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Research Article

SILENT TERRORISM: GROUNDWATER DEPLETION AND FOOD INSECURITY

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ABSTRACT
The current rate of global groundwater withdrawals ─ about 750-800 km^3 per year or about a quarter of total global water withdrawals ─ which is in excess of natural groundwater recharge rate, have depleted groundwater resources. This has resulted in several negative effects such as declining water tables, competitive deepening of wells, land subsidence, salt water intrusion, and water quality degradation. The complexity in regulating and monitoring groundwater withdrawals have made sustainable management of this resource very challenging. In this article, we present a term of Hydrogeo–terrorism or Silent Terrorism for attracting the attention of common-sense to groundwater protection and its dimensions and characteristics will be discussed.

Keywords*: Hydrogeoterrorism, Groundwater, Aquifer, Overexploitation, Silent Terrorism*

INTRODUCTION!!!
The World Food Summit of 1996 defined food security as existing when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life. Commonly, the concept of food security is defined as including both physical and economic access to food that meets people's dietary needs as well as their food preferences. In many countries, health problems related to dietary excess are an ever increasing threat, In fact, malnutrion and foodborne diarrhea are become double burden. Food security is built on three pillars (World Food Summit, 1996):

- Food availability: sufficient quantities of food available on a consistent basis.
- Food access: having sufficient resources to obtain appropriate foods for a nutritious diet.
- Food use: appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation.

Agriculture remains the largest employment sector in most developing countries and international agriculture agreements are crucial to a country's food security. Land and water resources and the way they are used are central to the challenge of improving food security across the world. Demographic pressures, climate change, and the increased competition for land and water are likely to increase vulnerability to food insecurity, particularly in Africa and Asia. Deeper structural problems have also become apparent in the natural resource base. Water scarcity is growing. Salinization and pollution of water courses and bodies, and degradation of water-related ecosystems are rising (FAO, 2011).
In 1948, the Universal Declaration of Human Rights affirmed the right of everyone to adequate food. However, access to adequate food in the rural areas of many developing countries depends heavily on access to natural resources, including water, that are necessary to produce food. The UN General Assembly declared access to clean drinking water and sanitation as a human right on 28 July 2010. But the right to water in the context of the right to food is a complex question. While drinking and cooking water would be protected, water for food production would probably not be covered under the minimum needs in arid areas (UN, 2012b).
Groundwater is the water that fills cracks and other openings in beds of rocks and sand. Each drop of rain that sinks into the soil moves downward to the water table, which is the water level in the groundwater reservoir. Groundwater does not normally occur in underground streams, lakes, or veins. Groundwater is found in soils and sands able to retain the water — much like a sponge holds water. Usually, groundwater is tapped through wells placed in water-bearing soils and rocks beneath the surface of the earth (NGWA, 2010). In other words, groundwater is subsurface water, which can be pumped upward to surface by

drilling a well (Jordan water authority, 2002). In many regions, the major use of groundwater is in irrigation for agricultural purposes.

According to *Ban Ki-moon* (*UN Secretary General*) over the coming decades, feeding a growing global population and ensuring food and nutrition security for all will depend on increasing food production. This, in turn, means ensuring the sustainable use of our most critical finite source water.

Water Crisis

According to FAO (2003), the first step in estimating the pressure of irrigation on water resources is to assess irrigation water requirements and withdrawals. Precipitation provides part of the water crops need to satisfy their transpiration requirements. The soil, acting as a buffer, stores part of the precipitation water and returns it to the crops in times of deficit. In humid climates, this mechanism is usually sufficient to ensure satisfactory growth in rain-fed agriculture. In arid climates or during the dry season, irrigation is required to compensate for the deficit resulting from insufficient or erratic precipitation. However, it is *water withdrawal for irrigation*, i.e. the volume of water extracted from rivers, lakes and aquifers for irrigation purposes, which should be used to measure the impact of irrigation on water resources. Irrigation water withdrawal normally far exceeds the consumptive water use in irrigation because of water lost during transport and distribution from its source to the crops. On average, for the 93 developing countries, it is estimated that irrigation efficiency was around 38 percent in 1997/99, varying from 25 percent in areas of abundant water resources (Latin America) to 40 percent in the Near East/North Africa region and 44 percent in South Asia where water scarcity calls for higher efficiencies. There are already very severe water shortages, in particular in the Near East/North Africa regions (FAO, 2003).

Some 2. 78 million trillion gallons of groundwater, 30. 1 percent of the world's freshwater, are estimated for the planet. About 90 percent of our freshwater supplies lie underground (NGWA, 2010). The current rate of global groundwater withdrawals ─ about 750-800 km^3 per year or about a quarter of total global water withdrawals ─ which is in excess of natural groundwater recharge rate, have depleted groundwater resources. This has resulted in declining water tables, decreasing yields of wells, increasing pumping costs, competitive deepening of wells, land subsidence, loss of wetlands and flowing springs and rivers, salt water intrusion and other salinity problems, water quality degradation, and damaging aquatic ecosystems. Such negative effects are common in major regions of North Africa, the Middle East, South and Central Asia, North China, North America, and Australia. While the value of this resource and the dramatic economic benefits are known, the complexity in regulating and monitoring groundwater withdrawals have made sustainable management of this resource very challenging (Madani and Dinar, 2011).

Groundwater is being pumped intensively and aquifers are becoming increasingly polluted and salinized in some coastal areas. Large parts of all continents are experiencing high rates of ecosystem impairment such as reduced soil quality, biodiversity loss, and harm to amenity and cultural heritage values and particularly reduced water quantity and quality (FAO, 2011). In low to medium income countries with high population growth, the demand for water is outstripping supply. Rising demand from both agriculture and other sectors is leading to competition for water resulting in environmental stress and socio-economic tension. Where rainfall is inadequate and new water development is not feasible, agricultural production is expected to be constrained more by water scarcity than land availability. As a result, locally intensive groundwater withdrawals are exceeding rates of natural replenishment. Because of the dependence of many key food production areas on groundwater, declining aquifer levels present a growing risk to local and global food production (FAO, 2011). Although groundwater is a renewable resource and water removed from the ground is constantly replaced, in some arid and semiarid regions such as Iran, a low rate of replenishment is exceeded by the rate of groundwater pumping, resulting in problems of groundwater mining. So, groundwater can be considered as *Non-renewable* resource. According to FAO (2003), over extraction of groundwater is widespread in both developed and developing countries. It arises when industrial, domestic and agricultural withdrawals of groundwater exceed the rate of natural recharge. In some areas, particularly in the Near East/North Africa region,

irrigation draws on fossil aquifers that receive little or no recharge at a level that is not sustainable (FAO, 2003). This horrible environmental disaster is preferred to be called and entitled *Hydrogeo–terrorism* by the authors. This term will be introduced, defined and discussed in the next parts of this paper.

Considering the recent decade drought, a long time is needed to allow replenishment of underlying groundwater reservoirs (aquifers); also such areas must be properly managed in order to prevent water-soluble waste products stored in these areas from infiltrating and polluting the underground supply.

This article presents the term of hydrogeo-terrorism and explains its dimensions and components. Also, it reviews water ground situation.

Purpose of the Study

The main purpose is to challenge behavior of groundwater overexploitation in the world. The specific aims includes:

- To take a look at groundwater use in the world
- To develop and present the term of Hydrogeo terrorism or Silent terrorism which threaten food security and environment.

MATERIALS AND METHODS

Documentary method is used in this study so it is based on literatures, archives and documents. This is an analytic and qualitative paper which is going to discuss awful trend of groundwater withdrawals in world.

Terrorism and Hydrogeo–Terrorism

There are mainly two confusing terrorism-combination words relevant to agro-ecology system: *environmental terrorism* and *eco-terrorism*. Not only their meaning is not similar at all, but also, conceptually and functionally, they have, to some extent opposite meaning. In brief, the former, destroys the environment, but the latter, saves it.

According to Chalecki (2001), at first glance, the distinction between environmental terrorism and eco-terrorism might seem academic. However, operationally there is a significant difference. Environmental terrorism involves targeting natural resources. Environmental terrorism can be defined as the unlawful use of force against *in situ* environmental resources so as to deprive populations of their benefit(s) and/or destroy other property (i.e. poisoning the water supply, setting fire to forest). Gleick (2006), delivers a similar definition: The term environmental terrorism should exclusively refer to the unlawful use of force against environmental resources or systems with the intent to harm individuals or deprive populations of environmental benefit(s) in the name of a political or social objective.

This distinguishes it from eco-terrorism, which should only be considered the unlawful use of force against people or property with the intent of saving the environment from further human encroachment and destruction (Gleick, 2006). Based in deep ecology theory, the professed aim of eco-terrorists is to slow or halt exploitation of natural resources and to bring public attention to environmental issues such as unsustainable logging or wildlife habitat loss through development (Gleick, 2006; Chalecki, 2001). Eco-terrorism involves targeting built environment such as roads, buildings and trucks, ostensibly in defense of natural resources[1]. Not to be confused with environmental terrorism, eco-terrorism is the violent destruction of property perpetrated by the radical fringes of environmental groups in the name of saving the environment from further human encroachment and destruction. Eco-terrorists do not practice environmental terrorism *per se* if they do not choose environmental resources as their targets. In other words, Eco-terrorists have damaged no resources and killed no one. For example, they target a ski resort, logging trucks and office buildings (Chalecki, 2001). Simply put, environmental terrorism involves

[1]There are a wide variety of tactics that have been used by eco-terrorists such as *tree spiking*. It is a common tactic that was first used by members of EarthFirst! In 1984. Tree spiking involves hammering a small spike into the trunk of a tree that may be logged with the intention of damaging the chainsaw or mill blades and may seriously injure the logger. Only one case of serious injury has been widely reported. (Ref: Long, D. 2004. *Ecoterrorism*. New York: Facts on File.).

targeting natural resources for a political, social or economic objectives. Eco-terrorism involves targeting social, political or economic resources for an environmental objective (Gleick, 2006).

Here, the authors are going to bring up and discus the new and third term: *Hydrogeo-terrorism.* The authors define *Hydrogeo-terrorism* as follows:

Any kind of soft actions (i.e. law legislating, policy-making, supervision and etc) or hard actions (i.e. drilling well in banned area, illegal deepening well, overextraction groundwater and etc) that result in the sharp decline of quantity and quality of aquifer water in such a manner that threaten food security and environment in long term.

These actions may be performed in formed or uninformed, intentional or unintentional, premeditated or not, with any purposes (Economic, political, social and etc). In case of policy makers, may refer to social and political purposes which done in uninformed functions. In case of farmers and users, hydrogeo-terrorism usually -not always- refers to premeditated, economically motivated violence perpetrated against non-combatant targets, always intended to benefit more and more from groundwater. If conventional terrorism acts be considered as murder, Hydrogeo-terrorism can be consider as manslaughter. Because many of farmers may not be aware of negative consequence of groundwater overexploitation on environment, water cycle and food security. The purpose of this paper is not to trivialize the efforts and hard work of producers, the aim is to pay more attention for conservation of valuable water resources for long period of time with efficient agriculture and green economy.

According to the definition, *Hydrogeo-terrorism* differs conceptually with these terms of *environmental terrorism* and *eco-terrorism*. Although the three terms apparently look similar, they are completely different even opposite, so cannot be set in one category.

According to Chalecki (2001), in general, acts of terrorism have four essential components: *motivation, means, target, and enemy*. Different kinds of terrorists, whether groups or individuals, have various motivations: religious (belief), cultural, political, economic, psychological, or some combination of these. Any physical and technical instruments may be used as a means which in case of political terrorism, the means at their disposal are often explosives, guns, poisons, or other destructive agents. Targets (i.e. buildings, human, environmental resources and etc.) vary according to the different parameters. Their enemies are usually governments or political figures, and in case of eco-terrorism, enemies such as commercial developers and biotech firms are chosen (Chalecki, 2001).

In case of *Hydrogeo-terrorism*, the four essential components will be adjusted and redefined. Target is quiet obvious: *Groundwater and Aquifer*. Different Hydrogeo-terrorists may be stimulated and motivated by various motivations. For example, farmers and well-drillers may be mainly motivated by economic drives or policy-makers maybe motivated or being forced by political purposes. Any technology and technical instruments such as drilling Rig, electricity power and high power water pumps may be used as means. The considerable component is enemy. There is no specific enemy (one who being damaged) .It may not be called real enemy. All people especially next generation and even hydrogeo-terrorists themselves and their families are considered as enemy intentionally or unintentionally. So it can be called silent terrorism. Because the competitive behavior for overextraction of water and the act of policy makers that facilitate and motivate this illegal competitive behavior, target the future generation. We don't fight them by gun, but are in war with them by water. In other words, by damaging groundwater as one of the most important natural resources, hydrogeo-terrorists are undermining not only human community, but also themselves; and really are self-destructive. In short, hydrogeo-terrorists are laying axe to human's own root. In fact, he/she fights with him/herself and threats his/her future by unwise or illegal actions. Hydrogeo-terrorists will destroy people's sense of safety and normality and introduces new and often substantial stress and uncertainty in individuals and communities. Hydrogeo-terrorists can be more creative and dangerous than we expect.

Society reacts differently to hydrogeo-terrorism in comparison to the other terrorisms. It probably is due to that destruction and elimination of groundwater -which we entitle *hydrogeo-terrorism*, are dilatory and imperceptible events. Hence, it doesn't receive adequate attention. So Hydrogeo terrorism can be consider

as silent terrorism. We often accept large casualties from hydrogeo-terrorism with a degree of sanguinity not matched by our response to other kinds of terrorism.

Considering the mentioned definition, Hydrogeo-terrorism process includes at least five dimensions:

- *People:* whether groups or individuals, can be divided into two main divisions. First, Winners such as farmers and well-drillers who are main perpetrator and benefit directly in short time period; Second, losers such as human community especially new generations who will seriously receive damage in long term period.
- *Organization and policy-makers:* which includes legislative power, executive power and judicature power, in general. They have an important role in macro-policy making. In fact, their weak function, motivate people to perpetrate more and more.
- *Technology and technical instruments:* that accelerate the trends (i.e. Drilling Rig[2], electricity power and high power water pumps). On the other hand, low efficiency of traditional irrigation system, force for hard function.
- *Agro-ecological and Environmental factors*: such as drought, low rainfall and geological parameters.
- *Socio-economics and cultural factors* that as the strong derives have key roles in shaping behavior from childhood to adulthood.

Some of the above dimensions are Background or contextual, and the others are Causes in perpetration of *Hydrogeo-terrorism* process.

This article will continue its focus on farmers' behaviors and affecting factors on their behavior in the hydrogeo-terrorism actions.

Pressure on water resources due to irrigation can be one of the applied indexes for hydrogeo- terrorism. According to FAO (2012), on average, for the 167 countries, it is estimated that the water requirement ratio is around 56 percent, varying from 23 percent in areas of abundant water resources (Central America) to 72 percent in Northern Africa (Table 1). Irrigation water withdrawal was estimated to account for only 5.1 percent of total renewable water resources for the 167 countries studied (Table 1). However, there are wide variations between regions, with the Kuwait using 2460 percent of its water resources in irrigation, while about 65 countries use less than 1 percent (Table 1) (Also, Latin America barely uses 2 percent and Europe 1 percent). Data clears that in ten countries (mostly from the Arabian counties, Northern Africa and Central Asia) used volumes of water for irrigation which are several times larger than their annual renewable water resources in their respective reference year. Despite the distortion of these ratios by the use of significant volume of secondary freshwater (water previously withdrawn and returned to rivers and groundwater) and non-conventional sources of water—direct use of treated or untreated wastewater, agricultural drainage water and even desalinated water for agriculture—as well as fossil groundwater in some cases, the situation remains critical in these countries (FAO, 2012). An additional 22 countries used more than 20 percent of their water resources, a threshold that could be used to indicate impending water scarcity. For some countries, relatively low national figures may give an overly optimistic impression of the level of water stress: China, for instance, is facing severe water shortage in the north while the south still has abundant water resources. Overexploitation of renewable groundwater also occurs at the local level in several countries of the Near East, Northern Africa, South and East Asia, Central America and in the Caribbean, even if at the national level the water balance may still be positive.

One of the major questions concerning the future of irrigation is whether there will be sufficient freshwater to satisfy the growing needs of agricultural and non-agricultural users. Estimates of irrigation potential are also based on renewable water resources, i.e. the resources replenished annually through the hydrological cycle. In arid countries where mining of fossil groundwater represents an important part of water withdrawal, the area under irrigation is usually larger than the irrigation potential (FAO, 2003).

[2] It is a kind of machine used in drilling water wells with the aim to reach groundwater layers and extract water there from.

It is estimated that the water requirement ratio in Iran, is around 57 percent. Also, Irrigation water withdrawal was estimated to account for only 62. 5 percent of total renewable water resources (table 1). In other words, the ratio of used volumes of water for irrigation in Iran is 12. 3 times larger than world's average.

CONCLUSION AND RECOMMENDATIONS

During the second half of the 20th century, world population had a twofold increase, agriculture doubled food production and developing countries increased per capita food consumption by 30 percent. So, Water is key to food security. Crops and livestock need water to grow. Agriculture requires large quantities of water for irrigation and of good quality for various production processes. While feeding the world and producing a diverse range of non-food crops such as cotton, rubber and industrial oils in an increasingly productive way, agriculture also confirmed its position as the biggest user of water on the globe. Irrigation now claims close to 70 percent of all freshwater appropriated for human use. (UN, 2012b)

While the world population is predicted to grow to 8. 3 billion in 2030 and to 9. 1 billion in 2050 and food demand is predicted to increase 50% and70% by 2030 and 2050 respectively, the main challenge facing the agricultural sector is irrigation water for producing food. According to UN (2012b), producing 1 kilo of rice, for example, requires about 3,500 liters of water, 1 kilo of beef some 15,000 liters, and a cup of coffee about 140 liters. This dietary shift is the greatest to impact on water consumption over the past 30 years. On the other hand Roughly 30% of the food produced worldwide – about 1. 3 billion tons - is lost or wasted every year, which means that the water used to produce it is also wasted. So, everyone (policy makers, farmers, etc.) who act (soft or hard) in a manner that threaten groundwater and consequently food security, can be named as hydrogeo terrorist. The action of hydrogeo terrorism may be informed or uninformed, intentional or unintentional, premeditated or not, with any purposes (Economic, political, social and etc.). In any way that happens, it is a main serious threat for food security.

The way that water is managed in agriculture has caused wide-scale changes in ecosystems and undermined the provision of a wide range of ecosystem services. The external cost of the damage to people and ecosystems, and clean-up processes, from the agricultural sector is significant.

As suggestions, to produce more nutritious food with less water, Innovative technologies are required to ensure a greener and more sustainable food production. They are needed to improve crop yields; implement efficient irrigation strategies; reuse of drainage water and use of water resources of marginal quality; produce smarter ways to use fertilizer and water; improve crop protection; reduce post-harvest losses; and create more sustainable livestock and marine production.

To focus on human capacities and institutional framework, Agricultural development in the least developing countries lies mainly in the hands of smallholders. Therefore, new institutional arrangements are needed that centralize the responsibility for water regulation. To improve the value chain, from production, post-harvest handling, processing, retailing, consumption to distribution and trade, efficient water and food recycling strategies can be addressed. It can help secure environmental water requirements when reuse of treated water is not culturally acceptable for other uses. At the end, it is emphasis that to prevent groundwater decline, common sense must be awake and water governance with a serious supervision is needed. Hydrogeo terrorism is a fact. Many of farmers may not be aware of negative consequence of groundwater overexploitation on environment, water cycle and food security. It is our mission to inform the community that the competitive behavior has to give up.

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