SPRINGS OF IBADAN SUSTAINABLE ALGTERNATE WATER SUPPLIES FOR URBAN COMMUNITIES

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Abstract

Ibadan city with a population of over 3.4 million has serious drinking water supply problems. Government of Oyo State has been planning larger water supply schemes, which are still not sustainable. Ibadan has over 24 natural springs and communities depend on them for their basic needs. These springs if properly protected can become sustainable sources for a larger section of the city population. This paper has shown how a small investment of less than 2 million Naira per source can improve these perennial sources and benefit the urban and peri-urban communities with improved and well-being.

Introduction

Globally, it is projected that by turn of the millennium, half of humanity will live in cities and towns and by 2030, and this figure is expected to rise to two-thirds. An additional two billion people will be living in urban slums and shanties as the 'urban poor'. This will translate into increased water demand in urban areas and stress on basic sanitation. Sadly enough, more than 40 per cent of the water that is currently supplied is wasted through water leakage in pipes and illegal connections. At the World Water Forum concluded in March 2003 in Kyoto, 31 countries and 100 experts joined and classified 147 countries into water rich and water poor countries using the criteria such as resource, access, capacity, use, and environmental impact. Top 10 water rich countries identified were: Finland, Canada, Iceland, Norway, Guyana, Suriname, Austria, Ireland, Sweden and Switzerland. Top 10 water poor countries classified were: Niger (the least), Ethiopia, Eritrea, Malawi, Djibouti, Chad, Benin, Rwanda, Burundi and Nigeria. Nigeria thus ranked among the 10 water poor countries.

Water resources in Nigeria are estimated to be about 267 billion m^3 of surface water and 526 m^3 of ground water per year (Musa 2009). The Ministry of Water Resources has prepared the Nation's Water Resources Master Plan for the period 1995-2020 with the technical assistance of the Japanese International Cooperation Agency (JICA). A country is said to be facing a serious water crisis when available water is lower than 1,000 m^3 per person per year. Below this level, the health and economic development of a nation are considerably hampered. When the annual per capita water availability drops below 500 m^3,

people's survival is compromised (Onyekakeyah 2006).

In Nigeria, for instance, millions of dollars have been sunk into major urban water projects in the various states, and yet, no city or town can boast of the availability of regular safe drinking water. Lagos, the megacity in Nigeria is the worst of all in spite of innumerable hand dug wells. Without such private sources of water, life in the city would grind to a halt. The status of sanitation is bizarre as the water shortage continues. Current trend is development of Estates in larger cities and they also face the same trauma (Onyekakeyah 2006). Provision of safe and sustainable water supply in urban centres is a challenge and centralized systems are not the solution. This paper describes the nature and use of springs as alternate water resources for urban and peri-urban communities in Ibadan.

Local Water Management -- A Growing Concept for Sustainability

The overall responsibility for water supply and sanitation in Nigeria lies with the Federal Ministry of Water Resources. Between 2000 and 2005, the government completed the development of 1,519 motorised boreholes and 3,552 hand-pump boreholes to cater for the water needs of 24.5 million people. In 2004, the Federal Ministry of Water Resources procured and distributed water-related equipment to States and Local Governments and contracts worth 10 billion Naira were awarded for the drilling of 3,250 additional motorised boreholes and 1,579 hand-pump boreholes. New ongoing projects included 482 primary hydrological stations, 50 groundwater monitoring boreholes and hydrological mapping for effective water resource administration, and 42 small- and medium scale dams (African Development Bank 2007). In spite of all the apparent efforts, the country is lagging behind meeting the Millennium Development Goals (MDGs). Communities are losing confidence in government handled projects.

The traditional focus on large-scale, centralized water management is fading away in many regions due to decreasing river flows, over-exploitation of available resources for irrigation and industry, shrinking funds from governments and International Development Partners, and growing awareness of environmental degradation. Local water management is a growing global fashion which permits more democratic participation of the communities, with transparency and accountability. Experience around the world also proved that local management is a solution for sustainable exploitation of scarce water supplies. Poor and deprived will have an opportunity to air their views and once empowered, can make the resources sustainable and economically viable. It also encourages the integration of traditional knowledge with innovative science to promote fair and efficient supply management. In these ways, water degradation and shortage can be transformed into sustainable sufficiency (Brooks 2002).

Springs – An Untapped Water Resource in the Urban Communities

Types of springs. Spring water is one of the most ancient methods of collecting naturally

occurring purified water. A spring is a concentrated discharge of groundwater appearing at the ground surface as a current of flowing water. Spring water is usually fed from water-bearing formation composed of sand or gravel or from fissured rock which overlays a base of clay or impervious rocks. The water runs through the layer until the aquifer meets the surface and is forced up under pressure from above (Morgan, 1990). After being filtered through soil and rock, groundwater is generally free from microbes and often safe to drink, however, spring water may be rapidly contaminated when it emerges at the surface, for example by contaminated surface water nearby or by wild or domestic animals, as well as by people who collect or use the water from the spring.

Springs are classified according to the cause, rock structure, discharge, temperature and availability. Most springs fluctuate in their rate of discharge. These fluctuations are in response to varying rates of recharge with periods ranging from minutes to years depending on the geologic and hydrologic conditions prevailing. Based on these fluctuations, they are grouped into various types (Figure 1). Nigeria has a large number of springs and various communities depend on them for their sustained water needs, healing powers and supernatural beliefs. The popular springs are given in Table 1.

Table 1. The most popular springs in Nigeria

State	Name of Spring	Characteristics
Bauchi	Yankari	A large pool carved out
Benue	Engmabia Warm Spring	Natural mystery situated at Orokram, Okpokwu LGA
	Ampo	A mysterious tree with spring water beneath for traditional healing (Healing)
Kogi	Ezeneja Warm Spring	A natural warm spring in Bassa LGA
Ondo	Ikogosi Warm / Cold Springs	Situated near Akure
Taraba	Lamurde Hot Spring	Situated at Lamurde in Numan Local Government Area

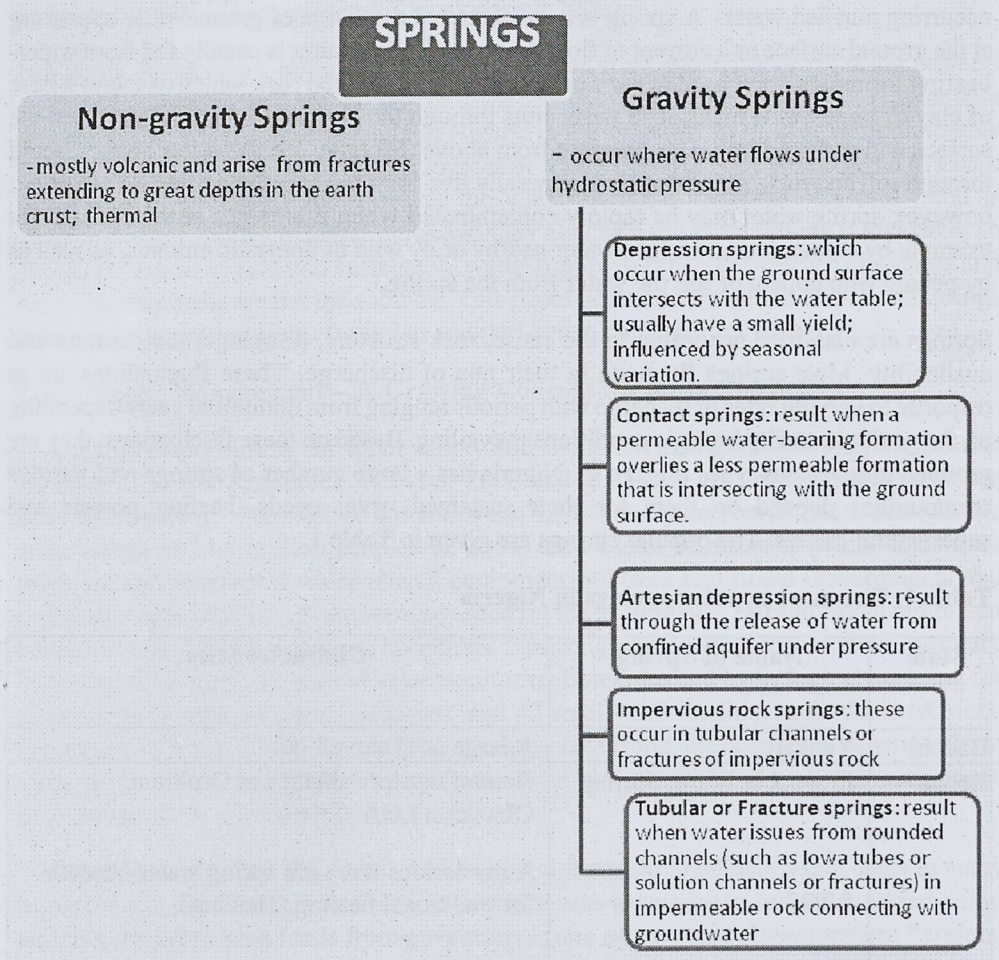


Figure 1: Various types of springs

Springs of Ibadan

Methodology

The study was carried out in Ibadan, the capital of Oyo State. The investigators visited all the springs listed, met the leaders of the communities and obtained entry after discussing the purpose of the project. Available literature was obtained from various reports, theses and other documents from the Sustainable Ibadan Project (SIP). A structured questionnaire was developed and administered to the selected households using the spring. The questions

enquired the age of the spring, background, number of people dependent on it, and cultural beliefs associated with the spring, the management of the spring, perceived quality and others. In addition, Focus Group Discussion (FGD) and Key Informant Interviews (KII) were also conducted to selected groups and leaders in the communities. Samples of spring water were collected during the rainy and dry seasons and analyzed for physico-chemical and bacteriological parameters. The parameters included pH, temperature, electrical conductivity, total dissolved solids, alkalinity, hardness, chloride, heavy metals such as lead, iron, copper, manganese and cadmium. The coliform index was followed. Standard methods (APHA 1992) were followed. Data were analyzed using inferential statistics.

Ibadan (Ìlú Èbá-dàn) City. In the local dialect, the city is referred as 'the town at the junction of the savannah and the forest'. It is the capital of Oyo State, and the third largest city in Nigeria by population (after Lagos and Kano), and the largest in geographical area. At Independence in 1960, Ibadan was the largest and the most populous city in Nigeria and the third in Africa after Cairo and Johannesburg. It is located in south-western Nigeria, 128 km inland northeast of Lagos and 345 km southwest of Abuja, the federal capital and is a prominent transit point between the coastal region and the areas to the north (Wikipedia, 2007). Its population is 2,550,593 (*National Bureau of Statistics*, Nigeria, 2006) according to 2006 census results (but estimated to be 3.4 million), including 11 local government areas (LGAs). The population of central Ibadan, including five LGAs, is 1,338,659 according to census results for 2006, covers an area of 128km^2. Ibadan had been the centre of administration of the old Western Region of Nigeria since the days of the British colonial rule, and parts of the city's ancient protective walls still stand to this day. The principal inhabitants of the city are the Yoruba people.

Ibadan water supply. The city of Ibadan receives a total of 107million litres per day (MLD) from Water Corporation (from Eleyele and Asejire dams) and thus serves only 22% of the city' population (Anon 2009). The estimated demand is 408 million litres per day. Presently, the residents of Ibadan augment their potable water needs from brooks, streams, rivers, lakes, ponds, individual wells and boreholes. A majority still depend on rain and spring water sources evident from Figure 2. These sources are polluted or contaminated directly or indirectly by human activities. Ground water is being exploited indiscriminately. There are numerous wells and boreholes, but the exact number is not available. The average yield of wells is 60 litres/min and boreholes yield between 0.27 – 4.38 litres/ second at an average depth of 66 metres. Sustainable ground water development is that the yield should be adequate for the present and also future generations. There is also considerable increase in the use of packaged water in sachets by the urban medium and low income groups at an affordable price.

Groundwater development schemes in Oyo State helped the situation to some extent. About 147 boreholes were sunk by the end of 1998. Landlords also provide these to attract good tenants. Sustainable ground water development is that the yield should be adequate for the

present and also future generations.

Mini-water schemes' development potential in Ibadan is very high. These sources are mostly (90%) sourced from springs. Some of the identified locations for future development are:

1. Ona, Sasa, Onikoko streams and Baba-Ogun pond in Iddo Local Government Area (LGA);
2. Idera, Muraina, Ose, Eleko, Ojunla streams, Jambata, Idi-Ogede and Okundosa ponds in Akinyele LGA;
3. Olopa, Ogbere, Ona, Orogun, Ogunpa, Kudeti, Omi, Thirty-thirty, Alamuyo, Bodija, Agbadagbudu and Oniyere streams in the inner Ibadan area; and
4. Owara, Oba, Omi, Molade streams and Adegbayi pond.

Sustainable Ibadan Project (SIP). To alleviate the shortages in water supply, the United Nations Centre for Human Settlement (UN-Habitat) and the United Nations Development Programme (UNDP) launched the Sustainable Cities Programme (SCP) using the Environmental Planning and Management (EPM) process. The main objective of this programme was to improve environmental factors by decentralizing the responsibility from the Federal to the local government, thus allowing the identification of environmental

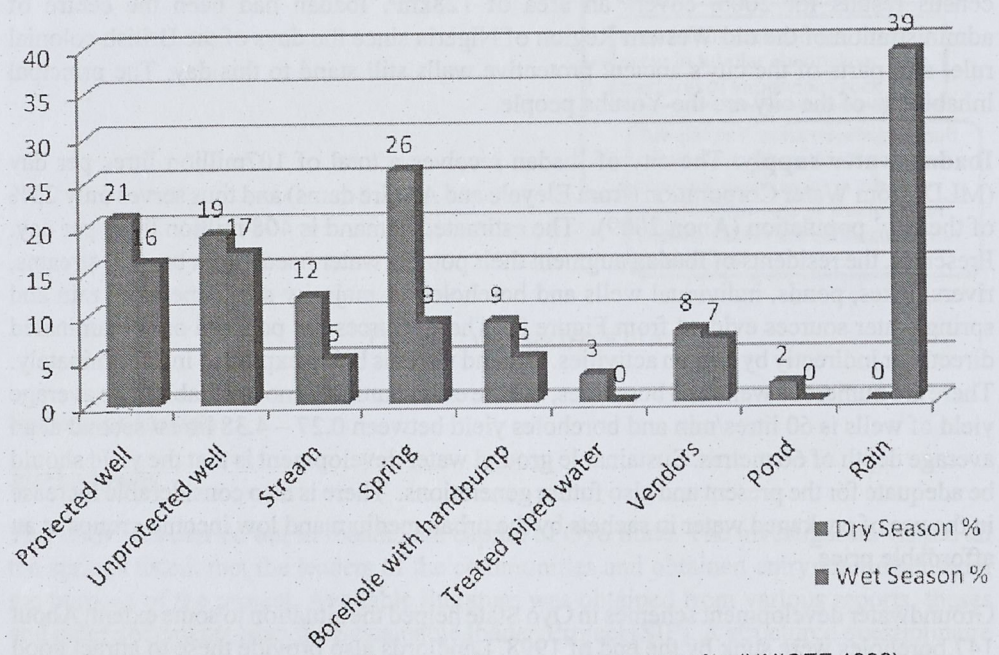


Figure 2: Sources of water used in an urban community (UNICEF 1999)

problems, funding, designing and management of projects through local participation. The Oyo State Government of Nigeria in 1992, joined other 14 cities across the world already engaged in the SCP/EPM process. By 1994, the Sustainable Ibadan Project (SIP) came into reality. Sequel to this, many environmental problems were identified, prioritized and solutions were sought. Some of the working groups were involved in water management-natural spring water development, boreholes and deep well as well as, mini water schemes. The spring water development project started in 1996 with the rehabilitation of three (3) natural springs- Akeu/Osun, Moga and Agbadagbudu. These were completed in November 1996, April 2002 and May 2002 respectively. Subsequently, replicates of these rehabilitated springs were developed- Onipasin, Sango/Isopako and Adegbayi (SIP, 2004). Later, the Yemoja- Olodo natural spring was rehabilitated.

Usage and sanitary features of the springs

The city of Ibadan has over 24 natural springs (Itama et al 2006), which supply potable water to the communities nearby (Table 2). Most of the springs are located in unplanned residential areas (Figure 3). Majority of the populace living in and around where these springs are located engage in small-scale businesses. Women mostly married and children play a major role in fetching water and many of the women are involved in decision taking on the maintenance of the spring and collection of revenue along with the men. The main features of the springs in Ibadan were:

- 75% of the springs served as sources of drinking water, while 25% served for household activities.
- Yield of water ranged from 3,320 - 8,308.8 litres for an 8-hour period.
- The number of users of each spring in the morning and evening in rainy and dry seasons indicate a high patronage. In addition to the community, several people from the neighbourhood also come to fetch water and at times it has been creating a problem in revenue collection and maintenance.
- An estimate of the number of people using the springs in a day (8 hours period) during rainy and dry seasons are given in Figure 4. The data indicate that the usage depends on the population size, availability of other sources, and nearness to the residential areas. Usually a few to 450 people gather in the morning and evening to fetch water. Women and children are more involved.
- Observations on the environmental sanitation of spring site showed (n=12; % in parenthesis): near refuse dump (50), smell of urine (58.3), smell of faeces (50), weedy (50), water logged (33.3), high land location (75), farming activities (91.7), littered with waste (38.5), waste leachates around (50), stormwater path (83.3), and locally protected (66.7).

Table 2. Distribution of springs in various LGAs in Ibadan (*Rehabilitated Springs)

N	Name of Spring	Location	LGA
1	*Akeu/Osun	Oke-Offa/Babasale	Ibadan North-East
2	*Onipasin	Near Oluyoro hospital	
3	Ologbojo	Agugu/Oremeji	
4	*Agbadagbudu	Yemetu/near Adeoyo hospital	Ibadan North
5	Rogan	Opposite University College Hospital	
6	Tayapon	Oke Aremo	
7	Alagbafo	Total garden	
8	Odo Iye	Beyond IP school	
9	*Sango	Sango	
10	Thirty-Thirty	Bodija	
11	Oke-Itunu	Alaro	
12	Alaro	Oke-Bola	Ibadan South-West
13	Omi	Omi-Adio	
14	Ogidi	Yejide road	
15	Oleyo	Oke Dada, Mapo	Ibadan South-East
16	*Adegbayi	Adegbayi/Old Ife road	Egbeda (Population served: 12,425)
17	*Yemoja-Olodo	Yemoja	
18	Arulogun	Kokoru village	Akinyele (Population served: 881)
19	Odo Baale	Ojoo	
20	Alamuyo	Oyeniran village	Lagelu (Population served: 9,750)
21	Omi	Adekola village	
22	Elewi Odo	Jonkn area	
23	*Moga	Moga	Ona-Ara (Population served: ?)
24	Oloro	Alugbo village	Iddo (Population served: 27,580)

Figure 3: Selected springs used by the communities without any protection

Spring uses and cultural beliefs

Traditionally, springs are associated with divinity, supernatural powers and certain cultural beliefs. The majority of the spring users who were interviewed had only basic primary education and a few secondary education. Most of them believed that the sources of spring water are 'big rivers' underground that could have come up to the surface due to obstruction on its direction of flow. They ascribed the 'seemingly clean' appearance of the spring water

to the water's passage through the sand and rock layers of the soil on its way to the surface. Some, however, believed that a goddess who controls the source of spring has to be appeased yearly in order to yield plenty of water. Most failed to render the spring water to any form of pre-treatment before use because of their positive perception of the quality of the spring water.

The majority of the focus group discussants said that spring water is put to general purpose uses which include drinking, cooking, dish and clothes washing and bathing. Usually women and children fetch the water but washer-men whose livelihood depends on it are found around the premises of these springs. The peak periods of use are the morning and evening hours of the day. Sometimes there are conflicts arising between people from the

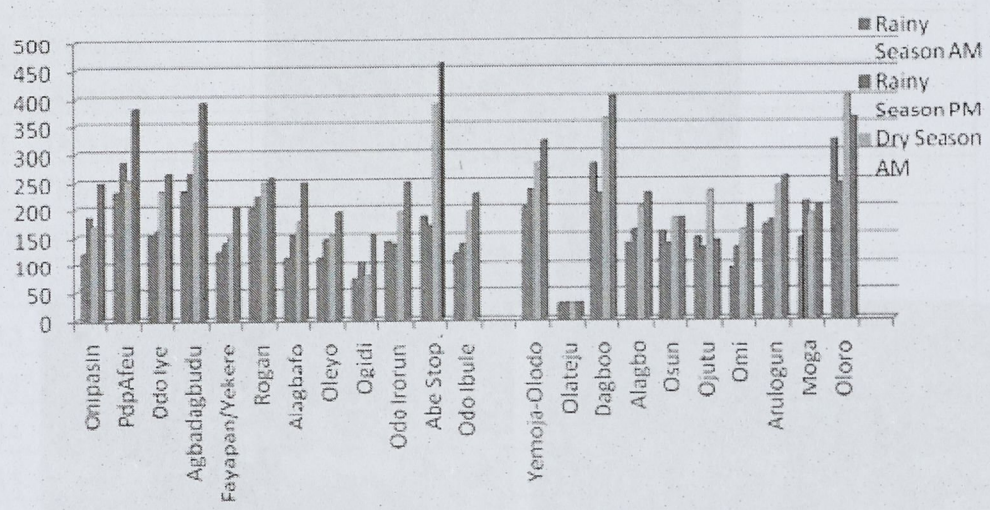


Figure 4: Daily use pattern of springs by people during rainy and dry seasons

neighbourhood and outsiders to draw water. These problems are resolved through the elders and the Bale (Chief) of the community.

Potable quality of water from the springs

The physico-chemical and bacteriological quality of the springs (Tables 3, 4 and 5) indicated the following:

1. The values for physico-chemical quality parameters pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), alkalinity, hardness and chloride were in conformity with standards recommended by Standards Organization of Nigeria (SON) and other international standards.
2. In some of the samples levels of heavy metals particularly lead, iron, copper, manganese and cadmium were found to be higher than the permissible limits; therefore the springs' water should be treated appropriately before consumption by the residents

in the study areas. Protection of springs is a cheap way of maintaining the water quality. Some of the heavy metals may originate from the traffic emissions and dust.

3. A major quality problem of springs is contamination from biological pollutants such as human faeces and other wastes as indicated by *Escherichia coli* derived from the immediate environment. From the sanitary features of the springs, the environment surrounding the springs is rather poor. This has to be improved by the communities using the springs.

Table 3. Potability characteristics of springs in the inner city of Ibadan
(Values are means of two samples)

IBNE= Ibadan North East; IBN= Ibadan North; IBSW=Ibadan South West; IBSE= Ibadan South East; IBNW= Ibadan North West.

Parameters	Rainy Season					Dry Season				
	IBNE	IBN	IBSW	IBSE	IBNW	IBNE	IBN	IBSW	IBSE	IBNW
Physical										
Temperarure (°C)	26.25	26.62	26.6	26.5	26.55	26.55	26.53	26.5	26.6	26.43
pH	6.53	6.64	6.89	6.25	6.98	6.6	6.76	6.93	6.34	6.83
Electrical Conductivity (mS/cm)	0.44	0.5	0.22	0.89	0.89	0.4	0.49	0.22	0.86	0.85
Total Dissolved Solids (mg/l)	209.5	245.6	98.5	410.2	405.8	225.7	225.02	110.4	430.3	428.3
Chemical (mg/l)										
Chloride	5.7	7.64	8.12	2.64	10.04	8.91	9.19	10.45	3.32	13.2
Alkalinity	51.3	40.5	31.8	58.9	54.5	55.6	48.3	37.1	50.14	58.4
Hardness	70.7	70.9	70.8	27.9	117.9	77.1	78.9	73.8	42.8	119.6
Heavy Metals (mg/l)										
Lead	0.091	0.006	0.081	0.0015	0.0017	0.094	0.0086	0.096	0.0039	0.0024
Copper	0.032	0.059	0.056	0.039	0.053	0.039	0.053	0.073	0.048	0.069
Iron	0.59	0.54	1.04	0.99	0.6	0.79	0.64	1.09	1.09	0.73
Manganese	0.081	0.134	0.23	0.19	0.59	0.11	0.16	0.28	0.21	0.08
Cadmium	0.005	0.004	0.003	0.009	0.004	0.006	0.006	0.003	0.009	0.005
Bacteriological (cfu/ml)										
Escherichia coli	158.5	133.2		118.5	126	156.75	108.5	104.7	87.5	112	123.8

Table 4. Potability characteristics of springs in the outer city of Ibadan

Parameters	Rainy Season				Dry Season			
	Egbeda	Akinyele	Lagelu	Iddo	Egbeda	Akinyele	Lagelu	Iddo
Physical								
Temperature (^{0}C)	26.58	26.3	26.4	26.3	26.4	26.35	26.3	26.4
pH	7.26	7.3	7.1	7.32	7.25	7.28	7.4	7.4
Electrical Conductivity (mS/cm)	0.14	0.17	0.17	0.1	0.11	0.19	0.17	0.1
Total Dissolved Solids (mg/l)	129.3	201.7	162.0	123	105.0	193.3	166.0	100.0
Chemical (mg/l)								
Chloride	54.98	59.45	59.52	58.72	57.85	61.75	63.13	59.0
Alkalinity	38.57	19.47	41.28	58.85	39.35	22.45	36.37	55.25
Hardness	53.3	37.17	62.41	54.35	57.83	41.17	56.43	18.38
Heavy Metals (mg/l)								
Lead	0.02	0.01	0.03	0.03	0.013	0.01	0.03	0.03
Copper	1.27	1.87	1.8	1.5	0.8	0.87	1.8	1.5
Iron	0.93	0.87	1.6	1.1	0.95	0.97	1.73	1.1
Manganese	0.74	0.46	0.47	0.7	1.17	0.59	0.5	0.7
Cadmium	0.013	0.01	0.03	0.01	0.013	0.01	0.03	0.04
Bacteriological (cfu/ml)								
Escherichia coli	49	9	129.3	136	47	11.3	148	150

Table 5. Drinking water quality guidelines from WHO, USEPA and Nigeria

Parameters	WHO Guideline value	US EPA Contaminant level	SON, Nigeria Maximum permitted levels
Physical			
pH	6.5-8.5	6.5 –8.5	6.5-8.5
Colour (Hazen unit)	5.0	15.0	15.0
Turbidity (NTU)	5.0	-	5.0
Conductivity (µs/cm)	-	-	1000
Chemical			
Chloride (mg/l)	250	250	250
Total Hardness (mg/$CaCO_3$)	100	-	150
Total Dissolved Solids mg/l	500	500	500
Nitrate (as mg/l N)	10.0	10.0	10
Nitrate (as mg/l NO_3)	45	-	50
Fluoride (mg/l)	1.5	4.0	1.5
Cyanide (mg/l)	0.10	0.2 (as free cyanide)	0.01 (as CN^-)
Sulphate (mg/l)	200	250	100
Aluminium (mg/l)	0.2	0.05-0.2*	0.2
Copper (mg/l)	1.0	1.0	1.0
Iron (mg/l)	0.3	0.3	0.3
Manganese (mg/l)	0.1	0.05	0.2
Zinc (mg/l)	5.0	0.5	3.0
Arsenic (mg/l)	0.05	0.05	0.01
Cadmium (mg/l)	0.005	0.005	0.003
Chromium (mg/l)	0.05	0.1	0.05
Lead (mg/l)	0.01	0.015mg/l TT6	0.01
Mercury (mg/l)	0.001	0.002 (inorganic)	0.001
Selenium (mg/l)	0.01	0.05	-
Microbiological			
Total Coliforms, MPN/100ml	0	0	0
Faecal coliforms, MPN/100ml	0	0	0

*** Florida Standard = 0.2mg/l**

Sources: WHO (1996, 1984); University of Florida Co-operative Extension Service, http://edis.ifas.ufl.edu/BODY_SS297; Standards Organisation of Nigeria (2007).

Agbadagbudu spring before rehabilitation

Development of Springs

Of the natural springs assessed in Ibadan, seven have been rehabilitated/protected and developed in accordance with the Sustainable Cities Programme (SCP) /Environmental Programme and Management (EPM) project. These are viz: Agbadagbudu, Sango, Akeu/Osun, Onipasin, Adebayi, Yemoja-Olodo and Moga natural springs. The spring water development project started in 1996 with the rehabilitation of three (3) natural springs- Akeu/Osun, Moga and Agbadagbudu. These were completed in November 1996, April 2002 and May 2002 respectively. Subsequently, replicates of these rehabilitated springs were developed- Onipasin, Sango/Isopako and Adegbayi (SIP, 2004). Later, the Yemoja-Olodo natural spring was rehabilitated. Examples of two typical springs are detailed here.

1. Agbadagbudu Spring

The spring has been in existence since time immemorial. It serves the water needs of Oje, Alekuso, Ojaoba, Opoyeosa, Olorisa Oko, Idikan and Oke Aremo communities. In the early days people used to fight for the water. The water is believed to have spiritual powers to heal barrenness and some childhood diseases like measles and smallpox. History reveals that Bashorun Ogunmola was believed to have worshipped the water goddess, Orisa Oguyan around the source of the water annually and before going to war. He was also believed to have blessed the water to provide healing powers for the community when they drank and bathed in it. Prayers seemed to have been answered. The first attempt to develop the spring was initiated in 1930 when Colonial rulers connected the pipes to Adeoyo Hospital and the defunct Ibadan Native Authority which are nearby. The location also served as recreational spot for the British. By 1954, the spring was abandoned for a long time until the landlords of the area took it upon themselves to improve the source. These efforts did not succeed until 2002, when the spring was rehabilitated to the benefit of a large number of people in the community and neighbourhood (Table 6).

Table 6. Quality of the spring water before and after rehabilitation

Quality parameter	Spring at source	Rehabilitated Spring (collected from hand pump)
pH value	5.81	5.85
Colour , Co-Pt scale	5.0	0
Turbidity, NTU	0	0
Total Suspended Solids, mg/l	0	0
Total hardness, mg/l	78.0	84.0
Total alkalinity, mg/l	8.0	24.0
Acidity, mg/l	482.0	338.0
Calcium hardness, mg/l	32.0	48.0
Chloride, mg/l	52.0	55.0
Nitrate, NO_3mg/l	1.33	0.66
Lead, mg/l	0	0
Faecal Coliform count, MPN/100ml	240	7

Agbadagbudu spring after rehabilitation
Total cost: ₦1.5 million: Oyo State Government 40%, Ibadan North LGA 30%, UNICEF/ WATSAN 10% in kind, Osot Engineering Co. 3%, Philanthropists 9%, SIP Working Groups 3%. 60,000 people use the facility within 3km radius.

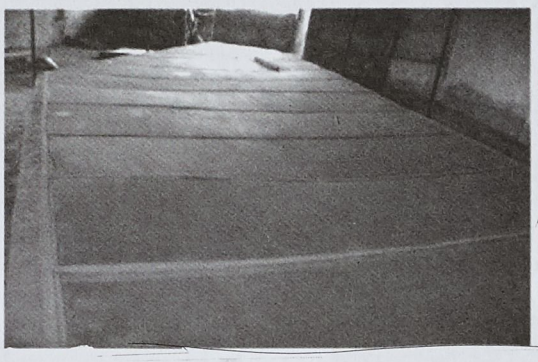
Onpasin spring

The spring in the olden days served as a worship centre for ablution, but neighbouring villagers from Beere, Ojaba, Oje contaminated the water by washing their legs inside the wate;, animals waded into the water as well. In a bid to forestall the "Unholy Act", a deaf and dumb slave was mandated to safeguard it by using his cane on any offender. The community therefore derived its name from the literal meaning – The man with the cane (Onipasin). The community under the leadership of SIP rehabilitated the spring in 2004 following the EPM approach. The cost and operational methods are similar to Agbadagbudu. Here the major problem has been leaves falling into the spring. A nylon net cover is therefore incorporated into the system (see photos below).

Onipasin spring before

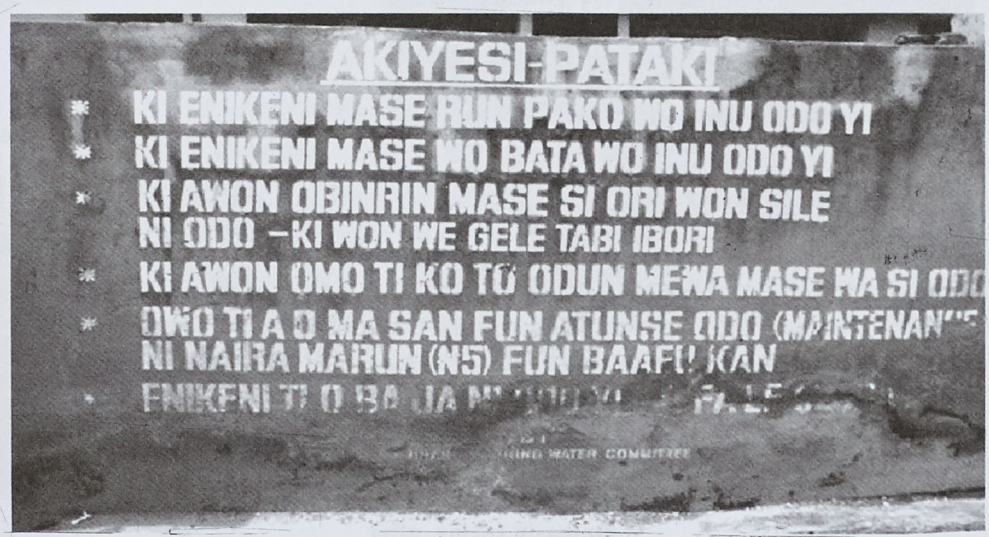
Onipasin spring, after

In view of the unacceptable colour and turbidity, a household treatment is recommended with a simple sand filter with 2 plastic buckets Bucket A (top) contained the filter material (clean sand on top of a layer of gravel with a cloth separating them) and the spring water is poured through a plastic bowl with holes to make water spread evenly. The filtered water is collected into bucket B below. There was a great reduction in the colour of the spring water, from yellowish to colourless and turbidity was also reduced. The filtered water was further subjected to solar disinfection by exposing to sunlight in the same bucket for about 6 hours. The quality of water improved greatly with zero coliforms. When the treatment of water is inadequate, simple sand filtration and exposure to solar radiation are economic methods to achieve the required quality (Oloruntoba et al 2006, Oloruntoba and Sridhar 2007, Sridhar and Oloruntoba 2008,Ajayi et al 2010).I



Nylon net cover

Sand filter



User instructions

The users

Household treatment was advocated, even though the spring is protected: using sand filtration, bleaching power, and solar radiation.

Results Achieved from Spring Development

1. Easy access to clean, potable and hygienic water, improved sanitation and reduced water-borne diseases.
2. Creation of informal bargaining fora (Working Group Sessions and later at Management Committee Meetings) where all stakeholders, Partners from the Private Sector, NGOs, Academic, Local Community, State Government Agencies and Local Government discuss freely to ensure the development of the initiative in a sustainable manner.
3. An increase in interactive skills of the participants from different sectors (Government, Academic, Private, NGO, Popular and Community).
4. Changes in philosophy of management and improved institutional capacity at the local/community level whereby ownership and management of projects are vested in the hands of the local communities.
5. Increased information generation which assists in necessary replication of projects in other communities/locations in Ibadan and elsewhere.

Sustainability Measures for Spring Waters

1. Financial Cost recovery measures (i.e. imposition of fixed levy on the houses within the community and introduction of user charge) to cover operating and maintenance costs.
2. Social and Economic: Putting in place of a Management Committee composed of the community members to ensure their ownership and subsequent maintenance of the project by the people of the Community.
3 Environmental: The use of resource management strategies to avoid over-utilization of the spring. This entails timing the usage of the project to a particular period of the day (i.e. 7 to 9AM and 5 to7PM) when water can be drawn from the project by the members of the community. Proper management of the spillage around the spring through organized drains also reduces water stagnation and mosquito breeding.

Conclusions and Lessons Learnt

This study has brought out a few points of interest. (1) Partnership for Environmental Management was evident that actors from all sectors, the private and popular sectors are prepared (given the chance) to work in partnership with the public sector to find lasting solutions. (2) Accessibility to Information: the inter-relationship among members of the SIP Working Group on the Spring Project facilitated easy access to information and data required for effective planning which hitherto had not been possible. (3) Mobilization of Resources for Implementation of Investment Projects: in the development of the Spring Project, resources were mobilized from the community, International Agencies and the public to develop the Natural Spring. The experience further demonstrated that once the project is well conceived with all the stakeholders, dependence on the government is reduced, cost becomes affordable and sustainability is achieved. The community also gains capacity building as an inherent component of the EPM process. Once alternate water supplies are made sustainable, pressure on large water schemes will be reduced. In the long run such approaches are economical.

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