Trace elements inlakewater

ThelakewaterischaracterizedbyhighpHandconductivity.Thedistributionoftraceelements inlake water,for both dissolvedandtotalconcentrationsshowswide rangefor mostelements. Aqueous contamination representsa crucial environmental issue, especiallywhen elementsare in highconcentrationinthebioavailableforms.WHOhealthbasedlimitguidelinevalues for drinking waterare shownintableforsomeoftheregulatedelements,andreferencemadeonthe NEMA guidelinevalues(NEMA 2006).

Guidelines values for health related inorganicchemical species

L.Baringo WHO(mgL^{-1})NEMA USEPA EU As

0.05

Cd 0.005

Total Cr 0.05

F- 1.5 1.5-1.7

Pb0.05

Hg 0.001

Cu

Se 0.01

Toxicinorganicelementsconcentrations(Hg,As,Be,Ba,Pb,Ni,Sn,Cu,Cr,Cd,Ag,Se)in wateraremoreprioritizedduetothepotentiallong termhumanhealthhazardsandwhenin excessivelevelstendtointerferewithmany beneficialusesofthewater,whileexcess concentrationsofsometracemetals(Al,Fe, Mn,Zn)areregulatedindrinking waterdueto aesthetic properties (FAO).

TheconcentrationofZnintap watercanbeconsiderablyhigherthanthatinsurfacewaterowing totheleachingactionofZnfromgalvanizedpipes,brassandotherZnalloys.Zincimpartsto water anundesirableastringenttasteandinconcentrationsinexcessof5ppm.The water may appear opalescent and develop agreasyfilm on boiling(FAO).

Macrophytessuchaswater hyacinthareconsideredgoodaccumulatorsofmetals,andusefulin phytoremediationofwastewaterscontaining highlevelsofmetals.Suchinformationonlake macrophytes is lacking, but could also be prioritized in futurestudies.

Flourideionconcentrationsinthe LakeBaringo basin

Flouride mineraldepositsoccurinthe Kenyanriftregion,andpresenceof highFinrocksare oftenthesourceofhighFcontentsinundergroundandsurfacewater.LakeBaringo,beinga waterscarcearea,thesurfacewaterofrivers,lake,togetherwithotherundergroundwater sourcesarethecommonsourcesofFexposuretothesurrounding communities.Fishare also exposedtoF fromthehabitat.Althoughthere isnomuchinformationonthe fishF contentsinL. Baringoandotherlakes,Gikunjuetal.,1992andGikunju1992reportedonF levels(ranging from1.3mgKg^{-1}to2.0 mgKg^{-1}wetweight)infilletsof tilapiinefish and*Micropterussalmoides*fromLakeNaivasha.Accordingtoastudy(Gantaetal.,2015),inahighfluoridatedbeltarea, theamountofFpresentinthefishesisdirectlyrelatedtotheseverity offlourosisamongstfish consuming populationsuggesting fishes as contributing factor to flourosisdepending upon dietary consumption.ThemeanFcontentofvariousriverandseafishes(bone,muscleandskin) ranged from0.22ppmto151ppm(river fishes)and0.83ppmto4.22ppm(sea water fishes). F showedmoreaffinity towardsthehardcalcifiedtissuesresultinginhigherconcentrationsoffin thebones.IntheNaivashabasinundergroundwaterswerefoundtocontainhighly variableF concentrations(0.22mgL^{-1} to74.98 mgL^{-1}),an indicationofgeochemical Fenrichmentin regionalgroundwaters (Olakaetal.,2016).Thisimpliesthatthe totalcontributioninhuman F intakescan vary greatly whenothersources ofintakesuchasfoodaretakenintoaccount.In general,long-termuseofdrinkingwaterwithFsignificantlyabove1.5mgL^{-1} canhaveserious effectsonhealth.Dentalandskeletalflourosisare associatedwithexposuretohighF concentrationsindrinking water (Fawelletal.,2006;SCHER2011).This observationisevident elsewhere,withintheEastAfricanriftvalley.Inmostareasofthe Ethiopianrift valley,wateris epidemiologically themostimportantsourceofF(75%-90%ofthedaily intake)flourosisnot only affectsthepeople’shealth,butalsohasseriouseconomicandsocialconsequences(Tekle- Haimanot et al., 2006;Tekle-Haimanot and Haile2014).

Tracemetals insuspendedandbottomsediments

Accumulationandvariationsofmetalsinsedimentsshows.Mostmetalconcentrationsare belowthefreshwatersedimentlevelsofpotential biologicalimpactstoaquaticorganismsbased onthe consensusbasedSGQ values,althoughPb,CdandNiexceededthe lower limitwhich recommends moresiteinvestigations

Consensusbasedmetalsedimentquality guideline(SQG)valuesareoftenusedtoindicate probablesedimentmetalnegativeeffectsontheaquaticenvironment.Using existing SQGfrom otherareas(Table5),Cd,Pb,ZnandNilevelswereallabovetheTECvaluesbutbelowthe PEL, indicatingthat there areno signs ofadverseeffects to aquaticorganisms.

Trace elements in fishspecies

Veryfewstudiesreport ontraceelements levelsinlakefloraandfauna.Theconcentrationlevels ofCdandHg foundinfishtissues(Table6)werebelowcriticallimitsforfishandfishery products.Leadlevelswereabovetheselimits(0.2to1.7 ppm).Thereisnodataon MeHgconcentrationsinthelakecompartments.Mercury isknowntobetransformedtoothermethyl forms withinthe aquatic environment, but only total concentrations values are available. Althoughthefractionofmethylmercury insedimentsissmall,themajority ofHgthat accumulates inbiota isinthe methylatedform(Langston1982;Bernhard andGeorge 1986) which is also themosttoxic form.

TargetHazardQuotient(THQ) wasusedtoassessnon-carcinogenic healthrisksof metalsto consumers.Calculatedrisksusing assumedparametersandreferencedoseforeachelementare shown in Table.e

Metal potential health risks evaluation

$$THQ = \frac{(EFr \times EDr \times IRfa \times C)}{(RfDo \times BWa \times AT)}$$

WhereEFr= exposurefrequency(365days/yr);

EDr =exposureduration;

IRfa=fooditemconsumption per day;For fishin Kenya5.2 kg/yr per capita; C

=metal concentration in food item mg/kg;

BWa=bodyweight average60-70kgfor adults;

RfDo =referencedosemg/kgbdwt/day(USEPA, 2012)

AT= averagetime for non-carcinogen 365 days peryear

AccordingtoTHQevaluationcalculationaTHQof≤1indicatesthatthereisnosignificantrisk tohealthof consumer;whereas,a valuegreater than1indicatesa possiblehealthrisksassociated consumption ofrespectiveelements.

Conclusion

Theprotectionofwaterresourcesisoneofthemainchallengesformostlakemanagersdueto thedifferentusesoflakewater,fluctuating waterlevelsandhighevaporationinaclosedbasin area,withincreasingwaterdemandsforsafeandcleanwater,especially inawaterscarcesemi-aridareasuch asLakeBaringo.Anthropogenicactivitieshavesignificantimpactsontrace elementsinthebasin,due totheagriculturalactivitiesandnaturalerosion,transportandloading ofexternalaerialandsurface runoffsintothelake.The highalkalinepHandcomplexationof metalionsinthelakewatercouldprobablybeasignificantcontrolinavailability ofmostmetals fromtheaqueousenvironment.Occurrencesof the toxic elements(As,Cd,Pb,Hg)andF ions needtobemonitoredmorefrequently (surfaceandundergroundwater,soils,sediments,aerial dust,fish,waterhyacinth)toimproveonthedatabaseonconcentrationsandloadings,and develop a sediments backgroundlevels data.

www.fao.org/docrep/X5624E/x5624e04.htm

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