

# Report on Testing of Vegetable / Edible Products, Soil & Water on the Bank of River Yamuna in Delhi



**Central Pollution Control Board**

(Ministry of Environment Forest, and Climate Change)

Government of India

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## Executive Summary

The catchment area of Yamuna is highly urbanized and several drains are discharging into river directly or indirectly in the stretch of Delhi. Frequent media reports are highlighting the contamination of vegetables by metals and pesticides grown along the bank of river Yamuna in Delhi. The Monitoring Committee on River Yamuna entrusted the task of testing of vegetables, edible products, soil and water samples to CPCB along with laboratories identified by FSSAI in the flood plain of river stretch in Delhi. Accordingly, joint sampling was carried out by constituting three teams on 21.06.2019.

In the present study it was observed that the ground water quality contains heavy metals such as Mn and Fe, predominantly which may be due to anthropogenic sources in all over the 48 Km stretch of River Yamuna. Additionally, a small concentration of Al, Cr and As have also been observed at Geeta Colony and Madanpur Khadar.

The river water quality was compared with drinking water standards of BIS 10500, 2012. Metals are detected in the river water with exceedances of mainly Al, Mn, Fe, Cu & Pb.

In absence of any specified Indian standards for soil samples, it was compared with NOAA SQuIRTS, 2004, US. The metal concentration was observed in soil sample in all the segments. The predominant metals observed were Co, Fe, Ni, Cu, As, Zn, Pb, Mn whereas, Sb and Hg were also observed at Madanpur Khadar. The high concentration of the metals is attributing to the excessive use of fertilizers.

No exceedance was observed in vegetable and fodder samples for metals and pesticides with respect to FSSAI notifications, 2011 (metals) and 2018 (pesticides) as no significant level of metals were observed in ground water.

In view of the above it is concluded that the contamination of soil was observed at most of the monitoring sites which may be due to excessive use of fertilizer. However, water quality of River Yamuna depicts trace amount of metals at some locations is primarily due to industrial wastewater discharge.

Organic farming may be encouraged to reduce the hazardous effect of chemical fertilizers and pesticides in Delhi flood plain of River Yamuna.

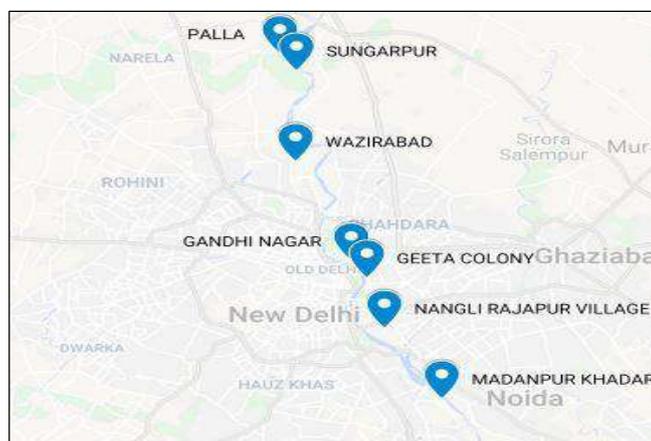
## **Follow-up action as per Minutes of the Meeting held on 09.04.2019 by Monitoring Committee on River Yamuna constituted by Hon'ble NGT in the matter of O.A. 06 of 2012 in the matter of Manoj Mishra Vs Union of India & Ors.**

### **1.0 Background**

As per minutes of the meeting held on 09/04/2019 in the office of the Monitoring committee on river Yamuna (MC) constituted by Hon'ble NGT in O.A No 06/2012 in the matter of Manoj Mishra Vs UoI, it was directed by Monitoring Committee to CPCB to test vegetables and other edible products grown on the bank of river Yamuna through laboratories identified by FSSAI in Delhi. MC also directed to analyse soil & water samples to test the presence of toxic chemicals, heavy metals and pesticides. A copy of minutes of the meeting is enclosed as **Annexure I**.

### **2.0 Scope of work**

River Yamuna flood plain in Delhi starts from Palla to downstream (d/s) Okhla, which is about 48 km stretch. This stretch can be divided into three stretches of approximately 16-17 km each as Delhi Segment I (Palla to Wazirabad), Delhi Segment II (Wazirabad to Nizamuddin Bridge) & Delhi Segment III (Nizamuddin Bridge to Okhla downstream) represented in **Figure 1**. It was decided that the selected laboratories shall also analyse samples for soil and water (River water, Ground water, Drain water) in each segment. Accordingly, three joint teams were constituted to collect samples of soil, water, vegetables and/ other edible products from the respective segment of Delhi. A schematic representation is given at **Figure 2**. Location Palla is situated at the border of Haryana and Delhi hence selected as reference location to understand the presence of metals and pesticides and compared to the Delhi stretch of River Yamuna flood plain.



**Figure1: River Yamuna flood plain stretch in Delhi from Palla to Okhla d/s.**

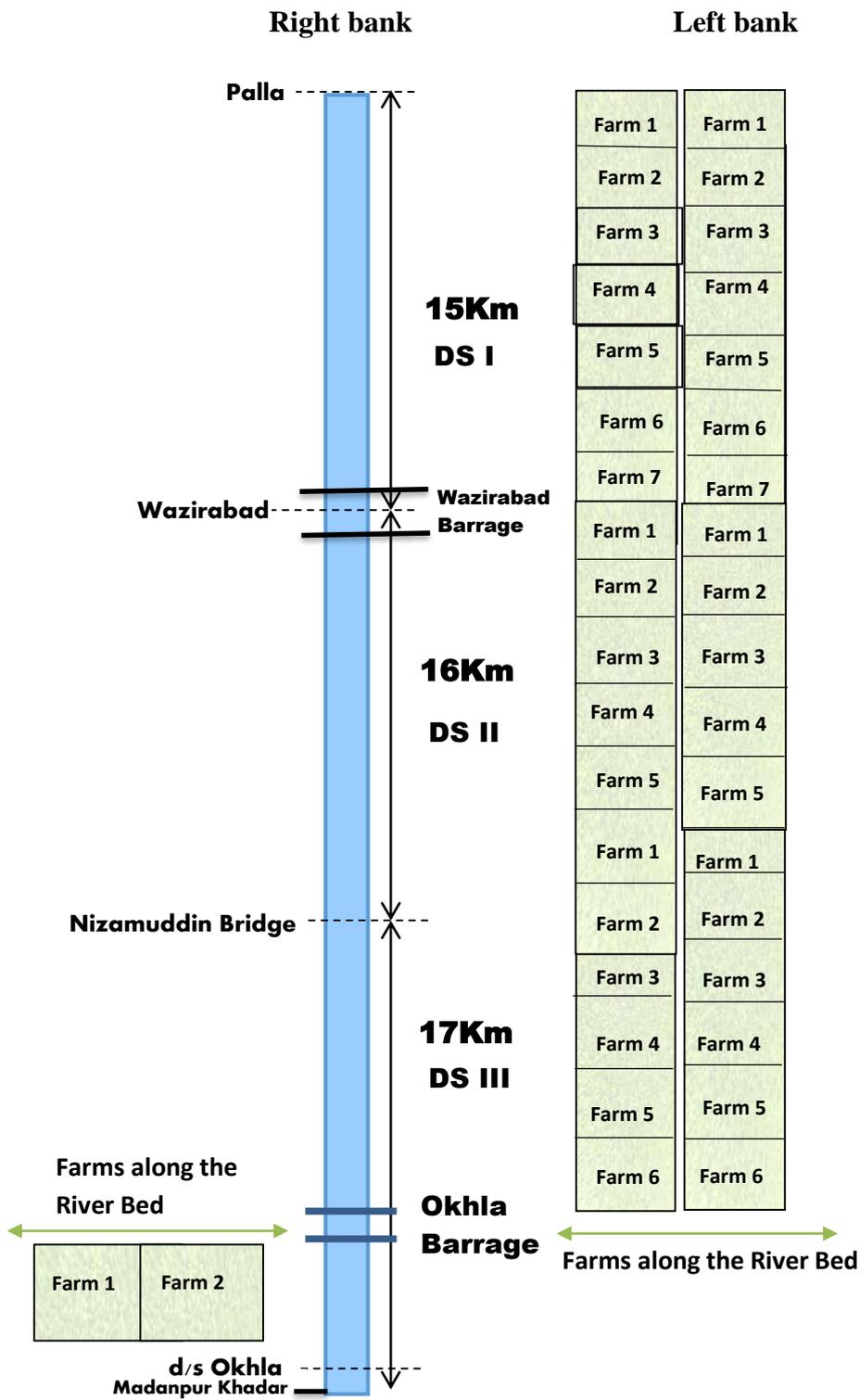


Figure 2: Line diagram of 48 km stretch of river Yamuna flood plains in Delhi.

### 3.0 Review of literature

Growing fruits and vegetables along the river is a common agriculture practice. The river passing through urban area is often contaminated with heavy metals. High concentration of heavy metals has been reported in vegetable growing with long term irrigation of treated and untreated wastewater [1]. Moreover, other anthropogenic sources such as manure, sewage sludge and fertilizers also enhance the heavy metal concentration in soil [2].

In another study, it was observed that the metal pollution index (concentration of metals) was highest for leafy vegetables followed by tuberous vegetable and compared to fruiting vegetable. Moreover, the metal uptake trend followed in all vegetable was Iron > Cobalt > Copper > Cadmium > Lead [3].

Report of Toxic Link an NGO indicated the survey carried out by IARI during 2001 to 2003 on fresh vegetables samples grown to examine the heavy metal contamination. The highest uptake of heavy metals such as Lead and Zinc up to 72 % and 21 % was observed [4].

The level of absorption not only depends on heavy metal but also on the species, cultivation method & time, chemical constituent, pH of soil, bio availability of metal, concentration in soil, availability of metal in free or complex form and other environmental conditions [1,3]. Mainly the heavy metal is absorbed by the plant roots and transported to the edible part. Various factors affect the assimilation of metals hence, even the presence of high metals ions in soil/water cannot be accumulated in edible parts of vegetables and fruits such as Lead is not easily absorbing by many plants. However, if plant roots absorb also it is not transported to edible parts. As an exception Indian mustard and spinach are known for their phytoremediation property and can take up lead in their leaves.

### 4.0 Methodology

Vegetables are mainly grown on the left bank of river Yamuna in Delhi. The three segments of Delhi were assigned to three joint teams comprising of CPCB officials and laboratories identified by FSSAI. Random samples of each matrix (soil, vegetables and other edible products, groundwater/river water/drain water used to grow vegetables) were collected and handed over to the respective laboratories as presented in **Table 1**. The sample collection and analysis was jointly performed by three teams including NABL accredited laboratories identified by FSSAI as NCML, ARBRO and FARE. The analysis of samples was done by respective laboratories.

**Table 1. Three segments of Delhi locations, sample matrix and the laboratories for sample analysis.**

S. no.	Segments	Locations	Samples	Sample Code	Laboratories involved in analysis			
1.	Delhi segment I	Palla (reference point)	Ground water	DS I GW-01	NCML laboratory			
			River water	DS I RW-01				
			Soil	DS I Soil-01				
			Zucchini	DS I VY 01/1				
			Lobia	DS I VY 01/2				
			Okra	DS I VY 01/3				
			Spinach	DS I VY 01/4				
		Sungarpur burning ghat	Ground water	DS I GW-02				
			River water	DS I RW-02				
			Soil	DS I Soil -02				
			Tomato	DS I VY 02/1				
			Okra	DS I VY 02/2				
			Brinjal	DS I VY 02/3				
		Wazirabad	Loki	DS I VY 02/4				
			Ground water	DS I GW-03				
			River water	DS I RW-03				
			Soil	DS I Soil-03				
			Loki	DS I VY 03/1				
2.	Delhi segment II	Geeta colony	Ground water	DS II GW 01	ARBRO laboratory			
			River water	DS II RW 01				
			Soil	DS II Soil 01				
			Brinjal	DS II VY 01				
			Spinach	DS II VY 01				
			Lady's finger	DS II VY 01				
		Kailash nagar drain	Drain water	DS II WW 01				
		Ramesh nagar/Gandhi nagar	Ground water	DS II GW 02				
			River water	DS II RW 02				
			Pumpkin	DS II VY 02				
			Stem amaranth	DS II VY 02				
			Ridge gourd	DS II VY 02				
		3.	Delhi segment III	Nangli Rajapur village		Ground water	DS III GW 01	FARE laboratory
						River water	DS III RW 01	
						Soil	DS III Soil 01	
						Lady's finger	DS III VY 01	
Sponge gourd	DS III VY 02							
Spinach	DS III VY 03							
Bottle gourd	DS III VY 06							
Jwar	DS III F-01							
Abu fazal drain	Drain water			DS III WW 01				
Madanpur Khadar village	Ground water			DS III GW 02				
	River water			DS III RW 02				
	Brinjal			DS III VY 04				
	Chilli			DS III VY 05				

**4.1 Sampling site:** Samples were collected in the stretch of Delhi from Palla to Okhla downstream (d/s) upto Madanpur Khadar in each segment of 15 Km (Palla to Wazirabad), 16 Km (Wazirabad to Nizamuddin bridge) and 17 Km (Nizamuddin bridge to Okhla downstream upto Madanpur Khadar).

**4.2 Sample collection:** The samples have been collected for water, soil, vegetables and fodder depicted in **Figure 3**. Location at Palla was selected as reference location (Segment I). The water sample have been collected for ground water (GW), river water (RW), and drain water (WW). The volume of 1 liter has been taken for each water sample. Moreover, soil sample has been collected as 1 kilogram (kg) from the sampling site by compositing from various corners of the same field or combining two fields. Similarly, each vegetable has been collected for 1 kg after composite sampling. Water Samples for metals were preserved in Nitric acid and for pesticides preservation was done in Ice.



**Figure 3. Sampling location and the samples collected by teams, Team I (Segment I), Team II (Segment II) and team III (Segment III).**

**4.3 Monitoring methodology:** Sampling was carried out in all the segments in Delhi on 21.06.2019. Number of samples collected by each team in segment I, II, III is given in **Table 2**. A format prepared by CPCB was also filled to obtained the detailed information on sample matrix, sample location, sample volume, sample coding and

parameters to be analysed, photographs, latitude and longitude etc. is given at **Annexure II**.

**Table 2. Total no. of samples collected by teams in three segments of river Yamuna flood plain in Delhi**

Segments	Sampling locations	Total samples collected	Sample matrix					
			Ground Water	River water	Drain water	Soil	Vegetables	Fodder
DS I	Palla to Wazirabad	19	3	3	0	3	10	-
DS II	Wazirabad to Nizamuddin Bridge	12	2	2	1	1	6	-
DS III	Nizamuddin Bridge to Okhla downstream	14	2	2	1	2	6	1
<b>Total</b>		<b>45</b>	<b>7</b>	<b>7</b>	<b>2</b>	<b>6</b>	<b>22</b>	<b>1</b>

**4.4 Sample analysis:** Sample analysis was done by FSSAI identified laboratories (NCML, ARBRO and FARE) following the standard protocol for analysis of metals and pesticides in water, soil, vegetables and other edible products. The list of parameters for analysis of metals (15 nos.) & pesticides (33 nos.) is tabulated in **Table 3**.

**Table 3: Parameters tested for metals and pesticides in each sample matrix**

S. no.	Parameters to be monitored for Vegetables, Soil, Water & Wastewater
1.	<b>Metals (15 Nos )</b> Al, Cr (Total), Mn, Fe, Co, Cu, Zn, Se, As, Cd, Sb, Hg, Pb, Ni, Sn
2.	<b>Pesticides (33 Nos)</b> a. Organochlorine Pesticides: $\alpha$ -HCH, $\beta$ -HCH, $\gamma$ -HCH, $\delta$ -HCH, Endosulfan-I, Endosulfan-II, Endosulfan sulfate, Dicofol, p,p'-DDE, p,p'-DDD p,p'-DDT, ALdrin, Dieldrin, Heptachlor. b. Organo-phosphorous pesticides: Chloropyriphos, Dimethoate, Ethion, Malathion, Methylparathion, Phorate, Phosphamidon, Quinolphos, Profenophos. c. Synthetic Pyrethroids: $\alpha$ -Cypermethrin, Deltamethrin, Fenpropethrin, Fenvalerate, $\lambda$ -Cyhalothrin, $\beta$ -Cyfluthrins d. Herbicides: Pendimethalin, Alachlor, Butachlor, Fluchloralin

#### 4.5 Legal framework

- The river water sample has been compared with drinking water standards of BIS 10500 for both metals and pesticides.
- The ground water samples were compared with the drinking water standards of BIS 10500 for both metals and pesticides. However, some of metals and pesticides standards are not available.
- Drain water samples have been compared with Schedule VI of General Discharge Standards notified under Environment (Protection) Rules, 1986.
- Comparison of soil samples was done with NOAA SQuiRT, US standards for both metal and pesticides.
- Analysis results for vegetables were compared with FSSAI notifications for both metals and pesticides. However, it is difficult to consolidate & draw conclusion, due to a specific limit for each metal/pesticide for particular vegetables and all the metals and pesticides standards were not available for the samples tested.
- Details of standards for comparison of results have been presented in **Annexure III**.



## 5.0 Analytical results

The comparative analysis of metals with the standards for each matrix of samples available have been represented in the **Table 4** such as A: Ground water (GW), B: River water (RW), C: Drain water (WW), D: Soil and E: Vegetables in all the three segments.

**Table 4: The comparative analysis of sample matrix**

### A: Ground water sample results

Segments	Samples	Aluminium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Arsenic	Selenium	Cadmium	Antimony	Tin	Mercury	Lead
	BIS 10500, 2012	0.03	0.05	0.1	0.3	-	0.02	0.05	5	0.01	0.01	0.003	-	-	0.001	0.01
Segment I	DS I GW -01	0.027	0.001	0.284	0.257	BDL	0.001	0.003	0.008	0.006	BDL	BDL	BDL	BDL	BDL	0.001
	DS I GW -02	BDL	BDL	0.494	0.019	BDL	BDL	0.001	0.005	0.009	BDL	BDL	BDL	BDL	BDL	BDL
	DS I GW -03	0.007	0.001	1.156	1.325	BDL	0.001	0.002	0.015	0.020	BDL	BDL	BDL	BDL	BDL	BDL
Segment II	DS II GW -01	0.006	BDL	0.523	3.837	BDL	BDL	BDL	0.045	0.023	BDL	BDL	BDL	BDL	BDL	BDL
	DS II GW -02	0.158	-	0.776	6.484	BDL	BDL	BDL	0.051	0.052	BDL	BDL	BDL	BDL	BDL	BDL
Segment III	DS III GW -01	0.024	0.012	1.063	2.488	BDL	0.002	BDL	0.027	0.032	BDL	BDL	BDL	BDL	BDL	0.002
	DS III GW -02	0.036	0.139	1.048	0.633	BDL	0.004	0.021	0.020	0.005	0.002	BDL	BDL	BDL	BDL	0.004

\*Standards for Cobalt, Antimony and Tin were unavailable in drinking water standards of BIS 10500.



## B: River water sample results

Segments	Samples	Aluminium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Arsenic	Selenium	Cadmium	Antimony	Tin	Mercury	Lead
	BIS 10500, 2012	0.03	0.05	0.1	0.3	-	0.02	0.05	5	0.01	0.01	0.003	-	-	0.001	0.01
Segment I	DS I RW -01	5.880	0.015	0.104	5.861	0.002	0.009	0.326	0.139	0.007	0.002	0.001	0.005	0.007	BDL	0.019
	DS I RW -02	1.848	0.007	0.048	2.234	0.001	0.005	0.256	0.139	0.005	0.001	0.001	0.004	0.007	BDL	0.015
	DS I RW -03	1.496	0.008	0.050	2.335	0.001	0.005	0.264	0.213	0.005	0.001	0.001	0.006	0.004	BDL	0.014
Segment II	DS II RW -01	0.306	0.168	0.165	0.603	BDL	0.012	BDL	0.034	0.002	BDL	BDL	0.010	BDL	BDL	0.003
	DS II RW -02	0.153	-	0.180	0.520	BDL	0.013	0.010	0.030	0.003	BDL	BDL	BDL	BDL	BDL	0.002
Segment III	DS III RW -01	0.097	0.015	0.222	0.338	BDL	0.015	0.020	0.042	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	DS III RW -02	0.160	0.020	0.266	0.633	BDL	0.012	0.028	0.049	0.007	BDL	BDL	BDL	BDL	BDL	BDL

\*River water samples were compared with the drinking water standards of BIS 10500 and standard was unavailable for Cobalt, Antimony and Tin.

## C: Drain water sample results

Segments	Samples	Aluminium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Arsenic	Selenium	Cadmium	Antimony	Tin	Mercury	Lead
	GSD, EP rules 1986	-	0.1	2	3	-	3	3	5	0.2	0.05	2	-	-	0.01	0.1
Segment II	DS II WW -01	0.009	BDL	0.284	0.094	BDL	BDL	BDL	BDL	0.014	BDL	BDL	BDL	BDL	BDL	BDL
Segment III	DS III WW -01	0.173	0.013	0.533	0.346	BDL	0.009	0.028	0.068	0.008	0.002	BDL	BDL	BDL	BDL	0.004

\*Drain water samples were compared with General Discharge Standards notified under schedule VI of Environment (Protection), Rules 1986. However, standards for Aluminium, Cobalt, antimony and Tin were unavailable.



### D: Soil sample results

Segments	Samples	Aluminium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Arsenic	Selenium	Cadmium	Antimony	Tin	Mercury	Lead
	NOAA SQuiRT, 2004	47000	37	330	18000	6.7	13	17	48	5.2	0.26	-	0.48	0.89	0.058	16
Segment I	DS I Soil I	9634.968	19.365	414.307	20249.638	9.609	21.212	25.484	94.537	5.913	BDL	0.665	BDL	BDL	BDL	16.187
	DS II soil II	7262.758	15.971	276.048	15609.883	7.151	13.745	18.100	50.623	5.164	BDL	BDL	BDL	0.077	BDL	9.773
	DS I Soil III	10885.608	20.436	435.839	22705.022	10.179	21.453	37.099	83.398	7.203	BDL	0.861	0.303	BDL	BDL	20.437
Segment II	DS II Soil I	4262.322	23.257	6.831	7818.292	3.475	9.370	26.756	86.187	BDL	0.126	BDL	BDL	0.257	BDL	16.101
Segment III	DS III Soil I	6758.761	23.340	441.722	15644.503	12.699	27.263	34.007	77.283	4.780	1.153	0.180	0.082	BDL	BDL	14.400
	DS III Soil II	4073.736	12.000	321.953	9787.152	10.590	20.683	24.910	55.070	6.000	2.230	1.311	0.955	BDL	0.210	19.820

\*Soil samples were compared with National Oceanic Atmospheric Administration, Screening Quick Reference Table (NOAA SQuiRT), US, 2004 and for Cadmium standard is not available.



## E: Vegetable sample results

Segments	Vegetables Name	Matrix	Aluminium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Arsenic	Selenium	Cadmium	Tin	Antimony	Mercury	Lead
		FSSAI	-	-	-	-	-	-	-	30	50	1.1	-	1.5	250	-	1
Segment I	Zucchini	DS I VY-01/1	33.106	0.131	0.824	5.888	0.012	0.064	1.368	1.017	BDL	BDL	0.024	0.010	BDL	BDL	0.235
	Lobia	DS I VY-01/2	28.621	0.049	4.069	12.982	BDL	0.219	1.679	4.698	0.014	BDL	BDL	BDL	BDL	BDL	0.065
	Okra	DS I VY-01/3	48.859	0.078	5.529	13.883	0.020	0.062	1.891	5.408	0.033	BDL	0.152	BDL	BDL	BDL	0.194
	Spinach	DS I VY-01/4	112.519	0.209	7.498	115.079	0.048	0.122	1.307	1.927	0.057	BDL	0.114	0.012	BDL	BDL	0.231
	Tomato	DS I VY-02/1	24.248	0.049	0.856	9.377	BDL	0.027	1.048	2.482	BDL	BDL	0.047	BDL	BDL	BDL	0.427
	Okra	DS I VY-02/2	45.660	0.186	1.840	18.241	0.012	0.146	1.214	3.977	0.012	BDL	0.050	BDL	BDL	BDL	0.103
	Brinjal	DS I VY-02/3	29.213	0.266	1.863	13.082	0.011	0.062	3.991	4.374	0.220	BDL	0.174	0.025	BDL	BDL	0.902
	Loki	DS I VY-03/1	14.823	0.029	0.685	2.103	BDL	0.058	1.301	1.959	BDL	BDL	0.015	BDL	BDL	BDL	0.058
	Lobia	DS I VY-03/2	26.642	0.109	3.899	20.323	0.017	0.352	1.433	5.406	0.013	BDL	0.011	0.010	BDL	BDL	0.401
	Sitafal	DS I VY-03/3	18.512	0.070	0.458	3.792	BDL	0.035	0.674	0.944	BDL	BDL	0.020	BDL	BDI	BDL	0.063
Segment II	Brinjal	DS II VY-01	2.139	BDL	0.824	11.383	BDL	BDL	1.099	12.575	BDL	BDL	BDL	BDL	BDL	BDL	0.228
	Spinach	DS II VY-01	21.114	BDL	3.237	47.855	BDL	BDL	1.123	3.926	BDL	BDL	BDL	BDL	BDL	BDL	0.144
	Lady finger	DS II VY-01	7.296	BDL	1.130	24.330	BDL	BDL	1.896	13.426	BDL	BDL	BDL	BDL	BDL	BDL	0.248
	Pumpkin	DS II VY-02	2.580	BDL	0.506	18.974	BDL	BDL	1.385	17.566	BDL	BDL	BDL	BDL	BDL	BDL	0.338
	Stem amaranth	DS II VY-02	85.939	BDL	6.716	173.902	0.087	0.166	1.626	10.779	BDL	BDL	BDL	BDL	BDL	BDL	0.392
	Ridge gourd	DS II VY-02	3.017	0.235	3.423	55.967	BDL	0.181	2.259	31.440	BDL	BDL	BDL	BDL	BDL	BDL	0.577
Segment III	Lady Finger	DS III VY-01	1.112	0.088	3.773	4.234	BDL	0.105	1.482	4.366	BDL	BDL	0.040	BDL	BDL	BDL	0.062
	Sponge Gourd	DS III VY-02	0.527	0.053	1.105	1.933	BDL	0.080	1.262	2.738	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Spinach	DS III VY-03	27.006	0.313	3.113	30.402	BDL	0.142	2.368	2.649	BDL	BDL	0.036	BDL	BDL	BDL	0.319
	Brinjal	DS III VY-04	0.275	0.086	1.472	3.319	BDL	0.068	1.542	2.779	BDL	BDL	0.045	BDL	BDL	BDL	BDL
	Chilli	DS III VY-05	1.256	0.251	1.677	7.739	BDL	0.155	1.591	2.808	BDL	BDL	0.047	BDL	BDL	BDL	BDL
	Bottle Gourd	DS III VY-06	0.826	0.026	1.088	2.666	BDL	0.186	1.408	2.147	0.024	BDL	BDL	BDL	BDL	BDL	BDL
	Jwar	DS III F-01	BDL	0.601	1.600	7.964	BDL	0.170	0.684	1.468	BDL	BDL	0.027	BDL	BDL	BDL	BDL

\*Vegetable samples were compared with Food Safety and Standards Authority of India, (FSSAI) notification dated 01/08/2011 and 24/12/2018. Standards for Aluminium, Chromium, Manganese, Iron, Cobalt, Nickel, Selenium and Antimony were not specified.

The ranges of metals observed as minimum and maximum has been tabulated in **Table 5** for all the three matrix.

**Table 5: The range observed for metals in samples collected for all three matrixes.**

Matrix	Values	Ground water (mg/l)	River water BIS 10500 (mg/l)	Drain water GSD, EP Rules 1986 mg/l	Soil NOAA, SQuiRT (mg/kg)	Vegetables FSSAI (mg/kg)
Aluminium (Al)	Min	0.006	0.0966	0.009	4073.7	2.58
	Max	0.158	1.848	0.1731	10886	112.52
Chromium (Cr)	Min	0.001	0.007	BDL	11.998	0.0256
	Max	0.139	0.168	0.0128	23.34	0.3131
Manganese (Mn)	Min	0.284	0.048	0.284	6.831	0.458
	Max	1.16	0.27	0.533	442	7.3
Iron (Fe)	Min	0.019	0.338	0.094	7818	2.103
	Max	6.85	5.86	0.346	22705.88	174
Cobalt (Co)	Min	BDL	0.001	BDL	3.475	BDL
	Max	0.005	0.002	BDL	12.7	0.087
Nickel (Ni)	Min	BDL	0.005	BDL	9.37	0.027
	Max	0.0037	0.0154	BDL	27.263	0.352
Copper (Cu)	Min	0.001	0.01	0.0086	18.1	0.674
	Max	0.021	0.326	BDL	37.1	3.991
Zinc (Zn)	Min	0.005	0.03	0.0279	50.62	0.944
	Max	0.051	0.213	BDL	94.54	31.44
Arsenic (As)	Min	0.005	0.002	0.068	4.78	BDL
	Max	0.052	0.007	0.014	7.203	0.22
Selenium (Se)	Min	BDL	0.001	0.008	0.126	BDL
	Max	0.002	0.002	BDL	2.2276	BDL
Cadmium (Cd)	Min	BDL	0.001	0.0021	0.178	0.024
	Max	BDL	BDL	BDL	0.86	0.17
Antimony (Sb)	Min	BDL	0.004	BDL	0.08249	BDL
	Max	BDL	0.007	BDL	0.303	BDL
Tin (Sn)	Min	BDL	0.005	BDL	0.077	0.01
	Max	0.002	0.007	BDL	0.257	BDL
Mercury (Hg)	Min	0.0001	0.0001	BDL	BDL	BDL
	Max	0.0005	0.0001	BDL	0.21	BDL
Lead (Pb)	Min	0.001	0.01	BDL	9.77	0.14
	Max	0.004	0.019	0.004	20.44	0.902

The analysed samples for all matrixes and the level of particular metals and pesticides showing exceedance above from the standards have been represented in the corresponding **Table 6**. Graphical representation of the data with respect to the reference location at Palla has been presented in **Annexure IV**.

**Table 6. Samples with exceedance/non-compliance in metals and pesticides above prescribed level**

Segment I	Metals with exceedance/non-compliance	Segment II	Metals with exceedance/non-compliance	Segment III	Metals with exceedance/non-compliance
<b>Ground water (07 Samples)</b>					
DS I GW -01-(Palla)	01 (Mn)	DS II GW -01	3 (Mn, Fe, As)	DS III GW -01	3 (Mn, Fe, As)
DS I GW -02	01 (Mn)	DS II GW -02	4 (Al, Mn, Fe, As)	DS III GW -02	4 (Al, Cr, Mn, Fe)
DS I GW -03	3 (Mn, Fe, As)	DS II GW -03	NA	DS III GW -03	NA
<b>River water samples (07 Samples)</b>					
DS I RW -01 (Palla)	5 (Al, Mn, Fe, Cu, Pb)	DS II RW -01	4 (Al, Cr, Mn, Fe)	DS III RW -01	3 (Al, Mn, Fe)
DS I RW -02	4 (Al, Fe, Cu, Pb)	DS II RW -02	3 (Al, Mn, Fe)	DS III RW -02	3 (Al, Mn, Fe)
DS I RW-03	4 (Al, Fe, Cu, Pb)	DS II RW -03	NA	DS III RW -03	NA
<b>Drain water (02 Samples)</b>					
DS I WW -01	NA	DS II WW -01	Nil	DS III WW -01	Nil
<b>Soil samples (06 Samples)</b>					
DS I Soil -01 (Palla)	8 (Mn, Fe, Co, Ni, Cu, Zn, As, Pb)	DS II Soil 1	3 (Cu,Zn, Pb)	DS III Soil 1	7 (Mn, Co, Ni, Cu, Zn, Se, Hg)
DS I Soil -02	4 (Co, Ni, Cu, Zn)	DS II Soil 2	NA	DS III Soil 2	9 (Co, Ni, Cu, Zn, As, Se, Sb, Hg, Pb)
DS I Soil -03	8 (Mn, Fe, Co, Ni, Cu, Zn, As, Pb)	DS II Soil 3	NA	DS III Soil 3	NA
<b>Vegetables (22 samples)</b>					
DS I	-	DSII		DS III	
Torai (Palla)	-	Brinjal	-	Lady Finger	-
Lobia	-	Spinach	-	Sponge gourd	-
Okra	-	Lady finger	-	Spinach	-
Spinach	-	Pumpkin	-	Brinjal	-
Tomato	-	Stem amaranth	-	Chilli	-
Okra	-	Ridge Gourd	-	Bottle gourd	-
Brinjal	-				
Loki	-				
Lobia	--				
Sitafal	-				
<b>Fodder (01 Samples)</b>					
DS I	NA	DS II	NA	DS III Jwar	Nil

\*NA: samples not collected & analysed, Nil: no value for metal has been observed.  
\*Soil samples are compared with NOAA SQuiRT, US due to absence of Indian standards available for comparison.

## 6.0 Observations

Based on the sampling results, following observations are made:

- I. In all three segments of flood plains of River Yamuna in Delhi extensive farming of vegetables were observed. Sampling was done in the summer season (June-19) hence the Kharif vegetables such as Ladyfinger, Spinach, Bottle gourd, pumpkin was available. No seasonal fruit such as Melon was observed. Very few fruit bearing trees of Guava, Chiku and Pomegranate were observed.
- II. No use of river water for irrigation in all three segments of flood plains of river Yamuna in Delhi was observed. Irrigation of vegetables was observed by groundwater in all segments whereas in Segment III irrigation was also seen by wastewater of Abu Fazal drain.
- III. Fertilizers and Pesticides were used in all three segments in the flood plain of River Yamuna.
- IV. No farming was observed in DS II for about 1-1.5 km (ISBT to Shastri Park). In DS III farming was not observed on the left bank of the river Yamuna of about 5 Km whereas, farming was observed on the right bank, downstream in Kalindi kunj area and samples were taken.
- V. Drain water samples were taken by teams in segments DS II (Kailash nagar drain) and DS III (Abu Fazal drain).

## 7.0 Findings

The major findings of the study have been summarized for all the matrixes are as follows:

### Ground water:

In all the three segments two metals viz. Mn and Fe are present, predominantly. In segment II at Geeta Colony As and Al have been observed in traces but above the standard desirable limit of drinking water standards of BIS 10500, 2012. Similarly, in segment III at Madanpur Khadar Al and Cr was also found in small concentration but above the standard.

### River water:

In river water samples mainly Al, Fe, Cu, Pb and Mn have been found exceeding in all segments with reference to drinking water standards of BIS 10500. Rivers are not supposed to receive metals and pesticides from the catchment.

### Drain water:

The drain water samples were collected in segment II and III and no metal was found in exceedance.

### Soil:

In absence of any specified Indian standards for soil samples, it was compared with NOAA SQiRTS, 2004, US. The metal exceedances in soil sample were found mainly for the metals Co, Fe, Ni, Cu, As, Zn, Pb and Mn in segment I. In segment II Cu, Zn, and Pb are exceeding. Additionally, in segment III exceedances for Mn, Co, Ni, Cu, Zn, Se, As, Sb, Hg and Pb have been also observed. The metals in soil is mainly attributed by chemical fertilizers having micronutrients.

### Vegetables:

As per available standards given by FSSAI for no metals and pesticides are exceeding in all the sample tested.

From the findings it is concluded that contamination of soil was observed at most of the monitoring sites which may be due to excessive use of fertilizers. However, water quality of River Yamuna depicts trace amount of metals at some locations is primarily due to industrial wastewater discharge.

No exceedance was observed in vegetable and fodder samples for metals and pesticides with respect to FSSAI notifications, 2011 (metals) and 2018 (pesticides) as no significant level of metals were observed in ground water.

The continuous use of fertilizers and pesticides may deteriorate the soil and water quality can also increase the chance of uptake of metals in to the vegetables/edible products.

## 8.0 Recommendations

- As discussed above that the water and soil samples are getting contaminated by the use of fertilizers and pesticides and long term application of both can cause adverse effect on vegetables. Hence, controlled farming should be looked into by the concerned Govt agencies in the flood plains of River Yamuna. Additionally, farming of vegetables/fruits that are prone to accumulate metals may also be discouraged.
- As exceedance of metals have been observed in all the segments of ground water and river water depicting the source from industrial wastewater which may be controlled by concerned agencies. Proper functioning of CETPs and individual ETPs may also be ensured to prevent the uncontrolled discharge of wastewater in river.
- Untreated wastewater of drains may not be used for growing vegetables. Treatment should be given to meet the standards before use in agriculture.
- In soil samples metals were observed which are attributed by anthropogenic activities such as indiscriminate use of chemical fertilizers having micronutrients and is the primary reason for metals in soil samples. Concerned Government agencies may take initiatives to control unwise use of chemical fertilizers.
- Organic farming such as compost manure, green manure, and bone meal can be emphasizing to reduce the hazardous effect of chemical fertilizers and pesticides. Exploration of techniques such as crop rotation and companion planting. Biological pest control mixed cropping and the fostering of insect predators can be encouraged.
- The involvement of voluntary organizations and institutions such as Central Soil Salinity Research Institute, Karnal and IARI, New Delhi, National Institute of plant Health Management, Hyderabad, Soil Science and Agriculture Chemistry Division, IARI, New Delhi etc. should carry out programmes to train the farmers for encouragement on usage of biofertilizers, biopesticides and organic manures.
- Awareness program such as training of farmers for the wise and proportionate use of fertiliser, pesticides, w.r.t. dosage and adverse effect on humans and environment as persistent organic pollutants may also be conveyed through concerned govt. agencies. Soil testing with soil health card and usage of neem coated urea may also be encouraged. Farmers are mainly dependent on shopkeepers to get knowhow of usage of fertilisers and pesticides.
- Farmers are encouraged to wash the produce vegetables/edible products in clean water.
- A regular or long term study should be carried out in order to depict the clear picture of absorbance of metal and pesticides in vegetables, fruits and fodder.

## 9.0 References

1. Suruchi and Pankaj Khanna (2011), Assesment of Heavy Metal Contamination in Different Vegetables Grown in and Around Urban Areas. Reseach Journal of Environmental Toxicology (5) 162-179.
2. Rajesh Kumar Sharma, MadhoolikaAgrawal, Fiona M. Marshall (2008), Heavy metal (Cu, Zn, Cd, and Pb) contamination of vegetables in urban India: A case. Environmental Pollution (154) 254-263.
3. Ashita Sharma, Jatindra Kaur Katnoria and Avinash Kumar Nagpal (2016), Heavy metals in vegetable: screening health risks involved in cultivation along wastewater drain and irrigation with wastewater. Springer Plus (5) 488.
4. Fiona Marshall, Ravi Agarwal, Dolf te Lintelo, D S Bhupal, Rana P B Singh, Neela Mukherjee, Chandra Sen, Nigel Poole, Madhoolika Agrawal, S D Singh. Heavy metal contamination of vegetable in Delhi, Excuetive summary of Technical report-March 2003. Toxic Links.

**Annexure I**

**OFFICE OF THE YAMUNA POLLUTION MONITORING COMMITTEE  
APPOINTED BY HON'BLE NGT  
ROOM NO. 58, INDIA INTERNATIONAL CENTRE  
40, MAX MUELLER MARG, LODHI ESTATE  
NEW DELHI – 110003**

No. YPMC/2019/ 167

Date: 15/04/2019

**Subject: Minutes of meeting held on 09.04.2019 with FSSAI and CPCB regarding testing of vegetables and fodder grown on the bank of river Yamuna.**

The MC held a meeting with the officials of the FSSAI and the CPCB to understand the extent to which vegetables grown on the floodplains of River Yamuna contain toxic chemicals, heavy metals and pesticides. The list of those who attended the meeting is enclosed. At the outset, attention of both FSSAI and the CPCB was drawn to observations of the NGT on the likelihood of toxicity caused by heavy metals and the need to take definitive action to prevent health hazards to consumers. From time to time news reports had also been published that vegetables grown on the banks of river Yamuna contain toxins and heavy metals etc. which are harmful for human consumption. There was however no conclusive study on these aspects and the first step was to check the the extent of harmful elements contained in the produce and the precautionary steps needed to be taken to protect consumers.

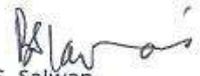
The Advisor FSSAI informed that there is an all India project under which the FSSAI is doing study of vegetables and food items and therefore the present study also can also be done following the same protocol. Further, the FSAAI has 32 testing accredited laboratories in Delhi region and the study relating to Yamuna can be done by engaging 3 to 4 laboratories.

After the discussion the following decisions were taken;

1. The FSSAI will identify 3-4 laboratories in Delhi and allocate the work of collecting sample and carrying out the tests for the presence of toxic chemicals, heavy metals and pesticides.
2. The sampling design and collection of samples will be done by the laboratories in collaboration with the CPCB.

3. The CPCB which has the responsibility for testing of chemicals in the environment, will undertake the testing of soil from areas adjacent to the River where vegetables and fruit and other edible items are being grown including , fodder, tubers, fruit and vegetables.
4. The sampling design should be such that it is statistically valid and fulfills the rigor of scientific scrutiny.
5. The FSAAI will compile, collate and analyze the results of tests carried out by the laboratories. The result of the soil tests carried out by the CPCB will be amalgamated in the report prepared by the FSAAI.
6. The budget for the Study will be provided by the CPCB out of the funds collected as EC under the Polluter Pays principle.
7. An interim report based on the progress achieved upto 30<sup>th</sup> April be submitted to the MC.

  
Shailaja Chandra,  
Member,  
Monitoring Committee for Yamuna

  
B.S. Sajwan,  
Member,  
Monitoring Committee for Yamuna

To:

1. Chairperson, FSSAI, Ministry of Health & Family Welfare, FDA Bhawan, Near Bal Bhawan, Kolta Road, New Delhi-110002.
2. The Chairman, CPCB, Parivesh Bhawan, East Arjun Nagar, Delhi 110032.
3. The Member Secretary, CPCB, Parivesh Bhawan, East Arjun Nagar, Delhi 110032.
4. Email to all participants.
5. MC Website

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Address: Room No. 58, India International Centre  
40, Max Mueller Marg, New Delhi - 110003  
Telephone No: 011- 24609270  
Email id: [rymonitoringcommittee@gmail.com](mailto:rymonitoringcommittee@gmail.com)



**Annexure II**

 CENTRAL POLLUTION CONTROL BOARD Parivesh Bhawan, East Arjun Nagar, Delhi-110032 Format for Sample Collection		Annexure II
1.	Organization	CPCB & Lab.....
2.	Project	For Submission to Yamuna Monitoring Committee constituted by Hon'ble NGT in O.A. No 06/2012 in the matter of Manoj Mishra vs UOI & other.
3.	Sampling ID with Date	
4.	Sampling Location	1.Delhi Segment I 2.Delhi Segment II 3.Delhi Segment III
5.	Latitude & Longitude of Sampling location	
6.	Sampling Distance from River Bank	100m 200m 500m More than 500m
5.	Sample Collected by	
6.	Sample Matrix (Tick relevant)	Water/Soil/Others
7.	Date & Time of sampling	
8.	Photographs of Sampling location & sample enclosed	Yes/No
9.	Field Observation	1. Using Pesticides (Y/N) 2. Irrigation Water used from: a) Ground Water b) River Water c) Drain Water
8.	Samples Details	
	i. Sample nature	Vegetable/ fruits/Other Edible products /Fodder/ Soil/ water & Wastewater
	ii. Sample Preservation Status	Preserved/ Not Preserved with.....
	iii. Types of Sample	Soil/Water or wastewater//GW Vegetables ( leafy Vegetables/ Tubers/ Roots/ Stem)
	iv. Type of Sample container	
	v. Sample Volume (ml)/ Weight (g) for solid	
	vi. Sample Code no/nos. (Please use back page of the requisition sheet, if the space is not sufficient)	
	vii. Total No. of Samples	
9.	Test Report to be Sent (Name & Address)	CPCB
	Parameters to be analysed: Please encircle / Tick Properly	Annexure I
10.	1. Heavy Metals 2. Pesticides/ Fungicides/Weedicides/Herbicides	

Indenter  
(Name & Contact No.)  
CPCB Official

Indenter  
(Name & Contact No.)  
Lab Official

### Annexure III

#### Reference standards for comparative result analysis

S. no.	Metals	Water (mg/L)			Soil (mg/kg)		Vegetables (mg/Kg)
		Ground water (Bureau of Indian Standards:10 500, 2012) Drinking water Standards	River water Bureau of Indian Standards:10 500, 2012) Drinking water Standards	Drain water (General discharge standards, EP, Rules, 1986)	National Oceanic and Atmospheric Administration , USA (NOAA SQUIRT, 2004)	Canadian Council of Ministers of the Environment, Canada, 2006	Food Safety and Standards Authority of India, notification dated 01/08/2011 and 24/12/2018
1	Al	0.03	0.03	NG	47000	-	NG
2	Cr	0.05	0.05	2	37	64	NG
3	Mn	0.1	0.1	2	330	-	NG
4	Fe	0.3	0.3	3	18000	-	NG
5	Co	NG	NG	NG	6.7	40	NG
6	Ni	0.02	0.02	3	13	45	NG
7	Cu	0.05	0.05	3	17	63	30
8	Zn	5	5	5	48	250	50
9	As	0.01	0.01	0.2	5.2	12	1.1
10	Se	0.01	0.01	0.05	0.26	-	NG
11	Cd	0.003	0.003	2	NG	1.4	1.5
12	Sb	NG	NG	NG	0.48	20	NG
13	Sn	NG	NG	NG	0.89	5	250
14	Hg	0.001	0.001	0.01	0.058	-	1.0
15	Pb	0.01	0.01	0.1	16	70	2.5
<b>Pesticides</b>							
1	Alpha-HCH	0.1	0.1	NG	50	-	1.0
2	Beta-HCH	0.04	0.04		50	-	1.0
3	Gamma-HCH	2	2		50	0.01	1.0
4	Delta-HCH	0.04	0.04		50	-	1.0
5	Endosulfan-I	0.4	0.4		NG	-	2.0
6	Endosulfan-II	0.4	0.4		NG	-	2.0
7	Endosulfan sulfate	0.4	0.4		NG	-	2.0
8	Dicofol	NG	NG		NG	-	5.0
9	p,p-DDE	1	1		NG	-	3.5
10	p,p DDD	1	1		NG	-	3.5
11	p,p DDT	1	1		NG	0.7	3.5
12	Aldrin	0.03	0.03		NG	-	0.1
13	Dieldrin	0.03	0.03		NG	-	0.1
14	Heptachlor	NG	NG		NG	-	0.05
15	Chlorpyriphos	30	30		NG	-	0.2
16	Dimethoate	NG	NG		NG	-	2.0
17	Ethion	3	3		NG	-	1.0
18	Malathion	190	190		NG	-	3
19	Methyl parathion	0.30	0.30		NG	-	0.1
20	Phorate	2	2		NG	-	0.05, tomato-0.1
21	Phosphamidon	NG	NG		NG	-	0.2
22	Quinolphos	NG	NG		NG	-	0.2 for chillies
23	Profenophos	NG	NG		NG	-	Specified food

S. no.	Metals	Water (mg/L)			Soil (mg/kg)		Vegetables (mg/Kg)
		Ground water (Bureau of Indian Standards:10 500, 2012) Drinking water Standards	River water Bureau of Indian Standards:10 500, 2012) Drinking water Standards	Drain water (General discharge standards, EP, Rules, 1986)	National Oceanic and Atmospheric Administration , USA (NOAA SQuiRT, 2004)	Canadian Council of Ministers of the Environment, Canada, 2006	Food Safety and Standards Authority of India, notification dated 01/08/2011 and 24/12/2018
24	Alpha-Cypermethrin	NG	NG		NG	-	Specified food
25	Deltamethrin	NG	NG		NG	-	Chili 0.05, Okra 0.05, Brinjal 0.3
26	Fenprothion	NG	NG		NG	-	Brinjal-0.2 Okra-0.5 Chilli-0.2
27	Fenvalerate	NG	NG		NG	-	Brinjal and Okra-2
28	$\lambda$ -Cyhalothrin	NG	NG		NG	-	0.01
29	$\beta$ -Cyfluthrin	NG	NG		NG	-	0.01
30	Pendimethalin	NG	NG		NG	-	Specified food, Chilli-0.05
31	Alachlor	20	20		NG	-	Specified food
32	Butachlor	125	125		NG	-	Specified food
33	Fluchloralin	NG	NG		NG	-	Specified food

\*NG: No guideline values, \*Highlighted pesticides are banned or will be banned by 2020 by Central Insecticide Board and Registration Committee (CIBRC). The list of banned pesticides has been given in **Appendix (1)**, dated 19.03.2019.

Source of standards selected for comparison of data in all matrix:

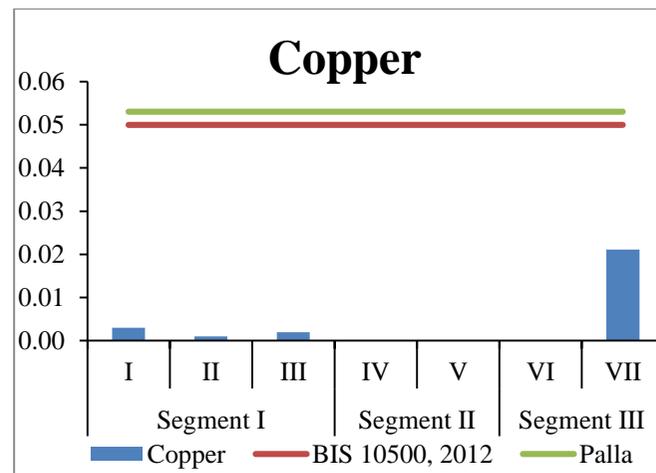
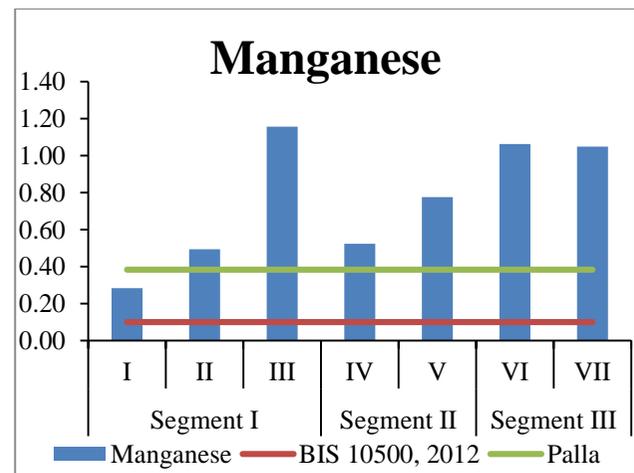
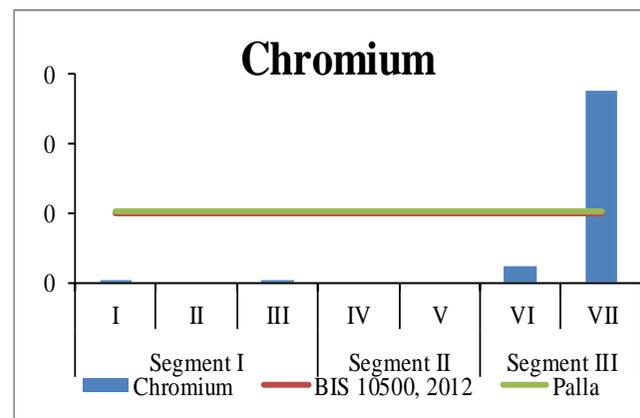
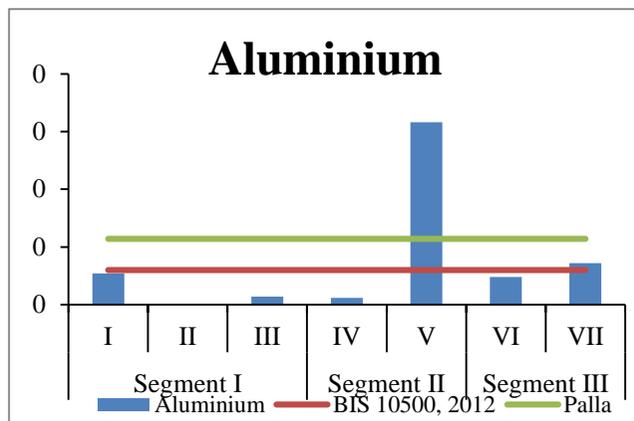
(i) Water: Bureau of Indian Standards (BIS) IS10500:2012 Ground water(GW) River water (RW) & for Drain Water General Discharge Standards, Environment (Protection) Rules, 1986.

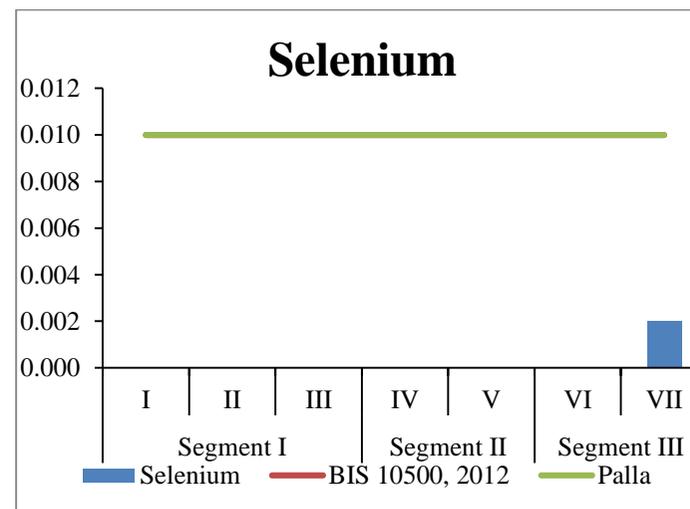
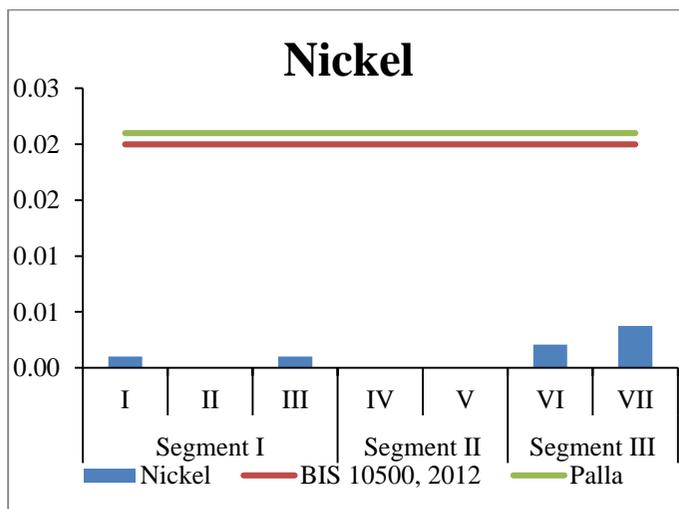
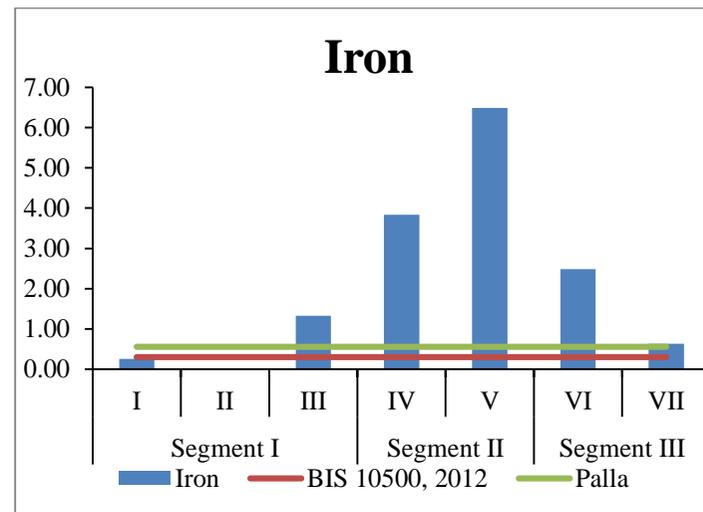
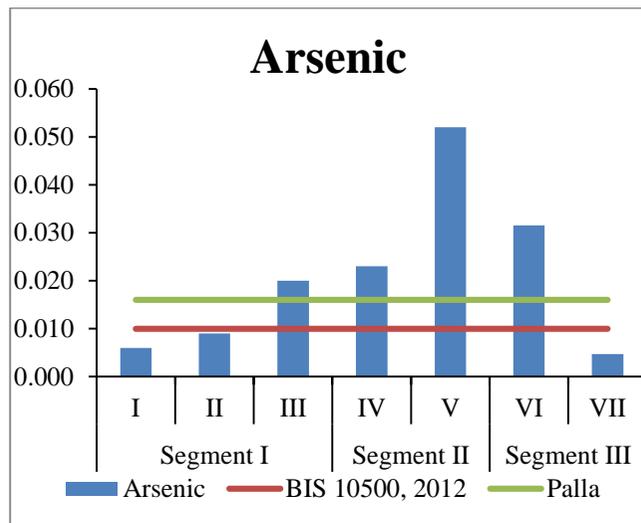
(ii) Soil: (a) National Oceanic Atmospheric Administration, Screening Quick Reference Table (NOAA SQuiRT), US: 2004

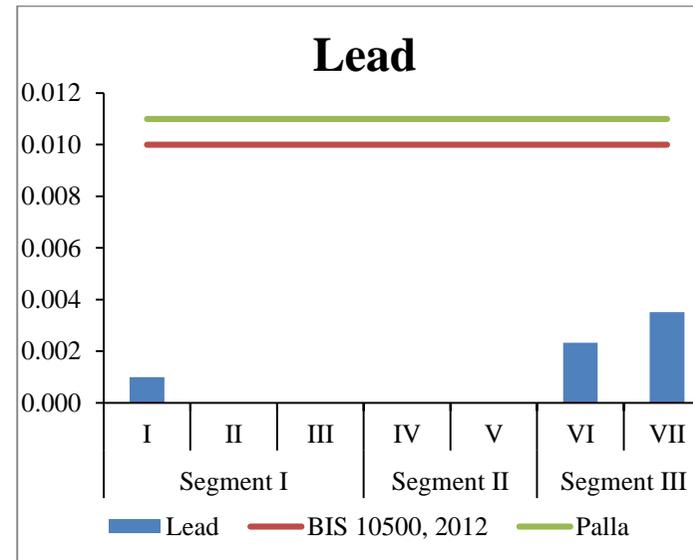
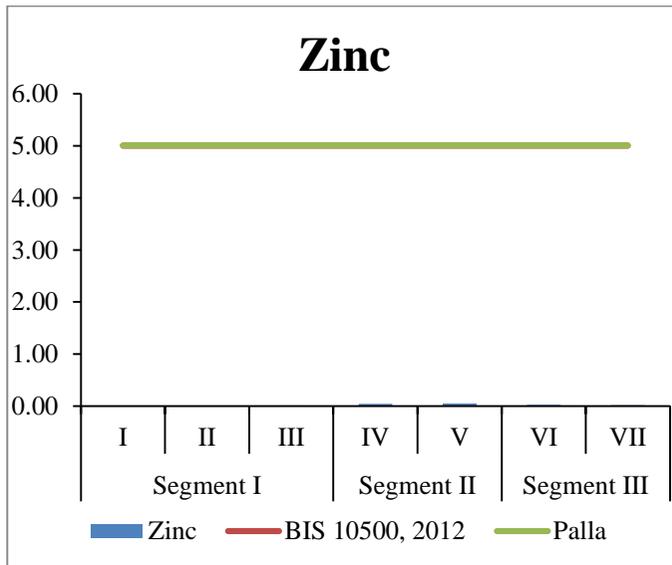
(b) Canadian Council of Ministers of the Environment, Canada, 2006

(iii) Vegetables: Food Safety and Standards Authority of India (FSSAI): 2011 (metals) and 2018 (pesticides)

**Graphical representation of the data with respect to the reference location at Palla**  
**(i) Ground water samples**

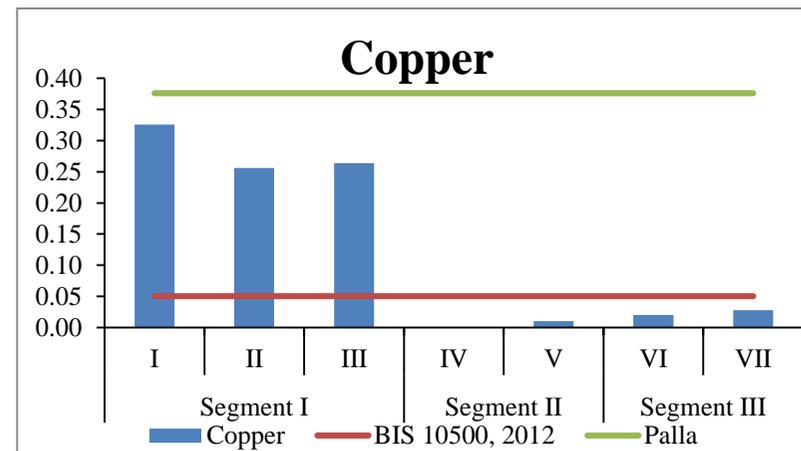
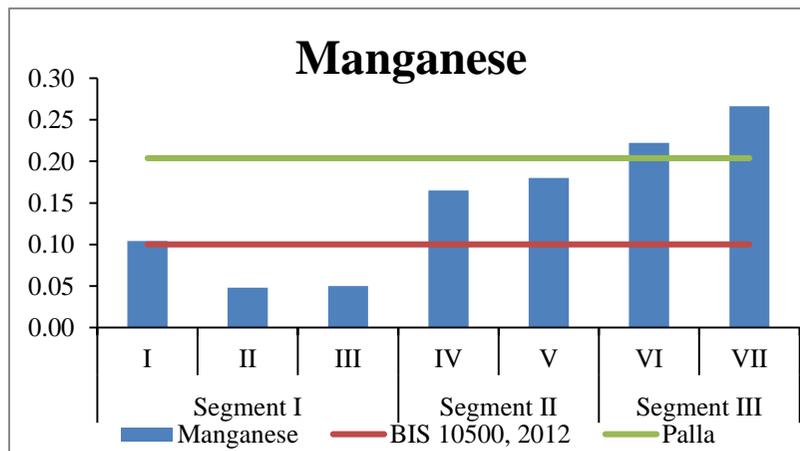
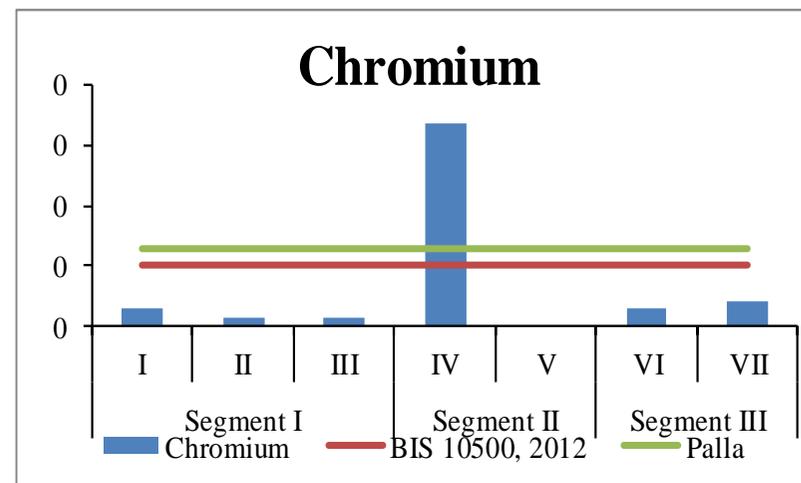
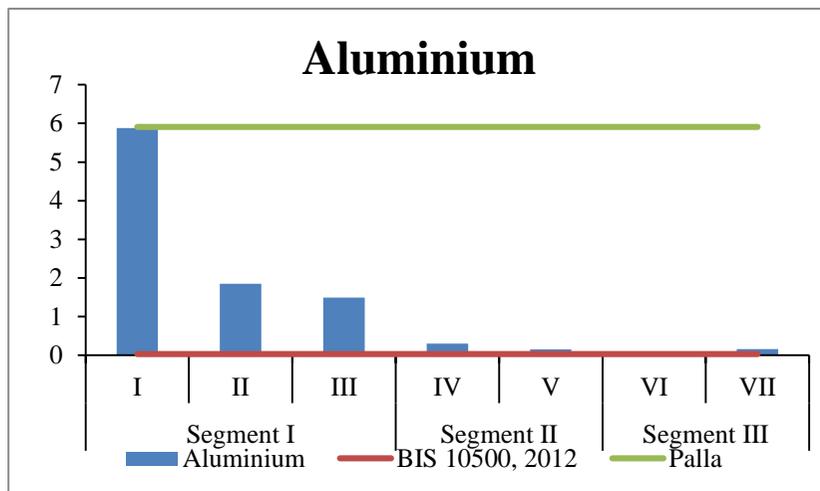


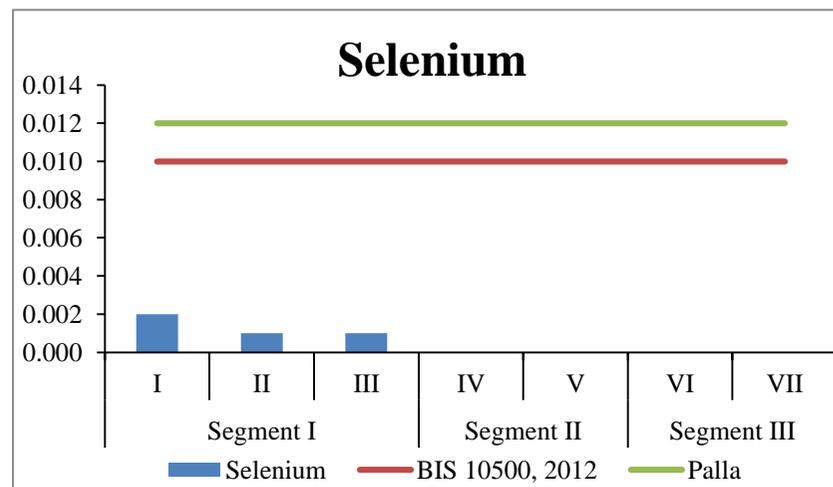
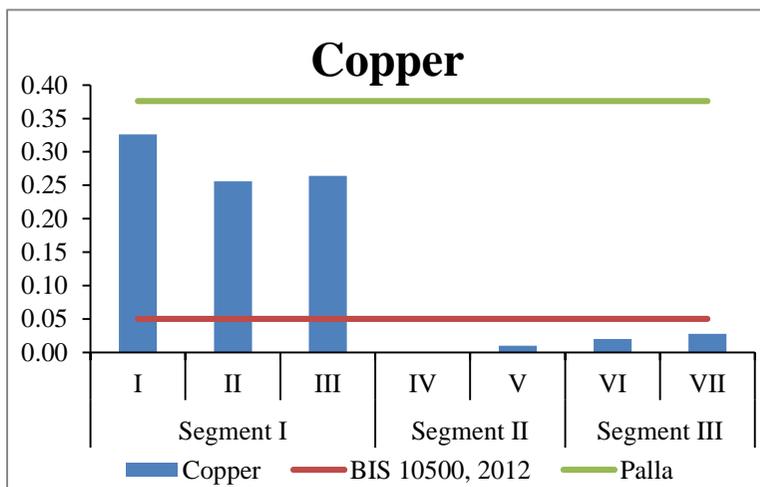
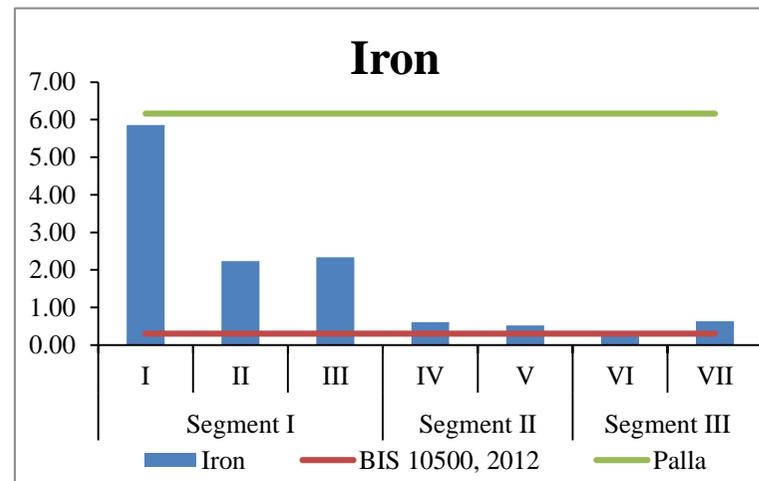
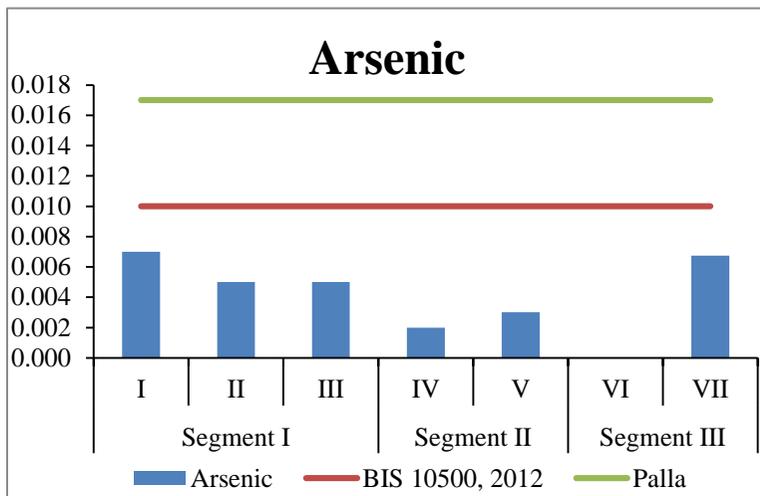


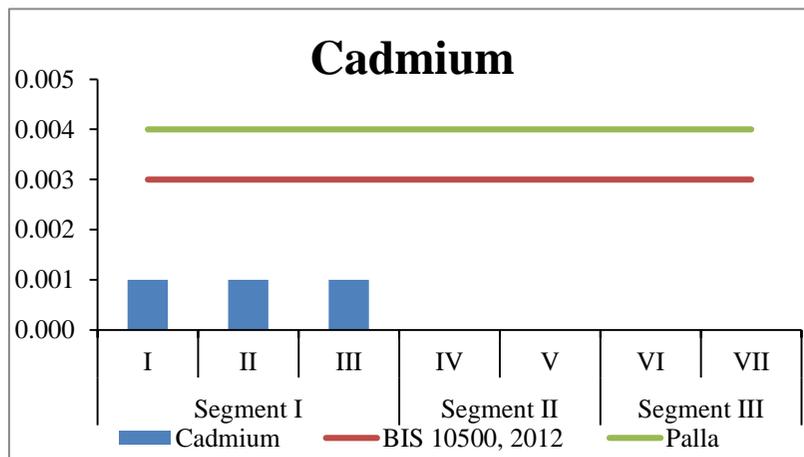
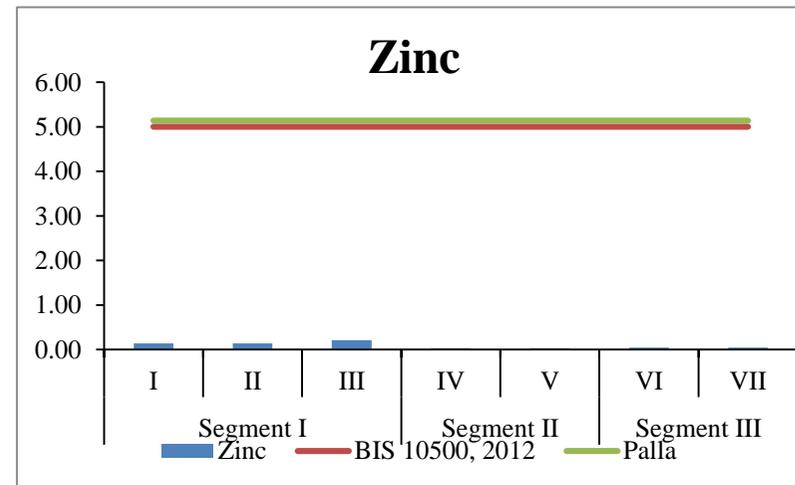
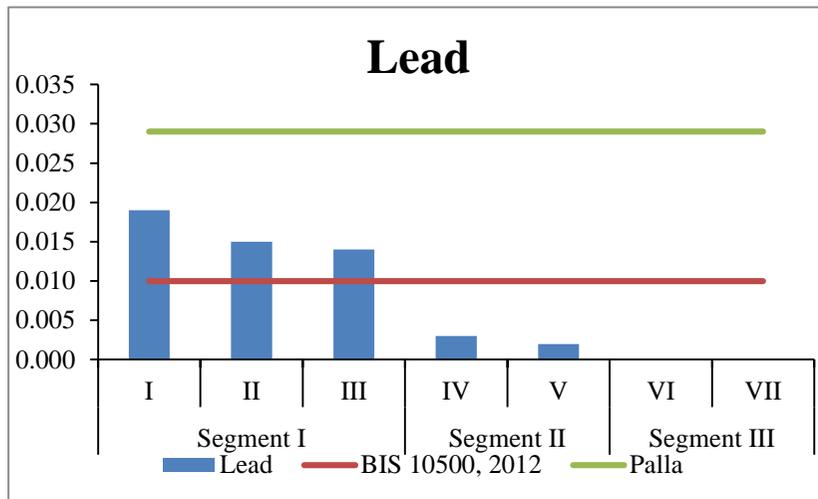




River water samples

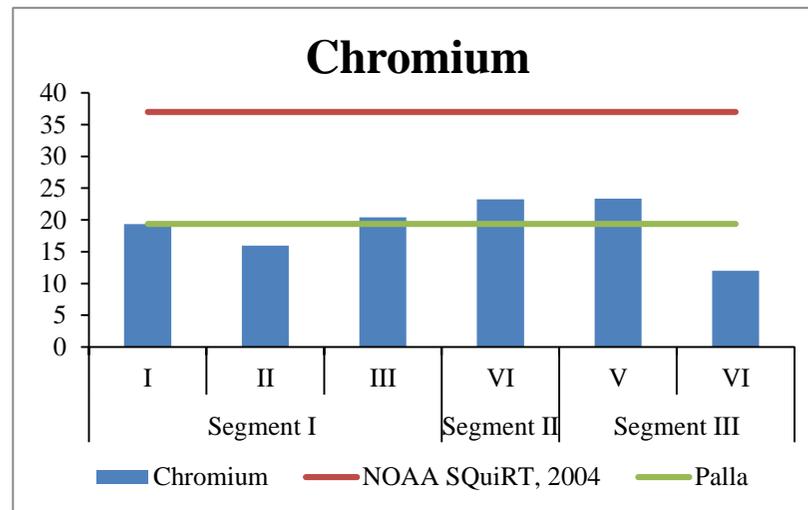
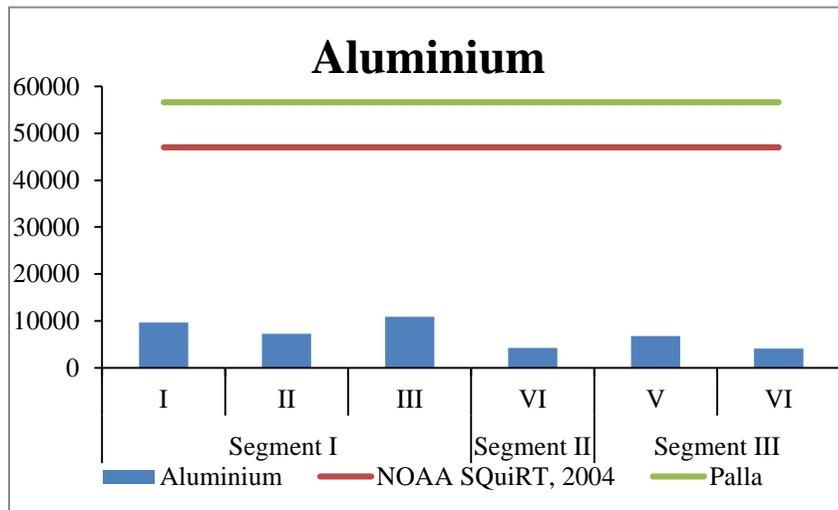


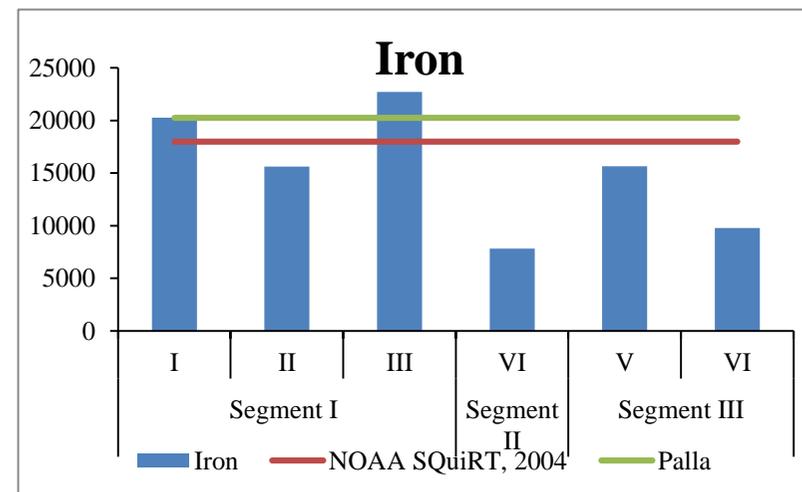
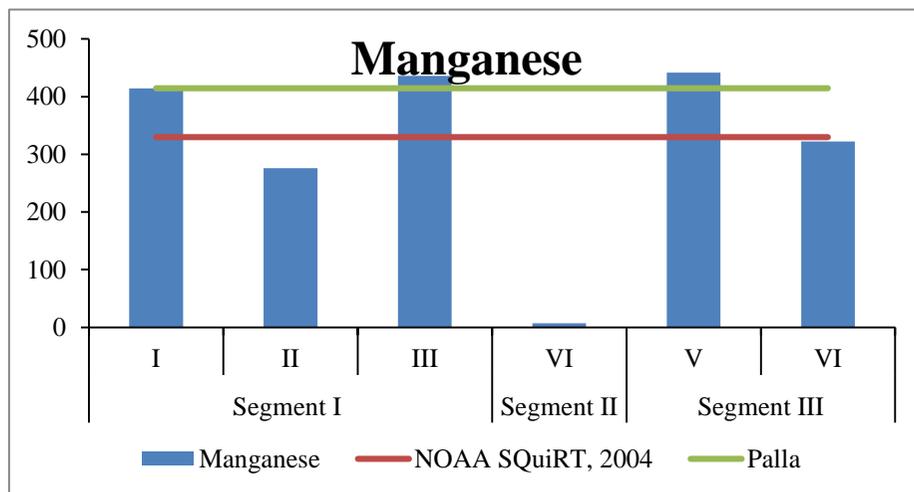
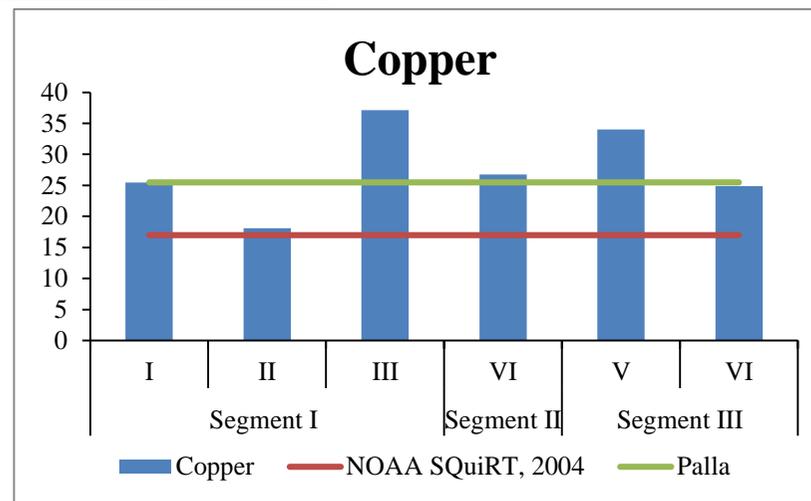
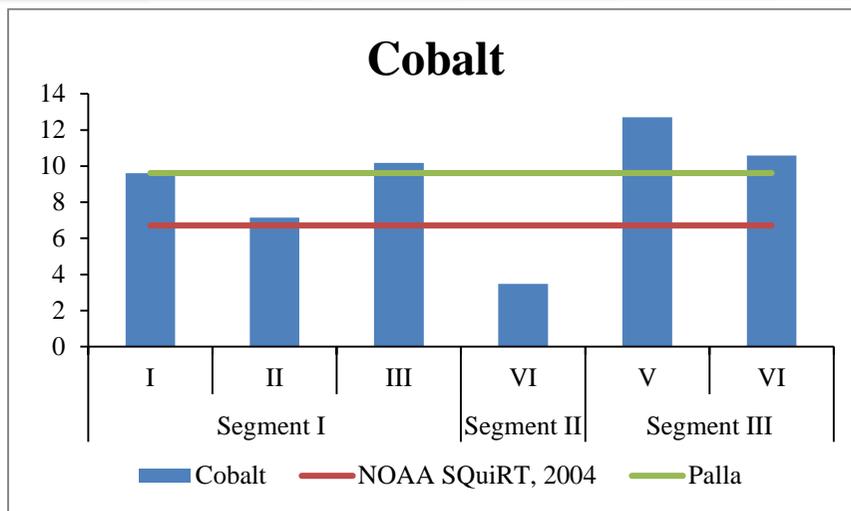


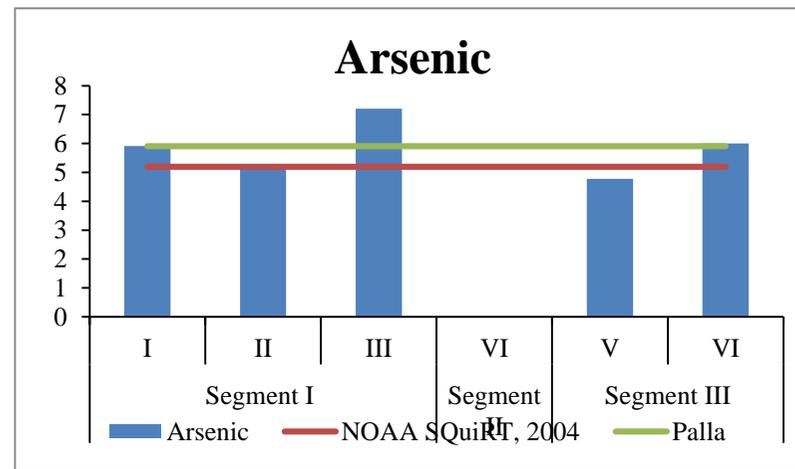
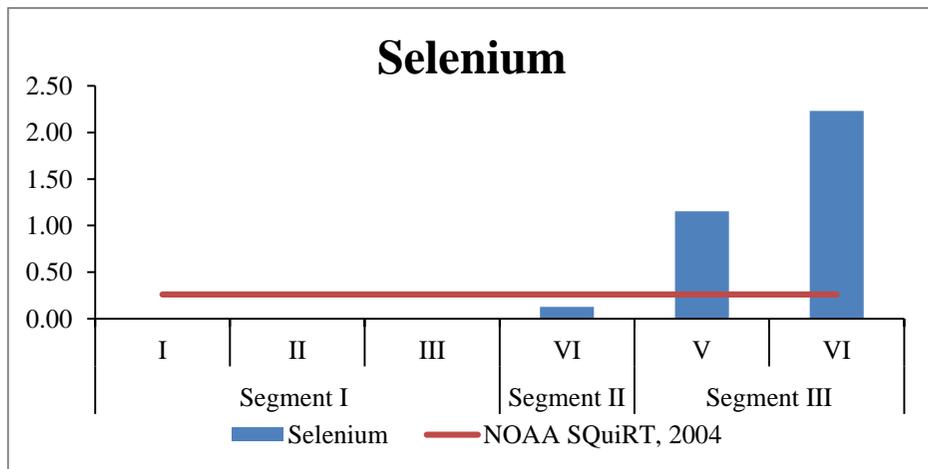
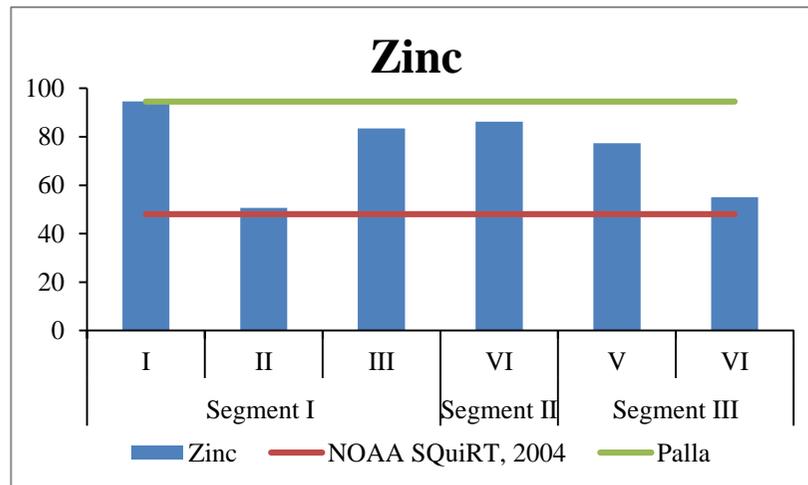
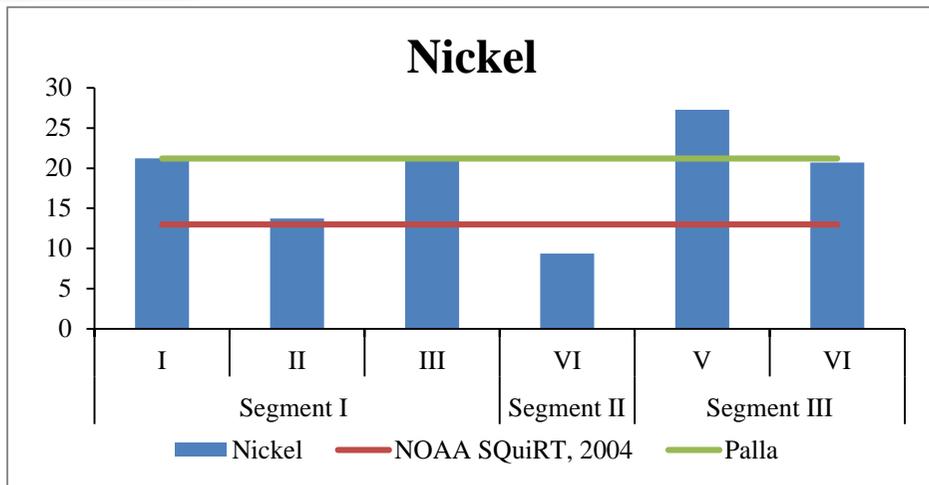


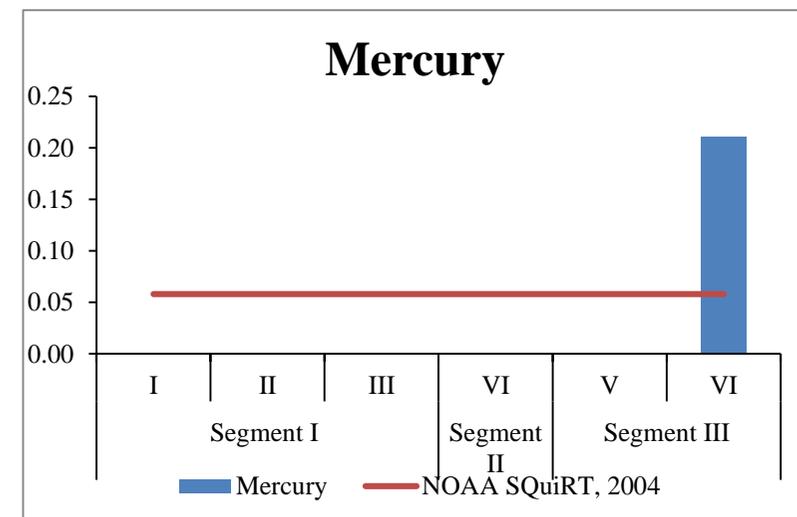
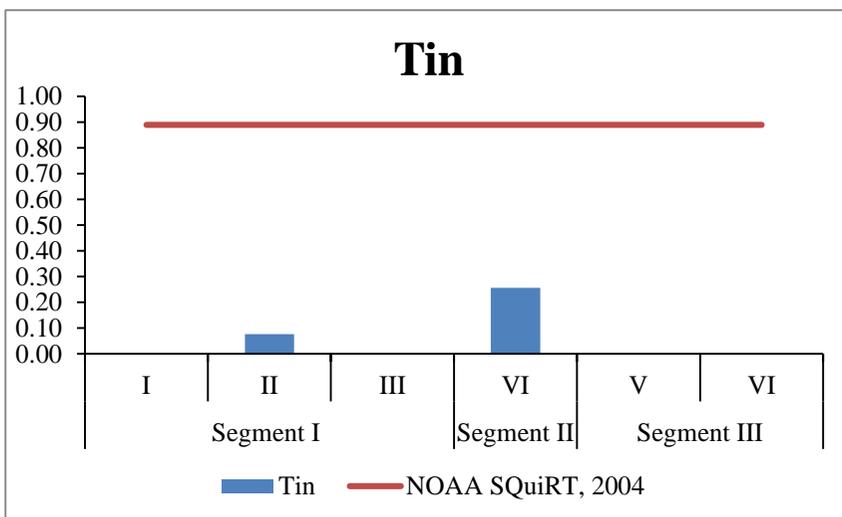
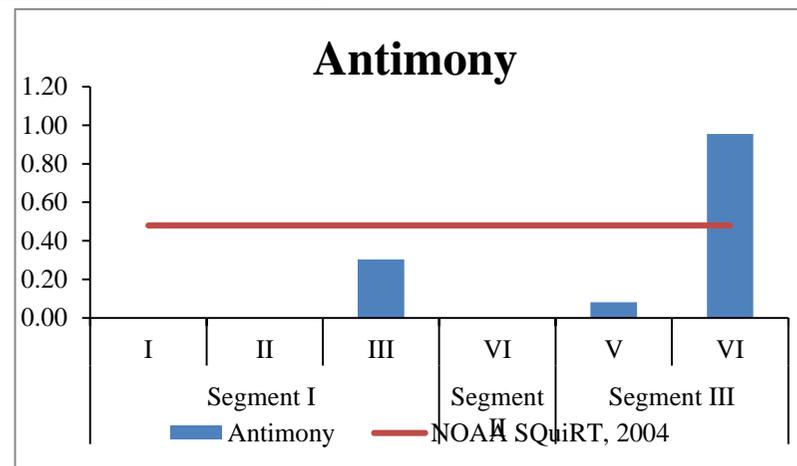
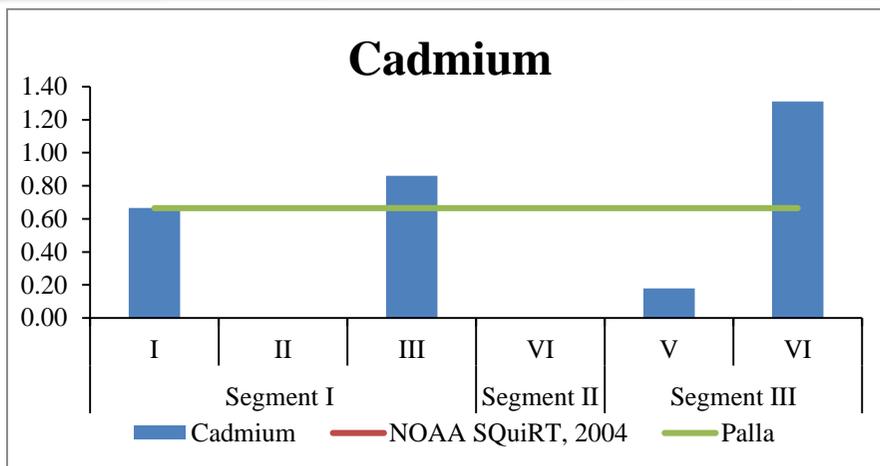


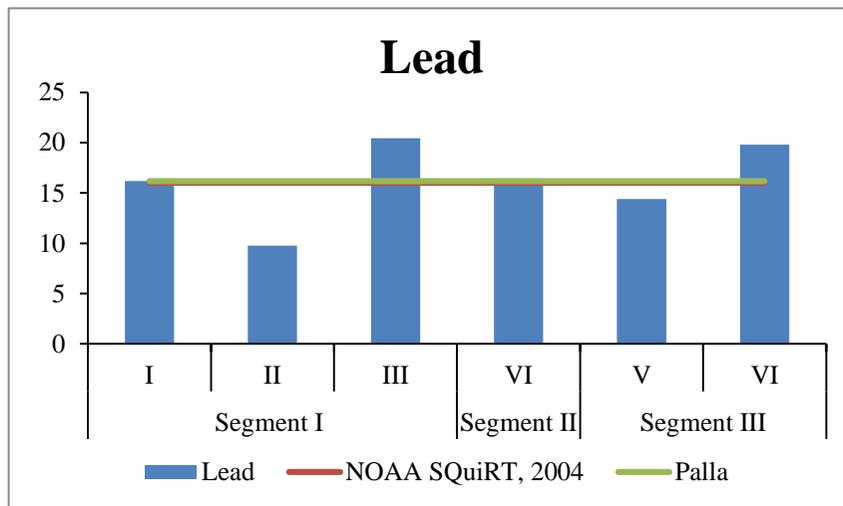
### Soil Samples











**Appendix 1**

**List of pesticides which are banned and restricted in use by  
 Central Insecticides Board & Registration Committee**  
 Department of Agriculture, Cooperation & Farmers Welfare,  
 Ministry of Agriculture & Farmers Welfare (dated 19.03.2019)

**I. PESTICIDES / FORMULATIONS BANNED IN INDIA**

<b>Pesticides Banned for manufacture, import and use</b>	
1.	Aldicarb (vide S.O. 682 (E) dated 17 <sup>th</sup> July 2001)
2.	Aldrin
3.	Benzene Hexachloride
4.	Benomyl (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
5.	Calcium Cyanide
6.	Carbaryl (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
7.	Chlorbenzilate (vide S.O. 682 (E) dated 17 <sup>th</sup> July 2001)
8.	Chlordane
9.	Chlorofenvinphos
10.	Copper Acetoarsenite
11.	Diazinon (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
12.	Dibromochloropropane (DBCP) (vide S.O. 569 (E) dated 25 <sup>th</sup> July 1989)
<b>A.</b>	13. Dieldrin (vide S.O. 682 (E) dated 17 <sup>th</sup> July 2001)
	14. Endosulfron (vide ad-Interim order of the Supreme Court of India in the Writ Petition (Civil) No. 213 of 2011 dated 13 <sup>th</sup> May, 2011 and finally disposed of dated 10 <sup>th</sup> January, 2017)
	15. Endrin
	16. Ethyl Mercury Chloride
	17. Ethyl Parathion
	18. Ethylene Dibromide (EDB) (vide S.O. 682 (E) dated 17 <sup>th</sup> July 2001)
	19. Fenarimol (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
	20. Fenthion (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
	21. Heptachlor
	22. Lindane (Gamma-HCH)
	23. Linuron (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
	24. Maleic Hydrazide (vide S.O. 682 (E) dated 17 <sup>th</sup> July 2001)

	25. Menazon
	26. Methoxy Ethyl Mercury Chloride (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
	27. Methyl Parathion (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
	28. Metoxuron
	29. Nitrofen
	30. Paraquat Dimethyl Sulphate
	31. Pentachloro Nitrobenzene (PCNB) (vide S.O. 569 (E) dated 25 <sup>th</sup> July 1989)
	32. Pentachlorophenol
	33. Phenyl Mercury Acetate
	34. Sodium Cyanide ( banned for Insecticidal purpose only vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)*
	35. Sodium Methane Arsonate
	36. Tetradifon
	37. Thiometon (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
	38. Toxaphene(Camphechlor) (vide S.O. 569 (E) dated 25 <sup>th</sup> July 1989)
	39. Tridemorph (vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018)
	40. Trichloro acetic acid (TCA) (vide S.O. 682 (E) dated 17 <sup>th</sup> July 2001)
	<b>Pesticide formulations banned for import, manufacture and use</b>
<b>B.</b>	1. Carbofuron 50% SP (vide S.O. 678 (E) dated 17 <sup>th</sup> July 2001)
	2. Methomyl 12.5% L
	3. Methomyl 24% formulation
	4. Phosphamidon 85% SL
<b>C.</b>	<b>Pesticide / Pesticide formulations banned for use but continued to manufacture for export</b>
	1. Captafol 80% Powder (vide S.O. 679 (E) dated 17 <sup>th</sup> July 2001)
	2. Nicotin Sulfate
<b>D.</b>	<b>Pesticides Withdrawn</b> (Withdrawal may become inoperative as soon as required complete data as per the guidelines is generated and submitted by the Pesticides Industry to the Government and accepted by the Registration Committee. (S.O 915(E) dated 15 <sup>th</sup> Jun,2006)
	1. Dalapon
	2. Ferbam
	3. Formothion

4.	Nickel Chloride
5.	Paradichlorobenzene (PDCB)
6.	Simazine
7.	Sirmate (S.O. 2485 (E) dated 24 <sup>th</sup> September 2014)
8.	Warfarin (vide S.O. 915 (E) dated 15 <sup>th</sup> June 2006)

\* Regulation to be continued in the extant manner for non-insecticidal uses.

## II. PESTICIDES RESTRICTED FOR USE IN THE COUNTRY

S.No.	Name of Pesticides	Details of Restrictions
1.	Aluminium Phosphide	<p>The Pest Control Operations with Aluminium Phosphide may be undertaken only by Govt./Govt. undertakings / Govt. Organizations / pest control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India except <sup>1</sup>Aluminium Phosphide 15 % 12 g tablet and <sup>2</sup>Aluminum Phosphide 6 % tablet. [RC decision circular F No. 14-11(2)-CIR-II (Vol. II) dated 21-09-1984 and G.S.R. 371(E) dated 20th may 1999]. <sup>1</sup>Decision of 282<sup>nd</sup> RC held on 02-11-2007 and, <sup>2</sup>Decision of 326<sup>th</sup> RC held on 15-02-2012.</p> <p>The production, marketing and use of Aluminium Phosphide tube packs with a capacity of 10 and 20 tablets of 3 g each of Aluminium Phosphide are banned completely. (S.O.677 (E) dated 17<sup>th</sup>July, 2001)</p>
2.	Captafol	<p>The use of Captafol as foliar spray is banned. Captafol shall be used only as seed dresser. (S.O.569 (E) dated 25<sup>th</sup>July, 1989)</p> <p>The manufacture of Captafol 80 % powder for dry seed treatment (DS) is banned for use in the country except manufacture for export. (S.O.679 (E) dated 17<sup>th</sup>July, 2001)</p>

3.	Cypermethrin	Cypermethrin 3 % Smoke Generator is to be used only through Pest Control Operators and not allowed to be used by the General Public. [Order of Hon,ble High Court of Delhi in WP(C) 10052 of 2009 dated 1407-2009 and LPA-429/2009 dated 08-09-2009]
4.	Dazomet	The use of Dazomet is not permitted on Tea. (S.O.3006 (E) dated 31 <sup>st</sup> Dec, 2008)
5.	Dichloro Diphenyl Trichloroethane (DDT)	<p>The use of DDT for the domestic Public Health Programme is restricted up to 10,000 Metric Tonnes per annum, except in case of any major outbreak of epidemic. M/s Hindustan Insecticides Ltd., the sole manufacturer of DDT in the country may manufacture DDT for export to other countries for use in vector control for public health purpose. The export of DDT to Parties and State non-Parties shall be strictly in accordance with the paragraph 2(b) article 3 of the Stockholm Convention on Persistent Organic Pollutants (POPs). (S.O.295 (E) dated 8<sup>th</sup> March, 2006)</p> <p>Use of DDT in Agriculture is withdrawn. In very special circumstances warranting the use of DDT for plant protection work, the state or central Govt. may purchase it directly from M/s Hindustan Insecticides Ltd. to be used under expert Governmental supervision. (S.O.378 (E) dated 26<sup>th</sup>May, 1989)</p>
6.	Fenitrothion	The use of Fenitrothion is banned in Agriculture except for locust control in scheduled desert area and public health. (S.O.706 (E) dated 03 <sup>rd</sup> May, 2007)
7.	Methyl Bromide	Methyl Bromide may be used only by Govt./Govt. undertakings/Govt. Organizations / Pest control operators under the strict supervision of Govt. Experts or Experts whose expertise is approved by the Plant Protection Advisor to Govt. of India.

		[G.S.R.371 (E) dated 20 <sup>th</sup> May, 1999 and earlier RC decision]
8.	Monocrotophos	Monocrotophos is banned for use on vegetables. (S.O.1482 (E) dated 10 <sup>th</sup> Oct, 2005)
9.	Trifluralin	(vide S.O 3951(E) dated 8 <sup>th</sup> August, 2018) (i) The Registration, import, manufacture, formulation, transport, sell and its all uses except use in wheat shall be prohibited and completely banned from date of publication of this Order. (ii) (ii) A cautionary statement has to be incorporated in the label and leaflet that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.

### III. PESTICIDES WHICH SHALL BE PHASED OUT VIDE GAZETTE NOTIFICATION NO. S.O. 3951 (E).

S. No.	Name of the pesticide	Insecticides to be phase out by 31 <sup>st</sup> December, 2020
1	<b>Alachlor</b>	(i) No new certificate of registration to manufacture shall be issued after publication of this Order. (ii) No person shall import, manufacture or formulate Alachlor with effect from the 1st January, 2019. (iii) The use of Alachlor shall be completely banned with effect from the 31st December, 2020. (iv) It is toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets " toxic to aquatic organism hence should not be used near water bodies, aquaculture or pisciculture area.
2	<b>Dichlorovos</b>	(i) No new certificate of registration to manufacture shall be issued after publication of this Order. (ii) No person shall import, manufacture or formulate dichlorvos with effect from the

		<p>January, 2019.</p> <p>(iii) The use of dichlorvos shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day.</p>
3	<b>Phorate</b>	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p> <p>(ii) No person shall import, manufacture or formulate Phorate with effect from the 1st January, 2019.</p> <p>(iii) The use of Phorate shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day.</p> <p>(vi) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds.</p>
4	<b>Phosphamidon</b>	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p> <p>(ii) No person shall import, manufacture or formulate Phosphamidon with effect from the 1st January, 2019.</p> <p>(iii) The use of Phosphamidon shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day.</p>

		(vi) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds.
5	<b>Triazophos</b>	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p> <p>(ii) No person shall import, manufacture or formulate Triazophos with effect from the 1 st January, 2019.</p> <p>(iii) The use of Triazophos shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day</p> <p>(vi) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds</p>
6	<b>Trichlorfon</b>	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p> <p>(ii) No person shall import, manufacture or formulate Trichlorfon with effect from the 1 st January, 2019.</p> <p>(iii) The use Trichlorfon shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds.</p>

## **Pesticides used for analysis which has been considered under the restricted use and banned category by Central Insecticides Board & Registration Committee**

<b>S. no.</b>	<b>Pesticides</b>	<b>Banned from</b>
1	Aldrin	19.03.2019
2	Dieldrin	(vide S.O. 682 (E) dated 17th July 2001)
3	Endosulfron	(vide ad-Interim order of the Supreme Court of India in the Writ Petition (Civil) No. 213 of 2011 dated 13th May, 2011 and finally disposed of dated 10th January, 2017)
4	Endrin	19.03.2019
5	Heptachlor	19.03.2019
6	Lindane (Gamma-HCH)	19.03.2019
7	Methyl Parathion	(vide S.O 3951(E) dated 8th August, 2018)
8	Phosphamidon 85% SL	S.O. 3951 (E), 31st December, 2020
9	Alachlor	S.O. 3951 (E), 31st December, 2020
10	Phorate	S.O. 3951 (E), 31st December, 2020
11	Phosphamidon	S.O. 3951 (E), 31st December, 2020