

# Protecting water resources by implementation water safety plans

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**Abstract:** Drinking water supply system in catchment, treatment, transmission, storage, distribution and consumers are always in danger of pollution that can threaten the health of consumers. In the existing system quality control of drinking water is based on end-point monitoring approach. This however can identify the contamination but can not prevent the occurrence of contamination. Water safety plan by applying risk management can lead to prevention of pollution in water resources and helping to ensure the quality of the water. Implementation of WSP will lead to change in the attitude of end-point monitoring approach to process control and quality assurance of drinking water. WSP in Tabriz in Iran under the guidance of the World Health Organization Regional Office has been implemented. WSP currently is running in 15 cities. Implementation of WSP all across the country is mandatory which is clearly announced in the national drinking water quality strategy that has been approved by the Cabinet as a rule.

**Keywords:** catchment to consumer, Iran, water safety plans, WSP implementation

## Introduction

The quantity and quality of the surface water and groundwater resources are affected by rapid economic development and climate change. According to Iranian national water and wastewater engineering company around 80% of Iranians rely on groundwater for their drinking water supply. Besides, water pollutants from industrial, agriculture and civilization activities restrict the availability of sustainable water resources. Due to water shortage on the one hand and the threat of water resources on the other hand, implementing water safety plan was the most appropriate strategy to deal with this problem.

Ministry of Health, responsible for monitoring the drinking water quality in urban and rural area, is responsible for implementation of water safety plans (WSP). Iranian National Water and Wastewater Engineering Company (NWVEC) as a chief executive is responsible for supplying drinking water in cities and villages. This mission is carried out through 34 urban and 31 rural companies all across the country. For implementation of WSP Many measures have been carried out in Iran are as follows:

1. Formation of national WSP steering committee with representatives of the ministry of health, ministry of energy, interior ministry, ministry of agriculture, ministry of industry, ministry of petroleum and environmental protection agency that somehow have role in water resources pollution or have duties to protect water quality from catchment to consumer
2. The inclusion of WSP in the VII national drinking water quality strategy was adopted by the Council of Ministers and its implementation is mandatory (Ministry of health 2011).
3. Circulars mandatory of WSP implementation for at least one city or village.
4. Holding a number of workshops to explain the characteristics of the WSP for senior executives as prerequisite program.
5. Implementation of WSP in cooperation with the WHO's regional office in the city of Tabriz as a pilot.
6. Training Instructors for the WSP implementation in other cities and villages
7. Training auditors to assess WSP.

The objective of this article was to introduce the experiences of Iran in implementation and development of WSP as an effective measure for protecting water resources and quality assurance in water supply.

## **Material and Methods**

The method is currently used to control water quality in Iran is based on the end-point monitoring approach. The major weaknesses of this method are including; (a) retrospective, (b) just identify the contamination not prevent, (c) just quality control not quality assurance, and (d) the volume of water that is tested rarely statistically representative the volume of water that is consumed. Bitter experiences such as viral infection in drinking water in a city with a large number of intestinal disease despite being negative coliform bacteria test results and appropriate concentration of chlorine residual in the distribution network or oil pollution incident at the entrance of water treatment plant with discharge of 10 m<sup>3</sup>/s because of ignoring the hazards in the system of water supply and many other accidents that cause pollution of water supplying, officials were forced to replace their existing system with another one with characteristics such as to avoid excessive reliance on end-point testing, focused on prevention and the focus on process control (NWWEC 2015).

## **Execution process**

Water Safety Plan implementation began in Iran from 2009 and as a first step national WSP steering committee with representatives of the ministry of health, ministry of energy, interior ministry, ministry of agriculture, ministry of industry, ministry of petroleum and environmental protection agency that somehow have role in water resources pollution, or have duties in water quality protection from catchment to consumer Established. Then, National Steering Committee (NSC) decided to have a city selected as pilot for the implementation of the water safety plan in collaboration with the WHO regional office consultants to gain experiences needed to implement WSP in other cities. With this intention, between some cities as a candidate at last Tabriz, because of the potential required for the project was chosen as a pilot. Tabriz city with a population of 1.7 million, more than 500 thousand water connection is the largest city in the north west of Iran (WHO 2009, 2011).

Tabriz selection criteria as pilot can be mentioned below:

1. Skilled and motivated human resources.
2. Advanced water laboratory with ability to test all kinds of parameters such as microbial, physicochemical, biological and micro pollutant such as heavy metals and DBPs.
3. The water supply system in Tabriz include various components such as river, dam reservoir, open canal of raw water, water treatment plant, transmission line, pumping stations, water storage tanks, water wells, disinfection systems and extensive distribution network and consumer that can be a good sample to exercise WSP steps .
4. Easy travelling of steering committee members and WHO's advisor between Tehran and Tabriz by Tabriz airport.

WSP implementation in Tabriz began in 2011 with the election of the members of the technical committee of Tabriz and holding a training course in cooperation with the WHO regional office and attended by members of the NSC. After one year, Tabriz WSP by the WHO assessor was evaluated and recommendations were made to fix defects. Also the results of Tabriz WSP were evaluated and criticized by members of the steering committee.

## Results of Tabriz WSP

In system description step of WSP in catchment, Technical committee of Tabriz WSP has not been able to gathering information from other organization, for example point pollution sources such as untreated industrial wastewater, geographical distribution of villages and effects of wastewater to environment and unsanitary disposal of solid waste in landfill sites wasn't considered. In identify hazards step of WSP implementation in catchment in comparison to other elements was not successful and wasn't lead to applied result that can prevent water resources pollution for example hazards like excessive usage of fertilizer and pesticides in agriculture division were not identified and there was no control measure to deal with them or hazards from unsanitary disposal of solid waste in landfill sites were neglected.

Despite the weaknesses in the implementation of WSP in catchment, applying WSP in water treatment plant transmission pipes, storage tank and distribution network was good experience for example isolation storage tank roof to prevent entering runoff or fencing around to prevent access irresponsible people shows an understanding of WSP. One of the most achievements of WSP in Tabriz is change attitude from treatment to prevention in authorities, it means instead of waiting until hazardous event occur and causing to crisis then try to deal with it, beforehand try to know it and somehow to control it.

## Second phase of WSP Development:

In the second phase, the NSC in 2013 decided to extend the implementation of the WSP in three other cities including Isfahan, Ahwaz and Kashan. This time the selection criteria in addition to issues such as appropriate organizational structure and human resources, records of events that affected water quality and causes serious crisis was considered. This time, training for technical committees of mentioned cities was holding by Iranian NSC and some members of the technical committee of Tabriz. According to the report presented by each technical committee of mentioned cities; steps of (a) description of the system (b) Identify hazards and hazardous events and risk assessment (c) determine and validate control measures, reassess and prioritize the risks and step (d) develop, implement and maintain an improvement is done and the rest of the steps gradually are running.

## Third phase of WSP Development

After of presentation of WSP implementation process by the technical committees of cities in second phase and their results in the control of hazardous event and other positive aspects of WSP in national seminar, many cities declared their readiness to implement WSP voluntarily. So in 2013 the NSC selected 11 other cities to implementation WSP, including Zahedan, Mashhad, Tehran, Sari, Rasht, Gorgan, Kermanshah, Bandar Abbas, Shiraz, Karaj and Urmia (Figure 1). Then, subsequently technical committee for the implementation of WSP was established in the mentioned cities. Regional training courses for technical committee were held in 4 stages. According to NSC's evaluation plan, in the mentioned cities the steps of "the description of the system" and "identify hazards and hazardous events and risk assessment" are completed. In order to monitor the progress of the WSP as well as fix problems in the

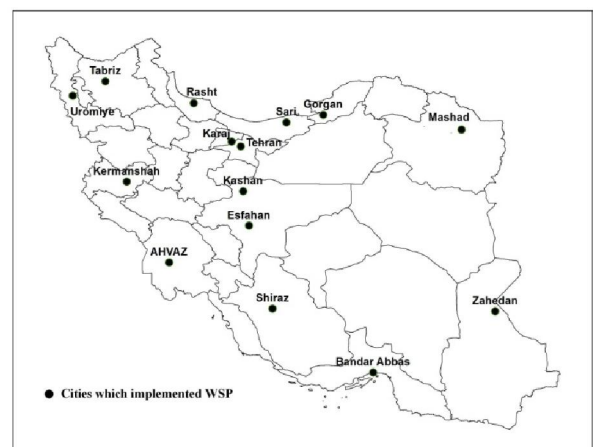


Figure 1: The locations of the cities were selected for implementing WSP

WSP implementation, three auditing groups were formed by NSC and training course for them was held in order to be familiar with auditing method of WSP and a checklist was prepared to be applied by these groups. The duty of these groups are to attend in these cities and review the documentation of WSP implementation and providing guidance to correct mistakes and eventually reporting progress to NSC. NSC intends to continue auditing WSP, in case of successful WSP implementation, a certificate with a validity period of one year to be presented to the technical committee and with the results of the audit in the coming years, this certificate can be extended or cancelled.

### **Development of WSP in rural and urban water and wastewater companies**

Urban and rural water and wastewater companies having water treatment plant, water transmission lines, storage tanks, distribution and consumer, so, they play a key role to WSP implementation in three parts of chain of water supply except catchment. The NWWEC in 2014 mandated the implementation of the WSP at least in a city and a rural complex in each company. This action will promote the process of WSP implementation. Representatives of the NSC in NWWEC have launched training operators of water and wastewater companies. Experiences gained from WSP implementation showed many of the measures that are currently doing in water and wastewater companies, especially in treatment plants and transmission pipeline, distribution and water storage tank are adaptable with WSP steps. And it is important to simplify the implementation of the WSP. For example, bacteriological, biological, physical and chemical tests of water quality in water treatment effluent, water storage tank or in water tap of consumer in compliance with national or international guidance by water and wastewater companies are adaptable with step 6 of WSP, operational monitoring, or physicochemical or microbiological tests carried out by the ministry of health or standard organization are adaptable with step 7 of WSP as validating WSP as a whole by external audit (WHO 2014).

However, some concepts, such as the identification of hazards and hazardous events, prioritize them by semi-quantitative risk matrix (WSP step3) or water supply system description (WSP step2) of issues that had not been done so far. WSP implementation for consumer issue that was not dealt with before and managers believed water supply system is responsible for water quality before consumers' connection and the effects on health and quality of water by interior equipment consumers (like pump or storage tank) were ignored. In other words consumers weren't considered in chain of water supply. Therefore in WSP consumers' satisfaction is included as a major part of the plan.

### **Conclusion**

With the implementation of WSP and learn more about different aspects of it, now there is no doubt about the necessity of this plan as a solution to prevent water resources' pollution and to ensure water quality. It is anticipated that with the full implementation of WSP in 15 towns, necessary experience achieved, especially on the steps of the program as well as to identify hazards, assess and validate the measures of control, prioritization of risks or determine the monitoring control measures, many of these experiences can be applied to other water supply systems. This will make the program more quickly done in other cities. WSP management model, in addition to his role in the issue of water quality and health can be considered a successful example of intersectional collaboration to resolve the similar issues. WSP implementation in the catchment is much more difficult and time consuming than other elements of water supply chain so it was decided WSP implementation in the treatment plant, transmission pipeline, water storage tank, distribution and consumer carry out by WSP group in water and wastewater co. And its findings will send to WSP technical team. So, technical committee will have more time to deal with catchment. On the other hand as a promotional tool in auditing plan for WSP implementation in the catchment is considered more points.

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