Uttar Pradesh Journal of Zoology

Volume 44, Issue 8, Page 16-28, 2023; Article no.UPJOZ.2565
ISSN: 0256-971X (P)

Physicochemical as Well Biological Parameters of Waste Water of the Last Chamber of the Septic Tank is Advocacy to the Hypothesis - '*A New Ecosystem of Aedes SP. Mosquito*': A Survey and Observations

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.56557/UPJOZ/2023/v44i83478

Editor(s):
(1) Prof. Aurora Martínez Romero, Juarez University, Mexico.
Reviewers:
(1) Giovanni Guimarães Landa, Centro Universitário de Caratinga – UNEC, Brazil.
(2) Kalifa Palm, Institut de Recherche en Sciences Appliquées et Technologies, Burkina Faso.

Original Research Article

Received: 05/03/2023
Accepted: 09/05/2023
Published: 11/05/2023

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ABSTRACT

Aedes sp. Mosquito a global life threatening insect,"it bred and develop in the clean and clear water", is an widely accepted theory regarding the life cycle of this vector.
To establish the Hypothesis: of the present Study, '*A NEW ECOSYSTEM OF Aedes sp. MOSQUITO*', analysis of Physicochemical and Biological parameters of Septik Tank water have been carried out at different laboratories.Total 5 nos of waste water samples have been collected and analyzed accordingly. Significant and interesting results have come out like,pH:8- 8.5, *Nitrate: Below Detection Level, DO:0.7 - 1.0 (mg/L) etc.*
*Besides, Light intensity (LUX) of the covered tank is 00 so it is an APHOTIC ZONE.
There is no trace of light and Nitrate in the water, so no problem of Eutrophication, no algal flora have been reported.
*It is highly helpful for easy movement for the larva and pupa of the mosquito.
* Bacterial Floral load is excessive high [Total Coliform -255 x 10^2 CFU).
* So the water is enriched with sufficient nutrition and food materials for their development.
Only but the important factor i.e. D.O.: - 0.85 mg/L, is in danger and toxic level for a normal aquatic creature, but this HYPOXIC CONDITION is not at all any problem for larva and pupa of Mosquito (*Aedes*. Sp.). Because they consume aerial Oxygen from the upper surface of the water with their SIPHON and TRUMP as an adaptive measure of their life cycle.
From the above survey and observations an inference can be drawn that highly adaptive *Aedes* sp. mosquitoes are successfully growing in the so called dirty but nutrition enriched water of Septic Tank
There is a strong interaction between *Aedes sp* .and Septic Tank. *Aedes* sp. also performing the role of entomological vector silently and creating a severe community health problem all over the world.

Keywords: Hypoxia; aphotic; bacterial-load; community-health.

1. INTRODUCTION

"*Aedes sp.*(Diptera: Culicideae) mosquito can't develop in the dirty water, it bred and develop only in the clean and clear water" [1] - a general rule widely accepted and following by the most of the authors and research workers for their studies on the life cycle of this frightening vector.

"Throughout most of South-East Asia, Ae. aegypti oviposits almost entirely in domestic and man-made water receptacles. (y) These include a multitude of receptacles found in and around urban environments (households, construction sites and factories) such as water-storage jars, saucers on which flowerpots rest, flower vases, cement baths, foot baths, wooden and metal barrels, metal cisterns, discarded tyres, bottles, tin cans, polystyrene containers, plastic cups, discarded wet-cell batteries, glass containers associated with "spirit houses" (shrines), drainpipes and ant-traps in which the legs of cupboards and tables are often rested" [2].

'Down to Earth', a magazine reported in Mosquito Matter that The blood-sucking pest is changing in rapid pace with changing environment. But studies on it are few and far between: 'Dengue-causing *Aedes aegypti* mosquito breeds in stagnant water containers such as drums, buckets, pots and flower vases. Surveys by NIMR [National Institute of Malarial Research-New Delhi] reveal that now Aedes aegypti also breeds in wells and tree holes, usually found in rural areas [3].

A report in the "NATURE" expressed that, "Dengue is a systemic viral infection transmitted between humans by Aedes mosquitoes. For some patients, dengue is a life-threatening illness. There are currently no licensed vaccines or specific therapeutics, and substantial vector control efforts have not stopped its rapid emergence and global spread. The contemporary worldwide distribution of the risk of dengue virus infection and its public health burden are poorly known" [4].

Since very recent time various views with evidences are emerging out in favour of the some other type i.e. changing mode of life cycle of *Aedes* sp. mosquito in the Urban and Semi Urban life style.

In the "NATURE ECOLOGY & EVOLUTION"- 27 October, 2022 it has been reported by some

authors that "*The prevalence of diseases borne by mosquitoes, particularly in the genus Aedes, is rising worldwide. This has been attributed, in part, to the dramatic rates of contemporary urbanization.* While *Aedes*-borne disease *risk varies within and between cities*, few investigations use urban science-based approaches to examine how city structure and function contribute to vector or pathogen introduction and maintenance. Here, *we integrate theories from complex adaptive systems, landscape ecology and urban geography to develop an urban systems framework for understanding Aedes-borne diseases*". "Ultimately, the framework strengthens existing theoretical and mixed qualitative–quantitative approaches, and advances considerations of how interventions including urban planning (for example, piped water provisioning) and emerging vector control strategies (for example, *Wolbachia*-infected mosquitoes) can be implemented to prevent and control the rising threat of *Aedes*-borne diseases" [5].

Different authors and research workers are immensely concentrated on *Urban Landscape and Ecology* to find out a justified and reasonable solution even by breaking the conventional concept on *Aedes* sp. Life cycle for this long lasting also burning problem of global and contemporary Ecological Problem.

Some studies have been conducted on the complex relation between *Aedes* sp. Mosquito and multi chambered septic tank (Open i.e. not with underground SOAK PIT system). "Zoologist of Zoological Society of India should give stress on this burning problem of strong and complicated interaction between Aedes sp .and Septic Tank, an inevitable component of Contemporary Ecology of modern as well neat and clean Urban life, under which situations Aedes sp. performing the role of entomological vector silently as well uninterruptedly and creating a severe community health problem all over the world. This contemporary ecological problem is very much significant and relevant from "Life Security on Earth" Point of view also" [6].

1.1 Visual Evidence from the Previous Study by the Same Authors

"In the SEPTIC TANK ECOSYSTEM at the Urban and Sub-Urban areas, some informations, along with field evidences, have been reported in detail on this aspects " [7].

"From the above studies and evidences [6,7] it can be consider apparently that there is a *important relationship between Aedes sp. mosquito life cycle and septic tank ecosystem".*

Fig. 1. A specially designed adult mosquito trapping cage is fitted at the out let port of the septic tank [6]

Fig. 2. After 48 hrs. of fitting the trapping cage, Fig. 1, so many adult mosquito have been trapped into the cage i.e. emerged out from the inside of the tank [6]

Fig. 3. Showing different Larva and pupal stages of *Aedes* sp. Mosquito in the sample water collected from 3rd chamber of multi chambered septic tank, being nurtured in the Laboratory [7]

Fig. 4. Adult *Aedes*.sp mosquito developed in the sample water collected from 3rd. Chamber of Multi Chambered Septic tank [7]

2. MATERIALS AND METHODS

To establish the Hypothesis of the present Study, analysis of the Physicochemical as well Biological parameters have been carried out at the Department of Zoology, BBMK University, Dhanbad, Jharkhand ; *CSIR - CENTRAL MECHANICAL ENGINEERING RESEARCH INSTITUTE (Environmental Enginering Group)*, Durgapur, West Bengal; and some other associated laboratory .,'

Total 5 nos of waste water samples have been collected and analyzed accordingly. Significant and interesting **Data** have been collected and recorded in tabular form as follows.

Light intensity (LUX) of the covered tank have been measured by using a *DIGITAL LUX METER* as follows:

Fig. 5. Septic tank prior to starting study and measurement of light intensity

Fig. 6. Light Sensor of the "LUX METER" placed outside the septic tank. Reading is :- 437 x100 = '43,700'Lux (Time - 10 AM)

Fig. 7. Light Sensor of the "LUX METER" placed inside the septic tank. Reading is :- 000 x100 = '00' Lux [APHOTIC CONDITION] (Time - 10.05 AM)

3. RESULTS AND DISCUSSION

I. Following Physicochemical and Biological Parameters of the Collected Sample Water Have Been Analyzed by following 'APHA' Method. The parameters of the collected waste water (Sample -1) has been tested by the Environmental Engineering Group of CENTRAL MECHANICAL ENGINEERING RESEARCH INSTITUTE, CSIR, Durgapur, West Bengal Official documents atttached herewith as ready reference Table 2.

We have been confined on following seven parameters out of those six are positively favourable for the growth and development of the larva of Aedes sp. Mosquito; But one is though apparently negative but clearly revealed that unfavourable condition has been overcame with its adaptive character of their life cycle.

Graphical Representation of the 7 remarkably important parameters, dominating and influencing the growth and development of the mosquitoes, are as follow.

II. The LIGHT INTENSITY recorded at 10.05 AM inside the Septic Tank Chamber is :- *"00"* Lux i,e. the site is an APHOTIC ZONE, where as outside of the tank light intensity recorded is :- 43,700 Lux, at the same time (10AM).

Parameters assessed in this study have both positive and negative reflection (effect) from Physicochemical analysis point of view of water, for that reason those parameters have been discussed in two separate head

Table 1. Waste water samples have been collected from the following locations for the present study

Sl. No	Sample	Location	Latitude (N)	Longitude (E)
1	Sample-1	Burnpur, West Bengal	23^0 39' 52''	86^0 55' 57''
2	Sample-2	Burnpur, West Bengal	"	"
3	Sample-3	Asansol, West Bengal	23^0 40' 26''	86^0 57' 8.6"
4	Sample-4	Asansol, West Bengal	"	"
5	Sample-5	Durgapur, West Bengal	23^0 32' 0.38''	87^0 19' 18.9''

Table 2. Sample-1, Parameters analyzed by the CENTRAL MECHANICAL ENGINEERING RESEARCH INSTITUTE (Environmental Engineering Group), CSIR, Durgapur, West Bengal

सी. एस. आई. आर- केंद्रीय यांत्रिक अभियांत्रिकी अनुसंधान संस्थान
CSIR- CENTRAL MECHANICAL ENGINEERING RESEARCH INSTITUTE
दुर्गापुर /Durgapur -713209
(Recognized by West Bengal Pollution Control Board)
पर्यावरण अभियांत्रिकी समूह/ Environmental Engineering Group
जल विश्लेषण की परीक्षण रिपोर्ट/Test Report of Water Analysis

Sample received on : 08.06.2022 Report Date:20.06.2022
Sample is Collected& Drawn by : Dr.Arup Ghosh,B.B College, Asansol
No. of Sample : 01 Ref: BDG/AID/1962/17-TSP-1398 (EEG/22/22-23)
Sample Name/Site : Waste water
Address : Dr. Amitava Basu ,Principal,B.B College, Asansol,
Report to : Dr. Amitava Basu , Principal, B.B College, Asansol,

SL. No.	Parameters	Result (Method Followed: APHA)	SL. No	Parameters	Result (Method Followed: APHA)
01.	pH	**8.18**	11	Calcium (mg/L)	**117.22**
02.	Total Dissolved Solids (mg/L) (TDS)	**1658**	12	Magnesium(mg/L)	**21.04**
03.	Conductivity (µS/cm)	**2764**	13	Iron(mg/L)	**0.85**
04.	Turbidity (NTU)	**30**	14	DO(mg/L)	**0.80**
05.	Chloride (mg/L)	**197**	15	COD(mg/L)	**151**
06.	Hardness (mg/L)	**379.62**	16	BOD(mg/L)	**41**
07.	Alkalinity (mg/L)	**1076**	17	O& G(mg/L)	**4.58**
08.	TSS (mg/L)	**102**	18	E. Coli/100 ml	**15x 10^2CFU**
09.	Nitrate (NO_3^-) (mg/L)	**BDL**	19.	Total Coliform/100ml	**255 x 10^2CFU**
10.	Phosphate (mg/L)	**75.92**			

BDL: Below Detection Limit

Reported by:
Signature: A. Mallick Nath

Approved by:
Signature: 20/6/2022
Dr. BISWAJIT RUJ
Chief Scientist
Environmental Engineering Group

Note: 1. Water sample is collected by the party/Client. Laboratory is not liable for source of the water sample.
2. This report refers to the values obtained at the time of testing and result related to the parameter tested.
3. This report may not to produce in part or full without written permission of the Lab -In -charge and competent authority.

Table 3. Physicochemical and biological parameters of the collected sample waters

Parameters	Sample -1	Sample -2	Sample -3	Sample - 4	Sample - 5
pH	**8.18**	**8.30**	**8.50**	**8.00**	**8.50**
Turbidity (NTU)	30	30	26	25	28
Conductivity (miu-S/cm)	**2764**	**2953**	**2625**	**2557**	**3114**
Alkalinity(mg/L)	1076	1080	1054	1032	1089
Hardness (mg/L)	379.62	367.46	377.53	325.81	353.15
Total Dissolved Solid (mg/L)	**1658**	**1932**	**1591**	**1525**	**2119**
TSS (mg/L)	**102**	**90**	**82**	**75**	**98**
DO(mg/L)	**0.80**	**0.70**	**0.80**	**1.00**	**0.70**
BOD(mg/L)	41	46	37	45	44
COD (mg/L)	151	170	142	175	179
Nitrate (NO_3^-) (mg/L)	**BDL****	**BDL**	**0.31**	**0.26**	**BDL**
Phosphate(mg/L)	75.92	81.32	84.70	82.78	74.21
Calcium (mg/L)	117.22	115.45	110.33	120.65	123.37
Magnesium(mg/L)	21.04	23.31	19.87	17.63	24.53
E Coli (CFU)	$15x10^2$	$13x10^2$	16.10^2	$13x10^2$	$17x10^2$
Total Coliform (CFU)	**$255x10^2$**	**$252x10^2$**	**$255x10^2$**	**$254x10^2$**	**$260x10^2$**

*** Below Detection Level*

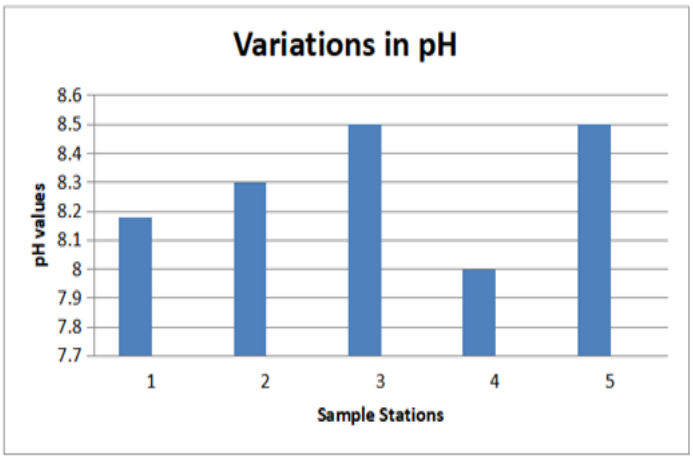

Fig. 8. pH level of different collected samples of water

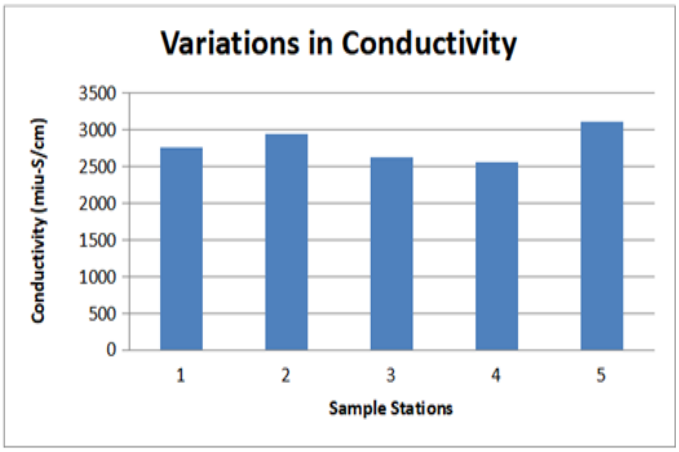

Fig. 9. Conductivity level of different collected samples of water

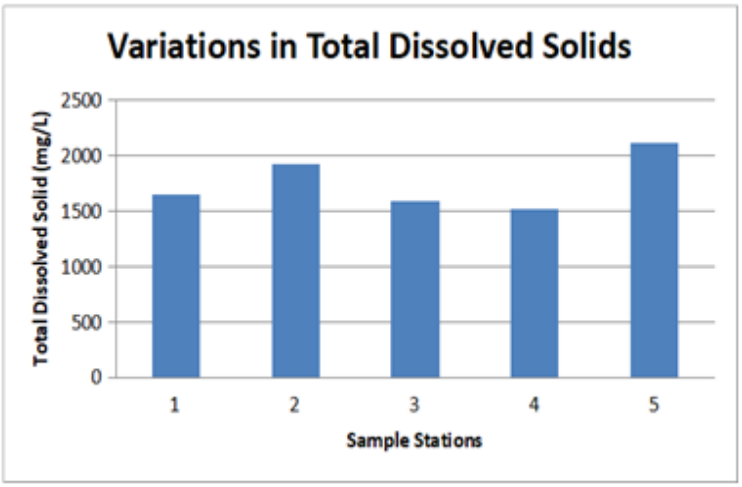

Fig. 10. Total Dissolved Solids (TDS) Level of Different Collected Samples of Water

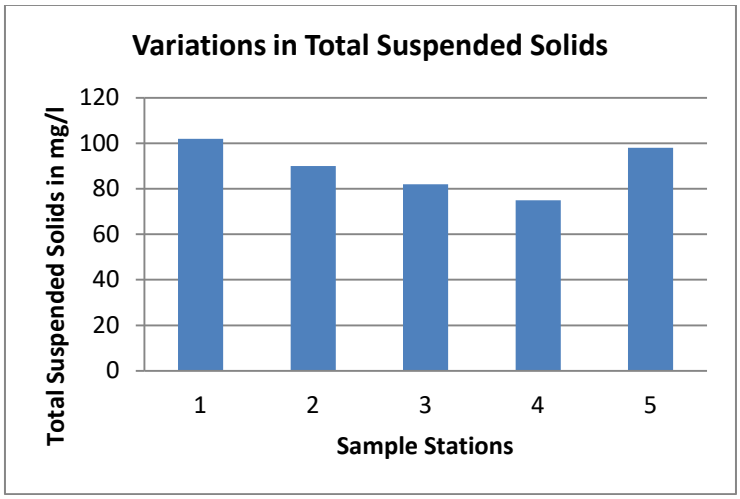

Fig. 11. Total suspended solids (TSS) level of different collected samples of water

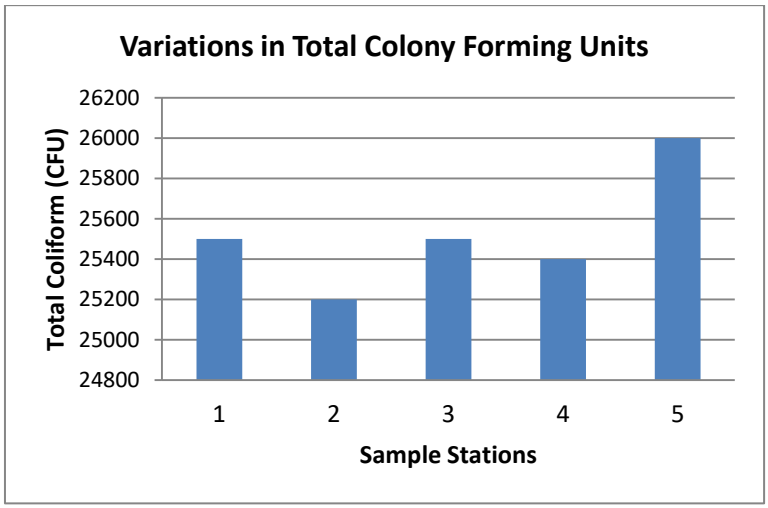

Fig. 12. Total coli form level (CFU) of different collected samples of water

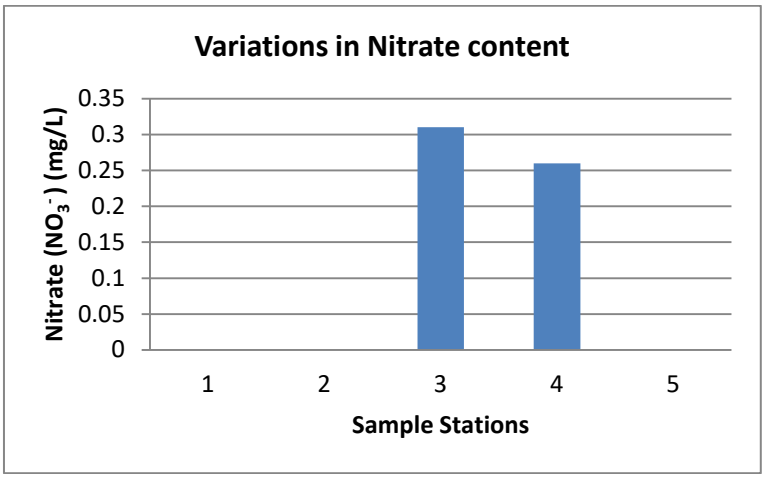

Fig. 13. Nitrate level of different collected samples of water

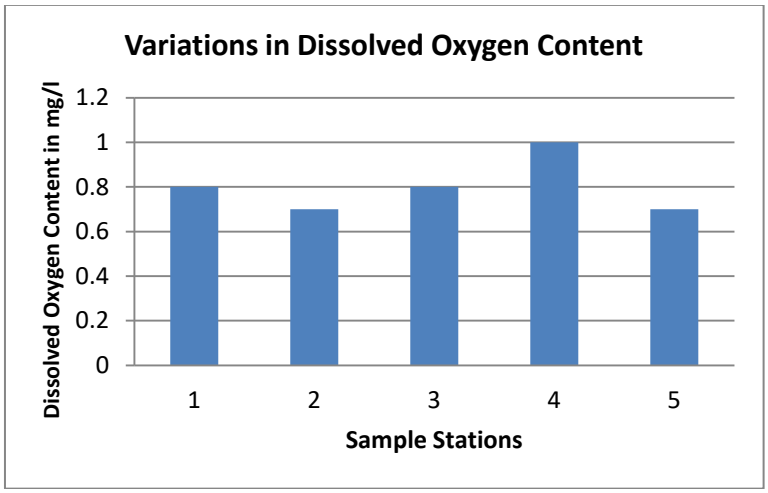

Fig. 14. Dissolved Oxygen (DO) Level of Different Collected Samples of Water [Negative picture in relation to a true Aquatic Creature]

pH: ‘ The pH of the water is known to influence the availability of micronutrients as well as trace metals’ [8,9]. *COLLECTED WATER SAMPLE SHOWN pH Range = 8.00 - 8.5 .*

The freshwater mosquito Aedes aegypti and the euryhaline Ochlerotatus taeniorhynchus tolerate very similar pH ranges. Both species complete larval development in waters ranging from pH 4 to pH 11 [10].

So pH range of the studied water sample collected from Septic Tanks are within the favourable range for the growth and development of the larva of *Aedes* sp. mosquito

Conductivity: ‘Water conductivity is mainly attributed to the dissolved ions liberated from the decomposed plant matter’ [11] and ‘input of inorganic and organic wastes’ [12]. EC depends on the dissolved solids in the discharged water. So those are showing high level of decomposed organic wastes, thus supporting supply of sufficient nutritional materials to the larva of mosquito.

Total dissolved solids (TDS): TDS is a measure of the combined content of all contaminants contained in the water. TDS are composed mainly of bicarbonates, chlorides, carbonates, phosphates, and nitrates of calcium, magnesium, sodium, and potassium; manganese; salt; and other particles [13].

The higher values of TDS [1525 - 2119 mg/L] reflecting the discharge of wastes (human excretory materials) which are supporting the supply of different essential nutritional

supplement to the biotic stake holders of the of the Septic Tank, like Larva of mosquito and different microorganism related with this Ecosystem [14].

TOTAL SUSPENDED SOLIDS (TSS): Total suspended solids (TSS) are defined as solids in water that can be trapped by a filter. A high range of TSS measure - 75 - 102 mg/L.

So these are also supporting for increasing the fertility of the septic tank water for vigorous growth of the biotic stake holders of the septic tank ecosystem.

ASSESMENT OF INDICATOR MICRO-ORGANISM:

Total Coliform: 'As the name suggests, coliform bacteria can work as the indicator organism because they give the signs and signals of disease-causing bacteria present in the water' [15].

'This sort of bacteria does not have the destructive potential of making ill because it is mostly present in the water to make aware of the contamination pathways that may include SEPTIC SYSTEM, surface water, or animal or HUMAN WASTE' [16].

'The strength of faecal matter in sewage is monitored by coliform counts, a water quality parameter that acts as an indicator of pathogens that most commonly cause diarrhoea, as well as typhoid and a whole host of enteric diseases.' 'Raw sewage typically has a *faecal coliform* count in the range of 10^6 up to 10^8 Most Probable Number (MPN)/100ml.'(18) or Colony Forming Unit (CFU).

Total Coliform measured in the collected samples are in the range of 25200 - 26000 CFU, so it is indicating that supply of microorganisms for the purpose of the nourishment to the mosquito larva and other stakeholders are sufficient enough.

Negatve Aspect:

Nitrate: Nitrate content is an important parameter to estimate organic pollution in a particular environment, and it represents the highest oxidized form of nitrogen. Nitrate is one of the very common contaminants in ground water and surface water. Nitrate occurs naturally in source water as a result of decaying plants. However, there are other manmade sources of nitrate that can increase its presence in source waters to dangerous levels. Agricultural sources of nitrates include livestock waste matter and chemical fertilizers. The presence of nitrates in the water samples is suggestive of some bacterial action and bacterial growth [17].

The Collected Water Of Most Sample Shown Nitrate level Below Detection Level (BDL) -0.26 mg/L.

The sample signifies that it is devoid of Eutrophication problem and helps the easy movement of larva of mosquito, i.e. a negative factor became a larval growth supporting physical process [18].

Dissolved Oxygen (D.O): Dissolved oxygen (DO) is the amount of oxygen that is present in water. *All aquatic animals* need DO to breathe. Low levels of oxygen (hypoxia) or no oxygen levels (anoxia) can occur when excess organic materials, such as large algal blooms or biodegradable organic matters, are decomposed by microorganisms. During this decomposition process, DO in the water is consumed. *As DO levels drop, some sensitive animals may move away, decline in health or even die.*

Each organism has its own DO tolerance range, generally, DO levels below 3 milligrams per liter (mg/L) are of concern and waters with levels below 1 mg/L are considered hypoxic and usually devoid of life.

Dissolved Oxygen level shown in the sample water - 0.7 to 1.0 i.e. hypoxic condition, larva of *Aedes sp.* Mosquito overcame the oxygen depletion condition by carry out respiration from aerial Oxygen with the help of TRUMP and SIPHON situated at the head and tail region of Pupa and Larva of *Aedes* sp.mosquito respectively.

Light Intensity: Light intensity recorded inside the septic tank is '000' (Zero Lux) where as outside of the tank is recorded as 43700 Lux at 10 AM i.e. an aphotic condition inside the tank has been created.

As a result of the fact i) Zero Lux Light and ii) Nitrate amount -Below Detection Level , caused no problem of Eutrophication as well no algal flora (specially Chlorophyceae and Cyanophyceae group) have also been reported.

4. CONCLUSION

From the above mentioned study, result and discussions it has been revealed that the so called dirty waste water of 3rd chamber of Septic Tank is enriched with different types of essential nutrients and microorganisms, basing on those positive aspects, growth and development of the larva of *Aedes* sp mosquitoes are robust and vigorous.

In addition to the above, two discussed negative aspects (Light and Nitrates) are also supportive for the smooth growth of the larva and another negative aspects(DO) Hypoxic condition of the tank water is also not an obstacle to the growth of the larva due to their special adaptive respiratory system, the *Aedes* sp larva utilising the Aerial Oxygen with the help of Siphon and Trump of the larva and pupa respectively in their life cycle.

For the presence of all above supportive physicochemial and biological factors, *Aedes* sp. Mosqito larva preferring this niche as their safe and comfortable resting as well nesting site.

From the present study it is also clear that there is a strong and complicated interaction between *Aedes sp* .and Septic Tank. Through this New Ecosystem *Aedes* sp. also performing the role of entomological vector silently and creating a severe community health problem all over the world.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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