

Lean Quality Circle

Welcome





QUALITY ASSURANCE AND TECHNOLOGY DEVELOPMENT DEPARTMENT

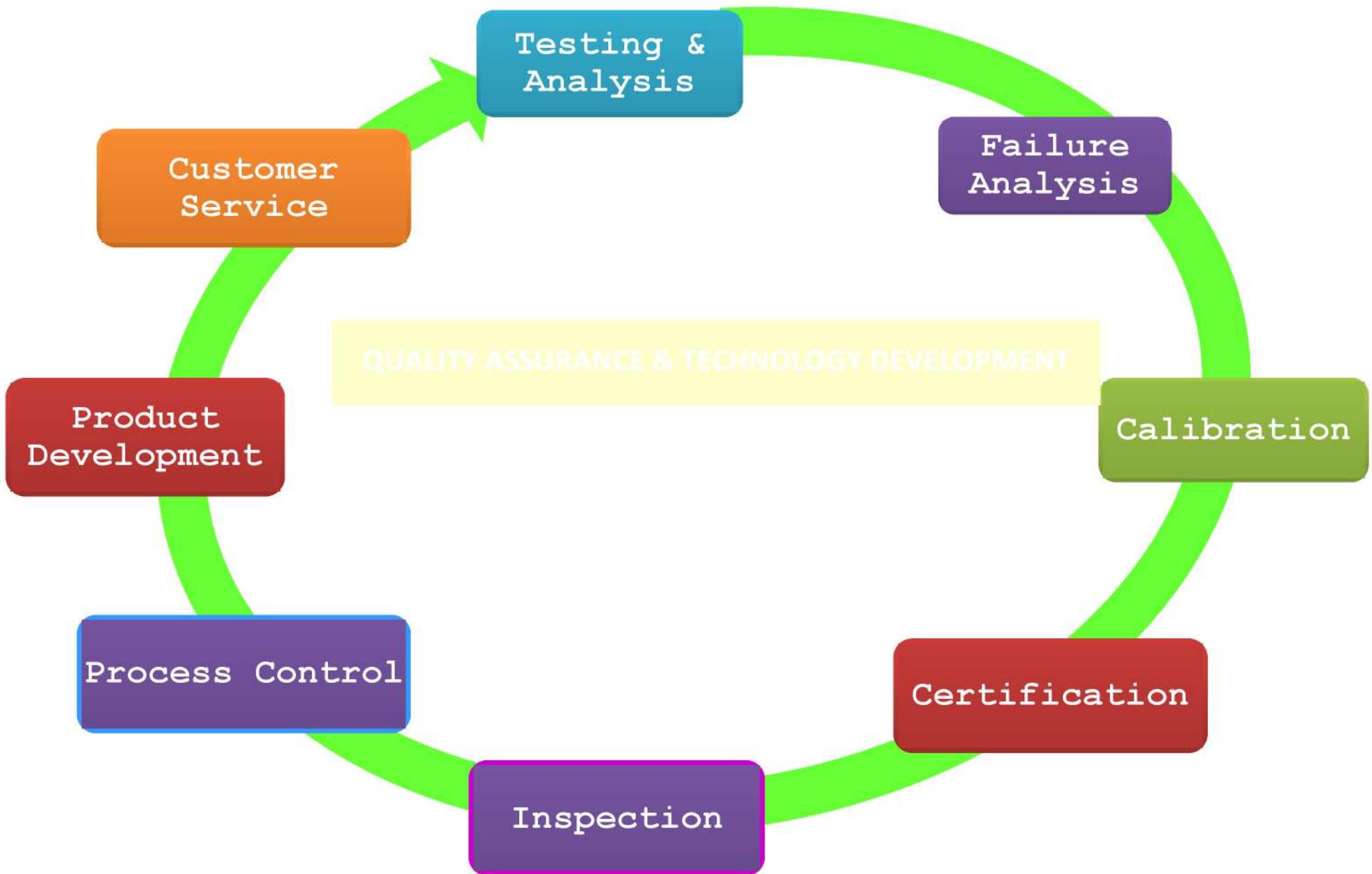
PROJECT name

MEGHPHUSHP

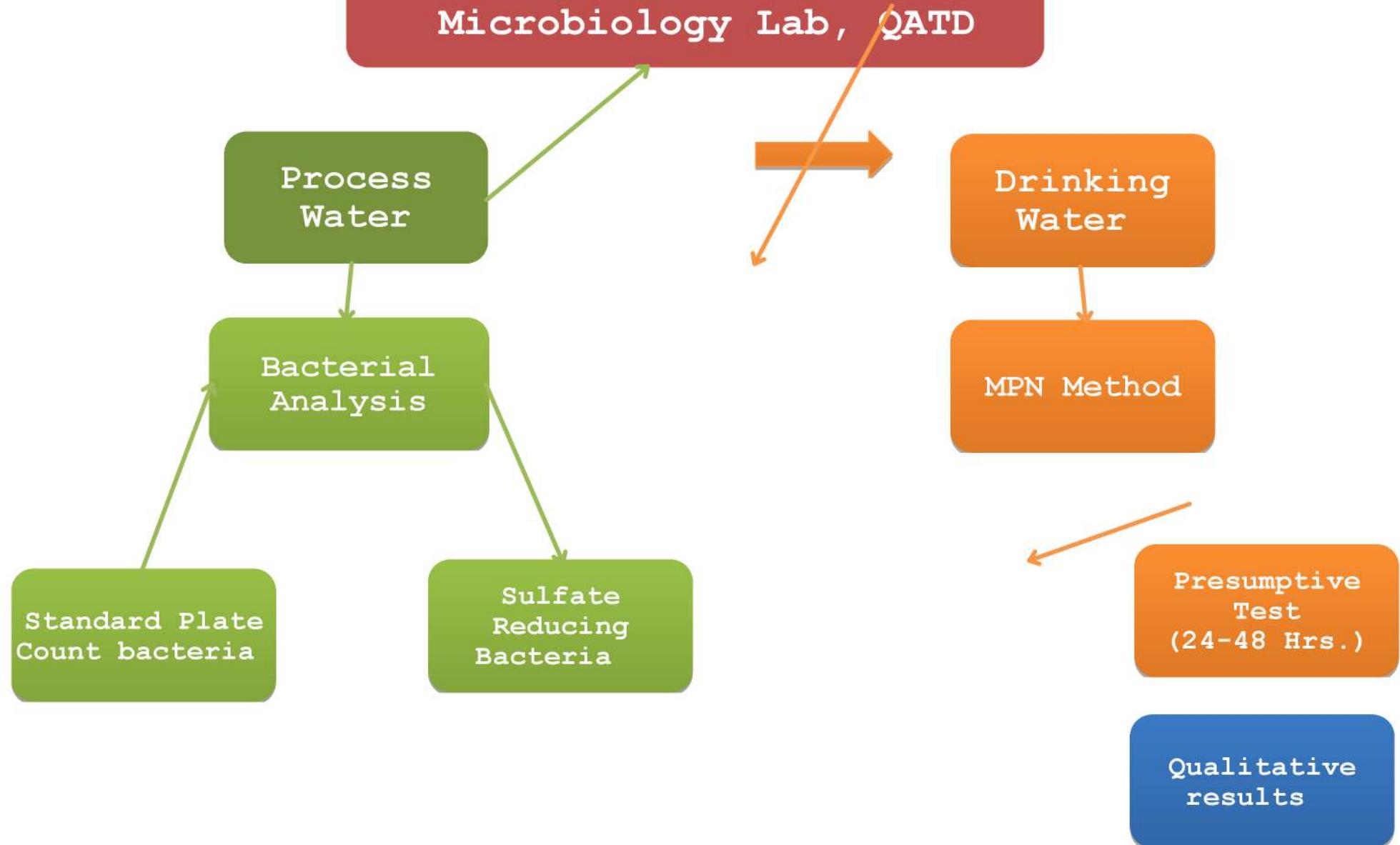
Project Title

**BACTERIAL ANALYSIS OF
DRINKING WATER USING
VRBA PETRIFILM TECHNIQUE**

Quality Assurance & Technology Development



Flow diagram of Microbiology Lab, QATD



Instant problem selected is....



“Increased Bacterial Contamination in Drinking Water”

Lean QC Profile

QC Name
Meghphushp



1

QC Formation date
01/02/2018

2

Project start date
12/02/2018

3

Project completion date
30/04/2018

4

No. of projects completed
01

5

THE ESTIMATED



Tools used....



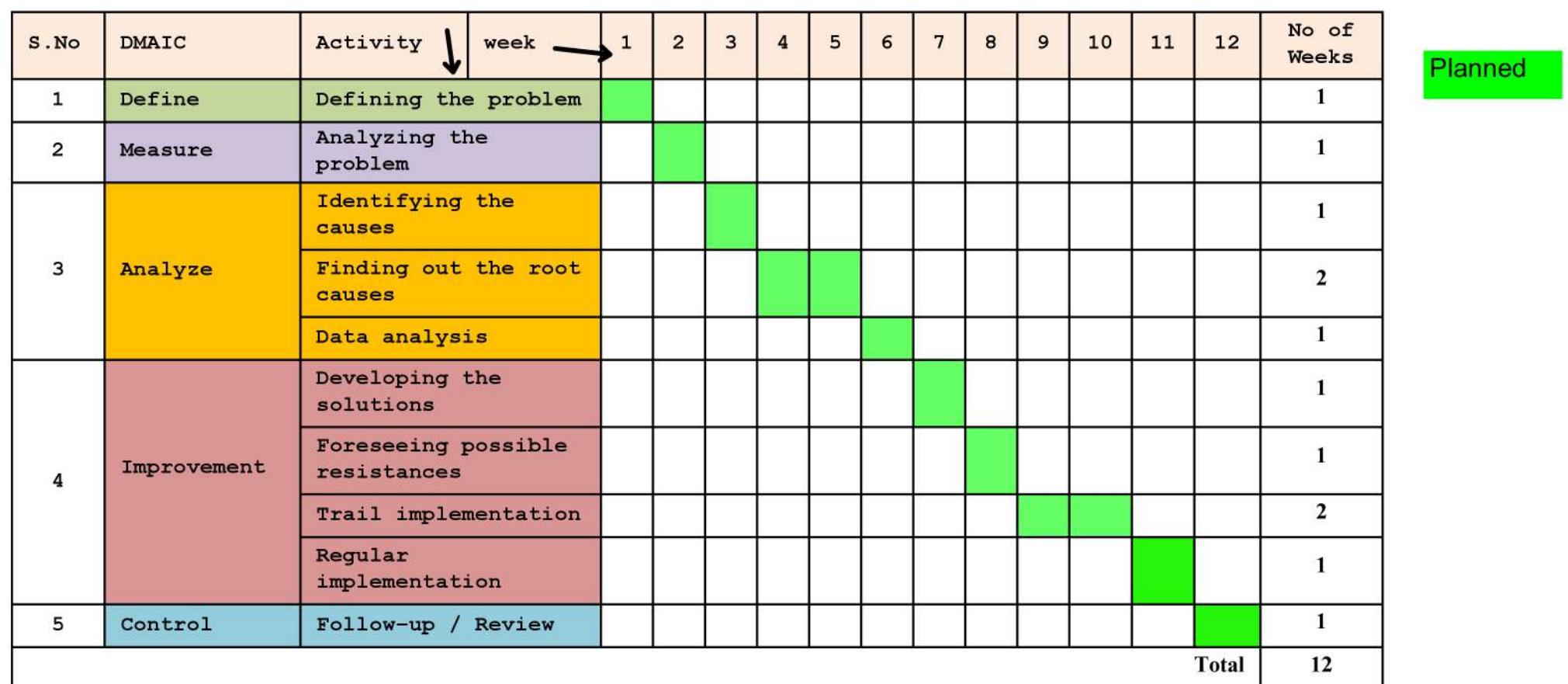
Milestone chart



Selection of Problem (Milestone Chart)

PROJECT STUDY PLANNING IS AN EFFECTIVE METHOD BY WHICH LEAN QUALITY CIRCLE MEMBERS ATTAIN THE SKILL TO PLAN THEIR ACTIVITIES WITH EFFECTIVE TIME MANAGEMENT

Quality circle Name	MEGHPUSHP	Facilitator	B.ARUNIMA	
Department	QA & TD	Members		
LQC. No.	37400011	Reason for Selection	Quantification	
Project No.	01	Date of beginning	02-02-2018	Date of completion 30-04-2018
Project	Bacterial Analysis in Drinking Water Using VRBA Dry Film Technique			

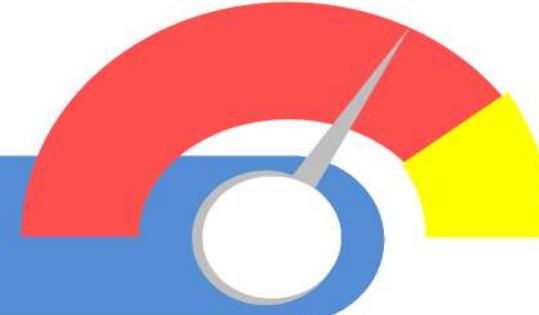


“Escherichia coli and coliform are the bacteria whose presence can indicate water contaminated by human or animal wastes”.



“As per IS 10500:2012 ,in drinking water samples, E.coli or coliforms shall not be detectable in any 100ml sample”.

Some strains of E.Coli can cause serious infections which are listed below:



CHOLANGITIS



TRAVELER'S DIARRHEA



BACTERIMIA

URINARY TRACKT INFECTION



CHOLECYSTITIS



PNEUMONIA

NEONATAL MENINGITIS

“Recently there has been a large outbreak due to shigatoxin producing E.coli is found to be highly fatal. And worst thing is no medicine for that.



DMAIC APPROACH



IMPACT OF THE



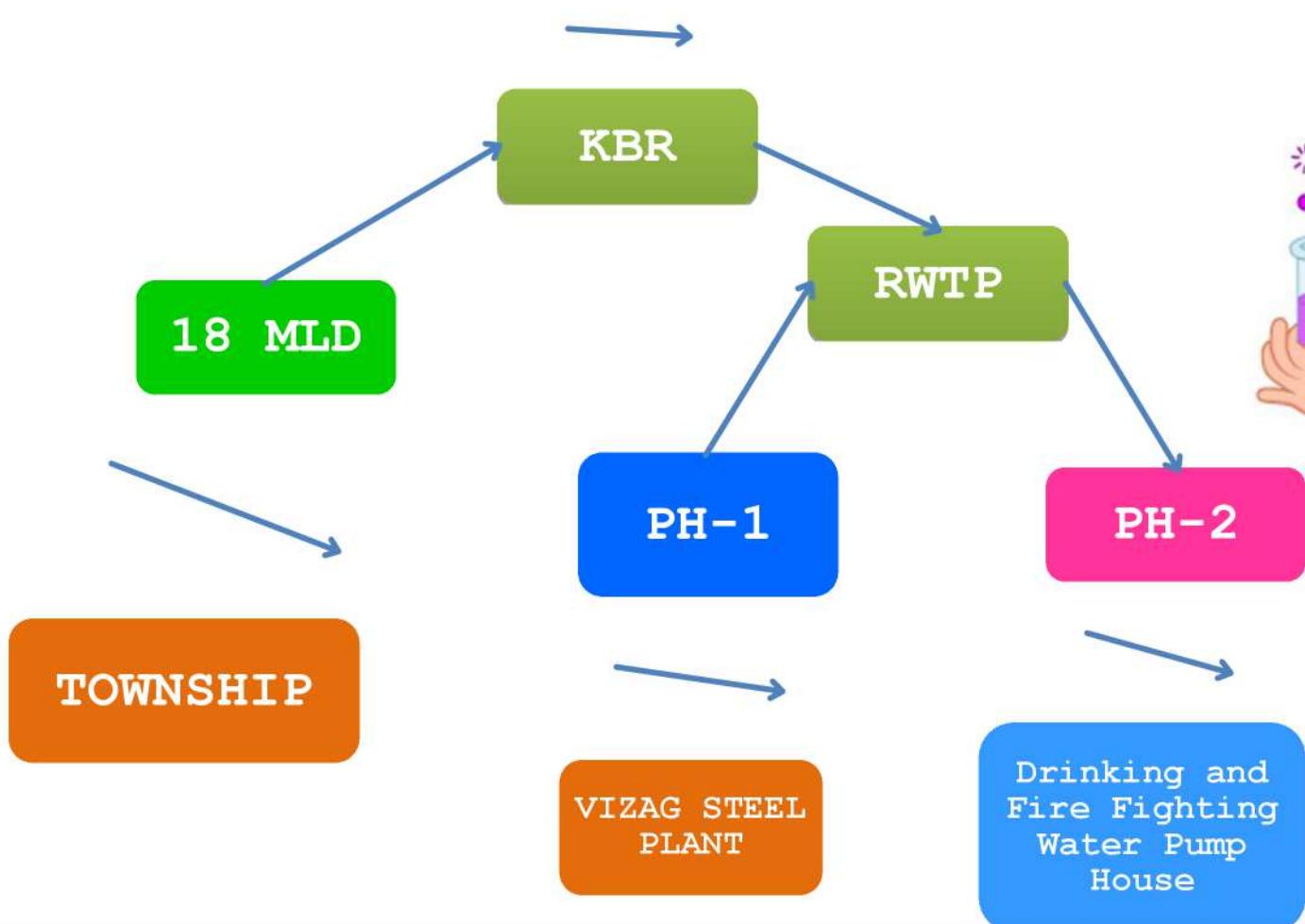
Tools used....



Flow diagrams

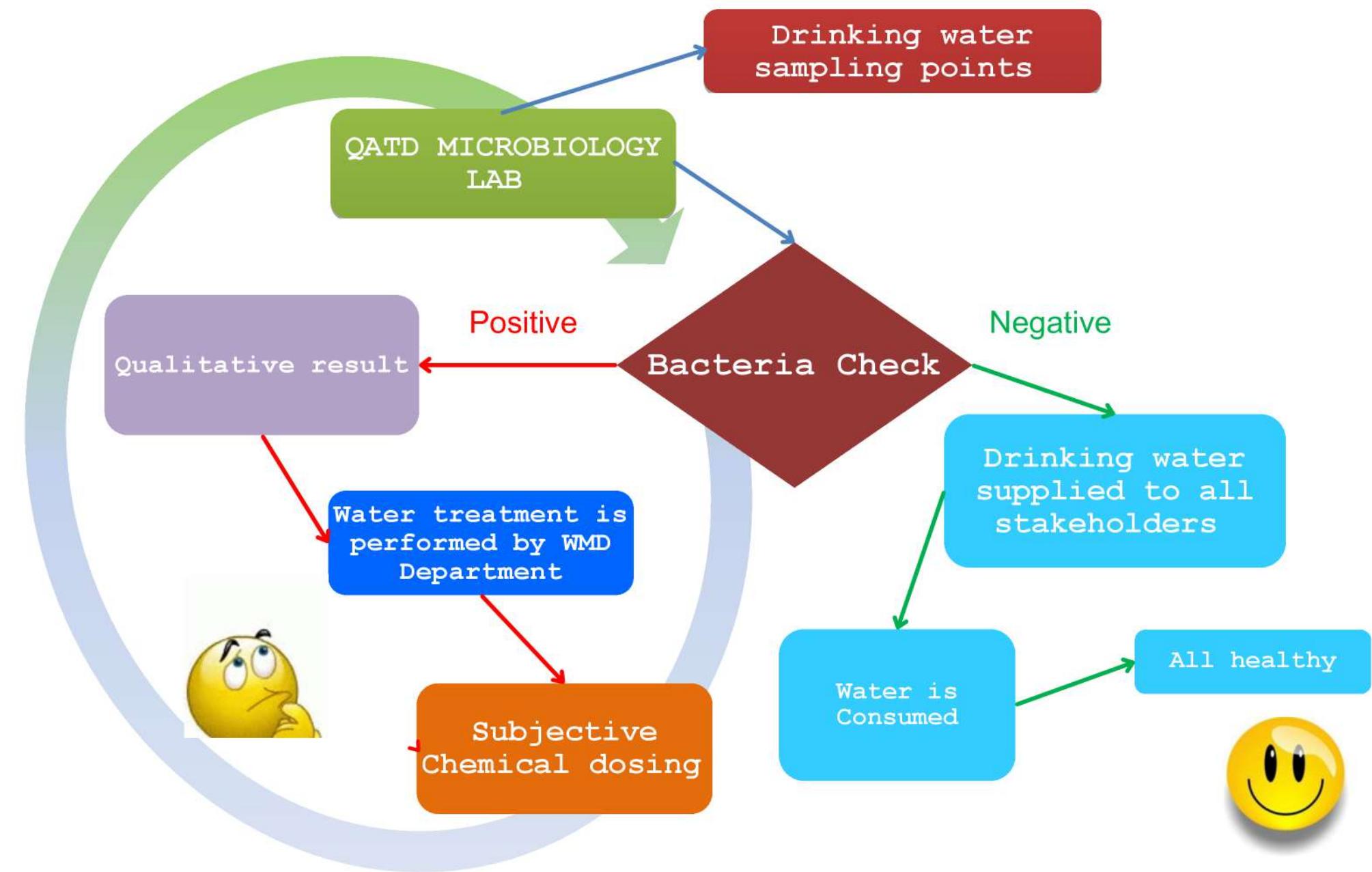
Drinking Water Sampling Points

Yeleswaram Reservoir



(Defining the problem)

Step-1





To Help in reducing bacterial contamination in drinking water distribution systems of RINL.

1. To quantify E.coli bacteria in drinking water
2. To Minimize resources and time span of analysis



ANALYSIS THE



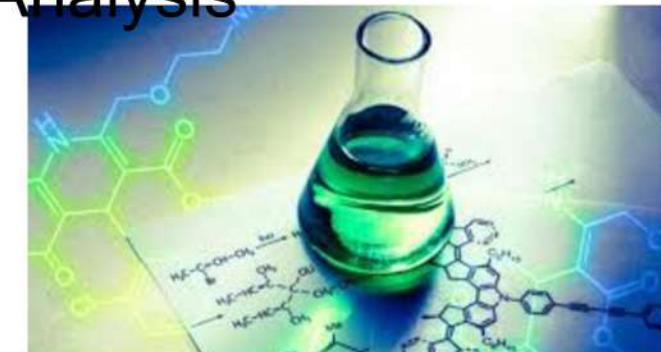
Tools used....



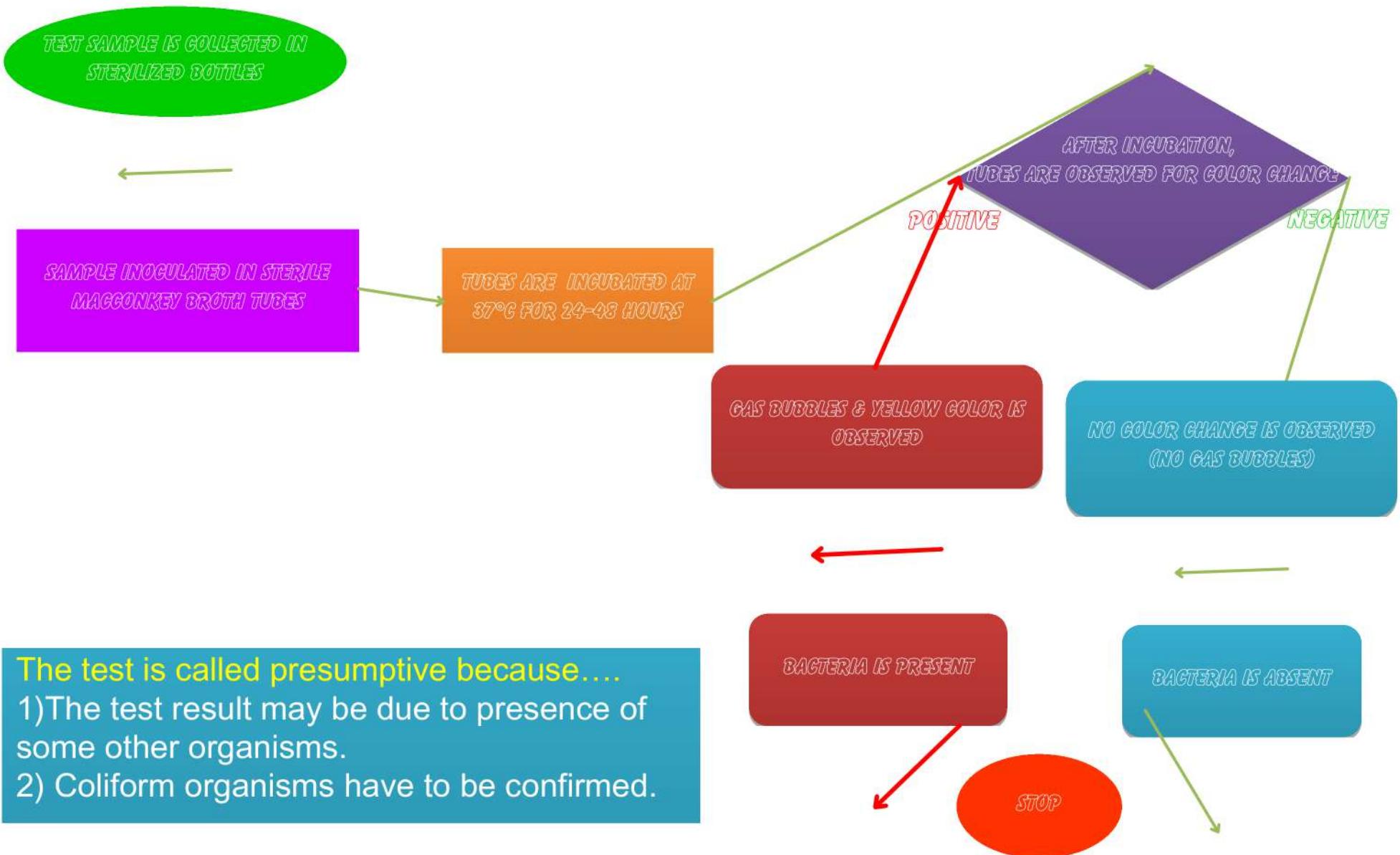
Data Collection



4W and 1H Analysis

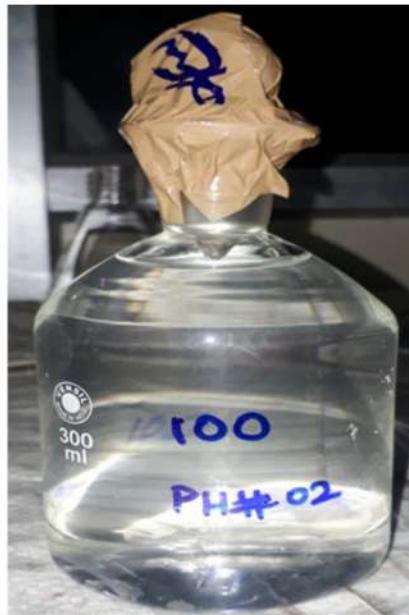


Flow Chart of the MPN Presumptive Method





Images of MPN Presumptive method of water sample





Data Collection

Drinking water log book



724	28-10-2017	PH # 02	NEGATIVE	
725	08-11-2017	PH # 02	NEGATIVE	
726	08-11-2017	PH # 28	NEGATIVE	
1		18 MLD OUTLET	NEGATIVE	
2		Sec IV - Q NO - 428/A	POSITIVE	
3		Sec VI - QH T Out let	POSITIVE	
4		WRM2 Control Room	POSITIVE	
5		PH # 11	POSITIVE	
6		18 MLD OUT let	POSITIVE	
7		Sec XII / Q NO - 139B	POSITIVE	
8		Sec II / Q NO - 309	POSITIVE	
9		PH # 02	POSITIVE	
10		PH # 28	NEGATIVE	
11		WRM2 Restrooms -2	NEGATIVE	
12		WRM2 Control Room	NEGATIVE	
13		18 MLD out let	NEGATIVE	
14		Sec XI	POSITIVE	
15		Sec IV	POSITIVE	
16		PH # 02	NEGATIVE	
17		PH # 28	NEGATIVE	
18		WRM2 control Room	NEGATIVE	
19		WRM2 RCPH	NEGATIVE	
20		18 MLD Stage II	NEGATNE	
21		Sec XI OH T Tank outlet	POSITIVE	
22		Sec IV OH tank outlet	POSITIVE	
23		PH # 02	NEGATIVE	
24				
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Data Collection

IOM's from water management department



MICROBIOLOGICAL TEST----- REQUISITION FORM DRINKING WATER

Ref.No:WK/WMD/ [REDACTED]

Date: 10-11-2018

REQUISITION FORM:

1. Name of system : WRN-2 & SBM

2. location : WRN-2 MIL CP-3

3. Sampling date and time : SBM MIL CP-3 -

4. Parameter to be Analyzed [REDACTED]

5. Conditions if any : Bottles received in sealed Condition
Bottles sealed after sampling
Bottle No: 301
Bottle No: 302
(WRN-2) [REDACTED]

Handwritten signature: H.W. 10/11/18 (BH.Nak)

Signature of Pump House I/C / Engineer

Increased Drinking water contamination (past 5 years)

Number of Bacteria positive Drinking water samples observed at Microbiology lab





IDENTIFICATION OF CAUSES



Tools used....



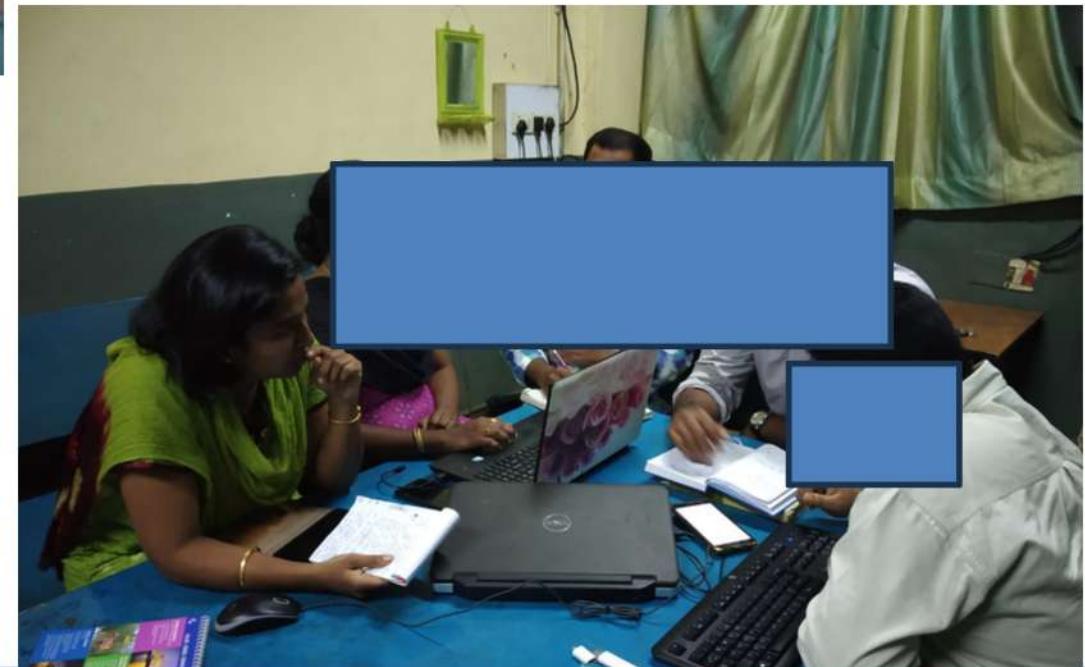
Brain storming



Cause and effect diagram

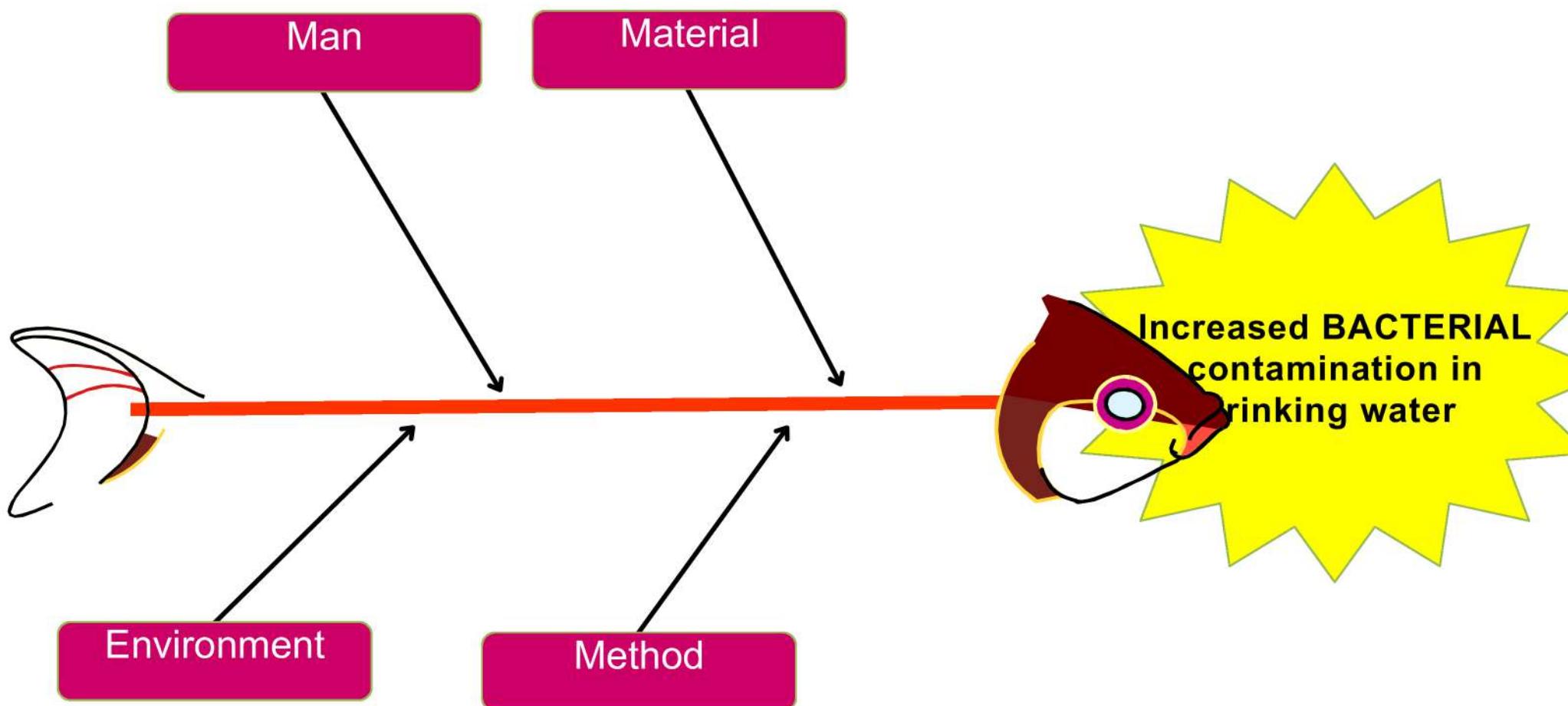


Brain storming activity



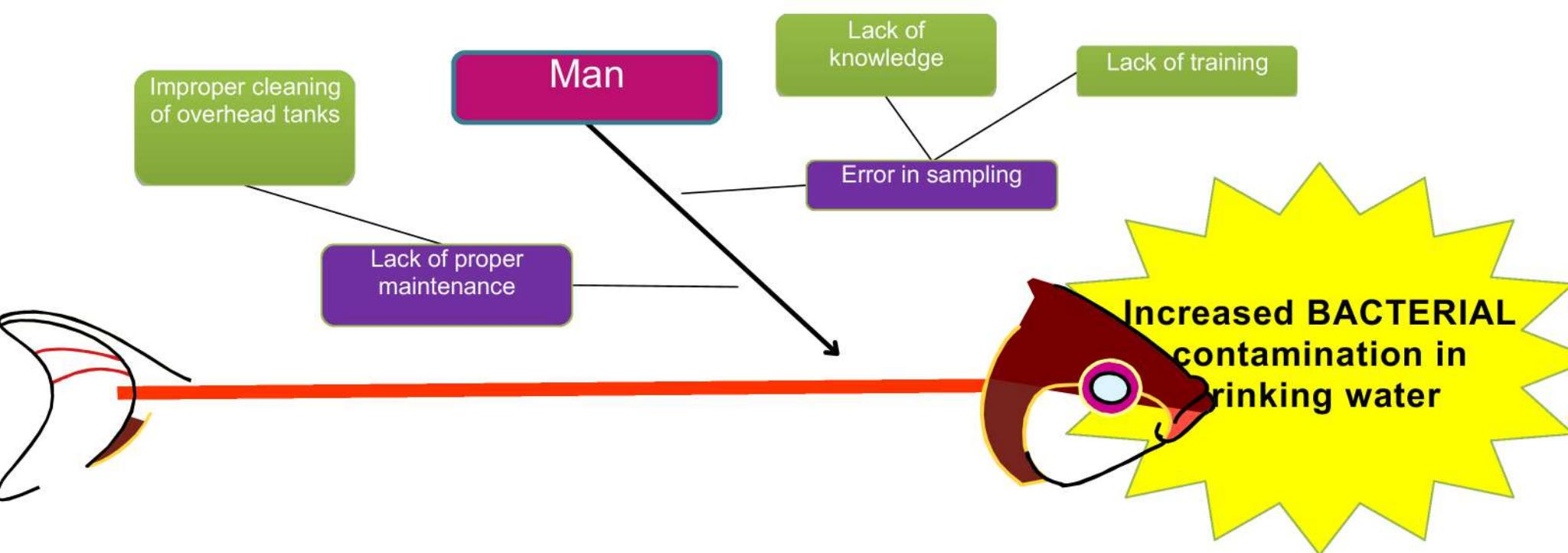


Cause and effect diagram



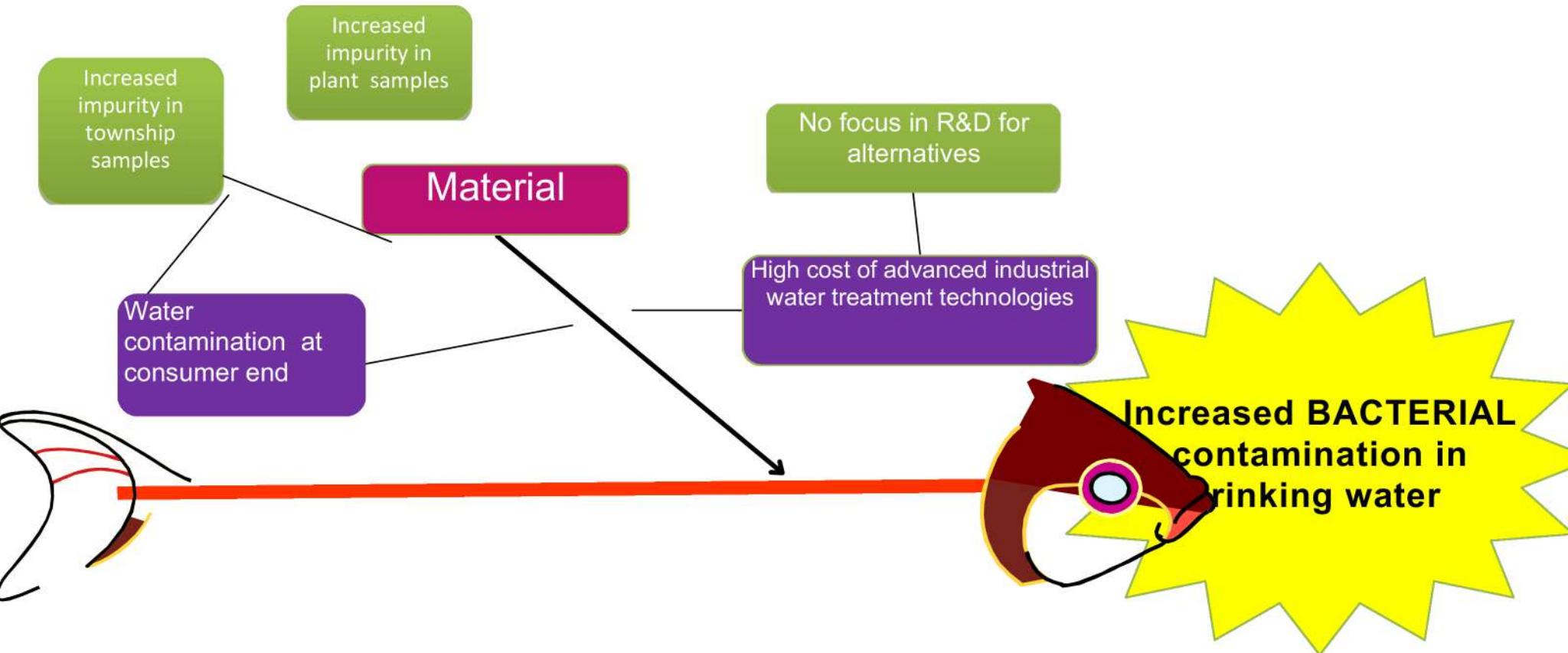


Sub-causes & Sub-Sub causes under MAN

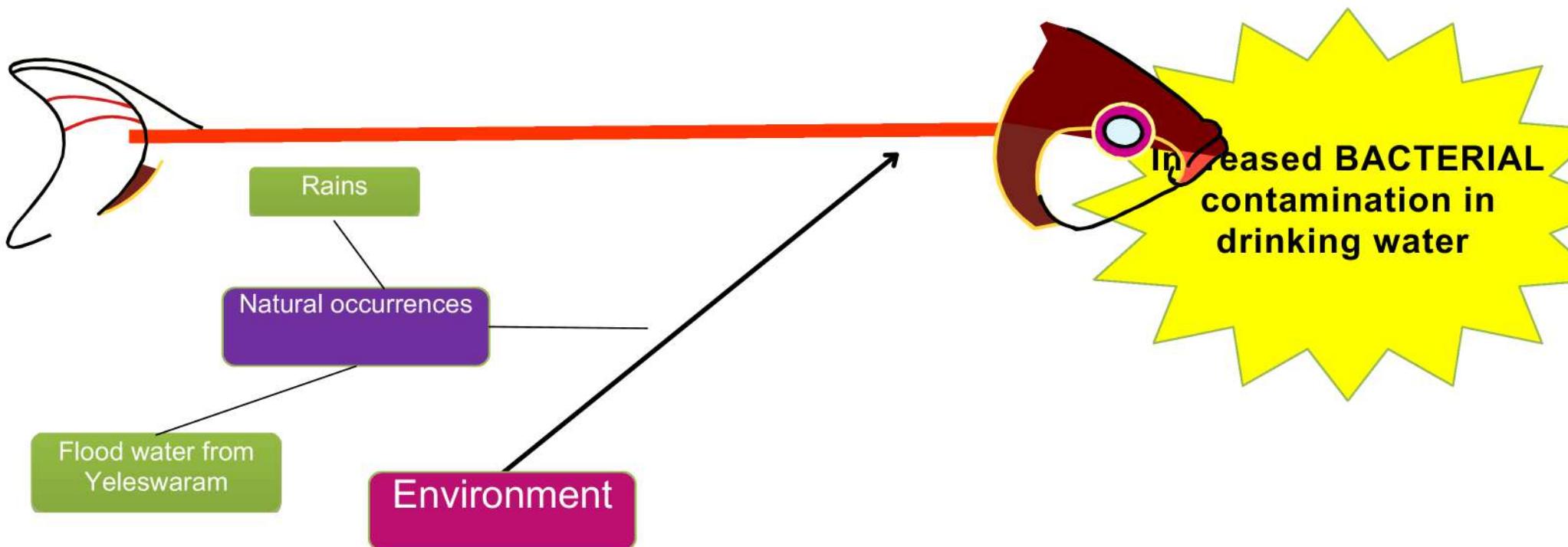




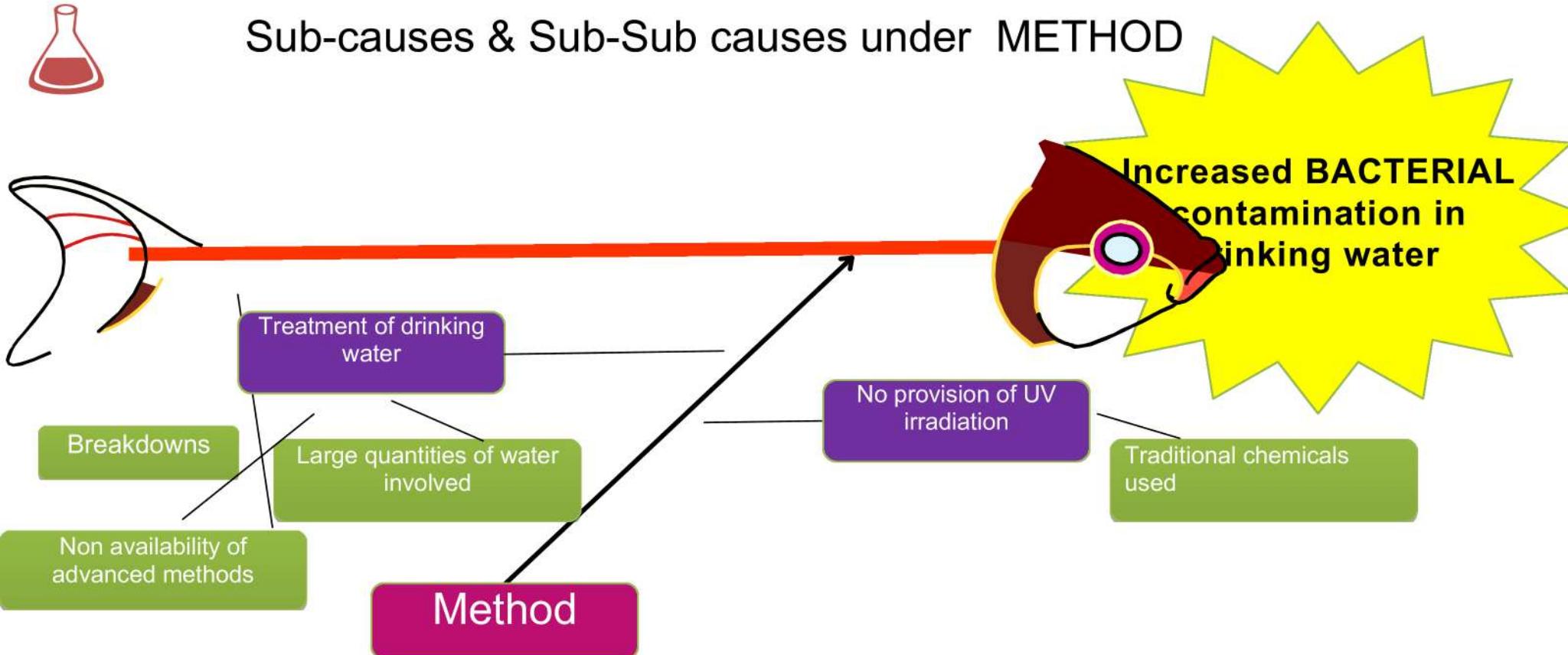
Sub-causes & Sub-Sub causes under MATERIAL

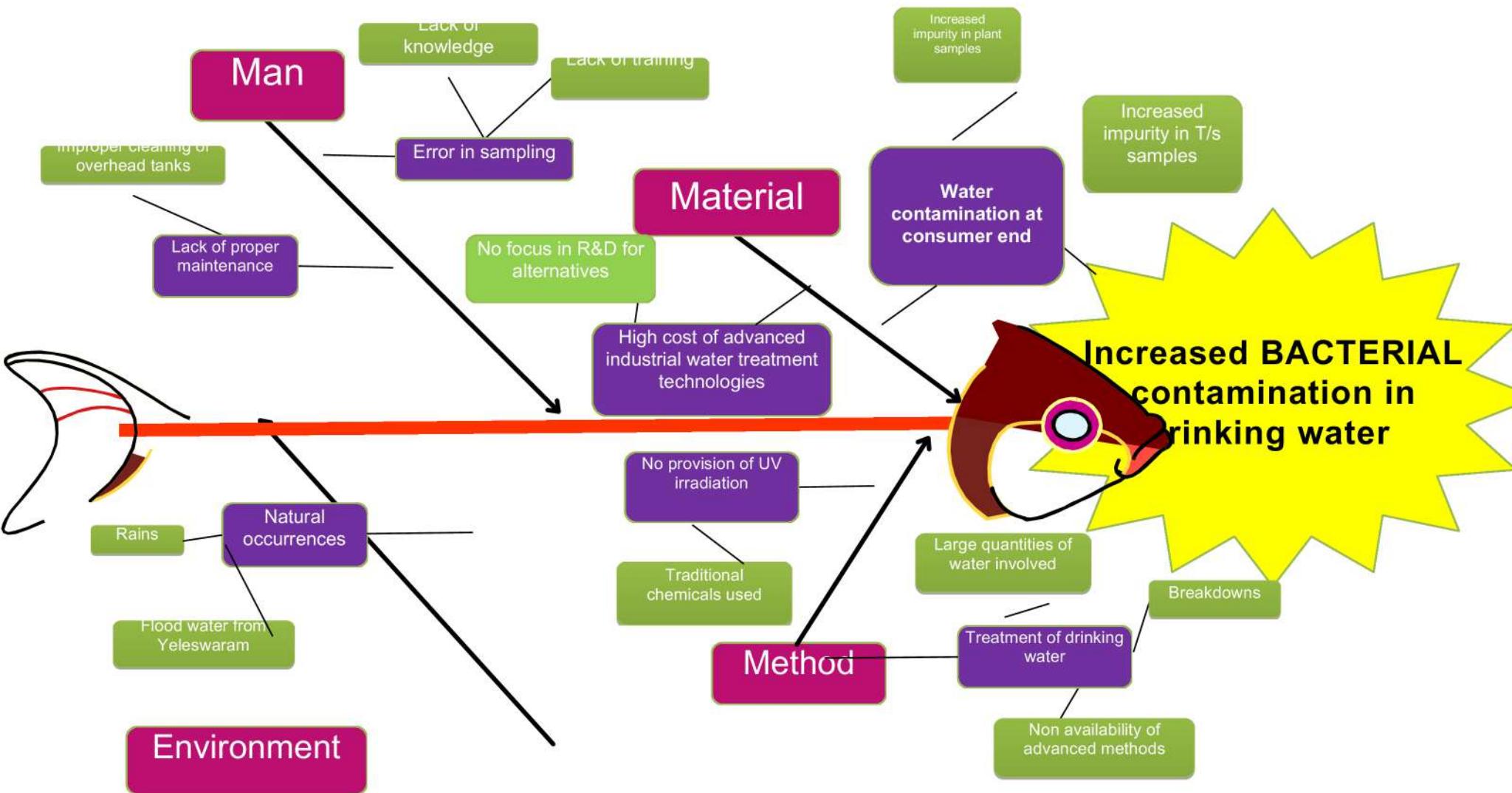


Sub-causes & Sub-Sub causes under ENVIRONMENT



Sub-causes & Sub-Sub causes under METHOD



 CONSOLIDATED CAUSE AND EFFECT DIAGRAM (FISH BONE DIAGRAM)



Assessment & Validation of causes

Root cause identification activities



Man related causes

By
Ambika & Narasimha



Environment related causes

By
Anil & Suman



Material related causes

By



Method related causes

By
Arunima

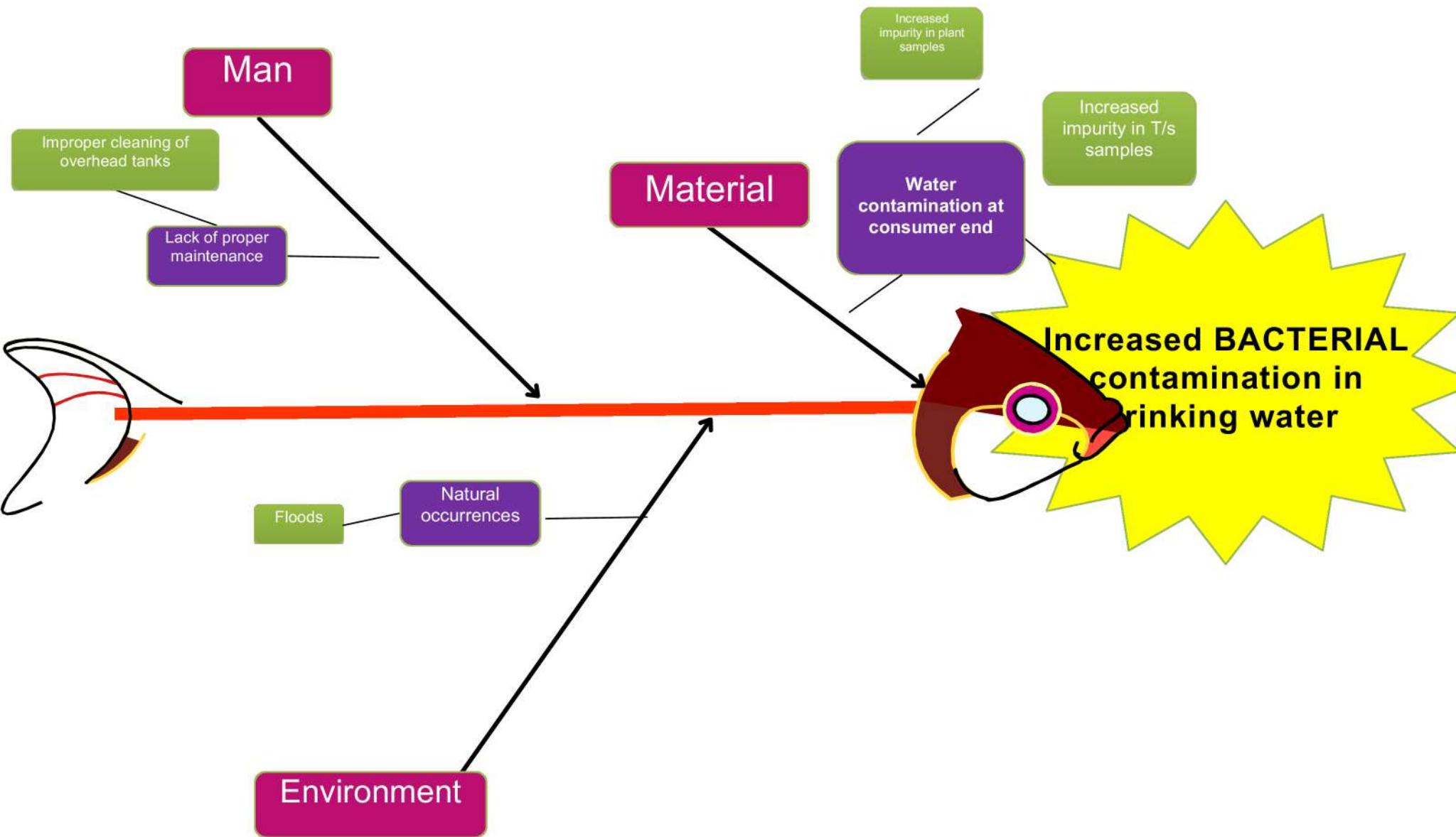


ANALYSE

Step-3

 MAN	Lack of proper maintenance	Improper cleaning of overhead tanks 	Yes
	Error in sampling	Lack of knowledge	No
		Lack of training	No
 MATERIAL	Water contamination at consumer end	Increased impurity in township samples 	Yes
		Increased impurity in plant samples 	Yes
	High cost of advanced industrial water treatment technologies	No focus in R&D for alternatives	No
 ENVIRONMENT	Natural occurrences	Rains	No
		Flood water from Yeleswaram 	Yes
 METHOD	No provision of UV irradiation	Traditional chemicals used	No
	Treatment of drinking water	Large quantities of water involved	No
		Breakdowns	No
		Non availability of advanced methods	No

VALIDATED CAUSES



DATA ANALYSIS

Tools used....



Data Collection



Data Analysis
(Graphs and diagrams)





Data of bacteria positive samples collected from register to sort out the probable causes.

	Increased impurity in township water	Increased impurity in plant water samples	Floods	Improper cleaning of overhead tanks
2014	3	0	1	0
2015	7	1	0	0
2016	20	0	1	1
2017	31	4	0	1
2018 (till march)	9	1	0	0
TOTAL	70	06	2	2

Identification of Critical Cause

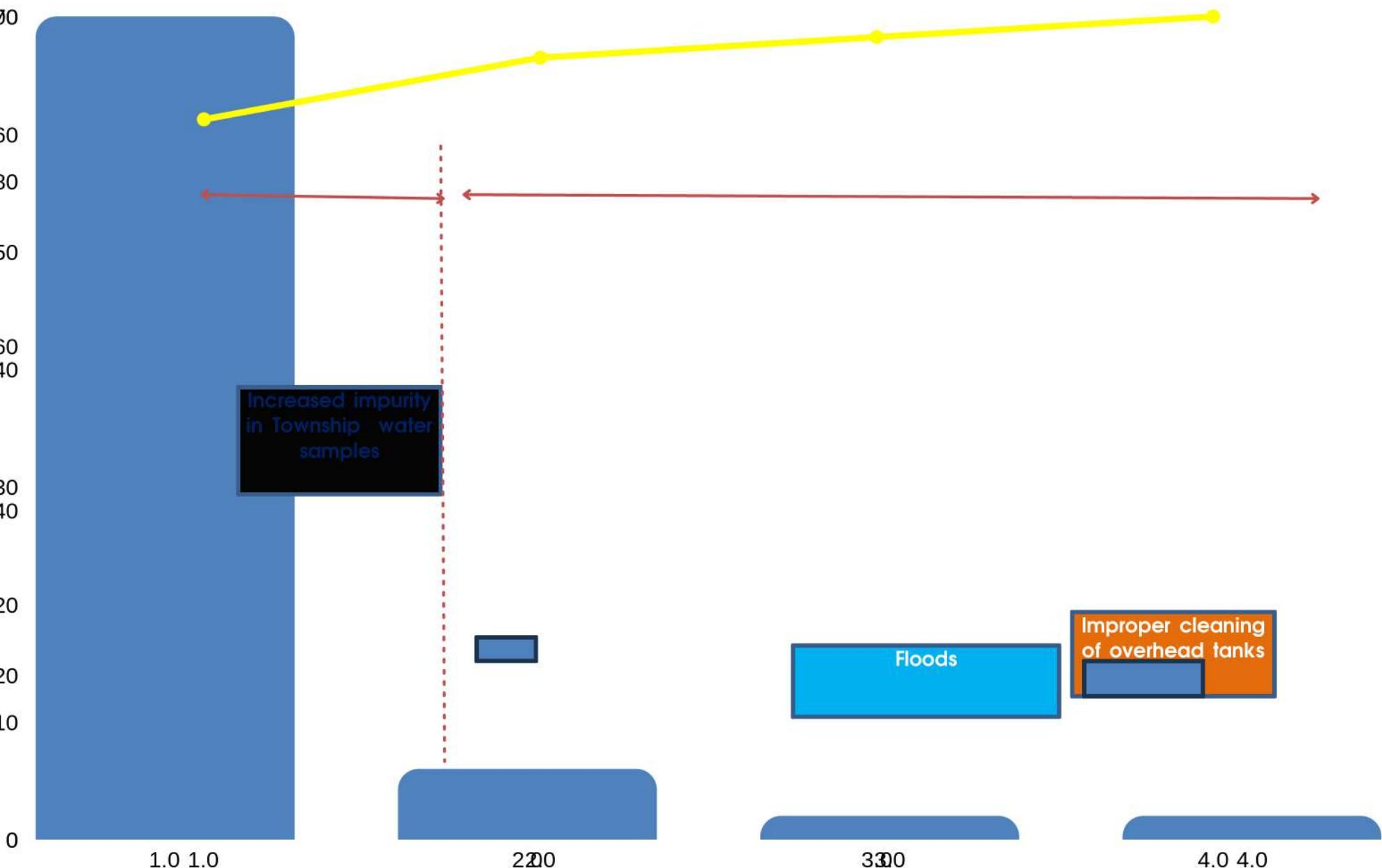


**DETAILS OF BACTERIAL CONTAMINATION IN DRINKING WATER
(PAST FIVE YEARS)**

Causes for Bacteria Positive Samples	Number of Positive samples	Percentage (%)	Cumulative (%)
• Increased impurity in water supplies	70	87.5	87.5
• Increased impurity in water supplies	6	7.5	95.0
• Floods	2	2.5	97.5
• Improper cleaning of overhead tanks	2	2.5	100
Total	80	100	

ANALYSE

Step-3



ROOT CAUSE ANALYSIS

Tools used....

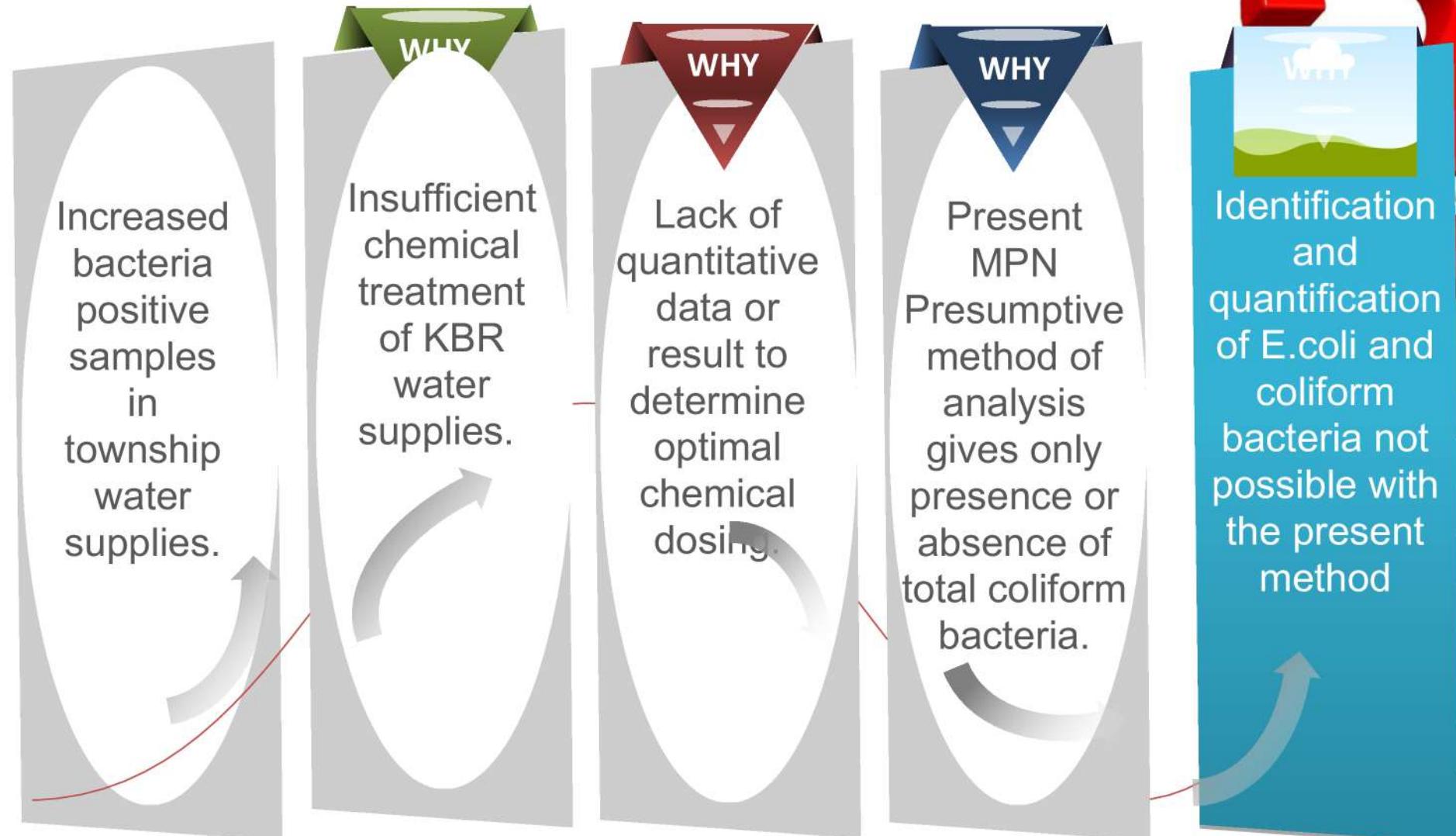


Why – Why Analysis ?





Why – Why Analysis ?



Present MPN method not suitable for quantification of bacteria

DEVELOPING THE

S
O
L
U
T
I
O
N

Tools used....



Brain storming



PDCA



Flow Charts

1

Usage of Complete
MPN method

Feasibility study

2

Usage of VRBA
plate method

3

Usage of VRBA
petrifilms method



To use complete method MPN test

Experiment 1

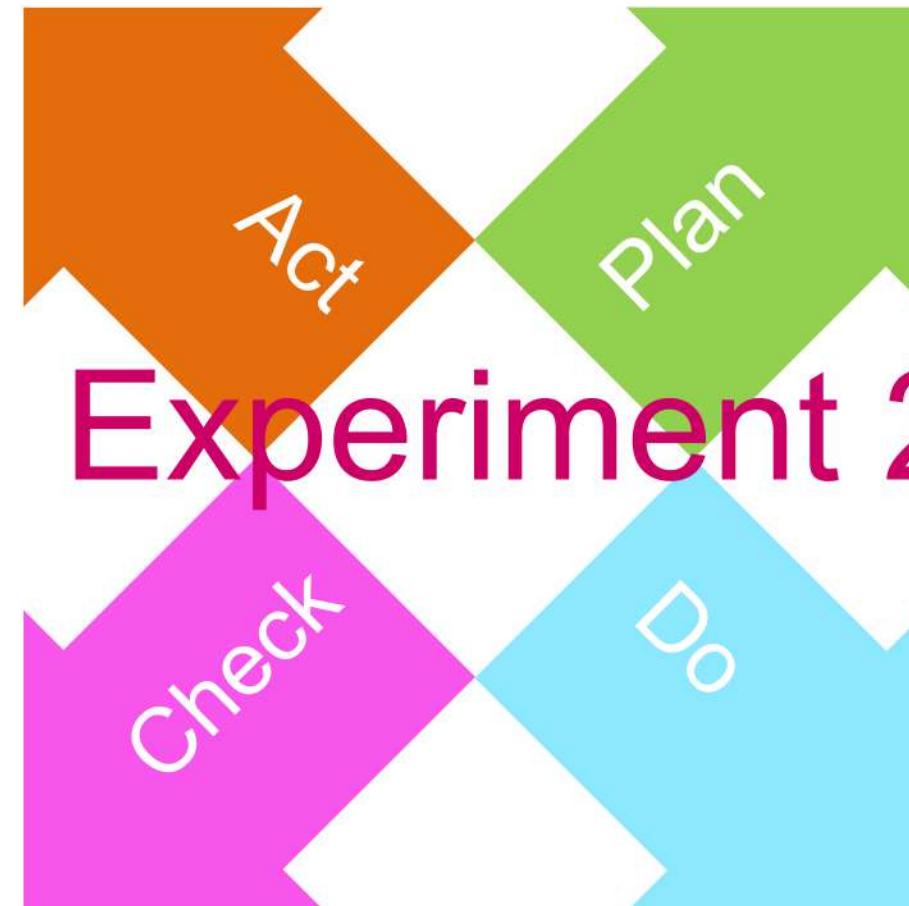
1. Checked the results after 5 days
2. It detects only **Total coliform count.**
3. But not the E.coli in specific.



1. Performed MPN tube test (15 tubes/sample)
2. EMB agar plates inoculated
3. Gram staining done



1. Checked the results after 48 hrs.
2. **Unable to differentiate E.coli and Coliforms because both are in red colours.**



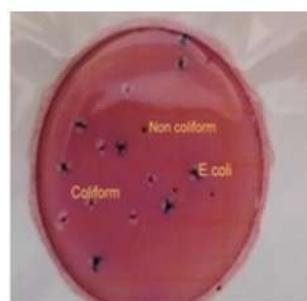
To use VRBA-Plate method (Conventional)



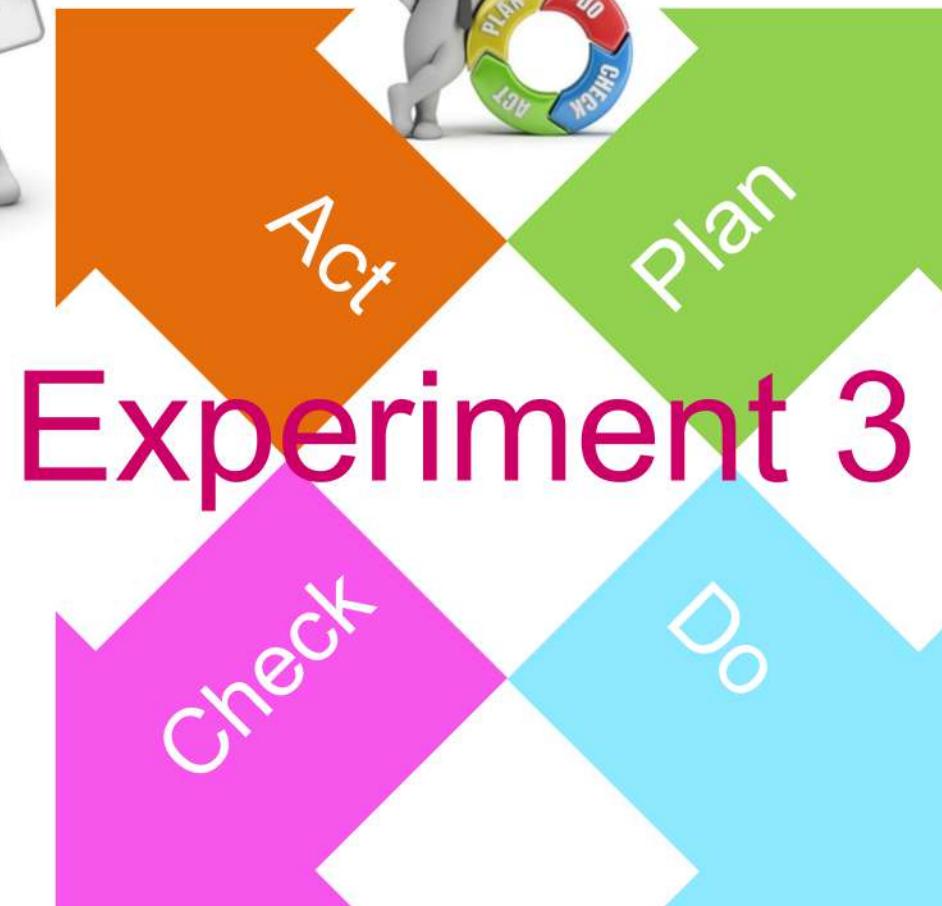
1. VRBA medium prepared and sterilized
2. Prepared VRBA Agar plates
3. Sample introduced and incubated



To use a new method
‘ VRBA-VIOLET
RED BILE AGAR
dry film’



Observed the differentiated colonies of both coliform (red) and E.coli (blue) in just 24 hrs.

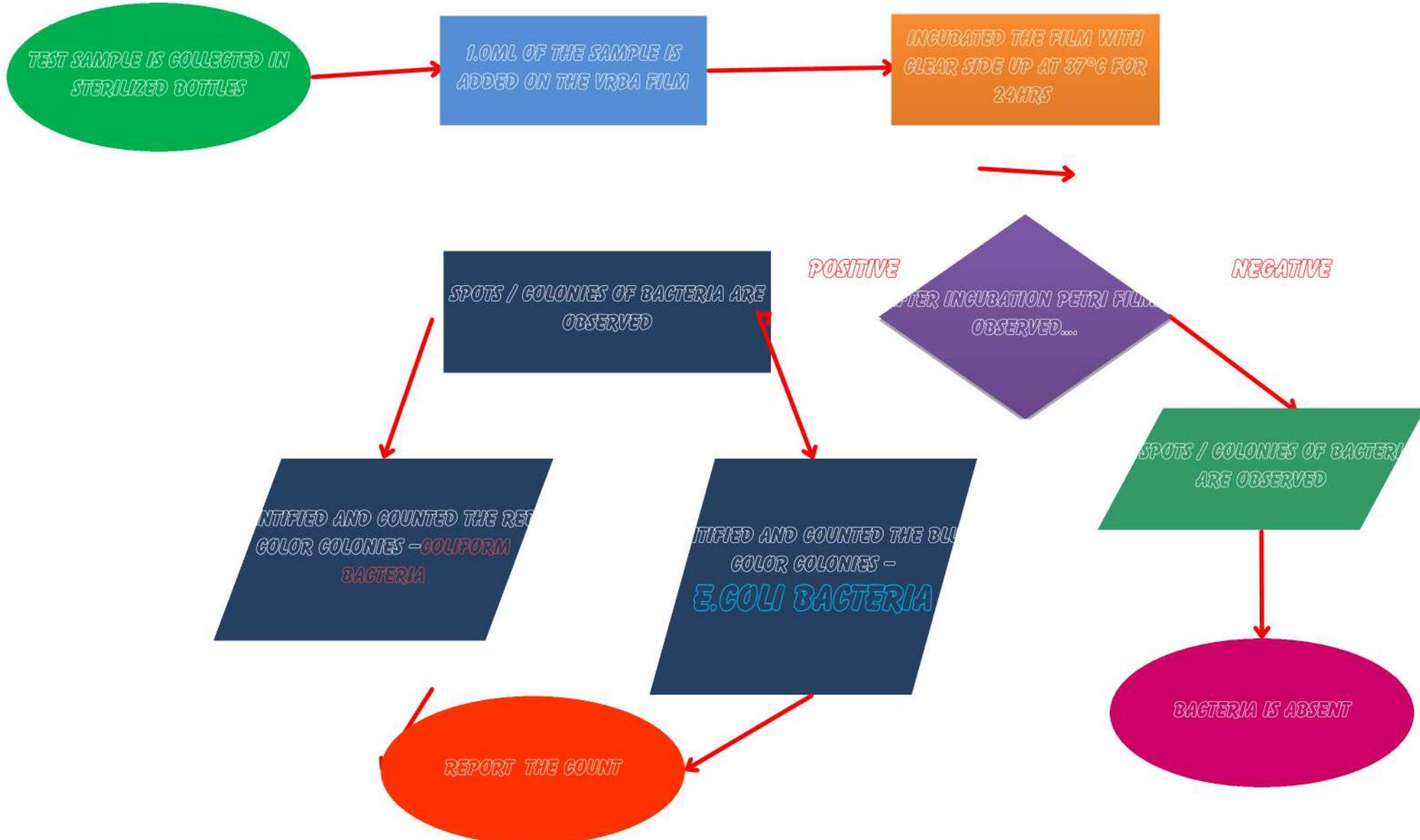


Sample inoculated on the film & ...



Flow diagram of Petrifilm Method

Step-4





Images of Petrifilms showing negative & positive results



Petrifilm without colonies



Our team decided to use a new method
“VRBA dry film (Petrifilm method)
for bacterial analysis in drinking water.



www.i

Action Plan for Implementation

Step-4

01

Activity

Getting the approval from the management

02

Activity

Collection of drinking water samples from various areas of plant

03

Activity

Collection of drinking water samples from various areas of township

04

Activity

Collection of drinking water samples from water purifiers

05

Activity

Analysis of samples using VRBA Petrifilm method

06

Activity

Identification and Quantification of bacterial colonies formed

07

Activity

Declaration of results

08

Activity

Submission of results to WMD for subsequent treatment of drinking water



Responsibility chart to plan Implementation

		Amb	a			
Getting the approval from management for acceptance and procure of petrifilms	1	P	S	S	S	
Collection of drinking water samples from various areas of plant	4	S	S	E	S	
Collection of drinking water samples from various areas of township	4	S	P	P	S	
Collection of drinking water samples from water purifiers	2	E	S	P	P	
Analysis of samples using VRBA petrifilms method	5	P	P	E	P	
Identification and quantification of bacterial colonies formed	1	P	P	S	E	
Declaration of results & preparation of reports	2	P	S	S	S	
Submission of project to BIS for approval	1	P	S	S	S	

P – PRIMARY RESPONSIBILITY,

EMERGENCY

S – SECONDARY,

E – ON



Probable resistances

Remedial actions

Show the approvals of international and national standards.



Unskilled person can also analyze

Remedial actions

Convinced the management about the technical and economical benefits of the method.



Arranged the demonstration and explained about simplicity and accuracy of the problem.



COMPARISON

MPN PRESUMPTIVE METHOD

1. No quantification
2. No Identification
3. No accuracy
4. More risk (Less Safety)
5. Costly
6. Laborious method
7. More wastage
8. Highly trained analyst is required

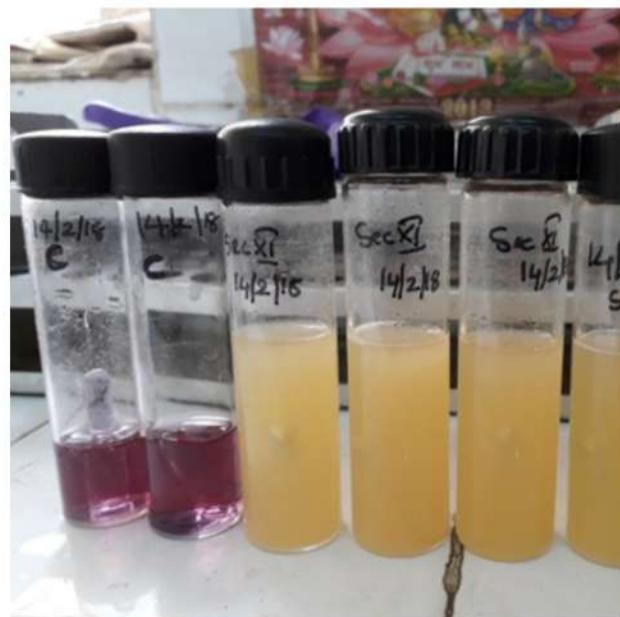
PETRIFILM VRBA METHOD

1. Better quantification
2. Clear Identification
3. More accuracy
4. More safe
5. Highly economical
6. Rapid method-1 day
7. Less wastage
8. Any unskilled person can also perform the analysis.

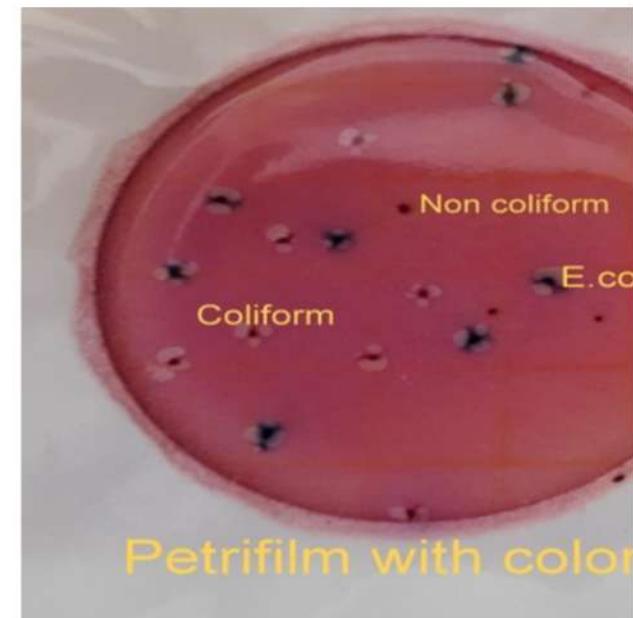


COMPARISON

MPN PRESUMPTIVE METHOD



PETRIFILM VRBA METHOD





Trial Implementation

Results of township water samples using Petrifilm method

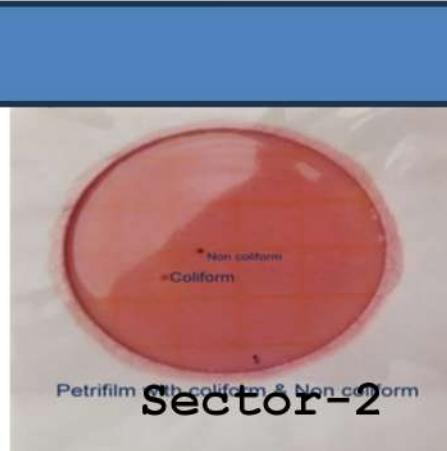
Source	<i>E. coli</i> /ml	coliform/ml
	Nil	Nil
	Nil	One (1)
	Nil	Nil
	One (1)	Nil
	Eight (8)	Seven (7)
	Thirteen (13)	Fifteen (15)
	Twenty two (22)	Thirty one (31)
	Four (4)	Nil
	One (1)	Nil





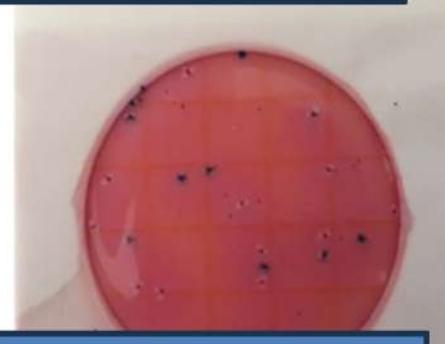
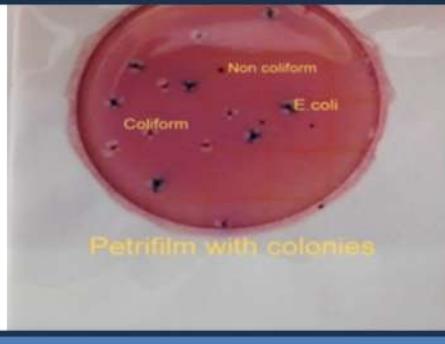
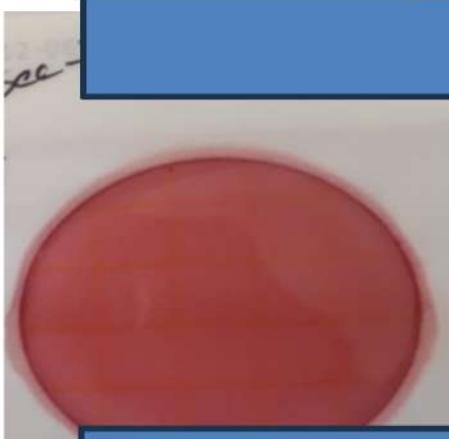
Image

water samples using Petrifilm method

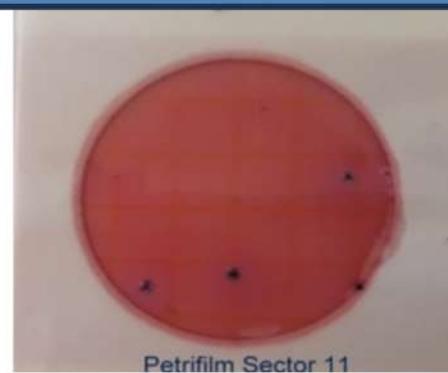
**Sector-1****Sector-2****Sector-3****Sector-4****Sector-5****Sector-6**



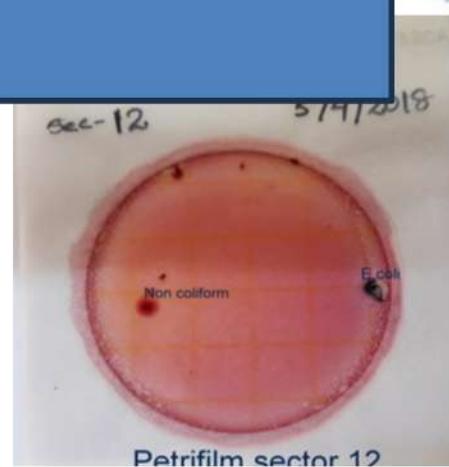
Images of water samples using Petrifilm method



Sector-10



Sector-11

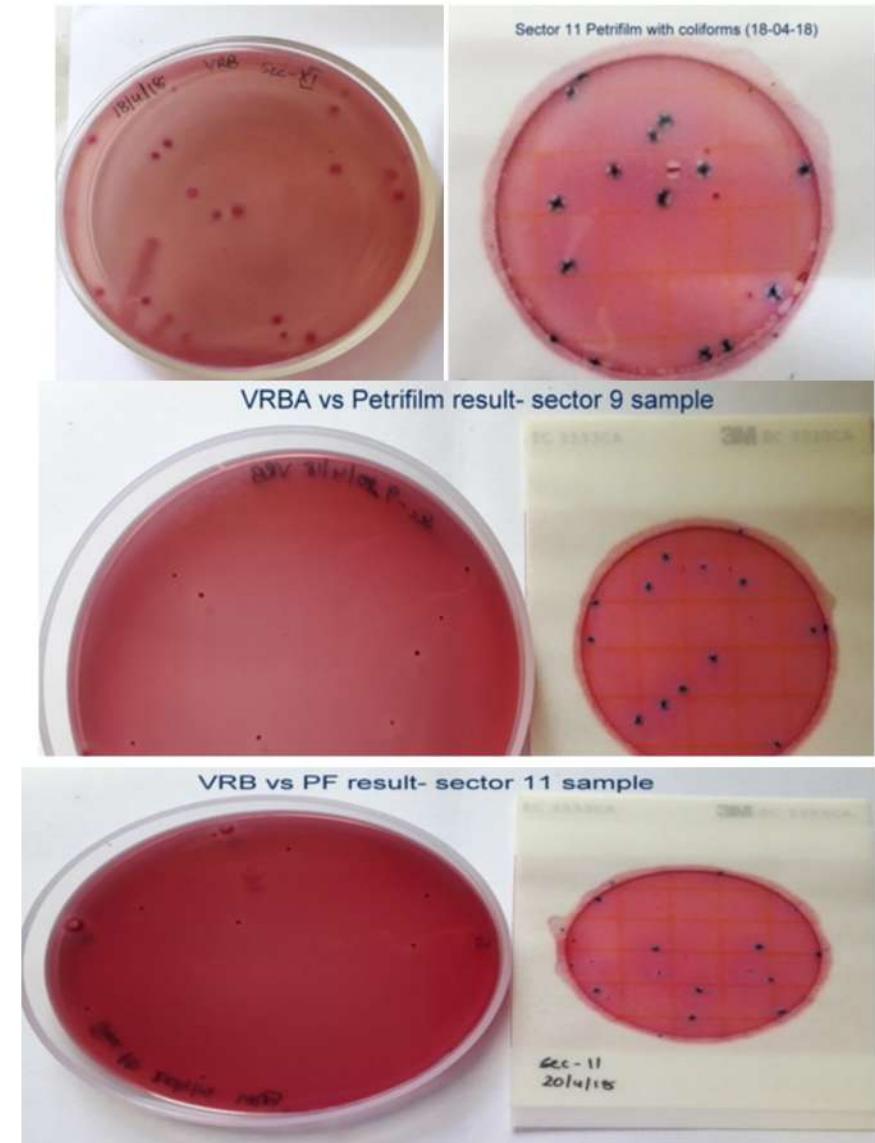
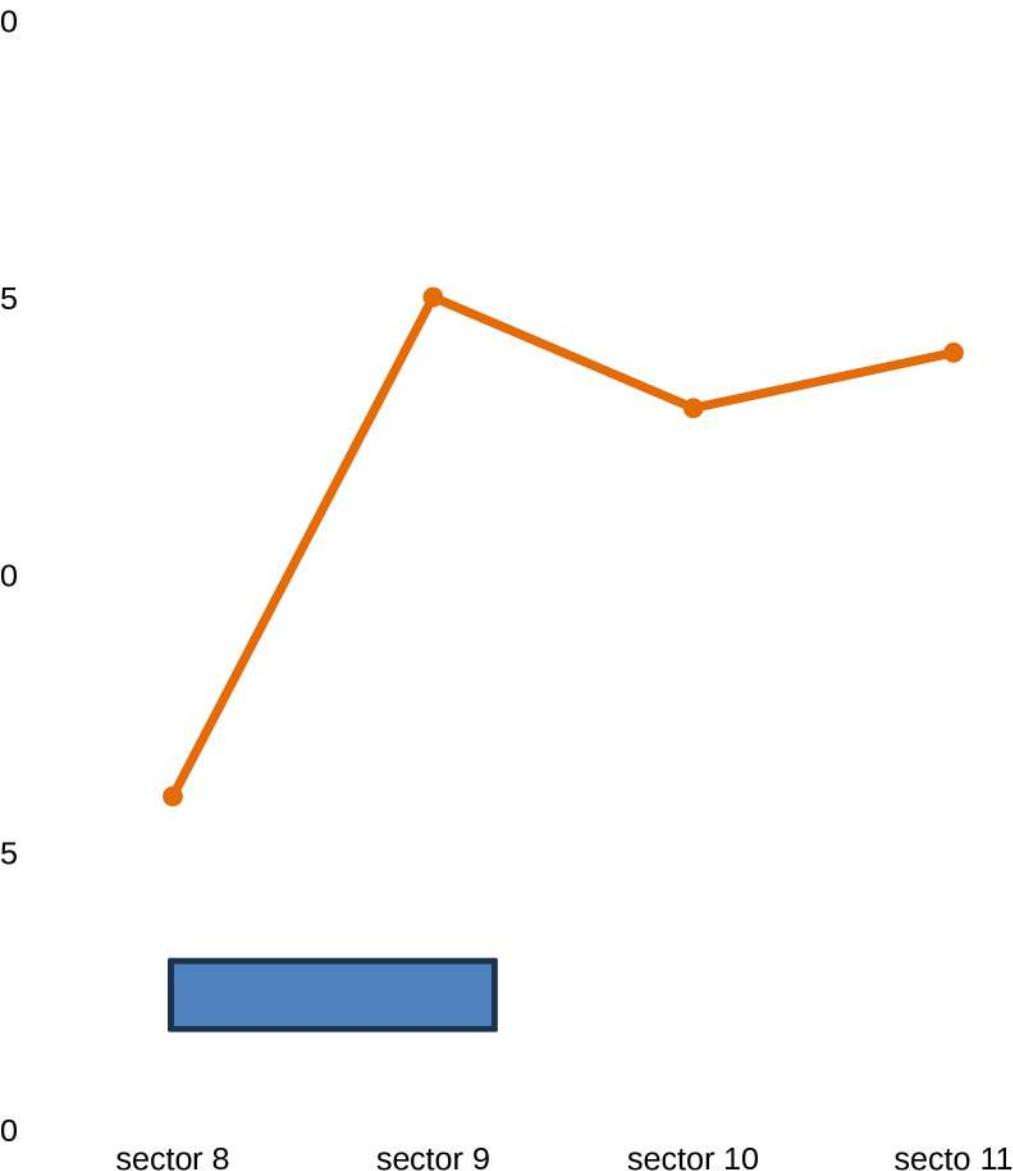


Slide No. 59





Validation of Petrifilm method with conventional method



Checking Performance



01 Ability to identify coliform bacteria in drinking water



02 Ability to identify E.coli bacteria in drinking water



03 Ability to quantify coliform bacteria in drinking water



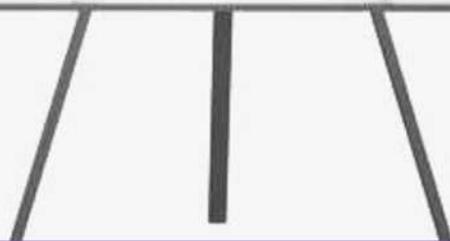
04 Ability to quantify E.coli bacteria in drinking water



05 Reliability of the new method is checked with standard



Trial Implementation Conclusion



Identified and quantified coliform and E.coli bacteria in drinking water effectively



Performance check after regular implementation



18/QATD/112

Dt: 16.03.2018

Sub: Study on bacteria in drinking water using a new method- 3M Petrifilm technique.

Recently **Dr. K Ambika Devi**, JM, QA&TD, E.No123855 has carried out a study on microbiological parameters of drinking water supplies to Township as well as to the Plant premises using a new method named **PETRIFILM TECHNIQUE** made by 3M corporation, USA. They are widely used in many microbiology-related industries and fields. A detailed study report is enclosed along with the other relevant information and documents (Annexure A).

3M Petrifilm technique is simple, fast, and an accurate microbial quantitative test with all standard approvals like APHA, US FDA, AOAC, etc. These films are meant to be more efficient method for detection and enumeration of microbial testing of drinking water samples compared to conventional plating techniques. This saves an average of 3.7 man hours per day. The method provides consistently accurate results within 24hrs with clear demarcation of E.coli and coliforms and reduces chances of human error.

This Petrifilm technique can be operated by any technical personnel without having any microbiological background. This is highly economical with each film costing approximately Rs 75/- and saves consumables used in conventional method worth around Rs.2700/- per sample analysis

Water Management Department can adopt this method for *in-situ* microbiological testing of drinking water samples with minimal infrastructure.

Any technical support (microbiological analysis) required for the thorough monitoring of the drinking water samples will be extended by QATD.

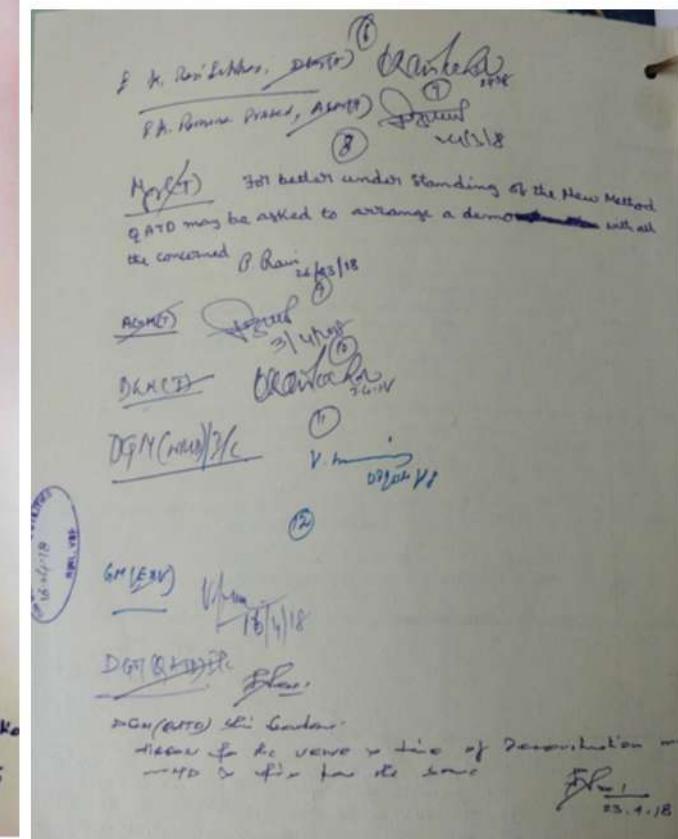
Submitted for kind perusal please

T Goutham
(T Goutham) 16/03/18
DGM (QA&TD)

DGM(QA&TD)/c

- ① A communication was sent to WMD for induction of the Petrifilm technique in the 1st week.
- ② The same to be forwarded to WMD for their views.
- ③ GM (ESU) may approach for instantaneous recognition from Dr. K. Ambika Devi, JM, QA&TD

GH (ESU) may please see and do needful.





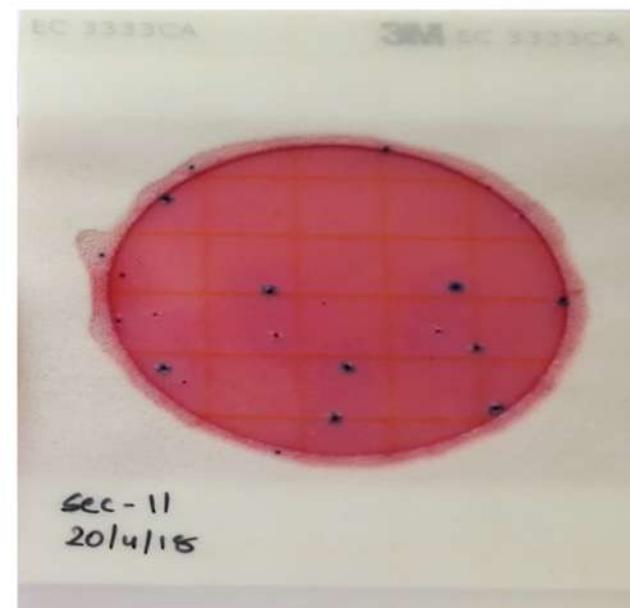
In line with the management approval we have implemented the new method for regular township samples in QATD – Microbiology lab and results were shared with WMD to take necessary action.



SAMPLE RESULTS BY PETRIFILM

APRIL 2018

18 MLD station outlet - E.coli: 1col/ml; Coliforms: 2col/ml
Sec IV OH - E.coli-4col/ml; Coliforms: 4col/ml
Sec X 420 - e tap- E.coli-15col/ml; Coliforms: 4col/ml
Sec XI OH - E.coli- 10col/ml; Coliforms: 5col/ml





Images of test report (IOM) for the samples during regular implementation

VISAKHAPATNAM STEEL PLANT
PORTABLE WATER MICROBIOLOGICAL TEST REPORT

REQUISITION FROM: KBR ZONE DATE: 16/4/18

1) Name of system & location : 18mld pump house
2) Sampling date & Time : 16-4-2018 11AM
3) Parameter to be analyzed : E.coli
4) Conditions, if any : bottles received in sealed condition &
bottles were sealed after sampling.
5) SAMPLE BOTTLE NO : LOCATION
1) 302 : 18 mld slay i cut let
2) 304 : Sec IV Tambe cut let
3) 303 : Sec XI Tamga cut let

Signature of the pump: [Redacted]





Performance check after regular implementation



SNO	Sampling Date	Source	Bacteria presence/absence	Stripping method	Signature	Remarks
767			NEGATIVE	nil	nil	
768			NEGATIVE	nil	nil	
769			NEGATIVE	nil	nil	
770			NEGATIVE	nil	nil	
771			NEGATIVE	nil	nil	
772			NEGATIVE	nil	nil	
773			NEGATIVE	nil	nil	
774			NEGATIVE	nil	nil	
775			NEGATIVE	nil	nil	
776			NEGATIVE	nil	nil	
777			NEGATIVE	nil	nil	
778			NEGATIVE	nil	nil	
779			NEGATIVE	nil	nil	
780			NEGATIVE	nil	nil	
781			NEGATIVE	nil	nil	
782			NEGATIVE	nil	nil	
783			NEGATIVE	nil	nil	
784			NEGATIVE	nil	nil	
785			NEGATIVE	nil	nil	
786			NEGATIVE	nil	nil	
787			NEGATIVE	nil	nil	
788			NEGATIVE	nil	nil	
789			NEGATIVE	nil	nil	
790			NEGATIVE	nil	nil	
791			NEGATIVE	nil	nil	
792			NEGATIVE	nil	nil	
793			NEGATIVE	nil	nil	
794			NEGATIVE	nil	nil	
795			NEGATIVE	nil	nil	
796			NEGATIVE	nil	nil	
797	12-09-18	Town admin drinking water	NEGATIVE	nil	nil	

Our goal

**“To help in reducing bacterial contamination
in
drinking water distribution system of RINL”**



Achieved



Our Objective

To Identify & Quantify Bacteria In Drinking water
Using a Rapid Technique is achieved

MAINTAINING THE



Tools used....



Check sheet



Milestone chart (After completion)



Check sheet



1	Demo to WMD department	March 2018
2	Purchase process in QATD	April 2018
3	BIS approval	April 2018
4	Purchase details shared with WMD department	June 2018
5	Follow up of implementation in WMD	July 2018
6	Follow up of BIS approval for inclusion in IS 1622	To till date



Demo given to the water management department



Our achievements

BIS submission letter

Rashtriya Ispat Nigam Limited

To (A Government of India Undertaking)

Shri V.Gopinath

Scientist 'E' & Head (Food & Agriculture)

E-mail: fad@bis.org.in

Bureau of Indian Standards,

Manak Bhawan,

Bahadur Shah Zafar Marg, New Delhi.



Dear Shri Gopinath,

Sub: Request for inclusion of Petrifilm method in the IS1622-1981 microbiological examination of drinking water.

In Visakhapatnam Steel Plant, QA&TD, Microbiology laboratory is following Standard method IS 1622-1981 for Microbiological examination of drinking water samples. Recently we came to know about the **Petrifilm** technique for Coliform and *E.coli* testing in drinking water samples. In the comparative analysis of Petrifilm technique with the conventional methods we found that the Petrifilm technique is giving equivalent results with the conventional –MPN technique and is economical and faster. This s

BIS Approval process shall take up to 3 years to include this method in standards.

This method has rec

acter microbial testing tec

comparing Petrifilm aqua p
Examination of water and
Coliforms and *E.coli* (enclose

Keeping the above i
E.coli testing in drinking wat
can be presented at BIS Food

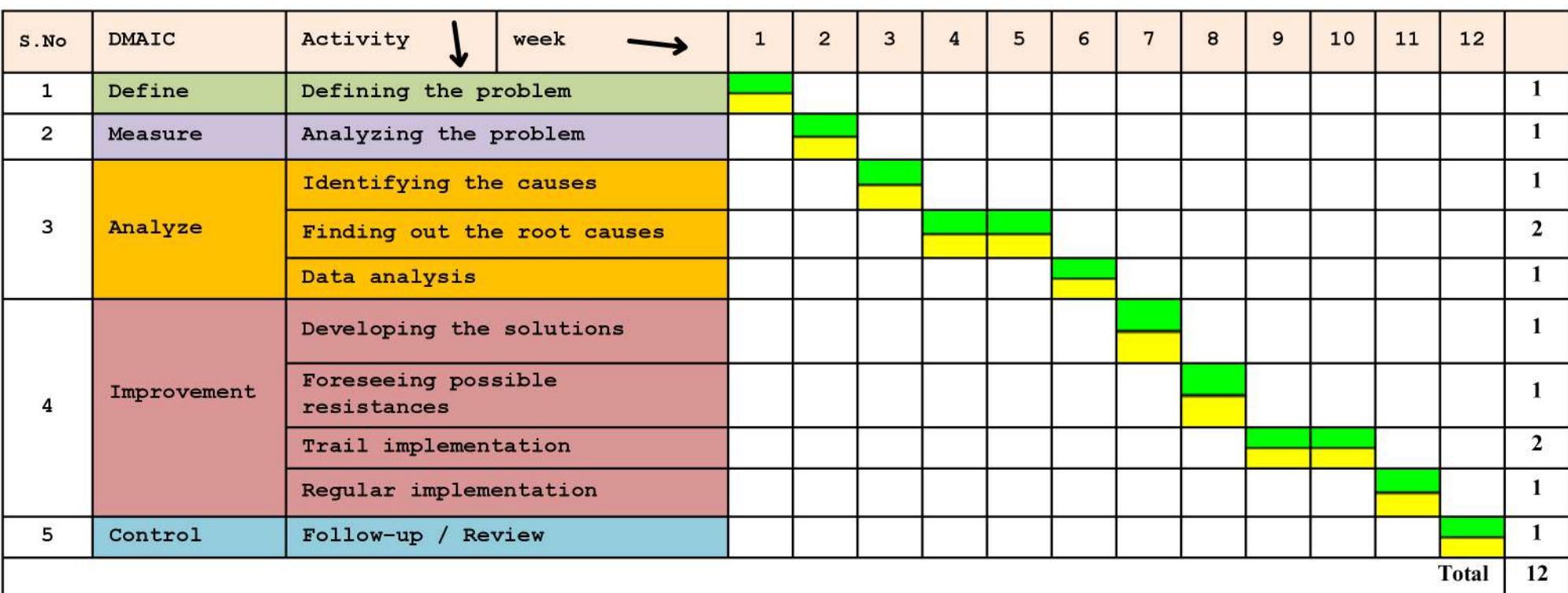


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PROJECT STUDY PLANING IS AN EFFECTIVE METHOD BY WHICH LEAN QUALITY CIRCLE MEMBERS ATTAIN THE SKILL TO PLAN THEIR ACTIVITIES WITH EFFECTIVE TIME MANAGEMENT

Quality circle Name	MEGHPUSHP	Facilitator	B.ARUNIMA	Leader	
Department	QA & TD	Members	C.SRI LAKHMA	D.SURENDRA	
LQC. No.		Reason for Selection			
Project No.	01	Date of beginning	02-02-2018	Date of completion	30-04-2018
Project		Bacterial Analysis in Drinking Water Using VRBA Dry Film Technique			



Planned

Achieved



Cost BenefitS

Old / Conventional Method	For total samples (per annum)	New / Petrifilm Method	New / Petrifilm Method	Net savings
Glassware	$2243 \times 84 = 1,88,412$	Micropipette	600	1,87,812
Chemicals	$325 \times 84 = 27,300$	Petrifilm	$75 \times 84 = 6,300$	21,000
Manpower	$3 \text{ persons} \times 5 \text{ days}$ $24 = 900000$	Manpower	$1 \text{ person} \times 2 \text{ days} \times$ $12 = 60,000$	3,90,000
Power	$2164 \times 5 \text{ days} \times 24$ $= 259680$	Power	$1000 \times 12 = 12,000$	1,17,840
Equipment	4,00,000	Equipment	10,000	3,85,000
Maintenance	50,000	Maintenance	-	-
Total Cost	18,25,392		88,900	17,36,492

Net savings per annum

→ Rs 17,36,492



Intangible Benefits

In-situ testing

Simple & readymade

Increased productivity

Greater consistency

Ease of use



Reduced chance of error

Fast & confirmed results

Longer shelf life

Equivalent to standard methods

Compact & space saving



Highlights of the new method

BEST WATER QUALITY TESTING TOOL



NO SPECIAL STORAGE REQUIRED



MORE NUMBER OF SAMPLES CAN BE ANALYSED AT ONCE



5 DAYS ANALYSIS IS REDUCED TO ONLY '1' DAY



OPTIMISED CHEMICAL DOSING



ELIMINATES CHLORINE OVER DOSING

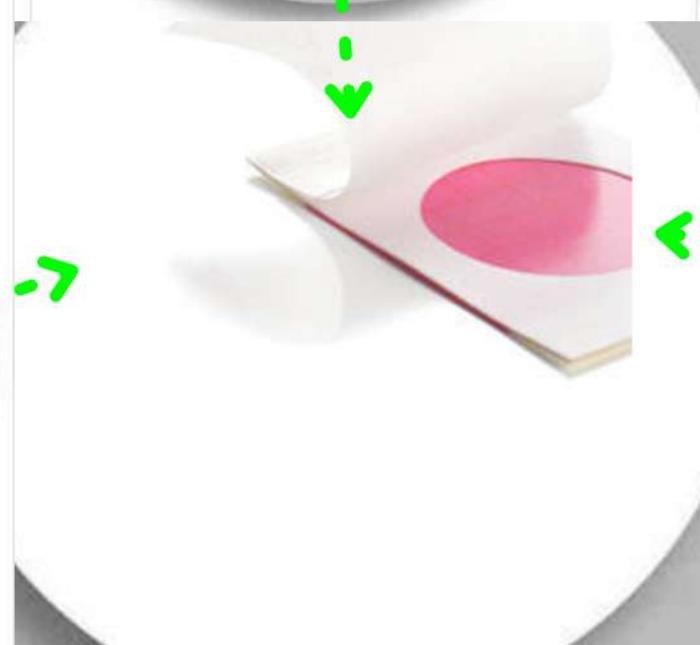
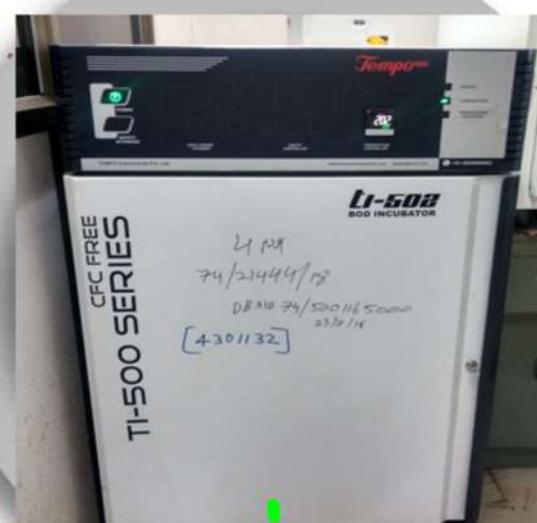


REDUCES WATER TREATMENT COST FOR WMD



CONTROL

Step-5





Esteemed users :

- “UN-HABITAT” is using this method for rapid assessment of water quality for its field studies
- At present this method is being used by **Hyderabad metro water supply board** adopted for regular drinking water
- Here are some users of this Petrifilm method:
 - ITC Ltd
 - PepsiCo holdings
 - Vijaya visakha dairy
 - Coastal corporation Ltd.
 - Marine India Ltd.
 - Vimtha Labs
 - Amway
 - Devi sea foods



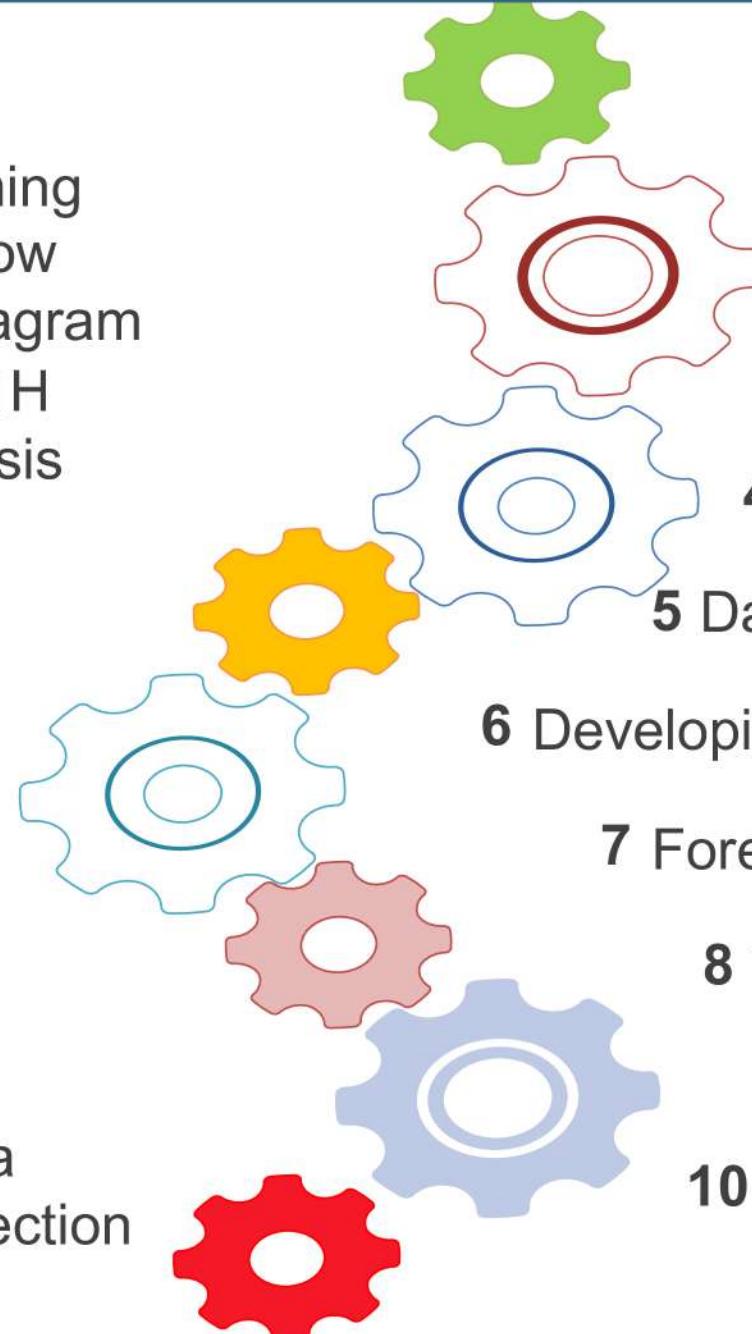
APPROVALS FOR VRBA PETRIFILM METHOD WORLDWIDE

USDA FSIS	USA	9cfr part 310.25
US FDA	USA	Chapter 4
AFNOR	France	01/8-06/01
AOAC	America (USA)	998.08
APHA	USA	9992B2(a)
AQIS	Australia	9504
HPBM, CAM	Canada	MFLP-41A
SAG	Chile	Jan-2004
IMVIMA	Colombia	2006021644
DIN	Germany	2000edition
FHM	Japan	Jul-2004
KCFR	Korea	7.8.6.3
NZFSA	New Zealand	Chapter4 section 4.8
PKN	Poland	Commission No.35



Tools & Techniques

- 1 Brain storming
- 2 Flow diagram
- 3 4W -1H analysis
- 4 C & E diagram
- 5 Pareto analysis
- 6 Why –why analysis
- 7 PDCA cycle
- 8 Check sheets
- 9 Data collection



- 1 Selecting the problem
- 2 Defining the problem
- 3 Analysing the problem
- 4 Identifying the causes
- 5 Data analysis
- 6 Developing the solution
- 7 Foreseeing probable results
- 8 Trial implementation
- 9 Regular implementation
- 10 Follow up and review

STEPS

ACKNOWLEDGEMENT

**Shri
G. Rajaraman
(HOD QATD)**

**Shri
Ruchira Gupta
(DGM COCCP QATD)**

**HOD
WMD Dept.**

**QATD
Personnel**

**Our sincere
thanks to...**

WMD Personnel

**MS Dept.
Personnel**



THANKYOU



We value your suggestions...