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Water scarcity as a global public dilemma: Public fiscal policies towards rainwater harvesting

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Abstract

Factors such as population growth rate, industrialization, increase in urbanization rate, unplanned urbanization, consumption of pesticides, climate change, which are experienced during the history of mankind, cause environmental pollution affecting future generations especially water resources. This situation, which constitutes a global public problem in today's world, has particularly reached threatening levels for usable/potable water resources. Under the prediction that the world will face 40% water scarcity by 2030, it is important that the rainwater will be stored and made usable. The article includes the applied fiscal policies around the world (e.g. public standards/practices, public incentive policies, output/result-oriented policies). The article presents the current situation in Turkey and suggests the legal regulation.

Keywords: *Global Public Goods, Public Incentive Policies, Rainwater Harvesting, Rain Tax*

1. Introduction

In the globalization process, the world faced to both the main change such as mobility, the increasing capital flow, the improvement in the information & communication technologies and the main problems that have got impact globally such as the pollution of environment, financial crisis, security, war. This process has brought the global externalities. For example, the pollution of environment caused climate change, water crises, water scarcity and drought, food crises, damaging of bio-diversity and etc.

The World Economic Forum ranked water crises as the top global risk for industries, societies and generations over the future (World Economic Forum, 2016).

Global public goods have importance to tend solving the major problems across border. Global public goods must have two characteristics (Kaul et al., 1999): i) the strong qualities of publicness as like as nonrivalry in consumption and nonexcludability; ii) the positive externalities across border in terms of countries, people and generations. As Kaul et al. (1999) determined that a globalizing world need a theory of global public goods to achieve crucial goals such as financial stability, human security, world peace, the reduction of environmental pollution or the biodiversity conservation. Consider, for example, the reduction of environmental pollution. In the rapidly globalized world, the reduction of environmental pollution is an important issue related to global climate change policies. The governance of environment protection (with related to global climate change policies) represents a global public good. Because its benefits are shared by all states in terms of security, human rights and bio-diversity.

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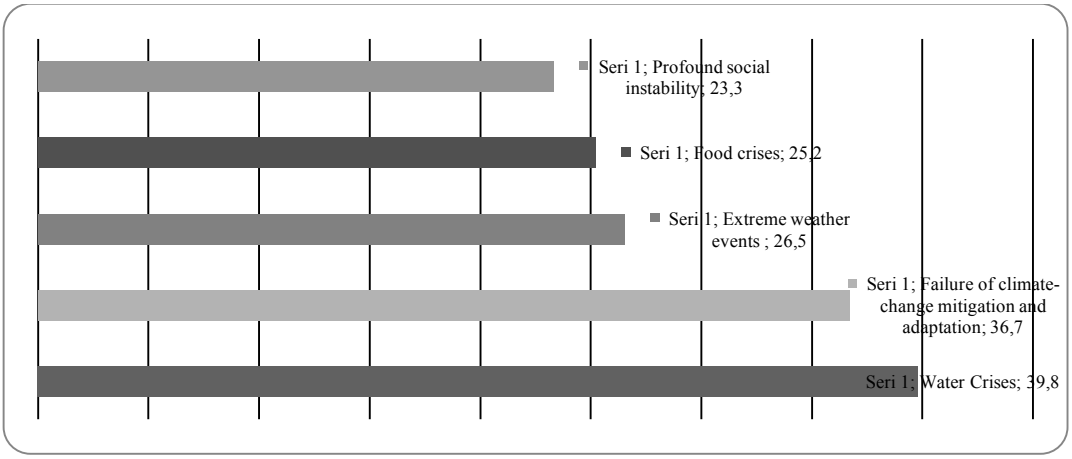
Figure 1. The top five global risks of highest fear for the next 10 Years (%)



Source: World Economic Forum (2015). Global Risks Perception Survey 2015.

2. Environment as a global public goods

Kaul and Mendoza (2003) assert expanding the standard definition of public goods on various levels (Kaul et al., 2003): i) *Goods have a special potential for being public if they have nonexcludable benefits, nonrival benefits, or both. ii) Goods are de facto public if they are nonexclusive and available for all to consume. iii) By analogy, de facto global public goods are defined as follows "global public goods are goods with benefits that extend to all countries, people, and generations*". A global public goods has the following characteristics (Kaul et al. 1999; Taylor, 2013): i) non-rivalrous (i.e. consumption of these goods by anyone does not reduce the quantity available to other agents); ii) non-excludable (i.e. it is impossible to prevent anyone from consuming it); iii) available worldwide. As Kaul et al. determined that a globalizing world need a theory of global public goods to achieve crucial goals such as the reduction of environmental pollution, the biological diversity conversation, climate change mitigation, financial stability, human security, alleviating poverty, peace. In the case of the global environment perception, World Economic Forum take attention that water crises due to global warming / climate change will be the riskiest at the local, national, regional and global level.

Water crises in the world is now leading to conflicts at community, national, regional and international levels. Therefore, the management and protection of the world's water resources must be based on the principles of justice, solidarity, reciprocity, equity, austerity, diversity and sustainability, because water is a human right (Withanage, 2017). At this point the environment (and the global environment protection policies against its hazards that are global warming, climate change, water scarcity, drought) would represent a global public good. The benefits of the mitigation of environmental hazards would be "non-excludable", in terms of all states would benefit from the global environment protection policies' existence regardless of their own contribution. And the benefits of its would be "non-rival", in terms of one state's enjoyment of the benefits would not diminish those available to another state.

Global environment problems (especially water scarcity&drought and their impacts - Table 1) are those that many countries have contributed to and no individual country can effectively address by acting alone (Uitoo, 2016). Because the global environment protection policies' benefits

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are shared by all states in terms of security, human rights and bio-diversity. The utilization of those benefits by a state doesn't reduce the other state's utilization.

Table 1. Water scarcity and drought impacts as a whole

Type of Impact	Water Scarcity and Drought Impact
Economic	Reduced production in various sectors i.e. agriculture, forestry, fishing, hydroelectric energy, tourism, industry
	Unemployment caused by reduced production
	Economi and fiscal loss due to reduced navigability of streams, rivers, and canals
	Damage to the tourism due to reduced water availability in water supply
	Income reduction for water firms due to reduced water supply and delivery
	Costs in emergency measures to increase resources and reduce demand
Environmental	Reduce in water supply and the quality of surface water and groundwater
	Damage to ecosystems, wetlands, biodiversity and disease
	Land degradation and desertification
	Lack of feed and drinking water
	Increased salt concentrations and more and larger fires
	Damages to river, wetlands life (e.g. flora, habitats) and air quality (e.g. polluting dust)
Social	Damage to public health and safety due to air and water quality
	Increase in social inequality, by way of larger effects on specific socio-economic groups
	Stresses between public administrations and affected groups & NGOs
	Changes in political attitudes
	Problems due to water allocation
	Impacts on life style (e.g. unemployment, difficulty in personal care, reuse of water at home, street and car washing prohibition, doubt on future, loss of property)
	Inequity in the distribution of drought mitigation measures among social groups
	Abandoning of all activities and migration

Source: Global Water Partnership Central and Eastern Europe (GWP CEE), 2015.

Water scarcity and drought produce various effects for mankind: from reduced productivity of natural resources (e.g. agriculture, fishing, forestry) to damage to non-managed natural resources (e.g. landscapes, biological diversity); from damage to life style (e.g. unemployment, migration) to stress between public administrations and affected groups; and to increase in social inequality.

At the multi-polar world order, the increasingly global nature of development challenges - such as climate change and reducing carbon dioxide emissions, migration, human rights, food security, diseases and financial stability- demonstrate that these global issues require global solutions by collaborating in international area with the involvement of emerging and developing countries (Gavas et al., 2011). In the absence of strong institutions and agreements aorund the world, water scarcity issues may lead to transboundary tensions (Kok et al., 2011).

Some of the UN agencies - such as United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP), United Nations Commission on Sustainable Development (UNCSD), United Nations Framework Convention on Climate Change (UNFCCC)- and

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the other entities (World Meteorological Organization - WMO, International Water Association - IWA, Intergovernmental Panel on Climate Change - IPCC, International Organization for Migration - IOM) are the fundamental programmes that to mitigation the global environmental problems in terms of human rights and to take the necessary measures.

3. The applied policies towards to prevent water scarcity

Water scarcity, that is perceived as one of the cause of global crisis, has three main dimensions (Kok et al., 2011; FAO, 2012):

- Physical dimension; scarcity in availability of water of acceptable quality in relation to aggregated demand;
- Economic and infrastructural dimensions; scarcity due to the lack of adequate infrastructure, irrespective of the level of water resources, because of financial, economic, technical or other constraints; and
- Political and legal dimensions; scarcity in access to water services, because of the failure of institutions (including legal rights) in place to ensure reliable, secure and equitable supply of water to users.

In this context, water scarcity, that pose a danger for sustainability of the natural resources base, is required an inter-sectoral and multidisiplinary approach to water resources management in order to maximize economic and social welfare and to continue the sustainable development. The enhancing this integration requires to take into account development, water supply, water use and water demand, and to place the emphasis on people and the ecosystems that sustain all of them. On the water demand management side, one of the successful programmes of water scarcity alleviation is to enhance the productivity of water use in all sectors. Also the other programmes are the pollution control, and to protect and restore the ecosystems that naturally capture, filter, store and release water, such as rivers, wetlands, forests and soils (UN-Water, 2006). On the water supply enhancement side, the successful programmes of water scarcity alleviation are to increase access to classic water resources (such as dam storage, groundwater withdrawals or harvesting rainwater); and to develop non-classical water resources (such as utilization of fossil groundwater, desalination the bore water or salt water) (FAO, 2012).

The classic water resources include the water available from rainfall and snowmelt, that is used on site or taken from rivers, streams, lakes, reservoirs, and aquifers. Such resources are renewable through the natural processes of the hydrological cycle. Furthermore classic water resources, non-classical water resources provide complementary sources for alleviating water scarcity in regions where renewable water resources are terribly scarce. Such water resources are used for agricultural and other sector through specialized processes such as desalination of seawater, bore water and highly brackish water; harvest of rainwater; collection, treatment, and utilization of wastewater; capture and reuse of agricultural drainage water; extraction of groundwater containing a variety of salts (Qadir et al., 2007).

Appropriate policies can lead the utilization of non-classical water sources, including adequate financial commitment for policy implementation and education of stakeholders, supported by increased collaboration between researchers, international organizations, governments and water

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users. Such policies include water planning, setting appropriate standards for water re-use, market-based reallocation, watershed management, and payment for ecosystem services (UN-Water, 2013).

4. Rainwater harvesting as a policy to prevent water scarcity

Rainwater Harvesting (RWH) has been in practice for more than 4000 years owing to the temporal and spatial variability of rainfall, in the widest sense, a technique used for collecting and storing rainwater for human use from roof tops, gutter, land surfaces of rock catchments (Gurjar, 2012). Rainwater is the main resource of water in especially agriculture. It has also been used successfully to increase water, which is an necessary element in the functioning of natural ecosystems, for industrial and domestic purposes. In addition to this, rainwater is integrated into water management strategies, which usually focus exclusively on surface water and groundwater. Countries need to integrate rainwater harvesting more fully into their integrated water resources management (IWRM) strategies and to promote its usage to alleviate water scarcity (UN-Water, 2006). The UN system is balanced to play a key role in facilitating the achievement of water security through internal and external collaboration with stakeholders such as governments, water and research institutions, non-govermental organisations, communities and individuals (UN-Water, 2013).

4.1. Rainwater harvesting system

Rainwater harvesting is the gathering, accumulating and storing of rainwater for different uses such as toillet, laundering, garden, water for firefighting. In other words rainwater harvesting is a technique for capturing and storing rainwater through hydro-structures such as recharge through hand pumps and unused dug well (Gupta and Naidu, 2015).

Rainwater harvesting system has been implemented in many countries such as United Kingdom, USA, Japan, China, India, Germany and Australia to meet the increasing water demand. The integration between rainwater harvesting system and existing traditional water supply systems will help to meet the demand and support in the sustainability of the water supply. There are six main elements (catchment surface, gutter and downspout, filtration, storage tank, delivery system, treatment) in rainwater harvesting system (Che-Ani et. al., 2009).

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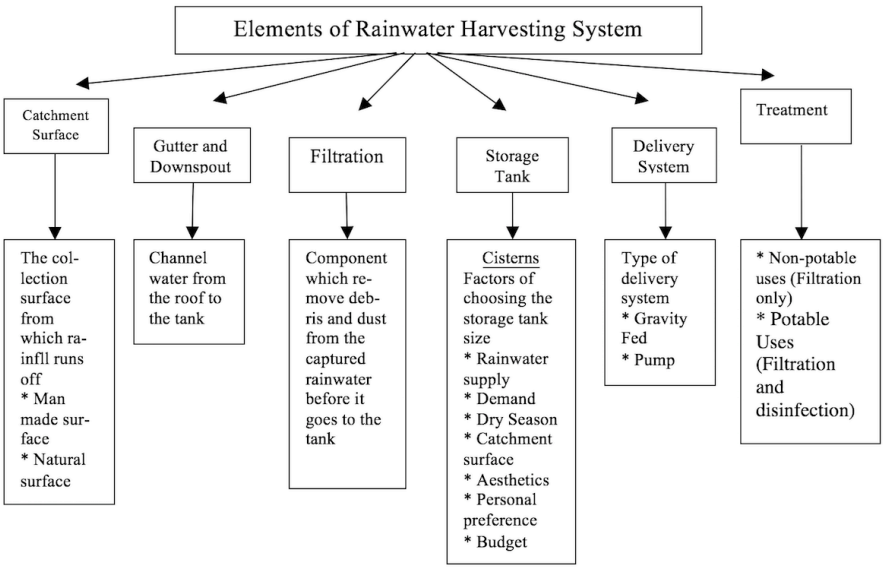
Figure 2. Elements of rainwater harvesting system as a whole



Source: Che-Ani et.al. (2009).

Rainwater harvesting system brings many advantages and disadvantages for all stakeholders as like as users, government and environment. Its advantages can be stated low-cost maintenance, lower water bills, ideal irrigation, reduced ground water demand, reduces soil erosion and floods, multi-purpose such as from flushing toilets to washing clothes, cars and dishes to keeping the garden freshly watered. Its disadvantages can be stated unreliable rainfall, starting costs, high-energy maintenance, chemical roof seepage, storage limits (Jones, 2014).

Rainwater harvesting system has got three benefits for government (Che-Ani et.al., 2009):

- Reduce the burden for new investment that will replace the present ageing systems and adding the water supply infrastructures.
- Potentially avoid the cost of accessing public water systems when it is economically impossible.
- Rainwater harvesting system can reduce construction cost in each stage. Because it can be easily retrofitted to an existing structure or built during new constuction.

The governments should be promote the adoption of 'Rainwater harvesting' as a mass movement because of its benefits on not only users but also government and environment.

4.2. Economic and fiscal ınstruments to encourage rainwater harvesting

In the world faced global water scarcity due to global warming, the governments apply "public standards / practices", "public incentive policies", "output / result - oriented policies" for rainwater harvesting. These policies both protect public health in the context of human rights, and promote the use of rainwater, the conservation and sustainability of resources.

A review of the literature on economic and fiscal instruments to support rainwater harvesting around the world can be classified into provision of subsidies, tax rebates, cost rebates, education and raising awareness, guidelines, restriction in usage of piped water (Mohd. Shahwahid et al., 2007):

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- Provision of subsidies: Because of the rainwater harvesting system's starting costs and high-energy maintenance, the government can provide subsidies to encourage the public to install rainwater harvesting system. For example, In Yamata City of Kanagawa (Japan), the local authorities installed 19 rainwater tanks in all 19 municipal primary schools as a means of promoting environment education. The tanks were made from recycled 250 litres whiskey barrels.
- Tax rebates: Tax rebates, that are valid for homeowners, other members of public who want to join in rainwater harvesting system, manufacturers, suppliers of rainwater harvesting systems or equipment, are directly impressive economic incentive. For example, in the city of Indore and Gwalior (India), a rebate of 6 % on property tax has been offered by the local government as an incentive to encourage and motivate the public for implementing rainwater harvesting systems. An other example, in Texas (USA), the State Government provides a Sales Tax Redemption for water efficiency equipment – including equipment for rain water harvesting in order to encourage the participation of the stakeholders. Rainwater harvesting materials are tax-free.
- Cost Rebates to Property Owners: Another measure is to provide rebates for the purchase and installation of rainwater harvesting equipment and installation. For example, in Sydney (Australia), rebates up to $800 is given for the installation of rainwater tanks, eligibility and amount of the rebate is determined on the fulfillment of required conditions, size of the tank and whether the rainwater is connected to your toilet or washing machine. In Australia, the amount of rebate varies from state to state and also on the size of the rainwater tank and where the water is utilised. For New South Wales, the maximum rebate is $1500; for Australian Capital Territory and Victoria, the maximum rebate is $1000 (Sterren et. al., 2012).
- Education and Raising Awareness: Another instrument is to create awareness for public through the campaigns by various related Government Agencies and mass media to be conducted to support benefit and importance of rainwater harvesting and utilization. For example, in Australia, certain state governments have introduced a rainwater tanks in the context of school program. And they have decided to give a rebate up to $2,500 to participating schools for the installation of a rainwater tank. Also, certain state governments have decided to train for awareness campaigns on importance of conserving water in the participating schools.
- Guidelines: The other measure is to prepare guidelines by government authorities. The government or local governments make the installing process easier for the consumers, who want to install rainwater harvesting systems, by providing standardized guidelines. For example, in Germany, although rainwater harvesting has yet to be made mandatory and no specific legislation is available, but there is the National Guidelines of DIN (Deutsches Institut fur Normung) that includes the general requirements for the appropriate system on the storage and utilization of rainwater.
- Restriction in Usage of Piped Water: The other instrument is the restriction in usage of piped water. This measure brings to limit to the usage of piped water certain time and amount, where is implemented in the cities with low annual rainfall in Australia.

When the public policies regarding rainwater harvesting are examined worldwide, we can see some important samples. Germany pioneered the rainwater harvesting legislation in many countries by making a discount for water fees to the buildings where rainwater harvesting system was

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installed. United Kingdom made a 100% tax reduction in the applied first year of rainwater harvesting system. USA brought the convenience in housing loans and various tax reductions in order to installing rainwater harvesting system. In addition to tax based incentives, some countries compelled the use of rainwater harvesting system. Japan compels the establishment of gray water treatment systems and rainwater catchment system in large buildings greater than 30.000 m^2. Some states in India compel the use of rainwater harvesting system on condition that: such as for in all buildings with a roof area greater than 100 m^2 and construction area greater than 1000 m^2 in New Delphi; for official institutions' buildings in Gujarat; for all buildings greater than 300 m^2 in Hyderebad; in new three storey buildings in Chennai (İlhan, 2012). As an extreme example, Israel should tried to raise and accumulate the rainfall by improving cloud seeds in Mekorot Report 2007 (Israel National Water Co.) (TUBITAK, 2011).

Under the predictions that in Turkey will consume water resources fully until 2030 and will be among the poorest countries, practice on the storage of rainwater have been carried out within the scope of the project. In this context, Turkey's National Climate Change Action Plan 2011-2023 has two important aims:

- Encouraging the application of rainwater infiltration into the soil and providing restoration of rainwater (2011-2013),
- Separation of sewage and rainwater collection systems in settlements (2011-2020).

The first aim needs the collabration Ministry of Foresty & Water Affairs, Ministry of Environment and Urbanisation and Universities.The second aim needs the collabration Ministry of Foresty & Water Affairs, Ministry of Environment and Urbanisation, Diroctorate General for State Hydraulic Works and Iller Bank (The Bank of Provinces). These regulations are hopeful progression for Turkey. But they are not enough for solution of water scarcity in future. The effective incentive mechanism should be established in parallel with the world examples in Turkey and the application area should be expanded. Now, Turkey must take modern measurements as like tax rebates, rain tax, various tax reductions, the convenience in housing loans and public standards.

5. Conclusion

In the globalized world, the most dangerous global risk is accepted the water crises. Water is of vital importance both as a human right, and as an exhaustible resource. In this period formed by global warming, climate change, all the actors (governments, local governments, activists, NGOs and users) should be aware of this hazard for the next generation. Indeed water scarcity and drought produce various effects for mankind: from reduced productivity of natural resources (e.g. agriculture, fishing, forestry) to damage to non-managed natural resources (e.g. landscapes, biological diversity); from damage to life style (e.g. unemployment, migration) to stress between public administrations and affected groups; and to increase in social inequality.

In the world faced global water scarcity due to global warming, the governments apply "public standards / practices", "public incentive policies", "output / result - oriented policies" for rainwater harvesting. In detail we can state the economic instruments to support rainwater harvesting aorund the world such as provision of subsidies, tax rebates, cost rebates, education and raising awareness, guidelines, restriction in usage of piped water. When the public policies regarding rainwater harvesting are examined worldwide, we can see some sample as like as with a reduction in water

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consumption in Germany; a 100% tax reduction in the first year of UK system; a reduction of up to $ 1,500 in volume of rain tanks to be used in the establishment of the system in Australia; convenience in housing loans and various tax reductions in USA; various tax reductions by local governments in India.

Water scarcity is an invisible problem for tomorrow. In this context, both national and international institutions must make an effort to tackle and to improve new measurements towards sustainability environment such as rainwater harvesting system, green building certification system (BREEAM - UK; LEED - USA; HQE - France; CASBEE - Japan; ÇEDBİK - Turkey), rain tax, the convenience in housing loans. The improving progress of water resources requires one hand tax incentives, the other hand law enforcement. In this point, public policies have undeniable effect and importance.

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