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Determination of the concentrations of heavy metals of aqua culture water at Vempa, Bhimavaram Mandal, West Godavari (AP)

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Abstract

Determination of concentrations of heavy metals (Cd, Hg, Pb, As, Mn, Cr, Ni, Cu, Zn, and Fe) of the 6 samples collected from Vempa Village in Bhimavaram Mandal, Andhara Pradesh, India. All the samples were labeled properly and analyzed for the heavy metal concentrations. The minimum and maximum heavy metal concentrations in different parts of the Vempa Village are discussed. Methyl isobutyl ketone (MIBK), was distilled and used for extraction of metals. Ammonium pyrrolydinedithiocarbamate (APDC) solution, 4%, Nitric acid solution 4.0 M, Nitric acid solution 1.0 M and Sodium hydroxide solution 1.0 M were prepared and used in analysis. Different methods are used for the determination of concentrations of heavy metals.

Key Words: Heavy Metals, MIBK, APDC, Cd, Hg, Pb, As, Mn, Cr, Ni, Cu, Zn and Fe

Introduction

Nowadays owing to high costs in cultivation and agriculture practices and vagaries in commercialism and consumption strategies, the farmers in and around Bhimavaram are shifting to new type of practices to solve the problem of food production. Andhra Pradesh is a major player in the aquaculture sector in India. Bhimavaram has immense potential for shrimp/fisheries exports. Nowadays hygiene standard are strictly enforced while exporting. Hence, cleanliness and quality are also need of the hour. In this respect a regular monitoring of water quality is essential to determine the status of water bodies with reference to fish culture. Hence, the current study was taken up for the study of fish pond water quality in and around of Bhimavaram Town, Andhra Pradesh, India.

The objectives of this study are as follows:

i) To study the concentrations of heavy metals in aqua culture pond water

ii) To identify the causes of fish pond water pollution and to recommend suitable remedies.

Materials and Methods

Study area

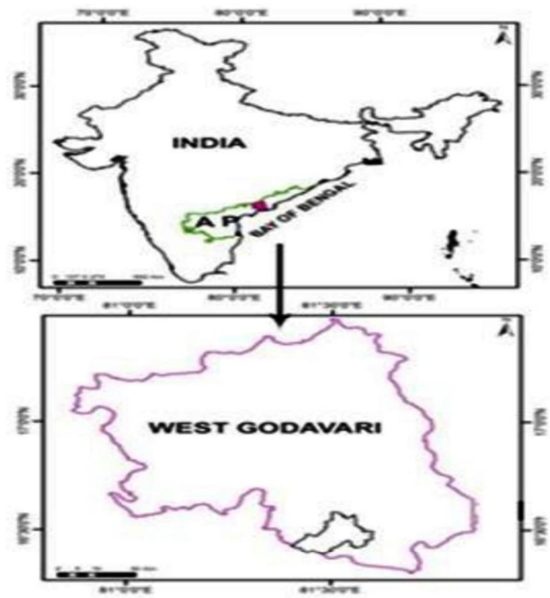

Figure: 1 Study area; Vempa Village, Bhimaaram Mandal, Andhr Pradesh, India

Figure: 1 Study area; Vempa Village, Bhimaaram Mandal, Andhr Pradesh, India State of Andhra Pradesh in India. The study area for the present investigation is Vempa village, rural of Bhimavaram Mandal. The study area of the Bhimavaram Mandal from West Godavari district is shown in Figure 1.

Samples collection

A large number of fish pond water samples were collected from 6 sites, from Vempa and its vicinity from July 2013 to June 2014. The samples of water were collected in the glass bottles.

Heavy metals analysis

Methyl isobutyl ketone (MIBK): Methyl isobutyl ketone (MIBK) was distilled and used for extraction of metals. Ammonium pyrrolydinedithiocarbamate (APDC) solution, 4%, Nitric acid solution 4.0 M, Nitric acid solution 1.0 M and Sodium hydroxide solution 1.0 M were prepared. The following methods are used for the determination of concentrations of heavy metals

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Sampling Stations	Village Name	Area (Ha)	Latitude	Longitude	Description of the study area
S1	Nadipalle	2.87	16° 29' 18.792" N	81° 34' 32.130" E	Located beside Muttumkodu branch channel
S2	Tundurru	0.82	16° 27' 41.686" N	81° 35' 32.351" E	Located nearby aquaculture ponds
S3	Vempa	1.72	16° 27' 52.756" N	81° 34' 19.364" E	Located nearby aquaculture ponds
S4	Vempa	4.83	16° 27' 7.656" N	81° 34' 42.416" E	Located beside aquaculture ponds
S5	Vempa	0.26	16° 25' 41.710" N	81° 34' 16.262" E	Located adjacent aquaculture ponds
S6	Vempa	1.20	16° 25' 29.301" N	81° 33' 31.403" E	Located nearby aquaculture ponds

	Heavy Metals	
1	Cadmium	Atomic absorption spectrometer method
2	Mercury	Cold vapour flame less atomic absorption
3	Lead	Atomic absorption spectrometer method
4	Arsenic	Atomic absorption spectrometer method
5	Manganese	Atomic absorption spectrometer method
6	Chromium	Colorimetric method
7	Nickel	Atomic absorption spectrometer method
8	Copper	Atomic absorption spectrometer method
9	Zinc	Atomic absorption spectrometer method
10	Iron	Colorometric – Phenanthroline method

Results and Discussion

Heavy metal concentration of aquaculture waters

All the 6 samples were labeled properly and analyzed for the heavy metal (Cd, Hg, Pb, As, Mn, Cr, Ni, Cu, Zn and Fe) concentrations. The minimum and maximum heavy metal concentration in different parts of the Vempa Village in Bhimavaram region has been presented in Figures 2 to 11.

Cadmium (Cd)

All water samples had measurable concentrations of Cd metal (Figure 2). However, the samples concentration lies between 0.001 to 0.001 mg/L. All samples are well below the standards given for drinking (BIS, WHO, EU, USEPA) and pond aquaculture purposes (Boyd, 1998) relevant maximum contaminant limits prescribed for Cd. Cadmium enters into aquaculture ponds because corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints.

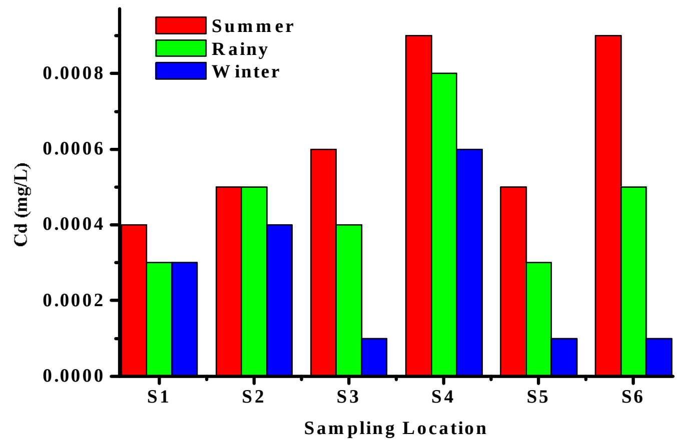

Figure: 2 Graph showing seasonal variation in Cd metal readings 2013-2014

Mercury (Hg)

Mercury (Hg) is toxic to both aquatic life and humans. Inorganic form occurs naturally in rocks and soils. The minimum and maximum mercury concentrations varied between 0.0001 to 0.0008 mg/L (Figure 3). It is being transported to the surface water through erosion and weathering. However, higher concentrations can be found in areas near the industries and agriculture. The most common sources are caustic soda, fossil fuel combustion, paint, pulp and paper, batteries, dental amalgam and bactericides.

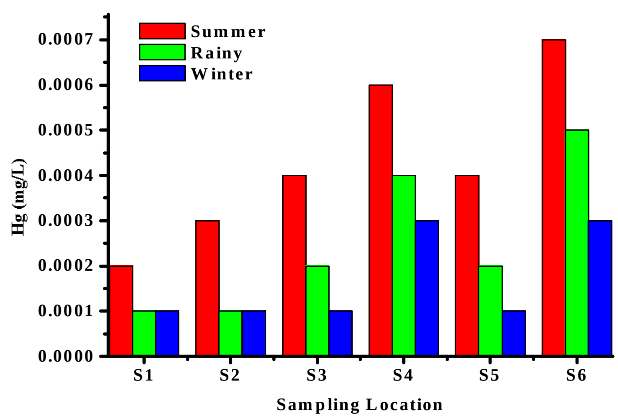

Figure: 3 Graph showing seasonal variation in Hg metal readings 2013-2014

Lead (Pb)

The minimum and maximum lead concentrations varied between 0.0009 to 0.008 mg/L all of the samples exceeded the relevant prescribed limits for drinking water for that element (Figure 4). The major sources of lead in drinking water are corrosion of household plumbing systems, and erosion of natural deposits.

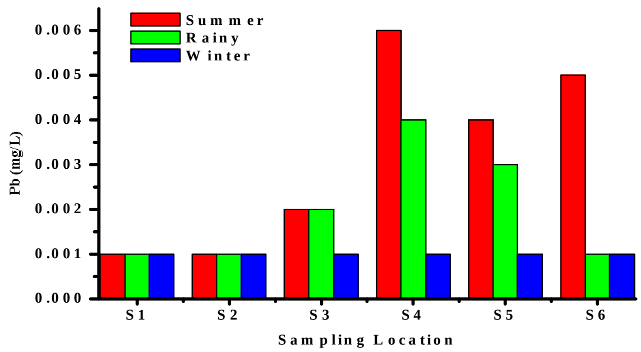

Figure: 4 Graph showing seasonal variation in Pb metal readings 2013-2014

Arsenic (As)

During the study period 2013-14 the Arsenic concentration levels in aquaculture water locations of study area are varied from 0.001 to 0.06 mg/L in the overall study areas (Figure 5). Arsenic enters aquaculture pond water sources by dissolution from rocks and soils, from biological recycling, from atmospheric fallout and especially from industrial wastes.

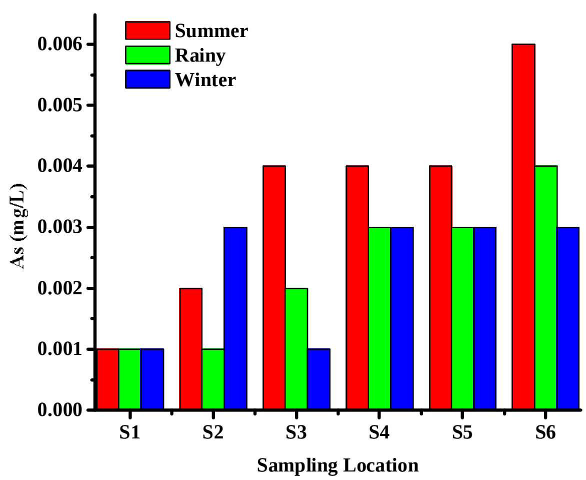

Figure: 5 Graph showing seasonal variation in As metal readings 2013-2014

Manganese (Mn)

The minimum and maximum manganese concentrations varied between 0.001 to 0.06 mg/L (Figure 6). Measurable concentrations of the manganese metal were found in all samples. However, only 15 of the samples exceeded the relevant prescribed limits for drinking water for that element. Mn is a very reactive element, found in nature and used extensively in industry for the manufacture of glass, ceramics, batteries, paints, varnishes, inks, dyes and fireworks. However, in ground waters subject to reducing conditions Mn can be leached from the soil and occur in high concentrations.

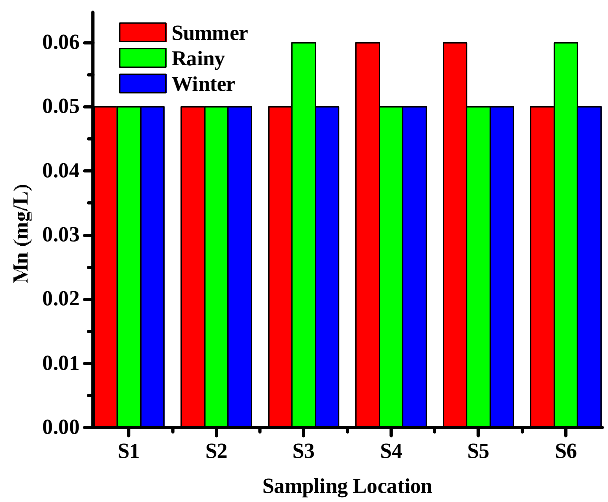

Figure: 6 Graph showing seasonal variation in Mn metal readings 2013-2014

Chromium (Cr)

The minimum and maximum Cr concentrations were found to be 0.0007 to 0.06 mg/L respectively (Figure 7). Fifty two water samples had measurable concentrations of Cr metal. However, the entire sample exceeded the Cr maximum contaminant limits stipulated for drinking water. Hexavalent chromium can enter water through industrial contamination from manufacturing facilities, including electroplating factories, leather tanneries and textile manufacturing facilities, or from disposal of fluids used in cooling towers. It also occurs naturally in some minerals. The commonly used tap water disinfectant chlorine can transform trivalent chromium into toxic hexavalent chromium. Chromium-6 is also produced by industrial processes and manufacturing activities including discharges from steel and pulp mills among others.

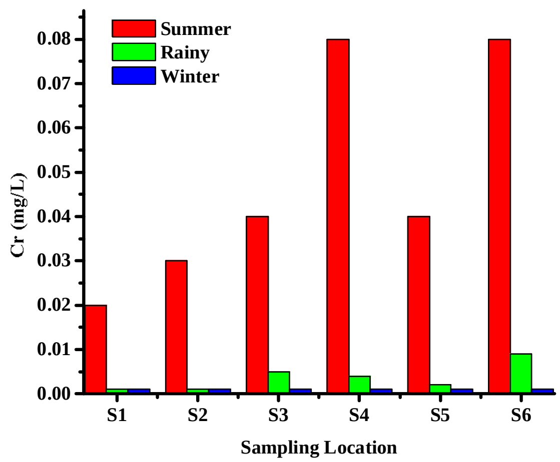

Figure: 7 Graph showing seasonal variation in Cr metal readings 2013-2014

Nickel (Ni)

Fifty two water samples had measurable concentrations of Ni between 0.0009 to 0.08 mg/L (Figure 8). Ni enters groundwater and surface water sources by dissolution from rocks and soils, from biological recycling, from atmospheric fallout and especially from industrial wastes through leaching from Ni-containing pipes.

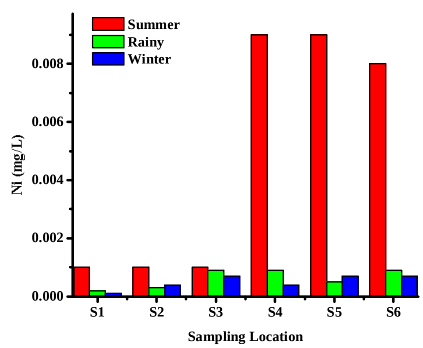

Figure: 8 Graph showing seasonal variation in Ni metal readings 2013-2014

Copper (Cu)

The minimum and maximum copper concentrations were found to be 0.0009 mg/L and 0.009 mg/L respectively (Figure 9). Cu enters the water system through mineral dissolution, industrial effluents, because of its use as algaecide, agricultural pesticide sprays and insecticide. Cu may be dissolved from water pipes and plumbing fixtures, especially by water whose pH is below 7. Cu salts are sometimes purposely added in small amounts to water supply reservoirs to suppress the growth of algae. Therefore Cu is more readily available for solution in surface and ground water than its low average abundance in rocks might imply.

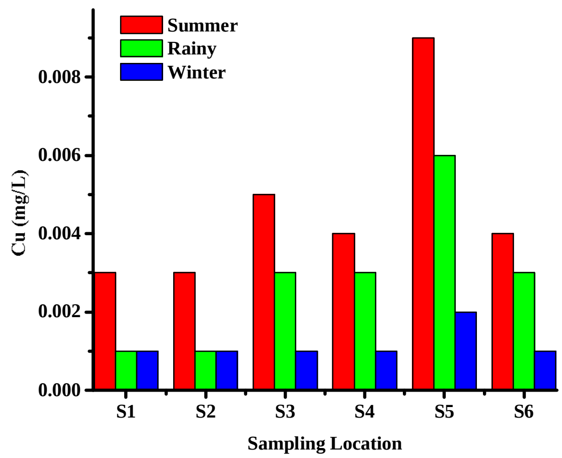

Figure: 9 Graph showing seasonal variation in Cu metal readings 2013-2014

Zinc (Zn)

The maximum and minimum concentration of zinc metal varied between the 0.001 to 0.009 mg/L(Figure 10). In all samples measurable concentration of Zn is found. The metal concentration is not exceeding the limits. Zn has lots of use like galvanization of steel, preparation of negative plates in electric batteries, vulcanization of rubber, wood preservatives and antiseptics and in rat and mouse poison (Zn-phosphide). Zn is also used extensively as a white pigment, zinc oxide (ZnO) in paint and rubber.

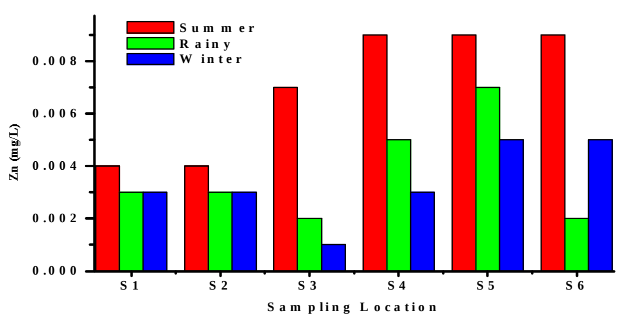

Figure: 10 Graph showing seasonal variation in Zn metal readings 2013-2014

Iron (Fe)

The minimum and maximum iron concentrations varied between 0.09 to 0.2 mg/L Measurable concentrations of the metal were found in all samples (Figure 11). However, all samples exceeded the relevant prescribed limits for drinking water. Iron exists naturally in rivers, lakes, and underground water. It may also be released to water from natural deposits, industrial wastes, refining of iron ores, and corrosion of iron containing metals.

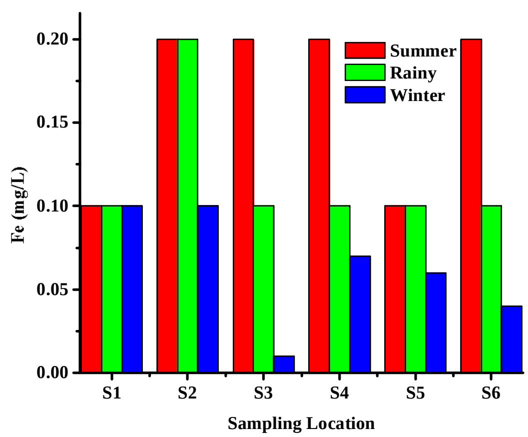

Figure: 11 Graph showing seasonal variation in Fe metal readings 2013-2014

Table 1 for S1: Results of water quality parameters tested in 3 different seasons					Water quality standards					
Heavy Metals		Summer	Rainy	Winter	BIS 10500 : 2012 Accept-able limit	BIS 10500 : 2012 Permi-ssible limit	WHO	EU	US EPA	Boyd (1998) Water Quality for Pond Aquaculture
Cadmium (as Cd)	mg/L	0.0004	0.0003	0.0003	0.003	-	0.003	0.005	0.005	0.001
Mercury (as Hg)	mg/L	0.0002	0.0001	0.0001	0.001	-	0.006	0.002	0.001	0.001
Lead (as Pb)	mg/L	0.001	0.001	0.001	0.01	-	0.01	0.015	0.01	0.003
Arsenic (as As)	mg/L	0.001	0.001	0.001	0.01	0.05	0.01	0.05	0.01	-
Manganese (as Mn)	mg/L	0.05	0.05	0.05	0.1	0.3	0.1	0.05	0.05	0.05 -0.2
Chromium (as Cr)	mg/L	0.02	0.001	0.001	0.05	-	0.05	0.1	0.05	-
Nickel (as Ni)	mg/L	0.001	0.0002	0.0001	0.02	-	0.07	0.1	0.02	0.001
Copper (as Cu)	mg/L	0.003	0.001	0.001	0.05	1.5	2	1.3	2.0	< 0.005
Zinc (as Zn)	mg/L	0.004	0.003	0.003	5	15	4	5	5.0	< 0.01
Iron (as Fe)	mg/L	0.1	0.1	0.1	0.3	-	0.3	0.3	0.2	0.01 -0.3

Bureau of Indian Standards IS 10500 : 2012; WHO Guidelines for Drinking-Water Quality (2011); US EPA Primary Drinking Water Standards; E.U: European Union /European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 of 2007); Water Quality for Pond Aquaculture-Acceptable Concentration Ranges in Aquaculture Pond Waters" Boyd (1998).

Note: 1. Season wise data primarily compared with Boyd (1998) water quality standards for pond aquaculture.
2. Parameters which exceed the permissible limits and which fall below the optimum range are highlighted with red colour.

Remarks: Heavy metal concentrations are well below the standards given for drinking (BIS, WHO, EU, US EPA) and pond aquaculture purposes (Boyd, 1998).

Sources for contamination: Agricultural runoff, Aqua-cultural practices such as addition of fish feeds and biocides, Irrigation canals contaminated by sewage, Fine organic or inorganic particles Industrial effluents

Suggestions: Less contaminated feeds should be preferred, Caution should be exercised while choosing biocide brands, Management of pond water quality by periodic monitoring, Minimize river pollution

Table 2 for S2: Results of water quality parameters tested in 3 different seasons					Water quality standards					
Heavy Metals		Summer	Rainy	Winter	BIS 10500 : 2012 Accept-able limit	BIS 10500 : 2012 Permi-ssible limit	WHO	EU	US EPA	Boyd (1998) Water Quality for Pond Aquaculture
Cadmium (as Cd)	mg/L	0.0005	0.0005	0.0004	0.003	-	0.003	0.005	0.005	0.001
Mercury (as Hg)	mg/L	0.0003	0.0001	0.0001	0.001	-	0.006	0.002	0.001	0.001
Lead (as Pb)	mg/L	0.001	0.001	0.001	0.01	-	0.01	0.015	0.01	0.003
Arsenic (as As)	mg/L	0.002	0.001	0.003	0.01	0.05	0.01	0.05	0.01	-
Manganese (as Mn)	mg/L	0.05	0.05	0.05	0.1	0.3	0.1	0.05	0.05	0.05 -0.2
Chromium (as Cr)	mg/L	0.03	0.001	0.001	0.05	-	0.05	0.1	0.05	-
Nickel (as Ni)	mg/L	0.001	0.0003	0.0004	0.02	-	0.07	0.1	0.02	0.001
Copper (as Cu)	mg/L	0.003	0.001	0.001	0.05	1.5	2	1.3	2.0	< 0.005
Zinc (as Zn)	mg/L	0.004	0.003	0.003	5	15	4	5	5.0	< 0.01
Iron (as Fe)	mg/L	0.2	0.2	0.1	0.3	-	0.3	0.3	0.2	0.01 -0.3

Bureau of Indian Standards IS 10500 : 2012; WHO Guidelines for Drinking-Water Quality (2011); US EPA Primary Drinking Water Standards; E.U: European Union /European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 of 2007); Water Quality for Pond Aquaculture-Acceptable Concentration Ranges in Aquaculture Pond Waters" Boyd (1998).

Note: 1. Season wise data primarily compared with Boyd (1998) water quality standards for pond aquaculture.
2. Parameters which exceed the permissible limits and which fall below the optimum range are highlighted with red colour.

Remarks: Heavy metal concentrations are well below the standards given for drinking (BIS, WHO, EU, US EPA) and pond aquaculture purposes (Boyd, 1998).

Sources for contamination: Agricultural runoff, Aqua-cultural practices such as addition of fish feeds and biocides, Irrigation canals contaminated by sewage, Fine organic or inorganic particles, Industrial effluents

Suggestions: Less contaminated feeds should be preferred, Caution should be exercised while choosing biocide brands, Management of pond water, quality by periodic monitoring, Minimize river pollution.

Table 3 for S3: Results of water quality parameters tested in 3 different seasons					Water quality standards					
Heavy Metals		Summer	Rainy	Winter	BIS 10500 : 2012 Accept-able limit	BIS 10500 : 2012 Permi-ssible limit	WHO	EU	US EPA	Boyd (1998) Water Quality for Pond Aquaculture
Cadmium (as Cd)	mg/L	0.0006	0.0004	0.0001	0.003	-	0.003	0.005	0.005	0.001
Mercury (as Hg)	mg/L	0.0004	0.0002	0.0001	0.001	-	0.006	0.002	0.001	0.001
Lead (as Pb)	mg/L	0.002	0.002	0.001	0.01	-	0.01	0.015	0.01	0.003
Arsenic (as As)	mg/L	0.004	0.002	0.001	0.01	0.05	0.01	0.05	0.01	-
Manganese (as Mn)	mg/L	0.05	0.06	0.05	0.1	0.3	0.1	0.05	0.05	0.05 -0.2
Chromium (as Cr)	mg/L	0.04	0.005	0.001	0.05	-	0.05	0.1	0.05	-
Nickel (as Ni)	mg/L	0.001	0.0009	0.0007	0.02	-	0.07	0.1	0.02	0.001
Copper (as Cu)	mg/L	0.005	0.003	0.001	0.05	1.5	2	1.3	2.0	< 0.005
Zinc (as Zn)	mg/L	0.007	0.002	0.001	5	15	4	5	5.0	< 0.01
Iron (as Fe)	mg/L	0.2	0.1	0.01	0.3	-	0.3	0.3	0.2	0.01 -0.3

Bureau of Indian Standards IS 10500 : 2012; WHO Guidelines for Drinking-Water Quality (2011); US EPA Primary Drinking Water Standards; E.U: European Union /European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 of 2007); Water Quality for Pond Aquaculture-Acceptable Concentration Ranges in Aquaculture Pond Waters" Boyd (1998).

Note: 1. Season wise data primarily compared with Boyd (1998) water quality standards for pond aquaculture.
2. Parameters which exceed the permissible limits and which fall below the optimum range are highlighted with red colour.

Remarks: Heavy metal concentrations are well below the standards given for drinking (BIS, WHO, EU, US EPA) and pond aquaculture purposes (Boyd, 1998).

Sources for contamination: Agricultural runoff, Aqua-cultural practices such as addition of fish feeds and biocides, Irrigation canals contaminated by sewage, Fine organic or inorganic particles, Industrial effluents

Suggestions: Less contaminated feeds should be preferred, Caution should be exercised while choosing biocide brands, Management of pond water quality by periodic monitoring, Minimize river pollution

Table 4 for S4: Results of water quality parameters tested in 3 different seasons					Water quality standards					
Heavy Metals		Summer	Rainy	Winter	BIS 10500 : 2012 Accept-able limit	BIS 10500 : 2012 Permi-ssible limit	WHO	EU	US EPA	Boyd (1998) Water Quality for Pond Aquaculture
Cadmium (as Cd)	mg/L	0.0009	0.0008	0.0006	0.003	-	0.003	0.005	0.005	0.001
Mercury (as Hg)	mg/L	0.0006	0.0004	0.0003	0.001	-	0.006	0.002	0.001	0.001
Lead (as Pb)	mg/L	0.006	0.004	0.001	0.01	-	0.01	0.015	0.01	0.003
Arsenic (as As)	mg/L	0.004	0.003	0.003	0.01	0.05	0.01	0.05	0.01	-
Manganese (as Mn)	mg/L	0.06	0.05	0.05	0.1	0.3	0.1	0.05	0.05	0.05 -0.2
Chromium (as Cr)	mg/L	0.08	0.004	0.001	0.05	-	0.05	0.1	0.05	-
Nickel (as Ni)	mg/L	0.009	0.0009	0.0004	0.02	-	0.07	0.1	0.02	0.001
Copper (as Cu)	mg/L	0.004	0.003	0.001	0.05	1.5	2	1.3	2.0	< 0.005
Zinc (as Zn)	mg/L	0.009	0.005	0.003	5	15	4	5	5.0	< 0.01
Iron (as Fe)	mg/L	0.2	0.1	0.07	0.3	-	0.3	0.3	0.2	0.01 -0.3
Bureau of Indian Standards IS 10500 : 2012; WHO Guidelines for Drinking-Water Quality (2011); US EPA Primary Drinking Water Standards; E.U: European Union /European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 of 2007); Water Quality for Pond Aquaculture-Acceptable Concentration Ranges in Aquaculture Pond Waters" Boyd (1998).										
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Remarks: Heavy metal concentrations are well below the standards given for drinking (BIS, WHO, EU, US EPA) and pond aquaculture purposes (Boyd, 1998).										
Sources for contamination: Agricultural runoff, Aqua-cultural practices such as addition of fish feeds and biocides, Irrigation canals contaminated by sewage, Fine organic or inorganic particles, Industrial effluents										
Suggestions: Less contaminated feeds should be preferred, Caution should be exercised while choosing biocide brands, Management of pond water quality by periodic monitoring, Minimize river pollution										

Table 5 for S5: Results of water quality parameters tested in 3 different seasons					Water quality standards					
Heavy Metals		Summer	Rainy	Winter	BIS 10500 : 2012 Accept-able limit	BIS 10500 : 2012 Permi-ssible limit	WHO	EU	US EPA	Boyd (1998) Water Quality for Pond Aquaculture
Cadmium (as Cd)	mg/L	0.0005	0.0003	0.0001	0.003	-	0.003	0.005	0.005	0.001
Mercury (as Hg)	mg/L	0.0004	0.0002	0.0001	0.001	-	0.006	0.002	0.001	0.001
Lead (as Pb)	mg/L	0.004	0.003	0.001	0.01	-	0.01	0.015	0.01	0.003
Arsenic (as As)	mg/L	0.004	0.003	0.003	0.01	0.05	0.01	0.05	0.01	-
Manganese (as Mn)	mg/L	0.06	0.05	0.05	0.1	0.3	0.1	0.05	0.05	0.05 -0.2
Chromium (as Cr)	mg/L	0.04	0.002	0.001	0.05	-	0.05	0.1	0.05	-
Nickel (as Ni)	mg/L	0.009	0.0005	0.0007	0.02	-	0.07	0.1	0.02	0.001
Copper (as Cu)	mg/L	0.009	0.006	0.002	0.05	1.5	2	1.3	2.0	< 0.005
Zinc (as Zn)	mg/L	0.009	0.007	0.005	5	15	4	5	5.0	< 0.01
Iron (as Fe)	mg/L	0.1	0.1	0.06	0.3	-	0.3	0.3	0.2	0.01 -0.3
Bureau of Indian Standards IS 10500 : 2012; WHO Guidelines for Drinking-Water Quality (2011); US EPA Primary Drinking Water Standards; E.U: European Union /European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 of 2007); Water Quality for Pond Aquaculture-Acceptable Concentration Ranges in Aquaculture Pond Waters" Boyd (1998).										
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Suggestions: Less contaminated feeds should be preferred, Caution should be exercised while choosing biocide brands, Management of pond water quality by periodic monitoring, Minimize river pollution										

Table 6 for S6: Results of water quality parameters tested in 3 different seasons					Water quality standards					
Heavy Metals		Summer	Rainy	Winter	BIS 10500 : 2012		WHO	EU	US EPA	Boyd (1998) Water Quality for Pond Aquaculture
					Accept-able limit	Permi-ssible limit				
Cadmium (as Cd)	mg/L	0.0009	0.0005	0.0001	0.003	-	0.003	0.005	0.005	0.001
Mercury (as Hg)	mg/L	0.0007	0.0005	0.0003	0.001	-	0.006	0.002	0.001	0.001
Lead (as Pb)	mg/L	0.005	0.001	0.001	0.01	-	0.01	0.015	0.01	0.003
Arsenic (as As)	mg/L	0.006	0.004	0.003	0.01	0.05	0.01	0.05	0.01	-
Manganese (as Mn)	mg/L	0.05	0.06	0.05	0.1	0.3	0.1	0.05	0.05	0.05 -0.2
Chromium (as Cr)	mg/L	0.08	0.009	0.001	0.05	-	0.05	0.1	0.05	-
Nickel (as Ni)	mg/L	0.008	0.0009	0.0007	0.02	-	0.07	0.1	0.02	0.001
Copper (as Cu)	mg/L	0.004	0.003	0.001	0.05	1.5	2	1.3	2.0	< 0.005
Zinc (as Zn)	mg/L	0.009	0.002	0.005	5	15	4	5	5.0	< 0.01
Iron (as Fe)	mg/L	0.2	0.1	0.04	0.3	-	0.3	0.3	0.2	0.01 -0.3

Bureau of Indian Standards IS 10500 : 2012; WHO Guidelines for Drinking-Water Quality (2011); US EPA Primary Drinking Water Standards; E.U: European Union /European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 of 2007); Water Quality for Pond Aquaculture-Acceptable Concentration Ranges in Aquaculture Pond Waters" Boyd (1998).

Note: 1. Season wise data primarily compared with Boyd (1998) water quality standards for pond aquaculture.
2. Parameters which exceed the permissible limits and which fall below the optimum range are highlighted with red colour.

Remarks: Heavy metal concentrations are well below the standards given for drinking (BIS, WHO, EU, US EPA) and pond aquaculture purposes (Boyd, 1998).

Sources for contamination: Agricultural runoff, Aqua-cultural practices such as addition of fish feeds and biocides, Irrigation canals contaminated by sewage, Fine organic or inorganic particles, Industrial effluents

Suggestions: Less contaminated feeds should be preferred, Caution should be exercised while choosing biocide brands, Management of pond water quality by periodic monitoring, Minimize river pollution

Conclusions and Suggestions : Based on the results obtained in the present investigations, critical analysis of the data and correlating the data with the prevailing conditions of the cultural practices, the water of fish pond in and around Vempa Village, we arrive at the following suggestions. Heavy metal concentrations are well below the standards given for drinking and pond aquaculture purposes. Less contaminated feeds should be preferred, Caution should be exercised while choosing biocide brands, Management of pond water quality by periodic monitoring, Minimize river pollution.

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