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Euphrates River Water Quality Studies in Iraq: Critical Review

Wahran M. Saod [a*], Emad A. Mohammed Salih Al-Heety [b], Areej H. Hussen[c]

[a*] Department of Chemistry, College of Science, University of Anbar, Anbar - Iraq
[b] Department of Applied Geology, College of Science, University of Anbar, Anbar - Iraq
[c] Ministry of Environment, Anbar- Iraq

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ABSTRACT

The published studies about the water quality of Euphrates River in Iraq till now have been reviewed critically. The revision of the published researches depend upon several bases including the period of samples collection, the number of sampling stations, water samples collection method, the analytical techniques employed to measure and analyze the results. This critical study concluded that the need to follow a specific protocol in selection sampling sites, how the samples are collected, how samples are analyzed, and pay attention to quality assurance and quality control during sample collection, preservation and analytical procedures.

1. Introduction

The Euphrates River stems from Turkey, streams through Syria and meets the Tigris in Iraq to form the Shatt al Arab, which flows into the Arabian Gulf. The Euphrates River is the longest and one of the most important rivers in history of South-western Asia in terms of basin area and length, and the second in terms of water volume. Forty percentage of the river exists in Turkey (about 1230 km), whilst the rest percentage is separated into two parts, 25% being in Syria (about710 km) and 35% in Iraq (about 1060 km) (1). Iraq needs Euphrates water for nourishment production and local water supply more than it needs it for energy generation. Iraq has developed series of dams, reservoirs, and controllers along Euphrates River. However, Iraq has had issues with water amount and quality, particularly after upstream dam construction. The salinity that steadily rises along the river intensifies the circumstances. Likewise, diminish in the amount of water from the Euphrates is considered as a continuous issue in Iraq (2). Because the water quantity that comes the Euphrates River in Iraq depend primarily on the upstream State (Turkey) and riparian State (Syria), in other words, outside the control of the downstream State (Iraq), we must to focus on the protection of water quality to ensure the preservation of water contained quantities of the Euphrates River as much as possible. Water quality is defined as a measure that can assess the utilization of water for various purposes utilizing physical, chemical and biological parameters. Water quality plays a central part in all aspects of living life forms in the earth which attracts consideration of environmental researchers, ecologist, hydrologist, watershed manag-

* Corresponding author. Tel.: +9647816086990

E-mail address: sc.wahran.s@uoanbar.edu.iq

ers, and agricultural scientists. Water quality changes in view of site, time, climate, and presence of contamination sources. Keeping up appropriate water quality is challenging task basically because of nearness of point and non-point sources (NPS) of contamination (3). The objective of this review is to examine to what extent criteria are applied in selection of sampling period, number of sampling stations, samples collection method, type and number of water quality parameters, analytical techniques and extent of discussion the results.

2.Material and method

2.1. Reviewed literature

This review is based on the analysis of 34 peer-reviewed papers and published studies which were published between 2008 and 2015. Papers relevant to the water quality were only considered and excluded the researches that focus on the contamination of river sediments and aquatic organisms. Although it was attempted to completely include all published studies, such full completeness was not possible to achieve due to lack of availability of published researches before 2008. The studies were classified according to the data acquisition that used into two groups:

1. Studies that relied on analysis of data collected by governmental institutions such as Ministry of Water Resources, Ministry of Environment and others (2,4,5 ,6,7, 8,9, 10, 11, 12,13). These studies represent 33% of the all reviewed studies.

2. Studies that depended on the data collected by the author (s), (14, 15, 16,17,18; 19,20,21, 22,23, 24,25; 26, 27,28, 29,30, 31; 32; 33 ,34,35,9). These studies form 67% from all reviewed publications.

3.Standards of critical review

3.1. Sampling period

The surface water is one of the hydrological cycle components and its quantity and quality affected by and affect the other components, such as, rainfall, groundwater…. etc. The water quality of rivers undergoes seasonal variation due to the mutual relations between the hydrologic cycle components. The sampling period is the period during which the water quality is monitored and the water samples are collected. The sampling period can have a substantial impact on obtained results. Information on the sampling period is provided in 87% of the reviewed articles. The researchers gave data of very different degrees of accuracy, ranging from the correct sampling date (announced sampling month and season) to rather uncertain data (described sampling year and did not report the sampling date), Figure 1. Forty-four percentage of analyzed articles relied on monthly sampling for the collection of water samples. The monthly sampling ranged from one month to twelve months (Hydrologic or water Year), Figure 2. The U.S. Geological Survey defines the water year as "the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1999 is called the "1999" water year". Only 26% of reviewed articles used the hydrologic or water year as a standard for water sampling. 55% of the analyzed publications focused on analyzing the temporal variation (monthly, seasonal and yearly) of water quality parameters measurements and concentration.

3.2. Selection of sampling sites

The controlling guideline for site selection is that information can be gathered that precisely delineate the intentional conditions, (for example, time of year and flow rate or stage) of the aqueous system being studied with respect to study destinations (USGS, 2006). Eighty-five percentage (85%) of the reviewed publications did not provide any information about sampling sites selection process. The other reviewed publications used the barrages along the river as a sampling site, such as Al-Hindia and Al-Ramadi barrages (8), (19) and other authors selected the river discharge gaging stations as a sampling site, such as Qaiam and Kufa (6) (31). 93% of the analyzed publications collected the water samples from more than one sampling site and 7% sampled water from one sampling site (6), (31), Figure 3.

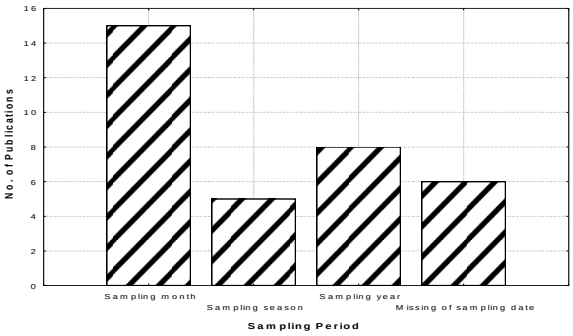

Figure 1. Classification of reviewed publications according to sampling period

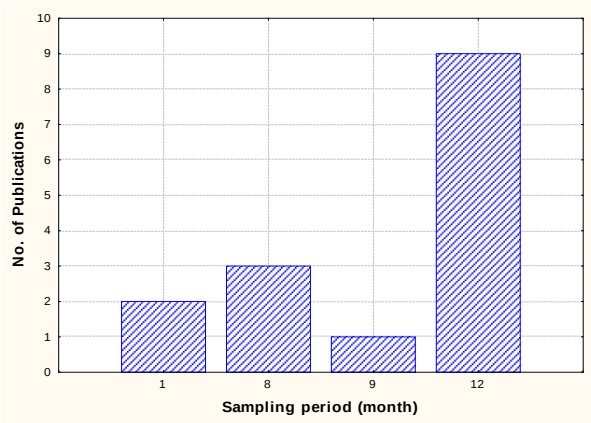

Figure 2. Classification of reviewed publications according to number of sampling month.

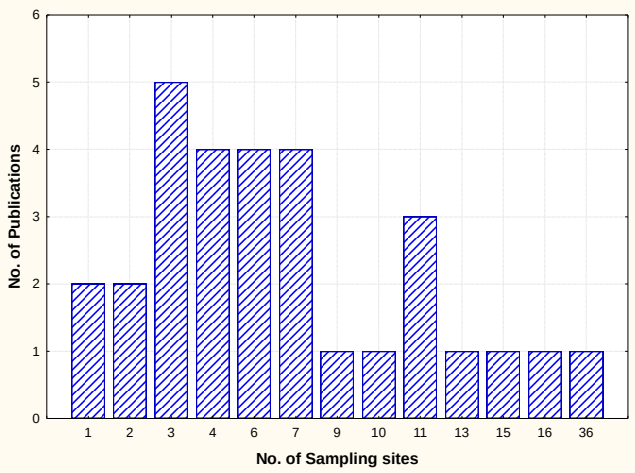

Figure 3. Classification of reviewed publications according to number of sampling sites.

3.3. Sampling frequency

For the purpose of this critical study, the sampling frequency is defined as number of the samples that are collected in one sampling site. In 21% of the analyzed publications it was specified how many samples were sampled at one site. In summary, 12%, 6% and 3% of the reviewed publications employed sample size of 2, 3 and several, respectively. The remaining publications 79% did not state the sample frequency.

3.4. Samples collection

The collection of representative samples is generally accomplished through the use of number of samplers or techniques. These sampling techniques include Kemmerer bottle, Bacon bomb sampler, Dip sampler and Direct method. Thirty percent of the publications used the direct method to collect the water samples. In this sampling technique, the water samples collect from the surface directly into the sample bottle. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. In the remaining publications (70%), there is no information about how the water samples were collected.

3.5. Sample packaging and transport

Once samples have been collected, several procedures should be followed. (1) Transfer the sample(s) into suitable labeled sample containers, (2) Preserve the sample if appropriate, or use pre-preserved sample bottles, (3) Cap the container, place in a ziploc plastic bag and cool to 4 C, (4) Record all pertinent data in the site logbook and on field data sheets and (5) Decontaminate all sampling equipment prior to the collection of additional samples with that sampling device. In the reviewed publications, little attention has paid to samples packaging and transport. 18% of the used publications described sample packaging in general without any details. The remaining publications (82%) did not describe the sample packaging and transport. One publication only explained transfer the samples to the laboratory (21).

3.6. Analytical procedures

The analytical procedures include preparation of sample for analysis, selection the suitable equipment or instrument, chemical analysis technique, calibration the equipments and instruments using standard or reference materials. 51% of the publications followed the standard cookbooks while the remaining publications did not that. The majority of the publications that did not follow the standard cookbooks were based on data available from other sources.

3.6. Quality assurance/ Quality control

The quality assurance (QA) is an integrated management system to ensure that Quality control (QC)

system is in place and working as intended. QC is a set of routine technical activities performed whose purpose is essentially error control with the use of QC samples such as blanks and spikes. Together, QA and QC help us to produce data of a known quality (e.g., precision, accuracy) and enhance the credibility of reported results (36). Based on QA procedures, all data must be archived on field data sheets or inside site logbooks and all instrumentation must be worked due to the operating instructions as supplied by manufacture, unless otherwise specified in the work plan. Instruments must be tested and calibrated before collection of samples and they should be reported. (37), (38). On the basis of the reviewed publications, it seems fair to state that very little attention has been paid to quality assurance (QA) during planning and performing of the sample collection, preservation and analytical procedures.

4.Discussion

With respect to sampling period, there is no set rule. The selection of sampling period depends on the aim of the study. If the aim of the study is assessment of the river is polluted or not, the sampling period ranges from day to month is suitable. The sampling period of one water year is suggested if the objective of the study is studying the temporal variations of water quality and impact of the climate elements on it. Identification of pollution sources require sampling period brings many years. The criteria applied for the selection of sampling sites, were of very different nature and inherently related to the respective study's aim (39). Sampling situations vary widely, therefore, no universal sampling procedure can be recommended [39]. Locality, distribution, and number of sampling stations can influence the quality and applicability of the subsequent information. In term of frequency of sampling, a few samples are taken from one sampling site are required to avoid point impacts and to give representative results (2), (39). Regarding the samples collection, there are several field manuals for the collection of water quality samples were published by different organizations such as, US Geological Survey (USGS), US Environment Protection Agency (USEPA), World Health Organization (WHO), …. etc. With respect sampling packaging and transport, there are several procedures to package and transport the water samples were published by USGS and USEPA and other organizations. In term of the analytical procedures (methods), these procedures are included in standard cookbooks by the U.S. Environmental Protection Agency (US EPA) and American Public Health Association (APHA). On the basis of the publications currently available, it seems fair to state that in most cases little attention has been paid to quality Assurance (QA) during planning and performing of the sample collection and preservation in contrast to analytical procedures.

5. Conclusions and recommendations

There is a critical lack of standardization and documentation of sample collection preservation and analysis in water quality of Euphrates River in Iraq. An important factor contributing to these shortcomings is the insufficient scientific culture in this domain. There is no attention has been paid to quality assurance (QA) and quality control (QC) of sample collection, preservation and analytical procedures. To ensure acquisition of real results representative of water quality of the Euphrates River in the future, we recommend to follow standard protocols in selection of water sampling sites, sample collection, preservation and transport and selection of the suitable analytical methods. We recommend also to pay attention to quality assurance (QA) and quality control (QC) of sample collection, preservation, transport and analytical procedures.

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