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Agricultural Water Management Policies under Scarcities In West bank and Gaza strip, Palestine

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Abstract – The big environmental challenge that the West bank and Gaza strip (WBG) are facing after the Israel occupation, is the scarcity of water. (WBG) has acute water shortage as a result of Israeli water politics which was based on the goal of usurping and controlling Palestinian lands and resources. The use of water for agricultural production in water-scarce regions requires more innovation and scientific research to raise benefit of every drop of water. Study aiming to identify the main methods, techniques and suggestion some policies for facing water scarcity, then recommending different methods will contribute in development of the Palestinian agricultural sector, by identifying more efficient policies of water resources management, by using: 1. Grey Water (GW) technique adoption using in both domestic and national levels which forming the main part of waste water using. 2. Water harvesting (WH) for collecting rainwater from rooftops, land surfaces, road surfaces and greenhouse. 3. Water pricing which plays two main roles: the financial role is a mechanism for recovering the investment, and the economic role of signaling to the scarcity value and the opportunity cost of water, by suggesting the new system of pricing according to the sectors priority. Study conclusions to increase people awareness about adoption these techniques, submitting results to policy makers, water specialist and all partners in national and international organizations, to cope with the crisis of renewable, in addition of suggesting tools and methods depending on national program working under the frame of national water policy.

Keywords – water; water politics; water management; Grey water; water harvesting; water pricing

1. Introduction

Water in near future can become as precious as oil. Even though the total amount of water made available by the hydrologic cycle is enough to provide the world's current population with adequate freshwater, most of the water is concentrated in specific regions leaving other areas water-deficient (Nofal et al, 2010). According our study which related to (WBG) water crisis and suggestions of water management policies under scarcities, this problem completely as a result of the Israeli military occupation of the Palestinian land and its denial by the Israeli of the ground water sources (Haddad, 2011). The major ground water source for municipalities has been the deep aquifer, while the water for agriculture is from shallow aquifers and springs, so mainly (WBG) is experiencing a severe water crisis caused mainly by the mismanagement of the Palestinian water resources, which in turn is affecting their farming patterns (MOA, 2012). Many towns of the (WBG) suffer from water shortage (PCBS, 2011), which is revealed by irregular and failures of the water supply systems especially during summer season.

Under these circumstances, Palestinian people started creating some methods to avoid Continuous shortage of water in agriculture, like some methods of water management systems and some informal ways and behaviors, representing the suggestion policies about rainwater harvesting, (GW) using, and water pricing (Gemma et al, 2011). In addition to the rain water, other supply networks have gained increasing interest among water resources for agriculture, especially for developing regions (Rygaardet et al, 2011). Water collected through Rain Water Harvesting (RWH) is seen as a valuable water source both for agricultural and domestic use in a world-wide overview, (Helmreich, 2009) identified RWH as an important component to increase self sufficiency value of water and its usefulness without controversy in (WBG) area as shown for the Indian megacity Chennai (Goel and Kumar, 2004), or for the Jordan (Salameh and Bannayan, 1999). According to health regulations, the Palestinian ministry of health does not permit the use of RWH for drinking and any storage or purification system must be under a strict supervision. This comprehensive regulation prevents any illegal use of harvested water for drinking by encouraging its using for agriculture (MOA, 2012).

Farmers in (WBG) going to work among recycled waste water (GW) and water harvesting, as a result of conditions of water scarcity, using of (GW) and (WH) in

agriculture stilling in a limited range, despite of has been thoroughly investigated in many studies, carried out in the water sector in Palestine, and the main issues concerning the reuse of wastewater such as the collection system, treatment plants, regulations and availability of standards and guidelines, where others focusing on planting some species, be suitable in brackish water desalination as method of water management policies on its theoretical framework (Mizyed, 2013).

In this study we are focusing on water management policies from different sides starting with greywater using by highlighting the international experiences, characterization and economic policies for these methods, advantages and methods of water harvesting, water pricing policy as a method of water management. Also summarizing how it will participate in developing the agricultural sector using water management as a policy under scarcity were studied through this subject need a lot of related and much deeper researches and require a multi-disciplinary approach to encompass both social and technical aspects and table the problem to policy makers and donors by finding the means to ensure that they are used continuously in a sustainable manner.

2. Palestine in this Paper

This study was conducted in (WBG) as a part of historical and now known as Palestinian Authority (PA) after the Oslo agreement since 1994. Historically Palestine consists of all land from the Mediterranean sea and the river of Jordan with total area of 27000km2, most of this land were occupied by the Israel Zionist in 1948, when Palestine were under the British mandate, and the rest area of Palestine which represents the West Bank including East Jerusalem and the Gaza Strip, occupied in 1976 war between Israel and Egypt, Syria and Jordan. The land area of the West Bank is estimated as 5572 km2 and the Gaza Strip is about 367 km2, (WBG) population projections reveal that mid-year population in 2011 around 4.17 million , 2.58 million were living in the West Bank and 1.59 million living in Gaza Strip (PCBS, 2011).

3. Palestinian Water Resources

Palestinian living in (WBG) current water supply is restricted and limited as a result of Israeli authorities practices (not sufficient for immediate and near term needs). Israeli consumers were provided with Palestinian water which is about four times of that available to Palestinians, and about the main water resourses distributed by Jordan river (Israel 100%; Palestine 0%), coastal aquifer (Israel 82%; Palestine 18%), mountain aquifer (Israel 83%; Palestine 17%), and other sources (Israel 100%;

Palestine 0%) , at present the average per capita water consumption by the Palestinian population is approximately 55 l/c/d, or 55% of the World health organization (WHO) minimum standard of 100 l/c/d (Mizyed, 2013). The annual rainfall in Palestine is about 10000 million cubic meters, however only 20% of this amount is being beneficial and seep into the ground and the rest is lost due to evaporation (60 -70%) and the rest flow towards the sea (PCBS, 2011). The estimated average annual ground water recharge in Palestine is 698 to 708 mcm/yr (648 mcm/yr in the West Bank and 50 – 60 mcm/yr in the Gaza Strip), and the only surface water source in the West Bank is the Jordan river (Haddad, 2011).

Objectives of study are to manage some policies and methods for facing water crisis in (WBG), that's by identifying technical, social, economic, and political challenges facing water crisis and sustainable of water management. Development of water management policies require and participating the current status and conditions, then analysis of (WBG) water situation and suggestion some development and strategic plans. These plans producing some regulations and standards were compared to international and regional experiments and then present the results of this study to the stockholders were able to evaluate their acceptance to re-use, adoptions and in accordance to available standards and regulations. In addition, the current study will be the starting point for more specified researches including different methods in one study as a package of water management policies, and more in-depth studies as for founding and adding more benefits for farmers and agriculture sector. Other approaches of this study included sighting on reviewing existing studies, in treated (GW) re-use and regulations, water harvesting, and water pricing as a group of policies for water management.

4. Methodology

Main methodology of study depending on secondary data gathered from previous studies, literatures reviewing from international and national studies, publications, and the local data base from related institutions about most methods and innovations participating in water management development and some policies in (WBG). The deep analysis of data from different studies is a powerful technique for understanding our strengths and weaknesses points and at the same time our opportunities and threats of popularization of this package of practice between farmers, institution and policy makers.

Figure 1. General location Map.

Historical Palestine map borders showing (WBG) surrounding with occupied Israel. And all the water resources especially from the north and the Jordan River sides are under Israel control, which is leading to inability to control all underground water outside and inside Palestine. And all that as a result of unfair water agreements between Palestine and Israel (Oslo agreement) which lost our right control on water recourses.

5. Discussion

5.1. Grey water using policy

Grey Water (GW) is part of wastewater collected separately from sewage flow from clothes washers, bathtubs, showers and sinks, but does not include wastewater from kitchen sinks, dishwashers or toilets. Dish, shower, sink, and laundry water comprise 50-80% of residential wastewater. GW may be used in groundwater recharge, landscaping and plant growth (Gemma et al, 2011). Due to the fact that GW is usually generated by the use of soap or soap products for body washing, its quality varies according to source, geographical location, demographics and level of occupancy (Salamehand Bannayan, 1999).

Historically, domestic greywater reuse was practiced to conserve water. However, social and economic constraints prevented its further development and integration in the urban water systems (Al-Jayyousi, 2003). It is likely that new innovations in water management will eventually lead to substantial changes in lifestyle, particularly if the use of water as a transport medium for our domestic waste is reduced or eliminated (Gemma et al, 2011). In most countries of the Mediterranean region, GW is reused at different extents within planned or unplanned schemes (Salamehand Bannayan, 1999). In several countries water reuse under special condition and greywater is submitted to adequate reclamation systems and treated effluents are being reused without any evidence of risk for human health (Al-Jayyousi, 2003.). Farmers are key stakeholders in the reuse of treated domestic GW for irrigation, but their position at the end of the water chain means that they are often marginalised in water resource decision-making processes, they have the capacity to accept GW idea and visible through their decision to irrigate with the resource or reject the idea, perhaps demonstrated through relocation or agricultural section should provide an interpretation of the results and should not contain any additional primary results or data.

abandonment or investment in the development of freshwater resources such as groundwater. The acknowledgement that there is a choice associated with the decision to reuse water makes it imperative to understand the factors and mechanisms at the farm level which make water reuse both acceptable and manageable as comparison between industrial use, domestic use and agricultural activities (Al-Jayyousi, 2003.).

5.2. Treatment of grey water (Biological systems)

Biological treatment is required to remove biodegradable material especially for systems that include large distribution networks such as hotels or community based recycling schemes. The benefits of biological and physical treatments are combined in processes such as Membrane Bioreactors (MBR) and Biologically Aerated Filters (BAF) which are small footprint processes capable of producing high-quality effluents. BAFs combine depth filtration with a fixed film biological reactor. As such, they present no absolute barrier to suspended materials and thus do not substantially disinfect the water (Lang et al, 2011).

5.3. International experience of greywater reuse

On the global scene, Japan, U.S and Australia maintain the highest profile in GW reuse (Gemma et al, 2011). Other countries involved in active GW research and applications include Canada, United Kingdom, Germany and Sweden (Lang et al, 2011). At the regional level most technicians and policy makers in the field of water management encouraged using GW treatment systems like Saudi Arabia, Cyprus and Jordan to optimize water use (Gemma et al, 2011). However, guidelines and technical specifications are still underway. Currently on site treatment systems have generally adopted the technology of conventional activated sludge plants for large treatment systems (Goeland Kumar, 2004). Each country has a different reason for the adoption of GW reuse. For example, the Japanese reuse initiative is driven by the demands of a high population density and small land space, while American, Australian, Saudi Arabian and Jordanian initiatives are direct responses to drought conditions and the unregulated uptake of domestic GW reuse for garden irrigation (Fayez and Al-Shareef, 2008). However, it seems that certain GW reuse initiatives are not focused directly upon attaining a more sustainable future; rather they are short-term reactions to water scarcity in addition to when from other world policies against water scarcity which Palestine is considered mainly affected from this problem (Lang et al, 2011).

5.4. Using Grey water policy for water management in Palestine

According to national water situation GW using is essential for Palestine status. GW using makes a significant contribution to the limited irrigation water supply and ensures the continuation of agriculture in parts of the country and water reuse for irrigation is conducted irrespective of the perception of the farmer towards the resource (Fayez and Al-Shareef, 2008). Because that one forms aims of this study focusing in future researches on water reuse should explore how farmers will be involved in water quality decision-making in water reuse schemes, how their involvement can be enhanced. In addition, further work is needed regarding both the positive and negative aspects of reclaimed water, how those aspects can be managed successfully in various agricultural systems and participation in agricultural development which is considered the main sector in Palestine (MOA, 2012).

Policy makers have an essential role to play through facilitating the process and identifying mechanisms through which farmers can integrated into management decisions surrounding reclaimed water quality and quantity provision (Abdulla and Al-Shareef, 2008). Reuse of treated GW needs many environmental, technical, socio-economic and legal implications, reuse of treated GW in some sensitive areas in Palestine might result in the contamination of groundwater aquifers and the shortages in water for agriculture require more efforts and arranging policies to encourage and controlling the reuse of treated GW which in the future may require treatment of GW to higher qualities allowing unrestricted reuse in agriculture as it has been adopted in developed countries. However, current economic and political conditions of the Palestinians make such an option not affordable to the majority of the people (Lang et al, 2011). Farmers' participation in developing the standards was lacking, considering cultural and religious concerns for such practices, so it is important to allow farmers as well as other civil society organizations to participate in the development of standards and regulations, but the GW reuse regulations were adopted considering international and regional standards (MOA, 2012). The observations of the WHO that severely restrict standards and considering the dynamic changes in the society it is important to review the implementation, applicability and acceptance of these standards with the development of reuse projects. The implementation mechanisms and the monitoring methods are still very important (Mizyed, 2013). The lack of infrastructure for collection and treatment of GW is a major obstacle for treated GW reuse in Palestine as well as in most developing countries. However, there are strengths and opportunities that could be utilized. The health and environmental concerns toward improved sanitary and hygiene conditions are resulting in a need to improve GW collection and treatment systems (Mizyed, 2013). Existing projects regarding the design and construction of GW disposal systems are opening new opportunities to improve sanitation conditions and increase the utilization of treated GW in agriculture and the educational level of farmers has improved significantly thus they are capable of adopting new techniques and options to improve their living conditions through utilizing new agricultural practices as a responsibility of policy makers and planner in Palestine (Al-Jayyousi, 2003).

5.5. Water harvesting policy

Rainwater harvesting is a common technology being used in Palestine for collecting and storing rainwater from rooftops, land surfaces, road surfaces, greenhouses tops, or rock catchments using simple techniques such as pots, tanks and cistern as well as more complex techniques such as underground check dams (Abu-Madi, 2009). The importance of this techniques is related to the limited control of 90% of ground water becouse the nature of west bank lands (sloping area) and most water collecting out of palestinian control in addition of a lot of water agreements as a result of Oslo agreements which restricted Palestinian water control. This agreement unfortunately is giving Israel the veto objection against any new project or digging new wells may be affecting on the water aquifers witches under occupation control (PCBS, 2011). Harvested rainwater is a renewable source of clean water that is ideal for domestic and landscape uses (Abu-Zreig et al, 2000). Water harvesting systems provide flexible solutions that can effectively meet the needs of new and existing, as well as of small and large sites. Using a water harvesting system is an ongoing process that can be developed over time. The greater attraction of a rainwater harvesting system is the low cost, accessibility and easy maintanence at the household level (Fayez and Al-Shareef, 2008). Water scarcity demands the maximum use of every drop of rainfall .Therefore, water management projects is reflecting one of the policies we need to increase, collect and use maximum amount of water in Palestine. Water harvesting methods to increase water supply has been practiced in many parts of the world, especially in arid and semi-arid countries like Jordan (Abu-Zreig et al, 2000). Rainfall is collected from areas specifically treated to increase precipitation runoff and stored in tanks for human and animal consumption and for supplemental irrigation (MOA, 2012).

A report by the United Nations Environmental Program, 1983, classified various means of increasing the runoff from an area: (i) cleaning sloping surface, (ii) mechanical treatment including compacting the surface, contour terracing and smoothing, (iii) application of chemicals to reduce infiltration and surface-binding materials to seal the surface, and (iv) covering the catchment area with a rigid or a flexible surface. Collecting rainfall in storage tanks can be very expensive and may result in wastage of large volumes due to evaporation (Fayez and Al-Shareef, 2008). This is particularly important in arid and semi-arid regions where the amount of evaporation greatly exceeds the amount of rainfall. One solution to the evaporation problem is to use closed storage tanks. Covered tanks can practically eliminate water evaporation but the cost is extremely high. The other solution is to store collected rainfall directly in the soil for crop production, and planting some field crops between trees and mountain glades (Fayez and Al-Shareef, 2008). The use of terraces, rippers, contour ridges and micro-catchments is widely recognized to increase soil water storage and agricultural production. These methods use the soil profile as a storage media eliminating the need for storage tanks and reducing water evaporation at minimal cost (Lang et al, 2011).

In general in most dry and semi dry areas especially Palestine, we need to develop some methods as apart of water management and national agricultural policies to precipitate in water availability for irrigarion which consider the most important themes of Agriculture and leads to sustainable agricultural development.

5.6. Water pricing policy

Most countries looking for water management policies as a method of facing water shortage are using the pricing of water as tool to support water management decisions. In addition to that, water underpriced may lead to its unsustainable water use (Alvarez-Mendiola and Andreu, 2012). Water resource managers are considering

the policy of reallocating a portion of the water supply from agriculture to other uses and they believed that increasing irrigation water prices could influence water consumption and thus make water available for non-agricultural sectors. Some studies examined the impacts of water pricing on agricultural water consumption and farming profitability and provide some guidelines for policy makers regarding water pricing as a tool to manage scarce water resources (Evenari, 1982).

Some study used hydro-economic modelling to evaluate the design of different water policies under conditions of water scarcity, sustainable water management relies on mathematical models to represent the complex interactions between the effects of these decisions on water resources and quantity using (FAO, 2002). Many water experts recognize water pricing as a policy intervention that can mitigate both quantity and quality dimensions of water scarcity and thus enhance efficient water use by depending on the type of water using in agriculture, domestic, tourism, factories and others, the quantity levels of water using by building economic price system leading to the sustainability and justice for all parts.

Pricing of water plays two main roles: First the financial role which is a mechanism for recovering the investment, operation and maintenance (O&M) costs and the economic role of signaling the scarcity value and the opportunity cost of water, to guide allocation decisions both within and across water subsectors, where economic terms represent the full cost of water includes O&M costs, capital costs, opportunity costs, and the costs of economic and environmental externalities (Evenari, 1982).

Related to the same subject and according the result of study carried out in Palestine, founded ground water is the only accessible water source for farmers in the study area (Tulkarm), they also rely partly on rainwater harvesting during winter. The surveyed farmers indicated that private persons own 89% of the wells, 10.2% are owned by farmers' cooperatives and only one well is owned by a local council (municipality) and the agricultural water consumption varies between farms depending on:

(i) water availability, (ii) water price, (iii) land area, (iv) Types of irrigated crops, (v) farmer experience, (vi) method of measuring water consumption, (vii) technical performance of the irrigation system, and (viii) type of irrigation system (Abu-Madi, 2009), these results let us thinking in the water pricing system as a tool for managing and control of water distributions between water owners and consumers, most studies approved to determine agricultural water consumption depending on water prices and will be the best fit generated by the regression model, the regression results suggest that irrigation water prices and the size of irrigated lands are inversely correlated with agricultural water consumption, in addition to irrigation pattern and farm annual income are positively correlated with agricultural water consumption.

Small-scale farmers tend to consume more irrigation water than others and thus they are more economically sensitive to increases in water prices, so may be looking for farm area according water prices and generally farmers determine irrigation requirements based on their experience and don't show interest in prices of water, so sometimes spending more water quantity than the suitable quantity (Helmreich, 2009). The value of water can be calculated for specific locations and times under varying conditions of water scarcity and water demands and basing it on various details such as how water is managed in a basin over time, taking into account all surface and groundwater resources, infrastructures, allocation rules and priorities, (Alvarez-Mendiola and Andreu, 2012.). These decisions about the costs and benefits of different allocation and pricing policies under conditions of water scarcity allows benefits of different water resources economically in order to identify the most efficient policies to reach active water management, (Helmreich, 2009).

Water pricing policies can guide management decisions on efficient water use. The researchers point out that water prices are also decided within social and national policies, to help ensure that they are fair for all sections of society (ensuring that poorer populations do not suffer under higher pricing policies) as well as environmentally sustainable, considering all these issues would make the dynamic simulation of groundwater demand in Palestine more realistic yet more complex (Helmreich, 2009). This is clearly beyond the scope of much paper explained these points which can be used as indications for further research more specific to study the local situation in Palestine. In spite of mentioned limitations forms, related to domination and weak regulations and rules in addition of randomizing special wells and other limitations. This study helps policy makers and farmers to achieve a ground water utilization of aquifer to its yearly recharging; total ground water demand on the time horizon decreases more than 25% relative to the baseline scenario (MOA, 2012). Besides a reduction in water consumption, the implementation of pricing scenario would lead to a decrease in employment directly generated by the agricultural sector (Alvarez-Mendiola and Andreu, 2012). The decrease in agricultural sector employment is a social impact caused by substitution of the most water intensive crops which are normally also more labour intensive by others with reduced water and labour requirements (Alvarez-Mendiola and Andreu, 2012). Many water management scientists approved that water pricing as a good agricultural policy will participate in solving Palestinian water problems which consider one of the major problems as a result of Israeli policies that by depending clear criterias and integrated studies reach justice and sustainability (MOA, 2012).

6. Conclusions

This study is concluding and characterizing the actual situation of Palestinians living in (WBG) within different water conditions and it can be concluded that there is an urgent need for more information and data about the characteristics of different types of water management methods in order to be able to evaluate the water status and building national water strategies for Palestinians in (WBG).

The Palestinian's actual sovereignty need to have supreme and independent political authority power and

reach the completely rule over a well-defined piece of land and all its natural resources including water resources, it has already established some polices and strategies regarding water management and conservation while the enforcement of regulations is still very weak due to the sovereignty issues over land and water by review of water agreements especially Oslo agreement which confiscated Palestinian right on water, lands and actually give Israel the veto power over anything having to do with water in the (WBG) by the (PA) colluded .

One of the main conclusions in addition to political and technical sides is that the study recommended for active participation of farmers in decision-making process at early stages of water management projects, training on financial, environmental, legal, institutional and economic issues relating to the utilization is essential while farmers should be allowed to take part in developing these standards will be precipitating in water management.

This study discussed some policies from different sides like greywater reuse which presents a potential option for water demand management, sustainability and also contributes to reducing fresh water use for irrigation. Treated greywater reuse in agriculture is a strategic option for enhancing agricultural water supply in Palestine. This study is recommending spreading the use of these techniques and developing methods leading to increasing the safety of using grey water techniques starting from house gardens to national projects without missing the socioeconomic side and the public awareness against its benefits. Palestine has a serious and worsening water supply problem. Using other techniques like rainwater harvesting from rooftops, land surfaces, road surfaces, greenhouses tops were technologies which existed in most parts of Palestine but were not widespread. The samples from roof systems showed that water can be used for drinking purposes but there is a need to improve understanding of the social impact, potential and performance of partial rainwater harvesting as practiced by families in small houses and for agricultural purposes. Also the study discussed water pricing policy usage as a tool in water management and the adoption of this tool form official authority to manage water scarce resources according to priorities and real national needs for satisfying the food security and sustainability as one of the main recommendations of this study but all these need more, deep, and participating studies with other related parts and working according to supreme political situation depending on the sector's importance in our national plan, the quantity used and giving the priority to the agriculture sector.

From the above diagram we summarized most of the factors that are affecting the adopting of the new methods and participation in water management policies like greywater use, water harvesting, and water pricing while the considered cornerstone in these relationships are the availability of clear and updated data and Information, strong policy makers and strategic plans included clear activities. According to the suggested policies under the Israeli occupation conditions in addition to limited water resources may be trying to precipitate in (WBG) water situation problems by management, simple policies, awareness by the players in hydro politics issues against the difficulties of water situation through lack of the strategically planned and independent control of our national resources so this proposed model of water resistance strategy may be participant in solving relatively (WBG) human accumulated disaster especially under Israel occupied control against Palestinians water rights which needs compilation efforts and systematic agriculture policies in one national framework.

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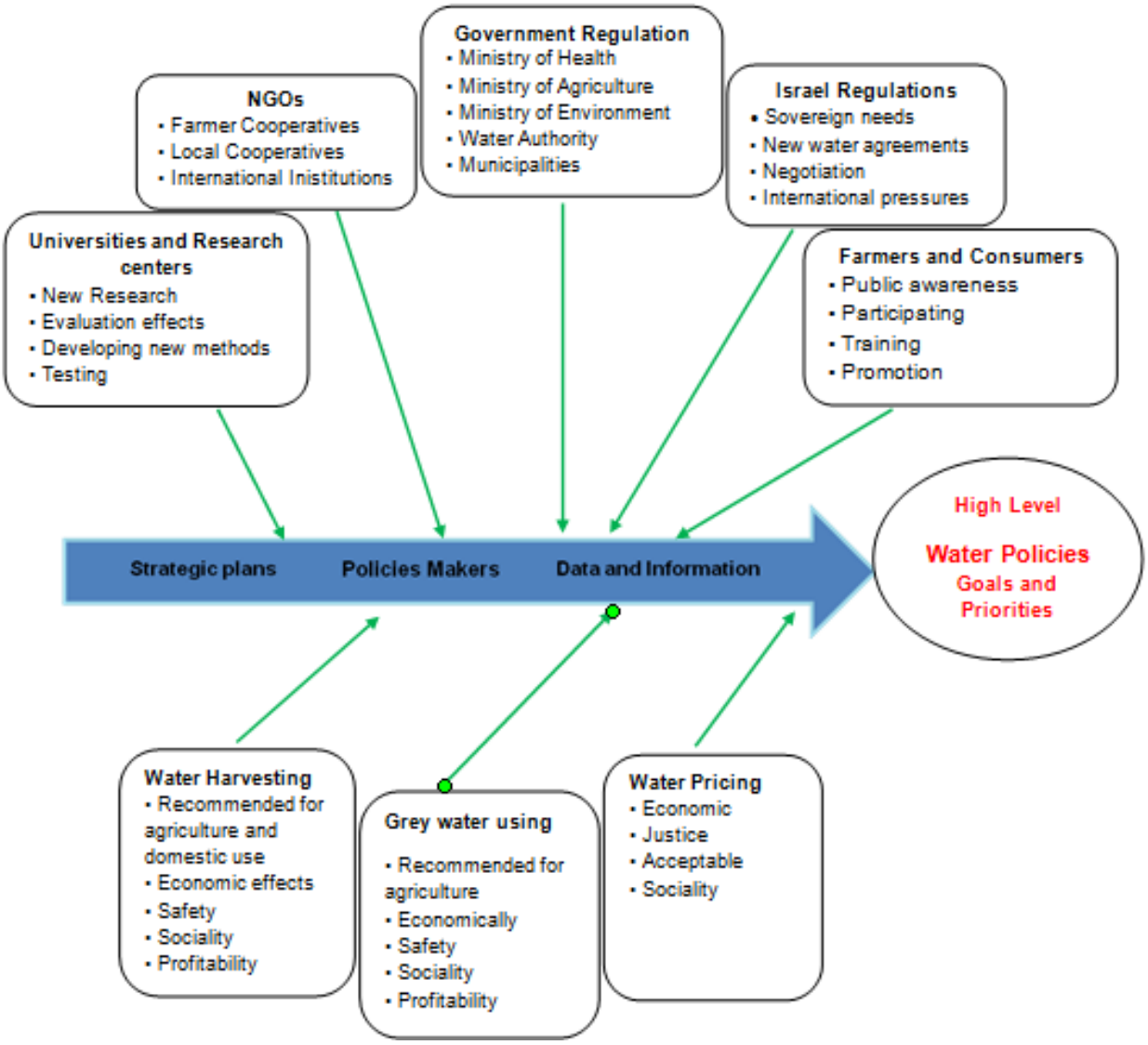

Figure 2. The main players and methods participating in water policies