

## **Raising Groundwater Awareness to Support Groundwater Protection Policy in the Emirate of Dubai, UAE**

<sup>1</sup>Izrar Ahmed, <sup>2</sup>Nadeem Tariq, <sup>3</sup>Aisha Al M. Al Muhery, <sup>4</sup>Mohamed Izzeldin and <sup>5</sup>Wajid Ali

<sup>1</sup>Soil & Water Resources Specialist, Natural Resources Conservation Section,  
Environment Department, Dubai Municipality, UAE, PB 67

<sup>2</sup>Environmental Officer, Natural Resources Conservation Section,  
Environment Department, Dubai Municipality, UAE, PB 67

<sup>3</sup>Head of Section, Natural Resources Conservation Section,  
Environment Department, Dubai Municipality, UAE, PB 67

<sup>4</sup>Senior Environmental Observer, Natural Resources Conservation Section,  
Environment Department, Dubai Municipality, UAE, PB 67

<sup>5</sup>Principal Environmental officer, Natural Resources Conservation Section,  
Environment Department, Dubai Municipality, UAE, PB 67

---

**Abstract:** Dubai Emirate is constantly facing challenges in managing its limited groundwater resources. Domestic supply is largely met by non conventional water, Groundwater is mainly used for irrigation, recreational and commercial uses. Despite efficient water conservation policy, there is still a lack of awareness of the natural water scarcity, the role of groundwater in the Emirate and the implications of its currently unsustainable use for overall water security. Groundwater education is an important part of the Policy implementation strategy. A lack of community interest and involvement is a significant limiting factor to implement local groundwater protection strategies. Raising awareness in the target users e.g. agriculture sector can help sustainable groundwater development. However unorganized structure of agriculture sector makes it challenging to execute an awareness program and getting maximum outcomes. The present study deals with the planning and execution of groundwater awareness campaign conducted in Emirate of Dubai during 2016-2017. The study discuss details of various components of the awareness campaign like selection of target areas, potential users, route accessibility, advertisement materials, use of social media, gift materials, slogans etc. GIS techniques have been employed efficiently to help executing the awareness programs with accuracy and precision. Efficient groundwater awareness programs should be given more importance as by adopting to sustainable management policies, community can play more effective role for protecting groundwater than the most comprehensive strategy.

**Key words:** Groundwater awareness campaign • Agriculture sector • Target areas • GIS techniques • Dubai Groundwater Policy

---

### **INTRODUCTION**

The scarcity of freshwater resources has become an important issue worldwide. As the natural water resources types continue to shrink dependency on non-conventional water types is increasing day by day. Groundwater is of particular importance for fragile food security especially in arid and semi-arid regions.

Groundwater resources in the United Arab Emirates (UAE) have always been regarded as the main source for irrigation and cultivation. Several year back, and prior to the recent expansion in the development desalination plants, the groundwater resources used to support more than 80% of the total water needs of the country. Despite the current reliance on the desalinated water and the significant increase in the reuse of treated wastewater,

groundwater still contributes by more than 50% of the water budget of the country [1, 2, 3]. Studies have implicated that more than rapid urbanization, unorganized and over use have accelerated the consumption of groundwater resources through irrigation, recreational and commercial uses causing groundwater depletion at alarming level. Groundwater constitutes about 23.7% of all water types demand. Agriculture and other irrigation amenities are by far the largest user of groundwater in Dubai with 99% of total use [4, 5].

Almost in all arid regions, overexploitation has emerged out as major threat for groundwater sustainability directly influencing the storage and quality. Moreover, arid region's characteristics rainfall provides little opportunity for the seasonal aquifer recharge, therefore, depletion continues and escalate with increasing groundwater exploitation rate. Policies concerning Groundwater resources management are being implemented at federal and local levels. Dubai local law No.15 (2008) provides legal framework for protection and management of groundwater resources whilst Dubai groundwater policy provide a clear government policy direction on the sustainable management of the Emirate's

groundwater resources for the benefit of the people of Dubai. Within the last few decades; Dubai Emirate's expanding demands of water from domestic, industrial and agricultural users placing greater stress on fragile water resources. Therefore, much attention is given to groundwater management by making groundwater protection policies and executing sustainable groundwater management programs.

Awareness campaigns are set to raise awareness and public partnership to promote national agenda among general public. Beside Governmental policies and corrective actions, people should realize the importance and state of affairs pertaining to groundwater management. People should aware of government efforts to protect and sustain groundwater resources. Since protection of the groundwater resources is primarily related to the consciousness of the local authorities and user community. They must either take proper measures to protect the resources or to educate the public in this issue. To achieve this aim, it is very important to involve the public administrative sector and the technical sector in preparing guidelines for integrated environmental evaluation [6].

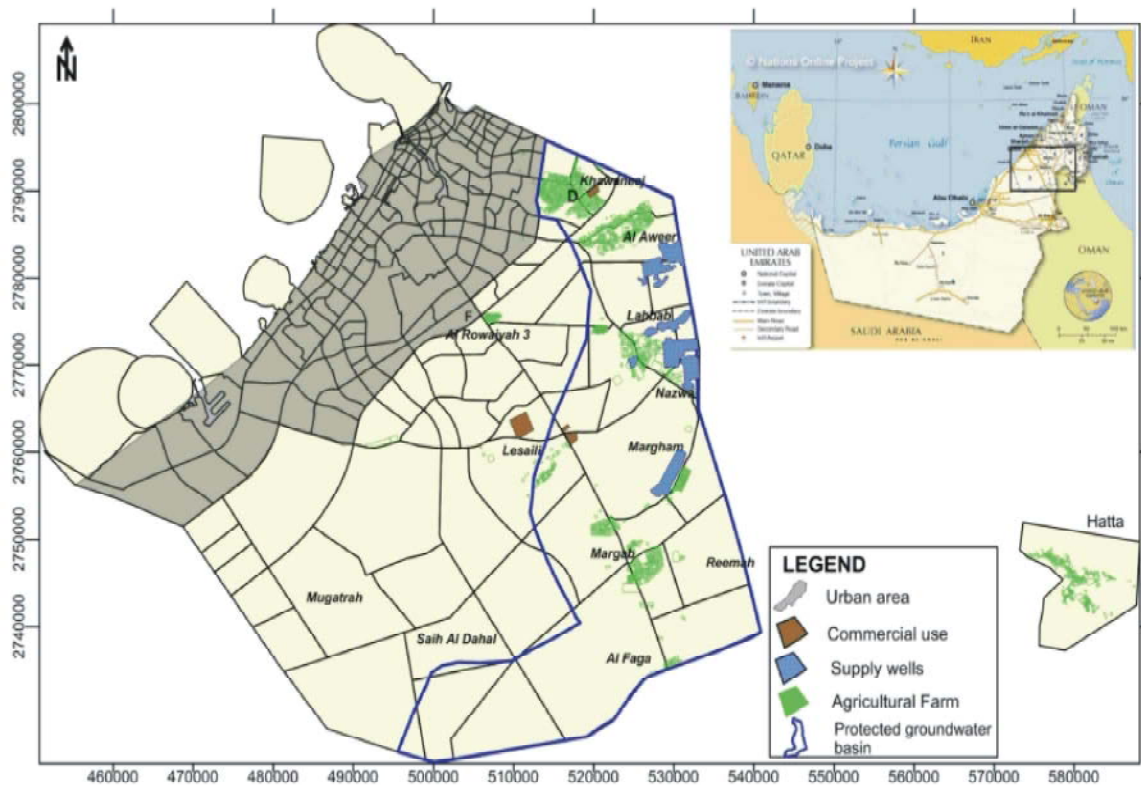


Fig. 1: Base map of the Study area

Dubai is highly urbanized and only a limited number of users are directly involved in groundwater use where it needs to be protected. Specialized groundwater programs addressed to target audiences often more effective than a general campaign. Utilizing this, the present study focuses on raising awareness on pertinent issues from planning to execution of the groundwater awareness campaign addressed to different groundwater users aiming to achieve sustainable groundwater developments.

**Study Area:** The present study covers whole Dubai emirate covering a total area of 4105 km<sup>2</sup> (Fig. 1). The city of Dubai is located on the emirate's northern coastline and heads the Dubai-Sharjah-Ajman metropolitan area. Dubai is the largest and most populous city in the United Arab Emirates. The climate of Dubai is dry sub-tropical. Rainfall is infrequent and generally occurs during the winter months and early spring. The summer period is hot and humid with temperatures ranging between 40°C to 50°C. Humidity is high during summer months and varies between 70% to 85%. Winter is cooler with average temperature of 24°C. Average annual precipitation is 94.3 mm [7].

The geology of the UAE, and the Arabian Gulf Area, has been substantially influenced by the deposition of marine sediments associated with numerous sea level changes during relatively recent geological time. With the exception of mountainous regions in the northeast, the country is relatively low-lying, with near-surface geology dominated by deposits of Quaternary to late Pleistocene age, including mobile Aeolian dune sands, sabkha deposits and marine sands. Hydrogeologically, Dubai is characterized by a single upper aquifer which extends from the Al Hajjar Mountains to the Gulf coast. The main aquifers in the desert regions of Dubai are Quaternary sands and gravels. Nonetheless, Groundwater is sensitive to the occurrence of rainfall, heavy groundwater abstraction and vulnerable to diffuse pollution [8]. Major groundwater use exists in Farm areas.

## MATERIALS AND METHODS

State of art methodology was adopted to carry out Groundwater awareness programs. Firstly program plans were made with complete review of background information like existing groundwater uses, target audiences, accessibility etc. Ideas were adopted from available literatures, online materials and awareness

programs of Dubai Municipality. GIS environment has been used to prepare field routes, target areas and location of awareness models. Updated landuse maps were prepared for stage bound awareness campaign. Day wise routes were assigned for each awareness field team. Gift items with program details and slogans were selected to be distributed with groundwater users. To raise the awareness, multilingual (Arabic, Urdu and English) short messages, audio clips, animated video and slogans were prepared. Social media platforms have been used to propagate awareness messages.

### Components of Groundwater Awareness Campaign

**Groundwater Status:** At this preliminary stage, available groundwater resources status reports and Dubai Municipality's monitoring programs were reviewed to establish existing groundwater conditions which the proposed program has to deal with. From the review of available information, relevant to the proposed awareness program were concludes as following;

- Dubai is characterized by a single upper aquifer and groundwater generally flows from the source areas in the eastern Al Hajjar mountains into the Emirate of Dubai and onward to the Gulf coast in the west.
- Groundwater is the only significant natural source of water in Dubai which has set declining trend due to high rate of groundwater discharge comparing to less recharge.
- Reliable estimates for the sustainable yield of the aquifer in the Emirate are not yet available. Preliminary estimates see local groundwater recharge from precipitation is 10-15% of annual abstraction.
- Groundwater use in non uniformly distributed mostly confined to eastern parts of Dubai Emirate. Major Groundwater use exists in Farm's areas clustered around peri-urban townships like Khawaneej, Aweer, Lehab, Ruwaiya, Lusaili, Margham, Nazwa, Marquab, Faqa and Hatta.
- Due to heavy abstraction, Groundwater is declining with an alarming rate.
- Some of the agricultural and animal farms (Izbah) are located in remote areas off the road
- Groundwater is mainly used for irrigating date palms and fodder.
- Farm's workers are mostly non Arabic speakers with nationality from Pakistan, Philippines, India, Bangladesh etc..., where irrigation practices are different and are not water efficient.

- Farms are generally equipped with modern to semi-modern irrigation techniques with few exceptions of flood irrigation.
- Majority of Groundwater wells head are not protected.
- There is no record inventory of amount of daily water use.

**Planning Model of Awareness Campaign:** The proposed campaign accounted available information to prepare outline of the awareness campaign. Dubai is highly urbanized and only a very limited number of actors are directly involved in land-use activities in the Emirate's non-urban areas where groundwater is used and where it needs to be protected. For this reason, specialized groundwater education measures addressed to government officials, farmers and potential polluters are more cost-effective than a campaign targeting the general audience. These specialized audiences will also be involved in the implementation of this Policy, i.e. through policy coordination mechanisms or as main stakeholders of the various management instruments deployed under this policy.

With the clarity of target areas, users types, and existing groundwater conditions following components were shortlisted to be included into the program.

- Awareness Gift items
- Posters and Calendar with appropriate messages
- Articulated trucks
- Radio message and Animated short movie
- Awareness models
- Stages of the programs
- Time duration of visits

Based on nature of components, a total of 03 teams were formed for the project campaign. 02 teams for field operations and 01 in-office supporting team working under project management.

**Components of Groundwater Awareness Campaign:** Understanding of existing condition has helped to identify main issues and efforts were made to select appropriate components to run a groundwater awareness campaign. After selection of items next job was to enhance quality of different components included in the proposed program to optimize the best outcomes.

**Time Duration:** Timing of awareness campaign is very important. A short campaign ending in 1 week or less is not desirable. People often feel reluctant to change old

and traditional practices for many reasons. Unfortunately, most groundwater protection strategies limit awareness and education to the traditional community consultation approach. The traditional approach typically involves talking to the rural community about groundwater protection efforts, but does not help the community members understand how they can help protect groundwater [9]. Some of groundwater agencies like Florida Groundwater Association observe National Groundwater Awareness Week. Therefore, awareness campaign should have enough time and materials to address harms of doing bad practices whilst benefits of adopting sustainable methods. Adopting this, the time duration of awareness program was kept 1 year while field campaign were carried out in three phases, each phase was of 1 month duration.

**Awareness Gift Items:** Awareness gifts are meant for 2 purposes i.e. floating awareness massages and get acquaintance with people who are directly engaged in groundwater use. Out of many items discussed T-Shirts, Caps, Wall clocks, Night torches were shortlisted to be distributed (Fig. 2). These items were selected with a rationale that people will use them frequently and reminded of groundwater campaign. All items carries campaign logo i.e. "Save groundwater for future".

**Poster and Calendar:** Using Poster and Calendar for spreading awareness is widely acclaimed as it provides enough space to write clear massages and/or folded up. Apart from that, poster and calendar will stay longer time reminding of awareness campaign objectives. Efforts have been made to discover specific groundwater issues needing corrective actions. Therefore, poster & calendar have been prepared with suitable pictures, relevant messages and required actions (Fig. 3 & 4) as given below:

- Use Improved Irrigation system
- Well head protection
- Obtain Well drilling permit
- Grow crops consuming less water
- Flood irrigation is banned by law

**Groundwater Sustainability Model:** 3D models symbolizing the awareness campaign was designed keeping in view pertinent localized groundwater issues. These models were permanently fixed at suitable locations. The locations for these models were selected based on maximum visibility to Farm owners and workers. Geographical Information system (GIS) environment were







Fig. 4: Groundwater awareness Calendar

employed to see traffic & road conditions, Farms locations, Mosques entrances, labours assembly points, market places, cafeteria and to locate accurate locations to display Groundwater sustainability models.

**Articulated Trucks:** Two medium sized articulated trucks were used for the campaign. The trucks have been modified and designed with program’s messages. Necessary permissions from concerned department like traffic police etc. were obtained. For truck routes and gift distribution; selection of targets areas and people, maximum area coverage, route selection are key elements which in present case were performed effectively using GIS techniques. In a unique style of raising awareness within the farmers community, specially designed trucks were used for advertisement. These trucks were given the

target areas i.e. agricultural areas (Fig. 5-1). The specially designed trucks (Fig. 5-2) were provided the selected routes to travel which were being monitored through real time GPS trackers information back in office support team (Fig. 5-3).

**Use of Social Media:** Success of any awareness program depends on how deeply its messages reached to the social framework of targeted audience. Use of social media has proved to be an effective tool to propagate groundwater awareness. Various Government departments, research organizations, NGO’s etc. are using it frequently with positive outcomes. Using the same idea, present study also utilized social media domain e.g Twitter, Instagram and Youtube [10] to educate and counsel people about Government’s efforts towards sustainable groundwater development (Fig. 6).

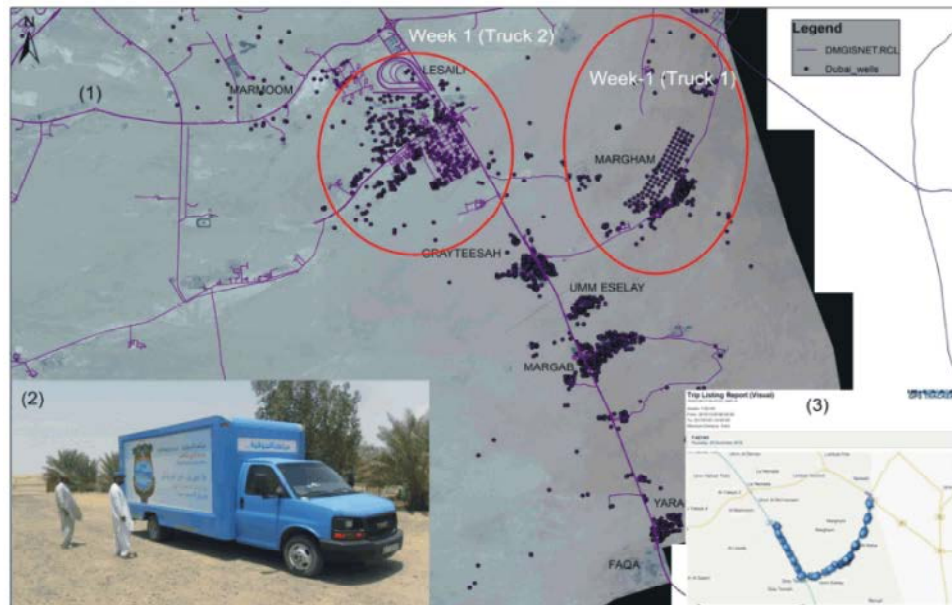


Fig. 5: Map showing (1) selection of target areas (2) Articulated truck for awareness campaign and (3) Real time GPS truck route report

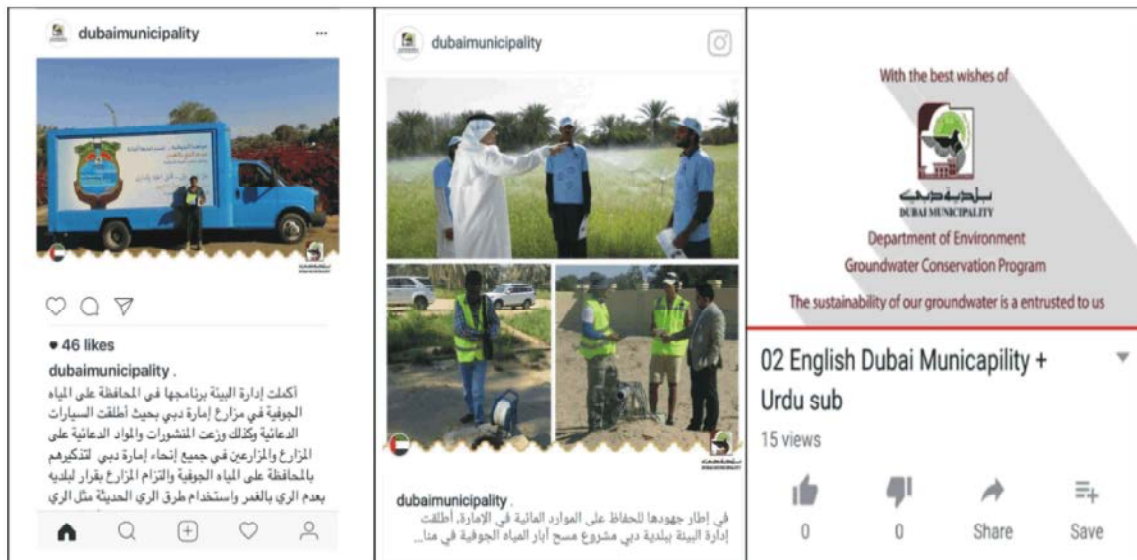


Fig. 6: Use of social media in Groundwater awareness campaign

## CONCLUSIONS AND RECOMMENDATIONS

The lack of community interest and involvement is identified as significant limiting factor when implementing local groundwater protection strategies. This is particularly evident where the rural community has been asked to change farm, irrigation methods and crops practices to protect what has been portrayed as a reliable strategic source for an urban water supply. The lack of community interest is

significant because changing daily activities are likely more effective for protecting groundwater than the most comprehensive strategy. Unfortunately, most groundwater protection strategies limit awareness and education to the traditional community consultation approach. The traditional approach typically involves talking to the rural community about groundwater protection efforts, but does not help the community members understand how they can help protect groundwater.

In the present study, groundwater awareness campaign has been carried out using different components including gifts distribution, audio-video messages, truck campaigns and social media posts. These programs aiming to educate general public about importance of groundwater resources and to cooperate with government initiatives in protection of the groundwater resources. specialized groundwater education measures addressed to farmers, other users, potential polluters and officials are more cost-effective than a campaign targeting the general audience. These specialized audiences will also be involved in the implementation of this policy, i.e. through policy coordination mechanisms (see below) or as main stakeholders of the various management instruments deployed under this policy (i.e. licensing and metering of groundwater extractions). To run such program and get maximum benefits, proper planning within GIS domain is found inevitable. GIS environment has been utilized in conducting awareness program through selection of suitable areas, targeted customers, roads and tracks etc. Integration of various information has been done to develop a criteria for delineation of groundwater protection zones.

As an alternative approach, groundwater user community should be treated as a group of potential partners who can implement groundwater protection policy by changing their activities around the home and farm.

- It is recommended that there should be a common platform to address pertinent issues and share dialogues with groundwater user community. This involves a considerable philosophical shift for agency or government from the traditional approach, and requires an understanding of how individual community members' process and act on information.
- It is recommended that concerned authority should observe groundwater awareness week each year to continue its awareness efforts concerning groundwater sustainability.

## ACKNOWLEDGEMENTS

Authors wish to thank Director, Environment Department, Dubai Municipality for necessary assistances and constant encouragement in carrying out this study. Financial assistance received under implementation of groundwater policy is highly acknowledged.

## REFERENCES

1. MOEW, 2010. United Arab Emirate Water Conservation Strategy. Final Report, Ministry of Environment and Water, pp: 240.
2. MOEW, 2013. Assessment of Groundwater Resources and Survey of Wells, Final Report, Ministry of Environment and Water, pp: 273.
3. Mohamed, M.A.M. and A.B. Hassane, 2016. Hydrochemistry assessment of groundwater quality in Al-Ain city, UAE. *Environmental Earth Sciences*, 75: 343-353.
4. D.M., 2015. Dubai Municipality Strategic Plan (2016 - 2021). 2016, 5 Strategic Pillars and 20 Strategic Objectives, Advertisement Poster.
5. D.M., 2014. Development of a Groundwater Protection Policy for the Emirate of Dubai. Technical Report, (N/07/2014), Dubai Municipality, Emirate of Dubai, 2014. pp: 31.
6. Ekmekçi, M. and G. Günay, 1997. Role of public aware-ness in groundwater protection. *Environmental Geology*, 30(1-2), 81-87.
7. DMO, 2009. Dubai Meteorological Office. Information available online at <https://services.dubaiairports.ae/dubaimet/met/climate.aspx>.
8. Farrant, A.R., S.J. Price, S.L.B. Arkley, A. Finlayson, R.J. Thomas and A. Leslie, 2012. Geology of the Al Lisaili; 2012, 1:100 000 map sheet, United Arab Emirates.
9. Simpson, H. and E. Hodgins, 2002. Proceedings of the Water Environment Federation, Watershed, pp: 1787-1802(16)
10. <https://youtu.be/qgpXDIXS6vo>.