerment.

And in the context of Odisha, where agriculture is the state's primary occupation and, according to census data from 2011, the majority of women are employed as non-workers or as agricultural labourers in Orissa's agrarian sector, their contribution to household income is largely overlooked (Pathak,2011). Thus, the current

paper investigates whether women's engagement in agroforestry management has contributed to empowering them. The research is being conducted in the Nuapada district of Odisha, where agriculture and forest economy are the primary sources of income for the population. Besides, in the Nuapada district, most of the population comprises the tribal population, i.e. 33.8 per cent. The great majority of them are underprivileged, and their empowerment is vital to bringing about a significant conversion in their lives. Furthermore, the research focuses on women's livelihood options, access to banks, savings, markets, land ownership, food security, voting rights, and the shifts in bargaining power inside and beyond the family.

I.   Review of literature

Several works of literature focus have on women's empowerment in rural settings.According to ILO, empowering rural women with good and productive jobs and fostering gender equality supports inclusive and sustainable economic growth while improving the ability to eradicate poverty, secure food and nutrition, and mitigate and adapt to climate change. And agroforestry has been demonstrated in numerous studies to provide opportunities for women's empowerment. Agroforestry practice has provided significant livelihood benefits for women, including food security, employment, and income generation (Semgalawe, 1998), acknowledged worldwide (Garrity, 2006; Mbwambo et al., 2013)

The majority of smallholder farmers in developing nations are women. According to Eklud (2009), agroforestry is ideal for women as it is a low-cost, low-technology system that gives women numerous choices. However, their primary job in the household is to provide food and water. Khadka (2019) claimed that women empowerment initiatives linked to agroforestry have helped show beneficial results in their economic and social aspects involving revenue production, family decision making, freedom to movement and family welfare. Abenkan and Boon (2011) noted that NTFP agriculture and commerce are essential for rural inadequate economic independence, particularly women. It investigates the potential contribution of NTFP farming to poverty reduction and livelihood development in Ghana, concentrating on the SefwiWiawso (SWD) and Bibiani-Bekwai (BBD) districts in the country's western region. The study revealed that NTFPs significantly contribute to women's economic empowerment and rural communities' sustainable development in Ghana.Marshall, Schreckenberg, and Newton (2006) mentionedthat NTFPs could assist in alleviating poverty by establishing "safety nets," which lessen the susceptibility of impoverished communities to risk

when crops fail or disease hits. They can also help assuage poverty by boosting revenue from more essential agricultural and non-farm revenue-generating activities (ifad.org).Uisso and Massao (2016) conducted a study in Tanzania and discovered that agroforestry techniques resulted in higher incomes for women. According to research in Sierra Leonean, women were more knowledgeable about tree characteristics than men: they could name up to thirty-one applications for tree species, whereas men only listed eight (Fortmann and Rocheleau, 1985).

Although women significantly contributed to the agroforestry system, they are often overlooked and undervalued. According to the literature, formal forestry practices are associated with men. The forestry industry is not gender-neutral. Even though several researchers have highlighted the essential impact performed by women in agroforestry practices, masculinity remains associated with forestry.Degrande&Arinloye, 2014 pointed out that the prospects of women in agroforestry are limited to activities that men do not value. Women face different constraints and challenges that limit their ability to achieve optimal production and agricultural development and are frequently disenfranchised from decisionmaking on land access and resource usage essential to their livelihoods (FAO,2017). Agarwal (1994) claimed that the gender disparity in property command is the biggest and most important economic issue affecting women's situations when addressing women's empowerment. The overall development of women includes their financial wellbeing, social status, and political representation in society.According to **Simone de Beauvoir**, "*the masculine is consistently depicted as the positive (or the standard), but the portrayal of the feminine is invariably inferior*."

Furthermore, a few studies have shown that providing adequate assistance to women in agrofarming has assisted in sustainably empowering farming techniques. The Self Employed Women's Association (SEWA) in India systematizes approximately 1.2 million small and medium companies controlled by women and smallholder farmers to engage in sustainable farming and agroforestry. And Kudumbashree's agricultural intervention is another example of guaranteeing food security and enhancing the livelihoods of Kerala's landless women. With funding from the Government of India's National Rural Livelihood Mission, an NGO called Madhyam Foundation in the districts of Khorda, Kalahandi, and Malkangiri (2018), in Odisha, and Life Academy of Vocational Studies in Koraput (2018), has helped to empower women in agriculture by making consistent investments to improve their participation, productivity, and to establish and maintain agriculture-related businesses. Also, the project aims to improve food security, raise household income, and promote

community-based institutions of women farmers. As a result, contributing to women's economic empowerment opens the path for gender equality, poverty alleviation, and inclusive economic growth.

Women in agroforestry are concerned about the dominant position of masculine standards, and patriarchalsociety's traditional social limitation confines women to the interior domain sector worldwide. Given the circumstances, empowerment has a wide-ranging impact on women's lives. As a result, the purpose of this paper is to bridge a knowledge gap and create insights for addressing gender and agroforestry concerns in Odisha's Nuapada district. The current study aims to understand better women's engagement in agroforestry and sustainable livelihood management, which is critical for women's empowerment in Odisha's Nuapada district.

II. Objectives:

Through a gender perspective, the study intends to investigate the benefits derived by women from agroforestry, resulting in empowerment and sustainable livelihood in the Odisha district of Nuapada. More precisely, the study examines the education profile, livelihood possibilities, access to the bank, savings, market access, land ownership, leadership position, improved negotiating power within and outside the home, voting rights, and food security all contribute to women's empowerment

III. Coverage:

Nuapada district has a dense forest area of 1849.69 sq. km out of a totalgeographical area of 3852 sq. km, which constitutes 48.00%. Natural resources and their management are essential to rural people's livelihoods of the people of Nuapada District. Their primary source of income is non-timber forest products (NTFP) such as Mahua Flower, Char, Harida and Bahada, Tol, etc. They obtain NTFP for both consumption and selling. However, the study is confined to the three tahasilsviz Nuapada, Komana and Khariar of Nuapada district as these areas have a widely dense forest.

V. Methodology:

The study opted to synchronize descriptive and exploratory design to conduct and complete the study. In order to collect data and information from the respondents, the research employs both qualitative and quantitative methods of investigation, with a sample size of 43. Various techniques enable us to investigate the broadest possible range of subject areas and achieve a wide range of goals.

The research made use of both primary and secondary data. Secondary techniques were reintroduced to clarify ideas, and in this context, books, journals, periodicals, magazines, and internet surfing were thoroughly examined. And primary data were gathered via the use of various techniques such as observation and an interview schedule.

VI. Major analysis:

The study's findings, as well as related analysis, are discussed in this section under the following subheadings:

A) Education background of the respondent:

As the crux of social development, education has the opportunity to be a robust tool for progress, but it is also hampered by continuous poverty cycles.Under the cross-cutting of caste and class, they are constantly exposed to various discriminations by tribal groups. And illiteracy among tribal communities is one of the primary reasons for multidimensional marginalisation. The central focus for survival, as in disadvantaged people such as tribal communities, is on livelihood. Extra investment in education, clothing, books and associated educational supplies is never a priority for indigenous people. However, in the study, 44.2 percent are illiterate, 20.9 can only sign, 23.3 have attended elementary school, and 11.6 percent have a secondary level educational qualification. The study shows that illiteracy, inaccessibility to amenities offered by developmental initiatives, and insufficient involvement in social institutions are the primary causes of their backwardness

Education background of the respo
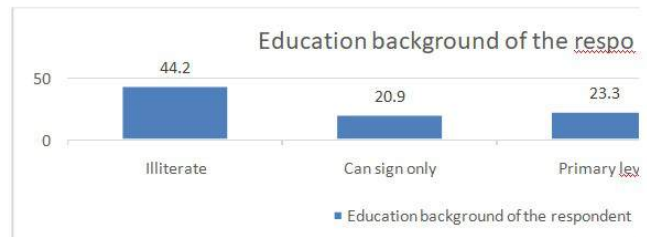
Table no-2	
Livelihood opportunity:	Percent
Ntfp products	93.00%
Handicraft	16.30%
Timber forest	34.90%
Fruit based	44.20%
Spices	41.90%
Off farm	18.60%
Livestock	58.10%
Mixed garden	37.20%
Coconut farming	23.30%

Farm labour	86.00%
Household garden	27.90%
Shifting cultivation	27.90%
(multiple responses from	
the respondent, thus total per cent is not 100)	

B) Livelihood Opportunity:

The quest for substantial livelihood prospects is one of the most critical difficulties for tribal women in today's era. The endeavour to engage with the agroforestry system has become much more intricate because of globalization, migration, displacement, vicious poverty, illiteracy background, manipulation from the labour market, social abuse, and much more unjustly distress. And, in terms of development indicators, tribal women are found to be lagging adrift, as they are engaged in primarily agricultural occupations, have a poor interdependency with forest-related economic activities, and have manufacturing firms that need to be upgraded in terms of contemporary standards. However, despite various odds, in the present study at Nuapada district, the tribal women are involved across multiple livelihood opportunities.

The majority of respondents (93.0 per cent tribal women) collect NTFP products from the forest, and 86.0 per cent are engaged in agricultural labourer. It must be highlighted that women have a hereditary connection with the forest to survive by gathering and extracting items from it. The study finds that males dominate forest and agriculture, even though women have been in forest and agriculture for generations, which forecast hegemonic masculine culture. Most women work in agriculture and forestry as informal
hired labour or on family farms and consider them part of their gender-related activities. This masculinized organisation is a dynamic and disputed workplace wherein gender conceptions are reinforced and challenged in everyday work through synchrotron connections, and McDowell also has stated this. Apart from that, 58.1 per cent of tribal women are were involved in livestock farming, 44.2 per cent in fruit-based agriculture, and 41.9 per cent in spice cultivation, respectively. While tribal women take up other livelihood opportunities are, 37.2% are in mixed gardening, 34.9 per cent are in timber forest cultivation, 23.3 per cent are in coconut farming, 27.9% in the household garden, 27.9% are in shifting

cultivation, 18.6% are in off agriculture, and 16.3% are making Handicraft from NTFP products.Earlier, numerous research findings had exhibited that tribal women are increasingly actively engaged in shifting cultivation in the state of Odisha in particular. Still, in the present, the study found that they are involved in shifting cultivation andare also involved in growing a variety of cultivation that necessitate labour-intensive tasks.

A. Communication pattern:

Connectivity is vital in and of itself as a driver of economic progress. Access to banking, savings, markets, and connectivity to the larger economy allow local resources to be effectively used following the broader marketplace's consumption of local products (Viswanath, 2021). Savings are also crucial for growth because they encourage domestic investment more significant efficiently and sustainably than external intervention.
However, numerous studies have suggested that indigenous women prefer informal means of saving over going to official institutions. According to the study, 69.9 percent of tribal women have a bank account. And they have stated that these accounts are operated by their male partner, as they have less expertise in dealing with formal financial institutions.

Table No-3	
Access To	**Percent**
Bank	
Yes	69.80%
No	30.2
Total	100
Saving	**Percent**
Less than 5000	14
5000-10,000	25.6
10,000-20,000	9.3
Above 20,000	16.3
No saving	34.9
Total :	100

Furthermore, 62.8 percent of tribal women claimed they are able to save from their earnings, whereas

37.2 had no savings. Of those polled, 25.6 percent were able to save between 5,000 to 10,000, while 16.3 percent saved more than 20,000. Saving is not widely practised among indigenous women since they have traditionally relied on substances form of revenue. There was no way to save. This has demonstrated an essential step in improving the economic growth possibilities of tribal women's participation and progressive thinking to meet their imminent contingencies.However, owing to the influence of modernity, particularly the involvement of SHG groups, the communication behaviour of the respondent has changed; thus, they are able to continue saving and trying to cope with the change, as stated by the majority of respondents in the survey.

In the study, accessibility to the market is related to selling the collected NTFP products or the cultivated products. And the study found that tribal women have changed from subsistence culture to market culture, and all the respondents mentioned that they have accessibility to the local market. Most tribal women grow food for their consumption and mainly sell the extra cultivation to the local market. All the respondents in the study stated that they do not need to go to market outside of their area since mediators directly receive agricultural or forest goods from indigenous women. The tribal women interviewed for the study sell spices such as pepper and cloves, Mahua Flower, Kendu leaves, Char, Harida and Bahada,honey, fruits, and other agricultural goods to intermediaries. The responder stated that they have no issue selling these things to intermediaries because all cultivated or gathered items sell out immediately. It demonstrates the exploitation and dominance of the middlemen in the market region of tribal occupancies, who obtain items at a reasonable price and sell them at a profitable price in the external market.

A.   Land ownership:

In the framework of gender equity, succession law has traditionally been the focal point where gender prejudice continues, and disparities in succession law proliferate for land rights. Bias against women's land ownership may be a severe constraint since it deprives rural women of

opportunities and capabilities to participate in agricultural production, reducing their incomes and restricting their involvement or impact in family activities or choices. Regardless of how smaller or bigger the land is, 58.1 per cent of women have land ownershipin the land records in this community, and 4.7 per cent have taken land in the lease for cultivation, which was found in the study. It shows a breakdown in the patriarchal tradition of ownership of land, which the husband only inherits. And this ownership of land is possible under The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (or Forest Rights Act)

25.6 per cent of respondents mentioned that their husband inherits the land, and 11.6 per cent said their father in law is the landowner. However, women in India usually hold land via inheritance. There is a vacuum between nominal ownership and absolute management authority over the land since succession is regulated by traditions and customary rules, slanted towards them. However, this is a significant remark that most of the women hold land ownership. It is also true in Odisha's case, which ranks in the top three states in land ownership by women. And NFHS data also support it as 63% of women, and 85% of men in the state own a house alone or jointly, compared to the national average of 37% for women and 65% for men. The NFHS also reports that 47% of women, and 69% of men, in Odisha own land alone or jointly. The national average stands at 28% for women and 49% for men. However, it is also not a denial that, despite women owning land, women are also found in the most significant percentages as agricultural labourers, either in their field or in other fields. According to the 2011 census, 69.33% of women work as labourers in the Nuapada area. Furthermore, the current survey confirms that 86.6 percent of respondents work as agricultural labourers. Thus, even though they

have land ownership in their name, the truth is that ownership has a distinct background with diverse meanings.

A.   Decision making:

Women's decisionmaking power should not be undervalued, whether within or outside the household, since it is essential to women's empowerment because their voices are frequently not adequately acknowledged. Women's active engagement is required for actual development to occur. So, the current study also investigated tribal women's decision-making mechanisms within and beyond the household.The women's decisionmaking portrays a patriarchal way of domination in the economic activities; even women contribute financially to the family.According to the study, 62.8 percent agree to spend money together, and 39.5 percent of household decisions are made jointly by both husband and wife.Thus it indicates the positive effect of active engagement of women and assimilation of women's viewpoints in spending

money together with their male partners. But in case of a decision like saving of money (62.8%), taking the loan (69.8%), going to market for essential purposing household item purchase (58.1%), the decision about agroforestry activities (55.8%), decision to buy, sell or transfer assets (58.1%) and to manage the monthly budget (58.1%) all are decided by the male member (spouse). All such results show that the agricultural decision-making process continues to exhibit the same common trends mentioned generations earlier in research. And the same result is noted by Chayal, K. et al. (2013) and Pandey et al. (2011). Males play a more significant role in farm operations, while farm women's constructive participation in farm decisionmaking is insignificant. And mapping gender role within the household is a complex phenomenon as gender roles are socially constructed, mainly manifest gender inequalities that are maintained for decades and might change over time (Agrawala, 1997).

Table No-6				
Decision making on	Me	My spouse	both me and my spouse	No response from the respondent
Spending the income	2.3 %	27.9%	62.8%	7.0%
about saving money	-	62.8%	25.6%	11.6%
The decision for taking the loan	-	69.8%	20.9 %	9.3%
Going to market for essential purposing household item purchase	2.3 %	58.1 %	34.9%	4.7%
The primary decision about agroforestry activities	25.6%	55.8%	18.6%	-
the decision to buy, sell or transfer assets	-	58.1%	25.6%	16.3%
decision within household	14.0%	46.5%	39.5%	--
managing the monthly budget	16.3 %	58.1 %	25.6%	--

A.   Leadership position:

Tribal women in SHG groups held positions of leadership in the study. It is interesting to note that 62.8 per cent of women help the role of leadership in the SHG groups. From 62.8 per cent have occupied the position of group leader (37.2%), treasure (2.3%), Secretary in the SHG groups (18.6%) and ladies association chairmen (2.3%). And 2.3% were the leader of the religious group.SHG may be considered to have sparked women's empowerment by giving opportunities and varied positions with the autonomy to carry them out. It has slowly changed the societal structure, anchored faith in tribal women's

abilities, gave remarkable confidence to the role assigned, and helped expand their talent.

G. Voting rights:

It is essential for the participation of women in decision-making, as it is critical for incorporating women's issues into government. The study was

made to know whether tribal women know about their voting rights and cast votes. 83.7 per cent of tribal women said they were aware of their voting rights, and 76.7 per cent said they have participated in their community's electoral process. It is a progressive development in which tribal women have exhibited their involvement in the election system to be a part of the law- making process critical for their communities and is essential to their advancement and the underpinning of gender-equal civilisation.

C) Food security:

Women's improved income status is related to greater food intake and improved nutrient intake of family members. According to evidence, many works of literature have mentioned that gender-based discrimination, or the denial of women's rights, is one of the primary causes of poverty and food and nutrition insecurity(FAO, 2019 & FAO, 2011). Gender inequality is acknowledged as both a source and a result of food insecurity.Since indigenous women's income is substantial and drops below the poverty level. As a result, it is critical to assess the family's food security situation. As empowerment is more thanjust economic and social upliftment, it should encompass all elements of women's growth.As a result, an attempt was made to determine if income from agroforestry is sufficient to fulfil the family's food supply.97.7% of respondents stated that their earnings from agroforestry are sufficient to meet their food needs.Furthermore, 48.9 percent of respondents reported that having access to three meals each day, 25.5 percent reported having a variety of foods in their meals, and 25.5 percent reported having food accessible all year.

Thus,it is reflected in the study that empowering women helped improve their negotiating power within the family, which typically leads to more significant expenditures being dedicated to diet and nutrition, with favourable results for the wellbeing of family members. Thomas also noted this similar view(1990). According to Hoddinott and Haddad (1994), income share held by women seems to have a favourable influence on child nutritive condition in Côte d'Ivoire. Other research

found that female empowerment improved food quality and nourishment in Senegal (Lepineand Strobl, 2013), Kenya (Fischer and Qaim, 2012), Bangladesh (Sraboni et al., 2014), Nepal (Malapit et al., 2015) and India (Imai et al., 2014).

Table no:	
Agroforestry provides food security	Percent
Yes	97.7
No	2.3
Total	100
Does income from agroforestry provides?	
Varity of foods	25.50%
Access to three mael a day	48.90%
Food throughtout the year	25.50%
Total	100.00%

VII. Conclusion :

From the findings and discussion stated above, women's empowerment should be inclusive, not in an assorted form. As tribal women in the study had portrayed, they are equally involved in various forms of cultivation that demand labour-intensive activities. The study shows a few positive accreditations: most tribal women had land ownership in their name, access to the bank, saving, leadership qualities, voting rights and positive effects on food security and nutritional status of household members. But when decision-making is involved in saving money, taking the loan, going to market for essential purposing household item purchase, agroforestry activities, managing the monthly budget, and buying, selling, or transferring assets is not satisfactory and questionable. It may be anticipated that as a result of the society's traditional and cultural context, women play a subservient position in the family, allowing males to make essential decisions in the family. But women'sare contributing to economic growth. However, they need a commensurate increase in their involvement in decision-making processes.The patriarchal society's traditional social limitation confines women to the interior realm. Women are almost typically assigned to the subsistence sector

rather than the economic sector. It has also been followed by realizing that women are not passive objects of growth but relatively active subjects and agents of talents, knowledge, and abilities that have been rendered unseen. Women, although being one of the most important contributors to the economy, remain invisible.As empowerment is a multidimensional concept and is a continuous process too. The government and other welfare organisations must intervene to

address these gender-related concerns that can influence the empowerment of tribal women in actual meaning.Another method to give women more influence in family decision making in impoverished areas is to equip them with more education.

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