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Water Harvesting in Palestine

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Abstract

Limited water resources in Palestine is a consequence of natural aridity in the region associated with political restrictions imposed on the Palestinian access and utilization of these resources. Since 1967 the stringent control of the Israeli Government on the development of Palestinian water resources has led to acute shortages in many of the Palestinian communities. This situation has led to directing the attention of decision makers in cooperation of donors to increase the investment in water harvesting.

This paper concentrates on three major methods or techniques of water collecting and storing on the personal and governmental levels.

The first is collecting rain water from roof tops in the winter season to be collected in small underground water well in the range of 50-70 cubic meters in size for each family. At the time being there are more than 50000 families in Palestine who depend on these wells for their domestic water supply most of the year. Many donors and NGO's are heavily involved in constructing these wells for the poor families.

The second technique is collecting rain water from the rooftop of agricultural greenhouses and storing it in water pools or concrete tanks. There is a good potential of more than 5 million cubic meters that can be collected at the time being from the top of more than 10000 donums of greenhouses. Donors and NGO's are driving local industry towards manufacturing ready made irrigation tanks at very cheap prices compared with different types of tanks with a capacity of 200-1000 cubic meters.

The third technique is collecting runoff water and storing in dams or artificially recharging it to the ground water basins. These types of projects are considered higher scale and being followed up on the governmental level. There are many feasibility studies are being conducted at the time being for implementing such projects. The speed of constructing these types of projects is connected with the political situation because it has something to do with water rights.

Keywords: Water harvesting, cisterns, collection, run off

Introduction

Limited water resources in the West Bank and Gaza Strip is a consequence of natural aridity of the region associated with the political restrictions imposed on the Palestinian access and utilization of these resources. Since 1967 the stringent control of the Israeli Government on the development of Palestinian Communities. The Palestinian local water resources have led to acute shortage in many of the Palestinian Communities. The Palestinian Water Authority (PWA) database shows more than 278 communities in the West Bank don't have piped networks. These communities represent 43% of the total

communities of the West Bank. These communities buy their water through the tankers usually at a high price reaching 3 USD/m³.

During the last few years and under the framework of Oslo II Accord, the PWA was implementing the interim agreement on water through the Joint Water Committee (Annex III, Article 40). Minimum progress was achieved due to the continued delay in approval of projects and issuance of licenses. Therefore, it is perceived that the problem of those communities will be an issue to consider for some years to come. Short and medium term solutions are being sought in order to solve part to the water supply problems.

The PWA is mandated to prepare emergency plans for the management of water resources under crises conditions. These range between natural conditions such as drought and floods, to political like the current Intifada.

The Palestinian Water Authority (PWA) has prepared a framework for an emergency plan in an attempt to solve water supply problems under the above-mentioned circumstances. The proposed plan includes different approached presenting solutions for immediate, short and medium term needs. These options are: i) provision subsidized water by tankers, ii) rehabilitation of water infrastructure iii) implementation of a water harvesting program through the construction of cisterns, and iv) purchasing of water tankers.

Construction of cisterns had been a priority according to PWA strategy specially in the prevailing situation given in order to: i) to provide a semi-sustainable solution for communities lacking water pipe networks, not expected to have such infrastructure installed for some years to come, ii) to reduce communities dependence on expensive water provided from tankers, especially during the rainy reason, iii) to contribute to the fulfillment of the national water policy that encourages water harvesting.

Water harvesting can be defined as the collection , treatment and storage of rain water runoff for the different uses. A special form of water harvesting consists of collecting rainfall from the roofs of houses and storing it in cisterns for domestic and agricultural use. This practice was widespread throughout the Middle East and Mediterranean region until a few decades ago. It is still in use in many rural areas. In the West Bank and Gaza Strip, rooftop rainwater harvesting is currently in more than 50,000 homes.

The benefits of such an approach are many as it provides a relatively cheap but sustainable option. In addition to that there is no need for high technical procedures or rare skills required for designing and managing the projects.

The PWA prepared a report titled as " Priorities for Construction of Harvesting Cisterns in Most of the Non-served Communities in the West Bank". An evaluation criterion has been developed for prioritizing and selection. Even the Priority has been divided into priority A, priority B, and priority C. The report includes a comprehensive table of results that includes water cisterns need to be built as an emergency distributed among the governorates on the West Bank according to the needs. The report also includes cisterns that have been constructed by the different NGO's and institutions including PWA.

Strategic Planning

The Palestinian Water Authority (PWA) since its establishment started drafting different kinds of strategic studies by the help of international and local experts in order to be able to manage water resource in the most effective and sustainable manner. Most

of these studies consider water harvesting as an important source of water. The most important studies mentioned below:

Palestinian Water Strategic Planning Study

This study is introducing some policies, recommendations and action plan for the development of water harvesting in general.

Policies

- Maximize rainfall infiltration into the aquifer.
- National water resources management policy to control and quality of storm water.
- Protection of people and property from flood hazards.
- Improvement and expansion of national data base.
- Maintain and increase sustainable yield of the aquifer.
- Flood control in urban area.
- Increased usage of storm water harvesting.

Recommendations for improvement

- Data shall be collected to cover rainfall, infiltration rate, runoff coefficient, quality, etc. which will help to develop PWA knowledge of rain fall and storm events.
- Codes of Practice will be established to enforce, by legislation for both
- existing and new development areas, increased control and use of storm
- water quantitatively and qualitatively.
- Check dams and infiltration wells will be constructed to enhance groundwater infiltration.
- Building control will be strengthened to reduce the connection of foul
- sewage to storm sewer pipes to enhance the quality.
- Storm water collection schemes should be linked to wastewater reuse schemes.
- Agricultural dependence on fresh water sources will be reduced.
- The impact of contamination sources and corresponding facilities on
- the environment will be assessed.

Action plan

- Additional check dams on wadis should be investigated regarding feasibility and cost benefit and, if appropriate constructed.
- The construction of storage ponds on site for farmer’s use should be promoted.
- Flood prone areas will be identified and upstream solutions to enhance infiltration will be promoted.
- Codes of practice for building and urban development will be adopted.
- National water resource management policy to be set up to control the quantity and quality of storm water.

- Increased emphasis on data collection will be put in place to better understand national rainfall events.

National Water Plan

In this plan the issue is more detailed and elaborated and categorized such strategy principles, collection targets, control targets and implementation action plan as the following:

Principles

The basic principles on which the PWA strategy is based are as follows:

- maximize on rainwater re-charge as far as practical by
- Recharging from dams on wadis, wastewater discharge surplus to agricultural needs and run-offs from large surfaced areas.
- Introduction of flood alleviation measures at the source.
- Construction of cisterns for domestic, small scale agricultural and industrial supplementary/ emergency supplies to the extent practical.

Collection

The targets for collection of rainwater run-off are:

- Maximization of the efficiency of surface water run-off from wadis and springs to a further 3% by 2010.
- Maximization on the surface run-off from covered areas by cisterns and/or recharge systems.

Control

The control targets to be introduced are:

- System of management, control and monitoring of re-charge to be established to be fully effective soon nation-wide.

Actions

The actions to be implemented are:

- Additional check dams on wadis to be investigated regarding feasibility and cost benefit and, if appropriate constructed.
- The construction of storage ponds on site for farmer's use to be promoted.
- Flood prone will be identified and upstream solutions to enhance infiltration will be promoted.
- Codes of practice for building and urban development will be adopted.

Environmental Benefits

Rainwater harvesting promotes conservation of water and energy needed to treat and pump water for service area of water system. Aside from conserving water use, it also minimises local erosion and flooding due to runoff from impervious areas such as pavement and roofs and decreases storm water run-off which picks-up contaminants and degrades drains. Rainwater harvesting on the household level promotes the participation of the.

family members specially women in the process of water conservation techniques in addition to increasing the green cover of their village

Harvesting systems

Harvesting systems is a special type of water system planned and designed to collect rain water runoff, treat it and store it efficiently for the different uses. Treatment of collected water is not used except for some small sedimentation pond before letting water to flow inside the storage. Water harvesting systems have many things in common such as they all should have collection catchments area and storage place. The shape and dimension and construction material could be different from one system to another. In Palestine, water harvesting is being used for both domestic and agricultural purposes. The storage place in domestic system is mostly called a well which a traditional name and has been used for long time. The term tank is not widely used but the term cistern is being used much widely in English reports and includes any closed storage system in both domestic and agriculture. Open storage is generally used in agriculture and has different names such as water pool or water pond..etc.

General requirements for constructing new wells

There are many requirements that the contractor or the house owner should take into considerations before constructing a new well in order to keep the collected water in a good quality as long as possible and to be able to collect enough quantity of rainwater to fill the well:

1. The well should be at least 15 meters away from cesspits or streets or any potential contamination source.
2. There should be a clean catchments area such as the rooftop of the house.
3. The neck of the well inlet should be raised at least 10cm from the ground in order to stop side contaminations.
4. There should be a tight door with a lock for the well.
5. The well should be far away from the roots of big trees.
6. The collected water should pass through a sedimentation pond at least 30 cm in diameter before entering the well.

Shapes and dimensions of wells

Many wells are being implemented these days by the different donors. The most common well called "Injasa" or pear shaped, because it looks like pear shape from inside. It starts at the top surface of the ground with a circular hole of one meter diameter and goes down at the same diameter to a depth of 1-2 meters depends on the nature of the ground. Then the excavation starts widening and deepening at the same time to a maximum depth of 6 meters. The diameter of the bottom of the well is around 6 meters. The total volume of the well ranges from 50 up to 70 cubic meters

This type of well is suitable in soft chalk rocks wich is easy to excavate through by simple tools. Then the interior wall of the wells should be plastered with concrete by experienced labors in order to make it water tight with no leakage.

In some areas the rocks are so hard which makes it impossible to use simple tools to dig a pear shaped, it is needed to use heavy machines such as excavators to excavate a rectangular hole of a depth 2-3 meters deep and a surface dimension ranges from 4 to 7

meters. Then the walls and the roof slap casted by reinforced concrete similar to regular concrete tanks. This type of tank or well could be built on the top of
the ground but house owners prefer underground in order to save space around the house for other uses such as house expansion or any other thing.

Water Harvesting in Agriculture

Agriculture is the main water consumer in Palestine both in the West Bank and the Gaza Strip where it consumes more than two thirds of the available fresh water. This calls for promoting conservation techniques specially harvesting methods on agriculture. The PWA and the Ministry of Agriculture strategies call for development of the efficiency of water use in irrigation by adopting new cropping patterns as possible in addition to introducing technological irrigation systems.

Water harvesting in agriculture is also another important conservation technique that should be developed in order to be able to cope with the increasing demand in water irrigation in the coming years. Water harvesting in agriculture is well know in Palestine for long time and some new development s has been introduced specially after the wide spread use of greenhouses.

The on-farm rainwater harvesting systems could be divided into two major categories:

The first one is without supplemental irrigation such as construction of terraces which has been in use for hundred of years in which terraces allow for storing of surface runoff water in target area and in some extent avoid runoff from the target area.

There are many different types of activities that farmers have been doing for long time in order to protect soil erosion and to enforce surface runoff water to infiltrate into the soil and deeper to the groundwater such as contour stone bund, semi-circular bunds, contour ridges ..etc.

The second category is water harvesting with supplemental irrigation in which the rain water is collected and stored in ponds or pools in the farm for direct use or to be used as supplemental source in the dry season. Runoff water is collected from and open area or from a man made catchment's area or from the top of greenhouses.

The collected water is stored in different simple constructions such as cisterns, earth pond, concrete ponds or steel sheet ponds or tanks.

Cisterns

Cisterns for agriculture irrigation are very similar to those of drinking water as shown above except for some changes such as the size is a little bigger which can go up to 100 cubic meters .

Earth ponds

This type of pond is the most commonly used especially in Jordan Valley and Gaza area. This pond is basically an open hole or an excavation in the soil or sand to a capacity of up to 250 cubic meters. The pond usually is covered by a suitable plastic sheet cover in order to be able to hold water for long time even though the life time of this plastic cove could go up to four years and then should be replaced by a new one.

This pond is usually filled out during winter time from the run off water collected from the top of greenhouses and directed through pipes to the pond .This pond is filled in the summer from the nearest water sources available in the area. The pond needs to be protected by a suitable fence and a gate in order to protect from any trespassing of any kind such as children or animals or anything else.

The construction cost of this pond is the lowest if compared to the other types of storing systems.

Metal tanks

This tank is built using locally manufactured galvanized corrugated steel sheets. These sheets come to the site of construction in certain curvature with fixture holes. The sheets are connected together by bolts to form a circle with the suitable diameter and of a height of 3.5 meters. The bottom of the tank is covered with sand in order to protect the lining of the tank. The lining usually consists of two layers where the first one is kittan to cover the inside walls of the tank. The second layer is made of PVC which covers the whole tank from inside in order to be able to hold water for long time. The capacity of this tank ranges from 200 up to 1000 cubic meters. This business in Palestine is relatively new compared to other types of tanks. At the time being there are two companies who produce and install these types of tanks for irrigation.

Hundreds of these tanks are being built these days by donor money through different active NGO's because the cost of construction is much less than concrete tanks at the same size.

Similar to other types of tanks or pond this tank is filled with run off water during winter time collected from the top of greenhouses and pumped back to irrigation network by suitable pumps. In summer time this tank is filled with water from the nearest source of water.

Concrete tanks

This type of tank is totally made of reinforced concrete casting at the walls and the bottom. The interior walls and the bottom are plastered in many layers by experienced labors in order to make it hold water for long time. Usually this tank is left out without a roof in order to reduce the construction cost which is the highest compared to other types of tanks.

The dimension of this tank is usually 8 x 8 and of a depth of 4 meter which makes a volume around 250 cubic meters.

This type of tank should be protected by a suitable fence such as earth pond in order to protect it from trespassing of any kind such as children or animals.

This tank is filled out similar to all other types of tanks by run off water from roof top of greenhouses in winter and in summer from nearest source of water.

Dams

Construction of dams is not familiar in Palestine due to Israeli occupation during the last few decades even though the possibility and the feasibility could exist to construct few dams especially in the West Bank area because it has more than 30 wadis discharging either in the Mediterranean Sea or in the Jordan River of in the Dead Sea. Rain water run off and

mountain slopes in the West Bank is much more than that in Gaza Strip. Table 1 shows major wadis in the West Bank area with its discharge and flow direction.

During the period of the Palestinian Water Authority no dams have been constructed due to the Israeli total control on catchments area of most wadis in what so called area C where area B and A are for cities and villages. Also the Palestinian Water Authority at the time being is postponing this issue after the final negotiation with Israel because the issue is connected to water rights and total control on the land.

In many planning studies wadis are considered as important source of water and by year 2020 the Palestinian National Authority could collect up to 60 million cubic meters of water annually from major wadis but this thing still needs a lot of feasibility studies and planning.

Table 1: Wadis in the West Bank with discharge and flow direction

No.	Wadi Name	Q MCM/year	Flow direction
1.	Sarida	22.8	MS
2.	Al-dilp	16.4	MS
3.	Qana	12.8	MS
4.	Massin	11.7	MS
5.	Abu Nar	8.7	MS
6.	Abraq	8.1	MS
7.	Salman	6.5	MS
8.	Moqata	3.6	MS
9.	Shiqma	3	MS
10.	Soreq	2.12	MS
11.	Al-Sara	1.73	MS
12.	Qilt	4.23	JR
13.	Fara'	6.45	JR
14.	Al-Ahmar	4.35	JR
15.	Auja	4.57	JR
16.	Nueima	1.73	JR
17.	Malih	1.22	JR
18.	Abu Sidra	.7	JR
19.	Ghar	6.5	DS
20.	Draja	5.25	DS
21	Mukallal	3.5	DS
22.	Nar	2.39	DS
23.	Abu Al- Hayyat	2.4	DS
24.	Hasasa	.48	DS
25.	Abu Muradin	.48	DS
26.	Mara	0.44	DS
27.	Qurman	0.36	DS
28.	Dura	0.8	JR

MS=Mediterranean Sea JR=Jordan River DS=Dead sea

Recommendations

Palestinians have a good experience in rainwater harvesting because they have been practicing it for more than 4000 years. Therefore, it is recommended that the decision makers in the water sector should build on this experience and develop more policies and strategies towards developing water harvesting technologies. In addition to the donor money which is being invested in building water harvesting system, it is recommended that the Palestinian government should allocate a special budget to develop this technology because it is clear that this investment is feasible specially in the very near future where the demand on water is going to double very soon due to increase in population and life hygienic conditions.

In all these projects community participation is a must for the success of implementation and maintenance. Participation should not be restricted to financial aspects but it could be labor and management during implementation.

It is recommended that water decision makers should start soon in studying the feasibility of constructing dams on each wadi in Palestine, such a study should include environmental, social, economical, political impact assessment.

Finally, it is recommended that water sector stakeholders in Palestine and the Arab world and even the Islamic world should create working groups in order to exchange experiences in this regard and more efforts should go towards fund raising for developing water harvesting systems especially for the poor countries

References

National Water Plan-PWA . 2000 .

Palestinian Water Strategic Planning Study, PECDAR. 2001.

Rainwater Harvesting Practices in the West Bank and Gaza Srip, by I. Nofal

Priorities for Construction of Harvesting Cisterns in Most of the Unserved Communities in the West Bank, PWA . 2002 .

http://cee.kuktem.edu.my/article.cfm?id=1584.

West Bank Integrated Water Resources Management Plan, PWA

الحصـــاد المائـــــي في فلســـطـــــين

حـــــازم كتانـــــة

سلطـــة المياه الفلسطينيـــة – فلسطـــين

تعود محدودية مصادر المياه في فلسطين إلي حالة الجفاف وعدم الاستقرار السياسي الذي يحـد من استغلال الفلسطينيين لمصادرهم المائية, ويسيطر الاحتلال الإسرائيلي منذ عام 1967 على مـصادر المياه ويحد من تطوير الفلسطينيين لمصادرهم المائية مما أسهم قي التفكير مـن قبـل صـانعي القـرار الفلسطينيين في تطوير طرق الحصاد المائي المختلفة حيث تم بلورة 3 طرق مختلفة الطريقة الأولى هـي جمع مياه الأمطار من أسطح الأبنية وتجميعها في خزانات أرضية (آبار جمع) بمعدك حجم 50-70 متـر مكعب في حيث تملك في الوقت الحاضر نحو 70 ألف أسرة فلسطينية بئر لجمع مياه الأمطار وسـاهم نشاط المنظمات الأهلية في إنشاء عدد كبير من هذه الآبار خاصة في السنوات الأخيرة.

الطريقة الثانية تتمثل في جمع مياه الأمطار من أسطح الدفيئات الزراعية وتجميعها في خزانات او برك مفتوحة. تعتبر هذه الطريقة فعالة من حيث قدرتها على تجميعه ما يزيد عن 5 مليون متر مكعـب سنويا من أسطح نحو 10000 دونم من الدفيئات الزراعية. وساهمت أنشطة المتنحين والمنظمات الأهلية في إنشاء بنية جيدة للصناعة المحلية المنتجة لخزانات بأحجام مختلفة وبتكاليف معقولة لاستخدامها ضمن تقنيات الحصاد المائي المختلفة حيث يمكن حاليا تصنيع خزانات معدنية بسعة تصل إلي 200-1000 متر مكعب ضمن مواصفات وأسعار جيدة.

الطريقة الثالثة هي جمع كميات من مياه الأمطار الجارية في خزانات او اسـتخدامها لتغذيـة الخزانات الجوفية وهي طرق متطلبة لإمكانيات كبيرة ومن اختـصاص الجهـات الحكوميـة علـى الأغلب.ويتواجد هناك عدة دراسات جدوى لإنشاء العديد من هذه المـشاريع في فلـسطين ويبقـى الإسراع في تنفيذ هذه المشاريع رهنا بالحالة السياسية والاتفاقيـات الـتي تـضمن الحقـوق المائيـة للفلسطينيين.


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