Data Management – Generating Information for Managing, Planning and Policy Making in Water Resources

Session 3: Data Management and Information Cycle-Water Quality

Seiichi Sasaki,
UNDP/GEF Kura Aras Project
IWRM Coordinator

Objective:

This presentation intends to familiarize young professionals and managers with a basic idea of water quality monitoring and management through data collection, analysis , interpretation and establishing information flow bypassing ‘’ information’’ to their decision making process.

Information Cycle

Day 2 IWRM Academy training on *Water Quality Management and IWRM* and *Day 3 session 1 and 2* introduced the conceptual approaches with respect to developing guidelines for types of monitoring programs such as baseline, point / non point sources pollution and mitigation measure.

Information cycle from data collection to decision making is interlinked to each other and information has to flow in order to incorporate into a decision making process.

Why We Collect Water Sample?

- characterize waters and identify changes or trends **BOTH** in **WATER QUALITY AND FLOW** over time
- identify existing or emerging water quality problems
- gather information to design pollution prevention or remediation programs and
- determine whether program goals -- such as compliance with pollution regulations or implementation of effective pollution control actions -- are being met; and respond to emergencies, such as spills and floods

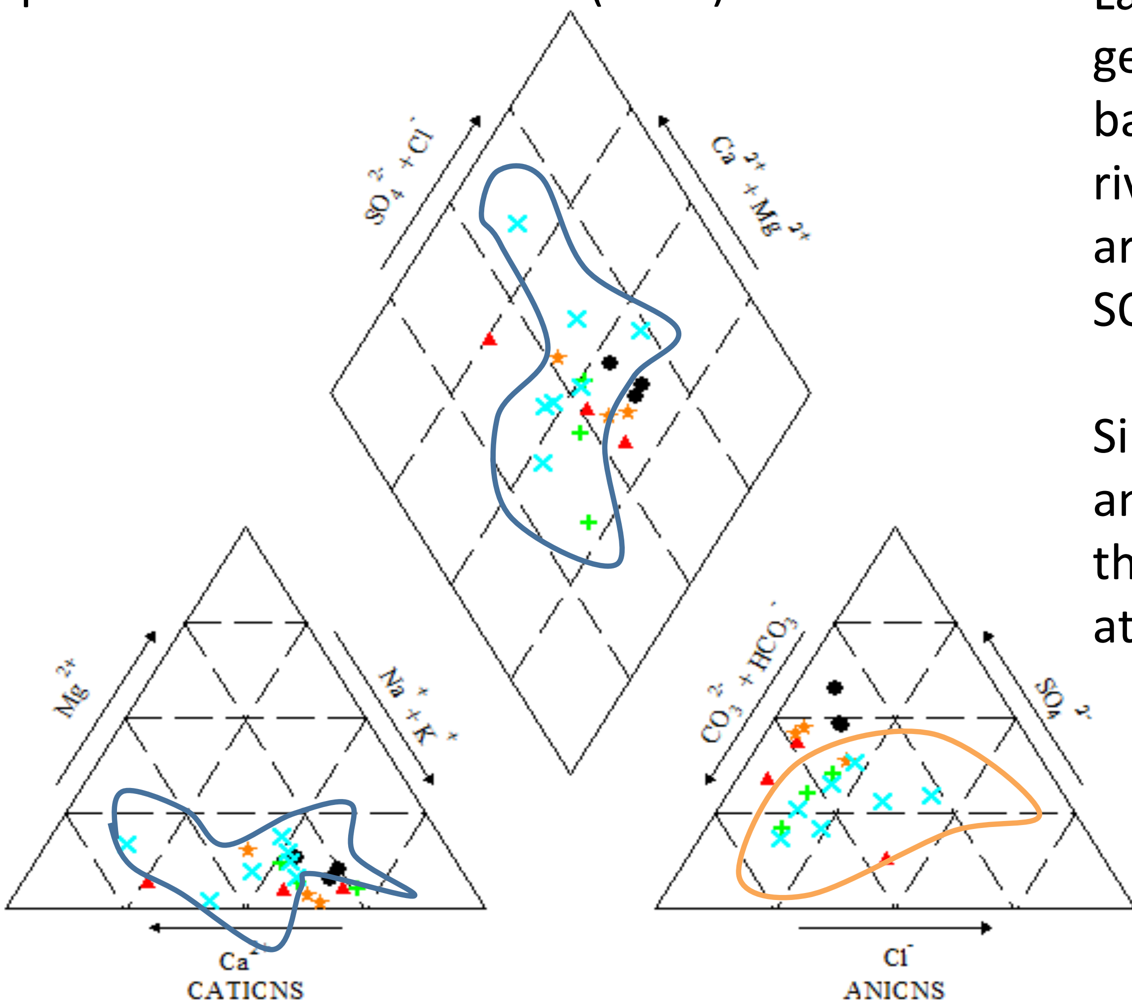
DATA COLLECTION

StationID	Date	Time	Depth	Discharge	Flow	Temperature	Pressure	Duration	Rigidity
124	1/26/2010	10:50	0.3	63	1.27	4.800000191		0	2.21
124	2/26/2010	10:35	0.3	66	1.2	5		0	3.22
124	3/22/2010	11:00	0.5			9.300000191		0	2.55
124	4/27/2010	10:00	0.3			11.19999981		0	2.16
124	5/24/2010	11:00	0.3			14.69999981		0	1.56
124	6/18/2010	10:00	0.3			20.5		0	2.08
124	7/15/2010	10:00	0.3			21.20000076		0	1.46

What does this set of data mean?

DATA MANAGEMENT
Parameter Attributes

Samples collected : Yevlax   in Kura River, (2010)
X points are from Aras River (2010)



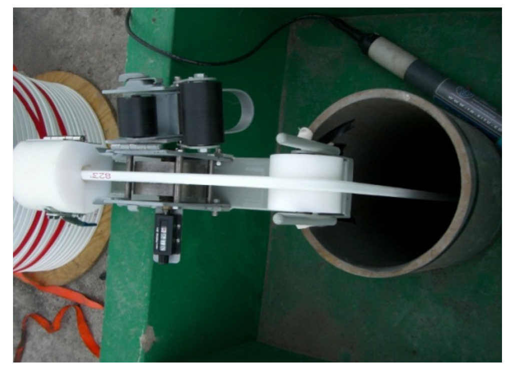
Laboratory scientists analyze general constituents for creating baseline for water quality in river, wetlands and lakes. They are Na^++K^+, Ca^{2+}, Mg^{2+}, Cl-, SO_4^{2-}, HCO_3^- and CO_3^{2-}.

Single data set may not mean anything, but when compile them together, data have attributes.

Note: The relative abundance of cations with the %meq/L of Na^++K^+, Ca^{2+}, and Mg^{2+} and the relative abundance of Cl-, SO_4^{2-}, and HCO_3^-+CO_3^{2-} are then plotted on the cations and anions triangle.

Information Needs and Strategy: Collected data carry variables influenced by;

- Types of Monitoring
- When to Sample
- What to Monitor
- Where to Monitor
- Who will Monitor
- How Long to Monitor



Types of Monitoring

- ***CAUSE AND EFFECT***

  tries to prove or disprove a cause and effect relationship between a specific land activity and water quality degradation.

- ***BEFORE AND AFTER***

  incorporates water quality monitoring before and after a change in management to determine if the mofication alters water quality.

Types of Monitoring

- ***ABOVE AND BELOW***

  involves sampling water quality over time immediately above and below potential sources of target pollution.

- ***PAIRED WATERSHEDS***

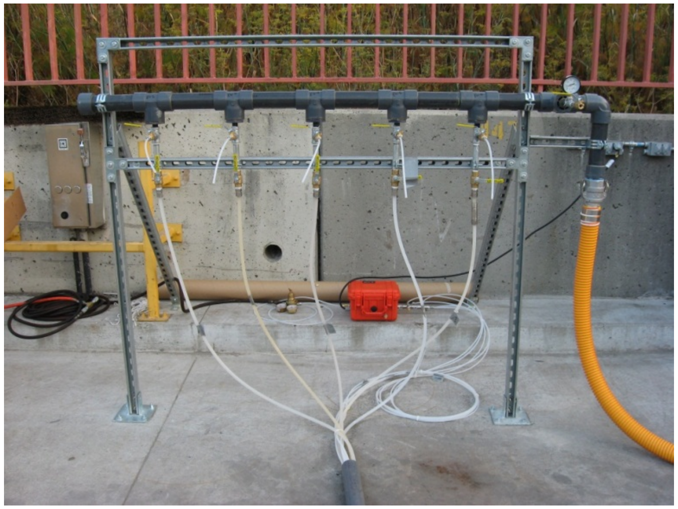
  involves monitoring water quality on two or more watersheds over time. One watershed is selected as control and the others are treated.

Types of Monitoring

- ***COMPLIANCE***

evaluates whether water quality parameters are within set minimum or maximum chemical values. If not meet minimum criteria for water quality, mitigation plan and action can be considered or implemented.

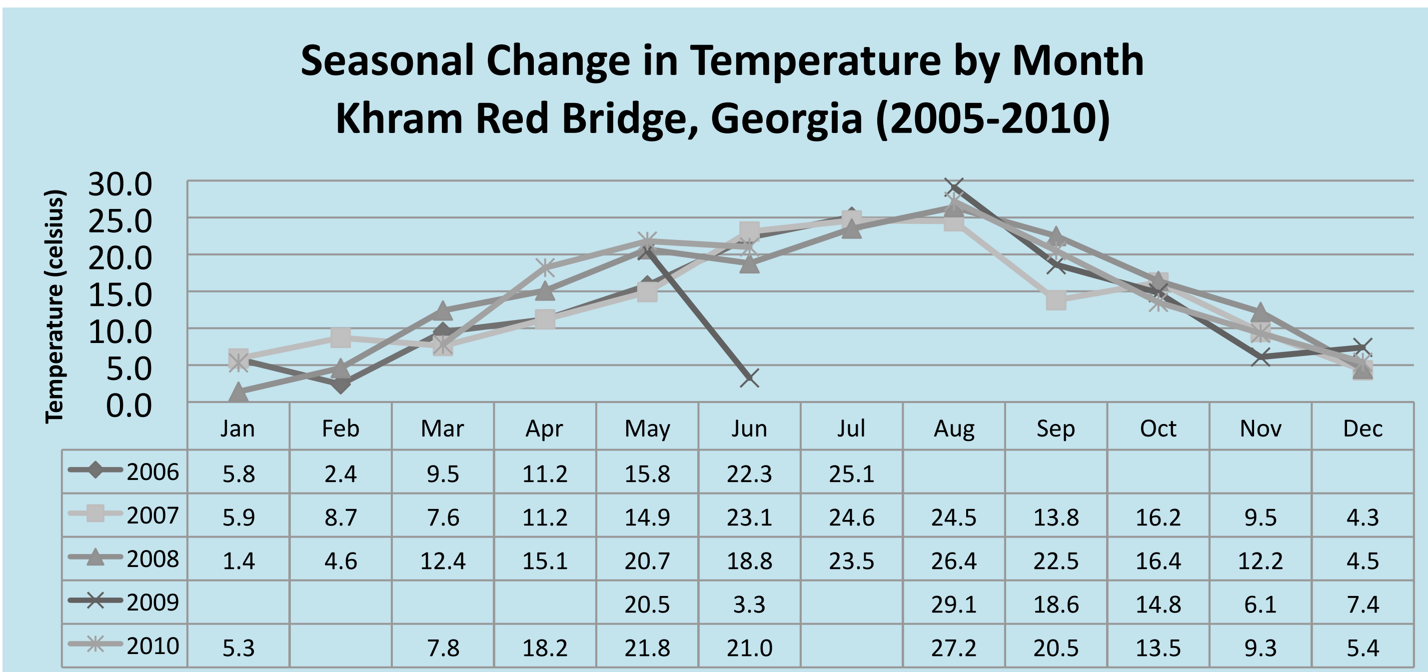
Diesel oil leaked from storage tanks and sunk into ground.



Did not meet the standard and impacted aquifer. Remediation apparatus pumping oil .

When to Sample

- The time of year, time of day, and flow conditions to be carefully considered.
- Temperature, dissolved oxygen, and bacteria/pathogen levels are often most critical during low flows.
- For proper interpretation, each water sample should be accompanied by a stream flow measurement.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	5.8	2.4	9.5	11.2	15.8	22.3	25.1					
2007	5.9	8.7	7.6	11.2	14.9	23.1	24.6	24.5	13.8	16.2	9.5	4.3
2008	1.4	4.6	12.4	15.1	20.7	18.8	23.5	26.4	22.5	16.4	12.2	4.5
2009					20.5	3.3		29.1	18.6	14.8	6.1	7.4
2010	5.3		7.8	18.2	21.8	21.0		27.2	20.5	13.5	9.3	5.4

EUWFD 2010

Where to Monitor

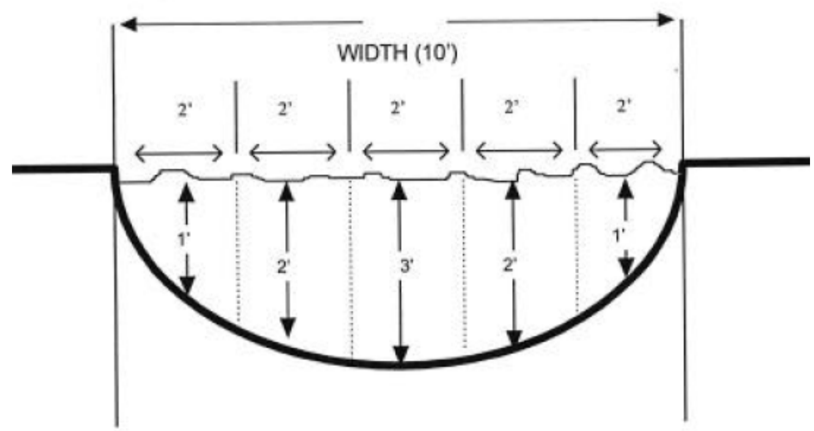
○ *Where Along the Stream*

For the monitoring design, consideration of impacts of inflows such as tributaries, springs, seeps, or irrigation return flows is critical.

○ *Where in Stream Cross Section*

Sample more than one spot in the stream cross section. Integrate water collection from the top to the bottom of the stream and across the stream.

Calculating the Area for a Channel Cross-Section

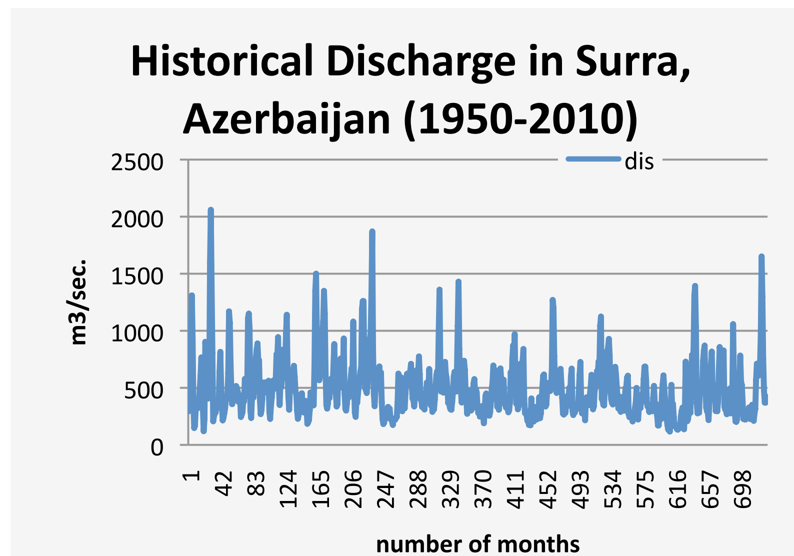


Who Will Monitor

- Who will conduct the monitoring, and what is their understanding of sampling water quality (weather, temperature, and seasonal change in flow)?

How Long to Monitor

- The more years you study an area the more accurately you can evaluate the situation with varying rainfall intensities and timing.



DATA MANAGEMENT

Why do you need data management?

Not only increasing efficiency access to data, but also data management is to create a basis for sharing information with other entities such as;

- River Planning Program
- Total Maximum Daily Load (TMDL) Program
- Surface Water Quality Monitoring
- Water Quality Standards Group
- External entities submitting data to information system database

Information Cycle

DATA MANAGEMENT

Criteria is defined as;

Site Location

- State/Territory
- Hydrologic Region

Site Identifier

- Site Name
- Site Number
- Multiple Sites
- Agency Code

Site Attribute

- Drainage Area
- Well Depth
- Hole Depth
- Aquifer Type

Parameter Attribute

- Parameter Code
- Group Name
- Parameter Name/Description
- Name of Constituent
- Parameter Unit

FIELD	Parameter Code
WATER TEMPERATURE (°C)	00010
PH (standard units)	00400
DISSOLVED OXYGEN (mg/L)	00300
SPECIFIC CONDUCTANCE (µmhos/cm @ 25 °C)	00094
TRANSPARENCY, SECCHI DISC (meters) **Important parameter for reservoir ranking	00078
DAYS SINCE PRECIPITATION EVENT (days)	72053
SALINITY - ppt (tidal waters only)	00480
CHLORINE, TOTAL RESIDUAL (mg/L) (downstream of WWTPs)	50060
FLOW SEVERITY:1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High,	01351

REPORTING AND INFORMATION USE

- Water quality data has one-to-many relationship between the sample/event file you created.

- An event record is defined as a unique sampling regime conducted at a specific date, place (station ID and depth), and time.
- Sample Event might consist of collecting a metals in sediment sample at station 12345 on 2 April 2012, 13:00 hrs.

- Water, tissue, sediment, and distinct types of biological samples are all considered separate event records.

FORMALIZATION OF REPORTING

Laboratory data is a critical basis of interpretation. Is your data presentation is straightforward?

IWRM WATER DISTRICT
WATER QUALITY ANALYSIS DEPARTMENT
CA ELAP Certificate Number

LABORATORY REPORT

units, DLR Start-End

METHOD REFERENCE	ANALYTE	RESULT	UNITS	DLR	MDL	START DATE	END DATE

AC43163
Sample Collected: 05/20/2009@16:35

By Seiichi Sasaki

Sample Type: Grab
Submitted: 05/21/2009 @ 07:09

METHOD REFERENCE	ANALYTE	RESULT	UNITS	DLR	MDL	START DATE	END DATE
Analytical Department:	***FIELD***						
SM2510 B	Electrical Conductivity (Field)	719	umhos/cm			5/20/09	5/20/09
SM4500-H+ B	pH (Field)	8.6	pH units			5/20/09	5/20/09
SM2550 B	Temperature (field)	21.9	degrees C			5/20/09	5/20/09
Analytical Department:	***METALS***						
EPA 200.8	Silver ICP	0.244	ug/L	0.2		6/1/09	6/1/09
EPA 200.8	Aluminum ICP	16.2	ug/L	0.5		6/1/09	6/1/09
EPA 200.8	Arsenic ICP	2.26	ug/L	0.5		6/1/09	6/1/09
EPA 200.8	Barium ICP	30.8	ug/L	0.5		6/1/09	6/1/09
EPA 200.8	Beryllium ICP	<0.5	ug/L	0.5		6/1/09	6/1/09
EPA 200.8	Boron ICP	95.2	ug/L	10		6/1/09	6/1/09

DATA SET (Water Quality)

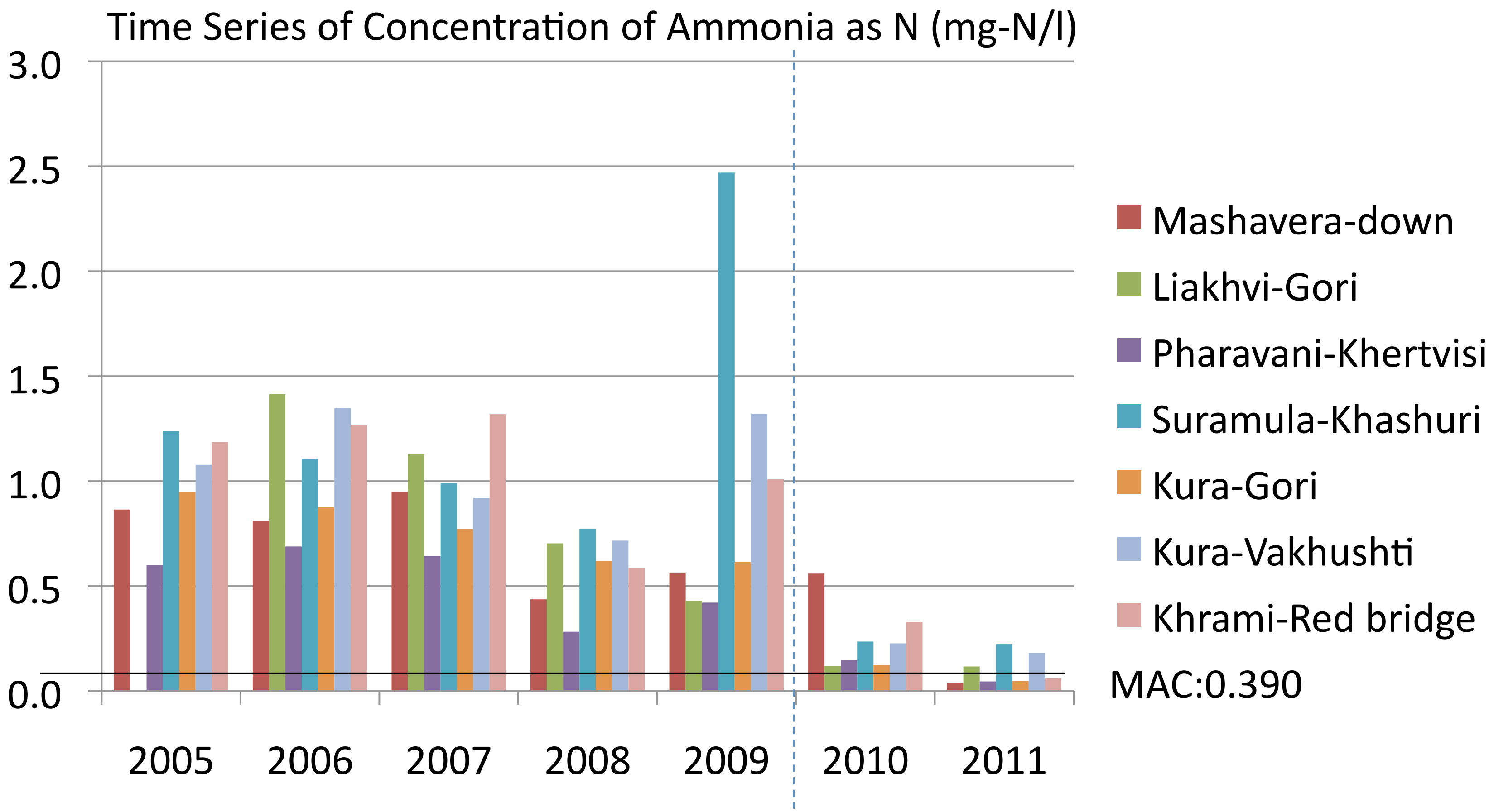
StationID	Date	Time	Depth	Discharge	Flow	Temperature	Pressure	Duration	Rigidity
124	1/26/2010	10:50	0.3	63	1.27	4.800000191		0	2.21
124	2/26/2010	10:35	0.3	66	1.2	5		0	3.22
124	3/22/2010	11:00	0.5			9.300000191		0	2.55
124	4/27/2010	10:00	0.3			11.19999981		0	2.16
124	5/24/2010	11:00	0.3			14.69999981		0	1.56
124	6/18/2010	10:00	0.3			20.5		0	2.08
124	7/15/2010	10:00	0.3			21.20000076		0	1.46

REPORTING AND INFORMATION USE For Georgia

Single data trend may not tell you about the conditions of river health, but

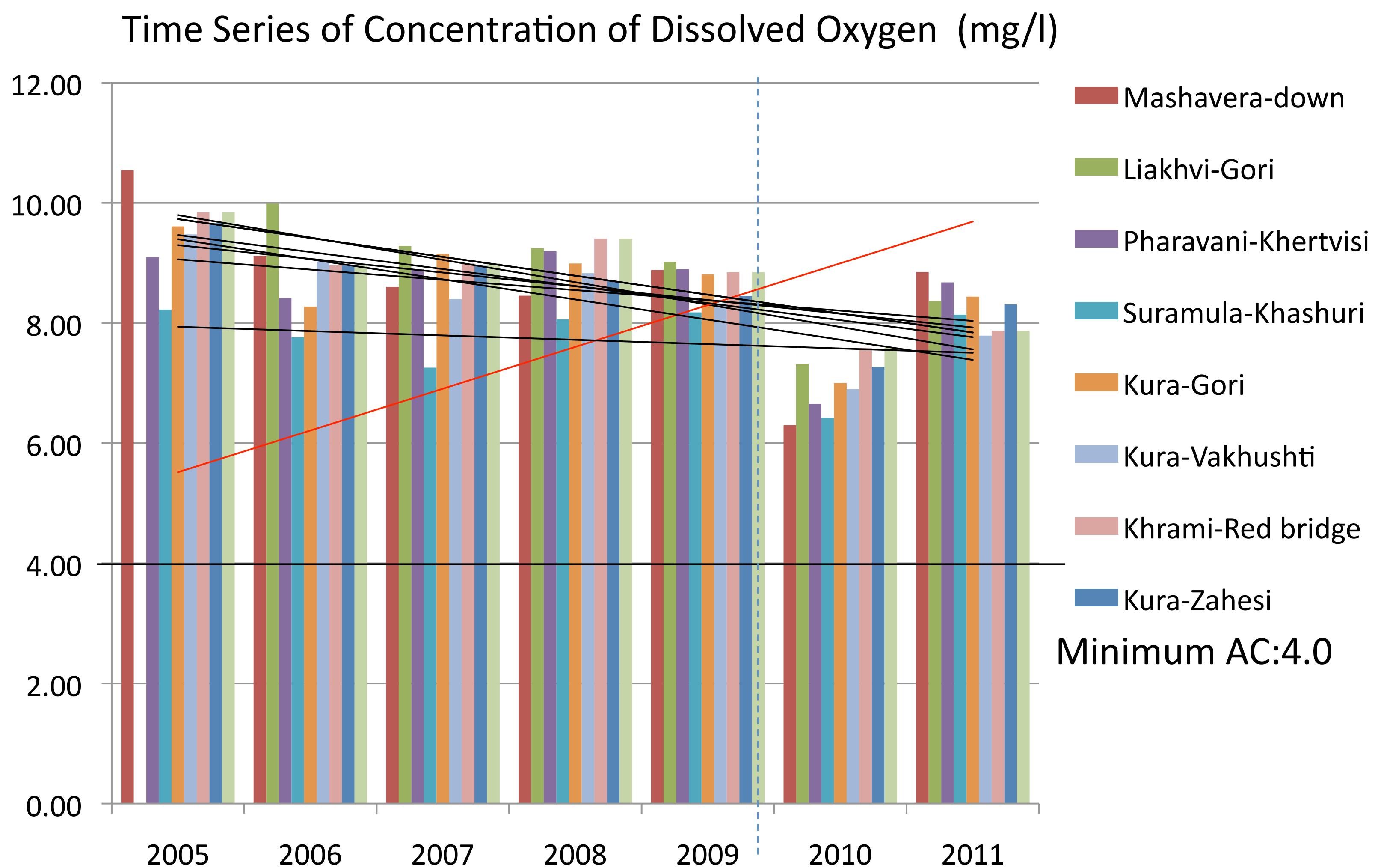
trend x trend x trend x trend=?

REPORTING AND INFORMATION USE For Georgia



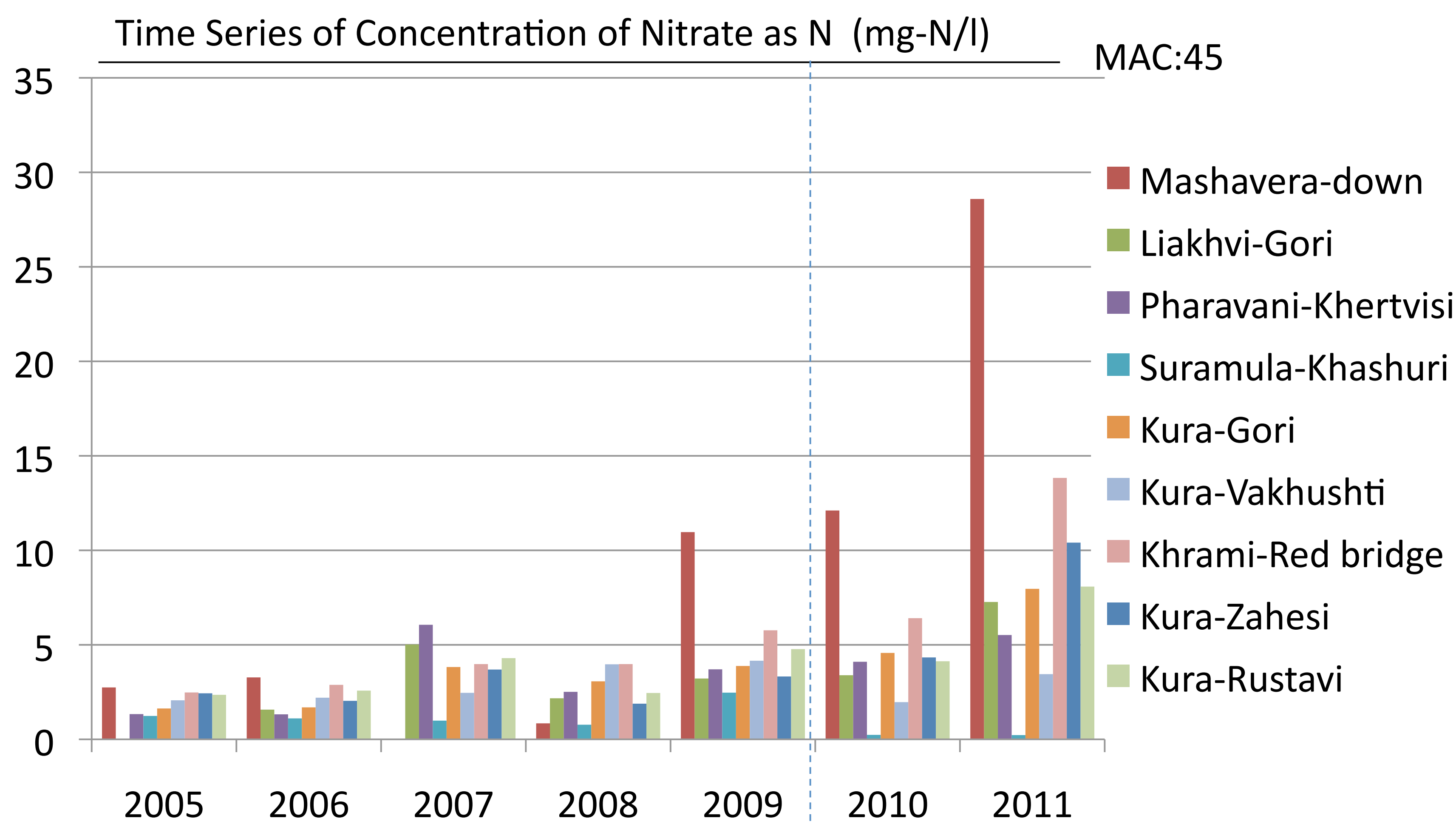
*Analytical methodology has been changed since 2010.

REPORTING AND INFORMATION USE For Georgia



*Analytical methodology has been changed since 2010.

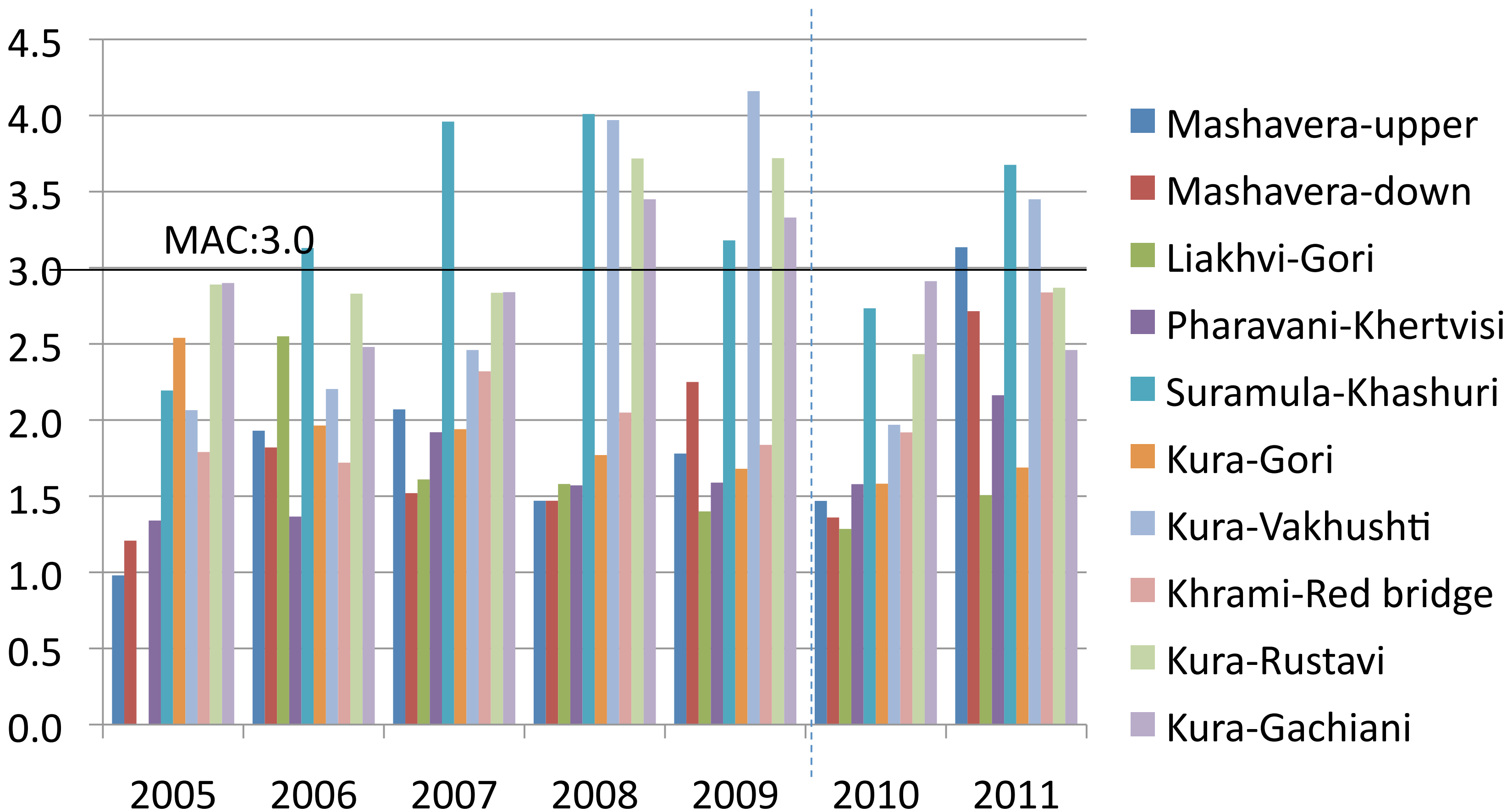
REPORTING AND INFORMATION USE For Georgia



*Analytical methodology has been changed since 2010.

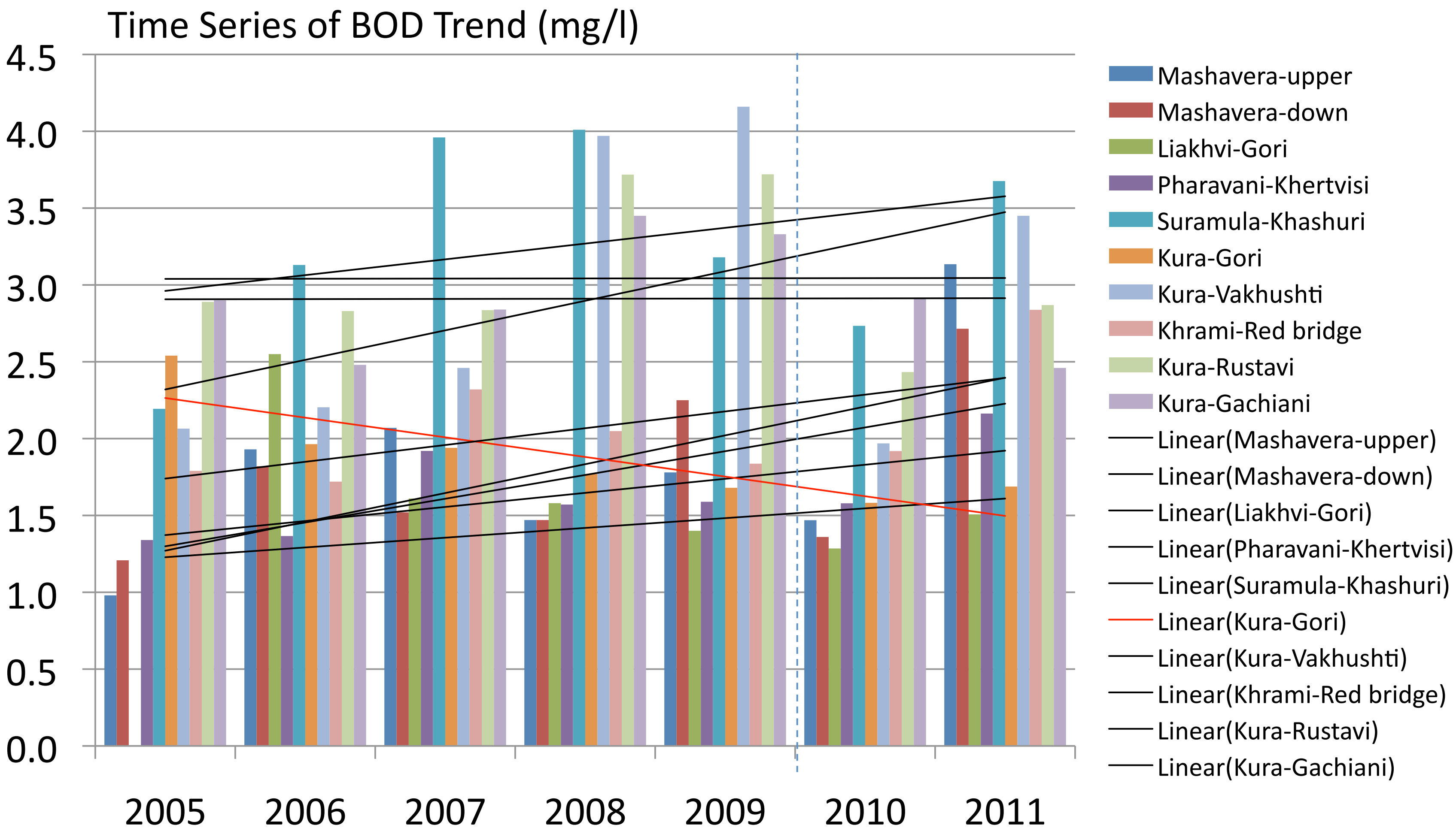
REPORTING AND INFORMATION USE For Georgia

Time Series of Concentration of BOD (mg/l)



*Analytical methodology has been changed since 2010.

REPORTING AND INFORMATION USE For Georgia



*Analytical methodology has been changed since 2010.

REPORTING AND INFORMATION USE For Georgia

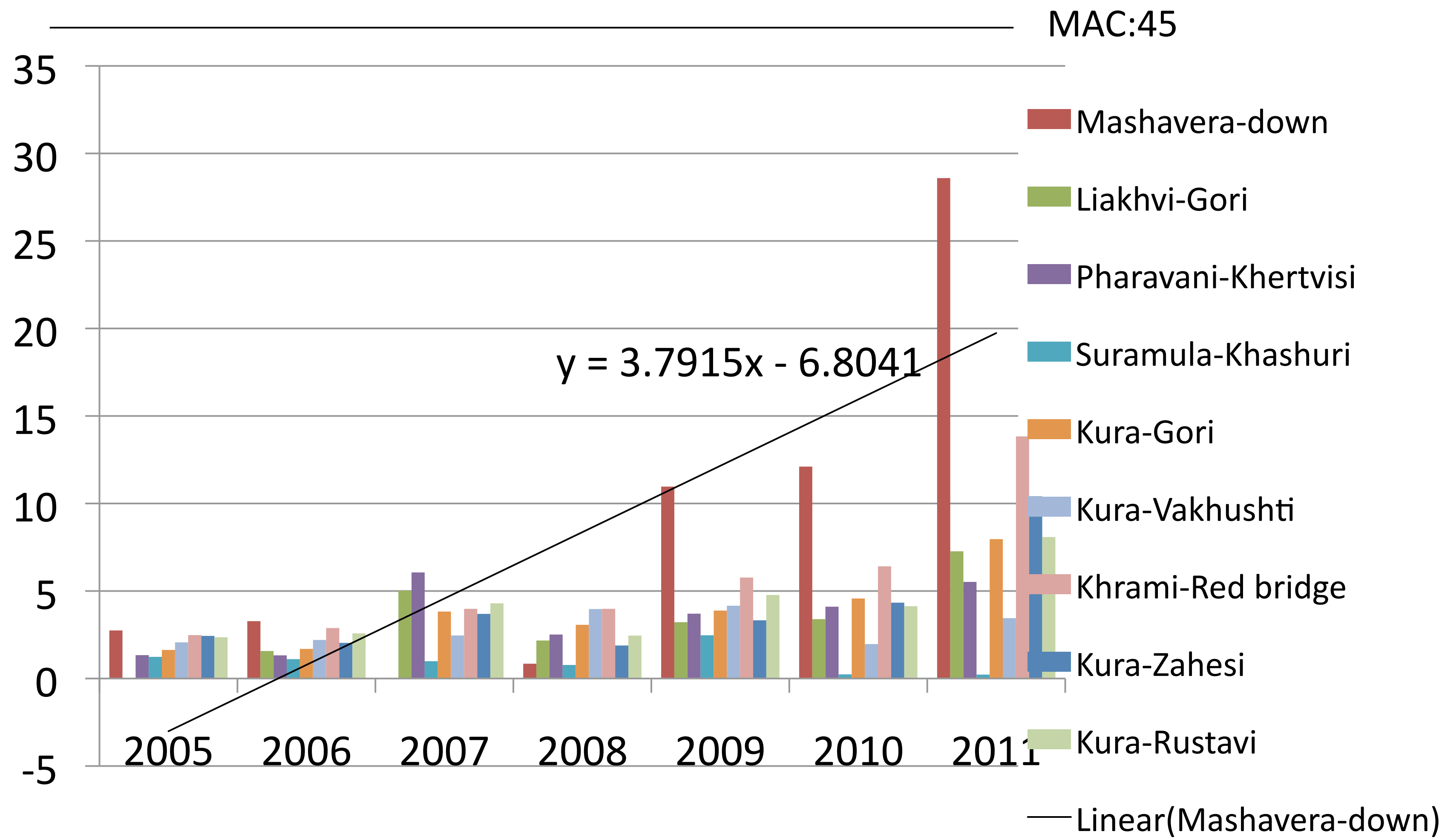
One could argue;

Ammonia INCREASE—>Ammonia DECREASE->Oxidation INDUCED– >Nitrate/Nitrite-INCREASE-> BOD INCREASE->**DECREASE OF DISSOLVED OXYGEN**-

Impacts on AQUATIC ECOSYSTEM-LOSS OF HABITAT- CHANGE IN CONDITIONS OF RIVER HEALTH

REPORTING AND INFORMATION USE For Georgia

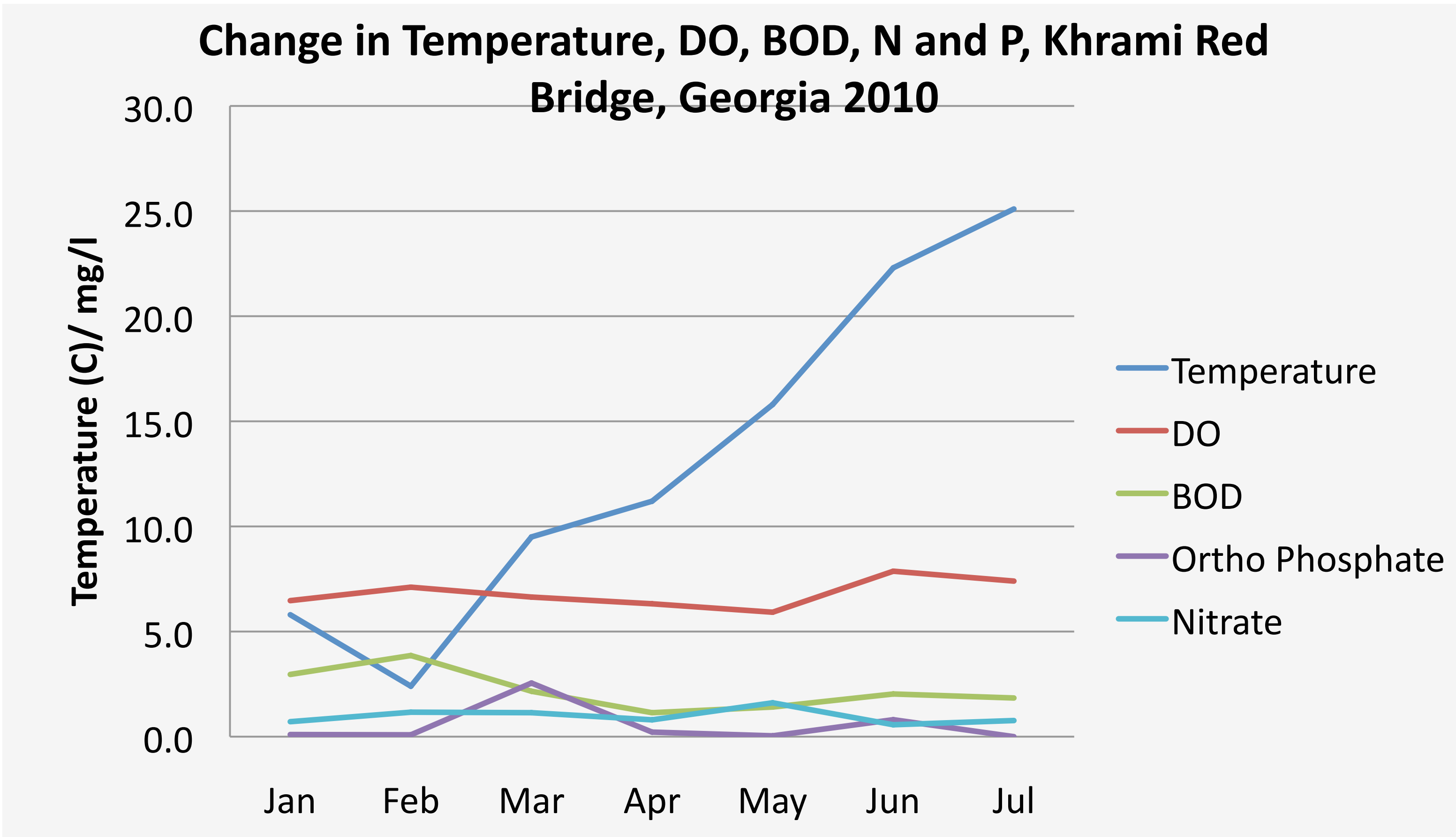
Trend of Change in Concentration of Nitrate as N (mg-N/l)



Potential Impacts

- Large amounts of algae can cause extreme fluctuations in dissolved oxygen.
- Dissolved oxygen may decrease to very low levels as a result of large numbers of oxygen consuming bacteria feeding on dead or decaying algae and other plants.
- If you drink water that is high in nitrates, it can interfere with the ability of your red blood cells to transport oxygen.
- Infants who drink water high in nitrates may turn "bluish" and appear to have difficulty in breathing since their bodies are not receiving enough oxygen.

REPORTING AND INFORMATION USE



Raw Data: EUWFD 2010

As temperature rises, solubility of oxygen reduces, but this does not apply. What are hidden variables to be taken into consideration?

REPORTING AND INFORMATION USE

Example of Water Quality Indices for Ecosystem with abundant nature

Index	Description	Indicators and Concentration Level		
		DO (mg/l)	NH4-N (mg/l)	Aquatic organism (example)
A	Exceptionally healthy environment	>7	<0.2	Plecopteran Himalopsyche
B	Healthy environment	>5	<0.5	*Cheumatopsyche*
C	Dirty water	3>	<2.0	Aselloidea Water stick insect
D	Polluted environment	<3	>2.0	Chironomidae

WATER QUALITY MANAGEMENT

Water Quality Management: What is your target indicator?

Objectives:

- provides a guidance for setting water quality objectives required to sustain current, or likely future, environmental values for natural and semi-natural water resources.
- management guidelines provide recommendations that water managers can use to guide practice and formulate policy, taking into account local conditions and associated costs and benefits.

Lessons learned

Long term goals;

- clear definition of environmental values, or uses; a good understanding of links between human activity and environmental quality,
- setting of unambiguous management goals; identification of appropriate water quality objectives, or targets; and
- effective management frameworks, including cooperative, feedback and auditing mechanisms