

The artificial groundwater recharge option for water resources management in Kenya

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Abstract

Kenya's legislative position in relation to ground-water artificial groundwater recharge (AGR) has been investigated. This is with a view bringing to fore the importance of including AGR as water management tool with great potential to improve both quality and quantity of water available.

Artificial ground-water recharge in Kenya is relatively new and lacks adequate policy and legislation for its effective implementation.

This paper discusses the current status of policy and legislative endeavours in artificial ground water recharge, high lighting the issues that require attention to make the methods' contribution in water supply, amelioration and conservation of groundwater effective.

The Lack of adequate policies, strategies and rules, made worse by gaps and overlap in roles of key sector players have been identified as key contributors in the lack of implementation strategies for using groundwater artificial recharge as management tool.

This paper highlights the status of legislation in groundwater artificial recharge in Kenya with roles of relevant sector players.

Keywords:

Artificial groundwater recharge: Kenya; Legislation: Enlivenment

1. Introduction

Kenya is classed as a water scarce country (FAO, 2015; Government of Kenya, 2006; Ogendi & Ong'oa, 2009) and surprisingly lacks elaborate water conservation (reuse and amelioration) plans. The main cause for this inadequacy like in many African nations can be traced to lack of viable policy framework, political will and resources. The latter vindicated by the undocumented increasing number of individuals securing their own reliable water supplies, by digging of wells and drilling of boreholes.

The rare mention of artificial groundwater recharge (AGR) as a strategy in both policy documents, climate adaptation strategies and water management studies in Kenya (e.g. Department of Water Resources, 2012; Government of Kenya, 2013, 2014; National Water Conservation & Pipeline Corporation, 2015) has undermined its position as a possible advantageous water supply, storage and amelioration method, with positive consequences, that can benefit from legislation.

An abundance of articles as exemplified (Institute of Economic Affairs, 2007) to address water management issues showing both historical and current efforts but have notably excluded conservation and amelioration of groundwater in Kenya.

artificial groundwater recharge of groundwater is one way to address water supply endeavours, water conservation and flood mitigation problems. AGR can be used to bridge seasonal water deficits and bank water for future use. (United Nations Environment Programme & Division of Technology, 1997, 1998, 1999).

Similar to problems in other water related endeavours that require science before enactment of appropriate laws, regulation and rules, AGR will need policy formulation based on known facts that would indicate comparative advantages that are likely to be accrued from implementing it.

The strategic inclusion of AGR as water resource management method would result in more endeavours to making available adequate resources for AGR study and implementation.

2. Methods

Legal instruments used by the two state institutions, National Environmental Management Agency (NEMA) and Water Resources Authority (WRA), with overall mandate in management of water resources have been reviewed to understand the focus of ideas on the role of these organizations to deal with amelioration and conservation of water, especially AGR. Their relevance, apart from collection of levies and fees for the government, in addressing the current and future water challenges of inadequacy in quality and quantity have been assessed. An examination of the current tools – rules, strategies, legislative acts that currently endeavour to anchor AGR in water resource management was made. The reforms in these organizations by various amendments and by new acts of law have been assessed. “The National Water Master Plan 2030” is composed of seven volumes, and is a key resource used in water policy formulation, having the most complete information on Kenya’s hydrological status of surface and groundwater. It notes that AGR is uncommon (Japan International Cooperation Agency - Nippon Koei Co., Ltd, 2013b) and does not consider AGR in the National master plan 2030, due to lack of sufficient data (Japan International Cooperation Agency - Nippon Koei Co. Ltd, 2013a). However broad suggestions for AGR’s consideration have been made for drought mitigation and groundwater amelioration (Japan International Cooperation Agency - Nippon Koei Co. Ltd, 2013c).

3. Results

Two bodies in Kenya are expected bear the most responsibility in regulating AGR. These are the National Environment Management Authority (NEMA) and the Water Resources Management Authority (WMRA), now Water Resources Authority (WRA). NEMA has had a role to play through legal Notice No 120 of 2006, i.e. Environmental Management and Coordination (EMCA, Water Quality) Regulations on Water Pollution (NEMA 2006). Subsequent updates have been made to EMCA and now we have EMCA 2015 which takes cognizance of Kenya's changed administrative set up since promulgation of the new constitution in 2012. The Water Resources Management Authority had in 2007 rule No. 78 (Water Act, 2002) on Artificial ground water recharge. This has however been superseded with the water act of 2016 (Government of Kenya 2016a) in which there is no mention of "Artificial recharge" in the whole document. However functions of the latter have been generalized on Part III, section 12. This broad description in subsection (d) states that the authority's function as to "receive water permit applications for water abstraction, water use and recharge and also to determine issue, vary water permits; and enforce the conditions of those permits"

Artificial groundwater recharge in urban areas would require consultation between three major stakeholders apart from the public. In Kenya these would be WRA, NEMA and County governments. Other lead agencies expected to have an interest in AGR include Kenya Wildlife Services (KWS) and Kenya Forest Services (KFS), by virtue of overall supervision of other natural resources that overlie aquifers under consideration. This brings to fore the need for consultations and provision of legislative tools to allow efficient management of regulations and their compliance in AGR activities. This is desirable to reduce unnecessary overlap and conflict would result and thereby achieving proper oversight that may not have been possible from poorly defined roles and responsibilities. This lack of clarity in roles had also been one of the motivations for the water sector reform (Government of Kenya, 2006)

Amongst the named stakeholders only NEMA has a legislative mechanism for obtaining input from professionals. It has the National Environment Council (NEC) established by Section 4(1) of the Environmental Management and Coordination Act no. 8 of 1999 with professional input in policy formulation from permanent Secretaries in responsible sectors in the first shedule of the Act, representatives of public universities, specialized research institutions, the business community and non-governmental organizations.

WRMA rules, 2007, on artificial groundwater recharge stated;

- (1) No person shall undertake to construct works for the purposes of conducting the artificial groundwater recharge of an aquifer, or not in a groundwater conservation area, unless the person has been duly authorized by the Authority so to do.
- (2) Any person applying for the necessary authority in compliance with sub-rule (1) shall give particulars relative to the application as the Authority may require, and the Authority may, after consideration of the application grant upon such conditions as it may deem necessary or refuse the application.
- (3) Any person who contravenes the provisions of this rule shall be guilty of an offense and shall be liable to a fine not exceeding ten thousand shillings or to imprisonment for a term not exceeding three months, or to both.

Like all activities that involve use of a natural resource, permitting for artificial groundwater recharge is necessary. However as currently set with no elaboration, these rules do not encourage private individuals,

sectors or players who may have capacity to invest in Artificial recharge. No national strategy for use of AGR technology exist as indicated by the three stated rules. The wording of the rules are person centred rather than event oriented. The import of the wording should be compared with other countries that also use permitting mechanism to regulate and manage groundwater, Illustration.

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Subsidiary legislation however may add further procedural specifications tailored to the particular nature of the activity involved, as illustrated in the examples below.

I - PHILIPPINES - Water Rules and Regulations

1. ... In the following instances the granting of permit/authority required under the provisions of P.D. 1067, is delegated by the Council to the corresponding agencies indicated and permit/authority pertaining to any of these instances shall be secured from the agency delegated:

... (c) Recharging ground water supplies - National Pollution Control Commission.

Whenever necessary the Council may exercise any of the above delegated authorities.

II - UNITED KINGDOM - The Groundwater Regulations, 1998

6. Artificial recharges for the purposes of groundwater management

Artificial recharges may be authorised on a case by case basis for the purpose of groundwater management notwithstanding regulations 4 and 5¹, but such authorisation shall only be granted if there is no risk of polluting groundwater.

Illustration 1: (Burchi, 2003) . . .

As noted above regulations should elaborate on activities to be carried out within requirements of the rules/laws, rather than single out persons as entities of concern.

4. Discussions

4.1 Legislative changes

Changes made in EMCA by government legislation in 2015, (Government of Kenya, 2015b) and 2016, (Government of Kenya, 2016a). in relation to groundwater, are noted to have only distinguished between low and medium risk groundwater endeavours, with the effect of lowering applicable impact assessment fees for community projects.

Despite Kenya's significant policy revision and restructuring of institutional roles by the water act of 2002 and decentralization of government in 2010 by the new constitution (African Ministers' Council on Water, 2011), no added value for water resources management has been accrued from it, as the decentralized systems roles remain selling water to consumers with no input to conservation or investigation of future new sources.

4.2 Legal instruments

WRA and NEMA, are the major legal public entities mandated to deal with water resources management. But as currently constituted they are likely to find it difficult to apply themselves in the management of artificial groundwater recharge. They are likely to be overwhelmed with regulating and monitoring uncontrolled growth of water supply wells and ill designed sanitation facilities that are polluting groundwater, amongst numerous other environmental concerns for NEMA that have monetary incentive to pursue.

Presently there are no laws that are related to AGR for qualitative and quantitative improvements. NEMA and WRA need to make concerted efforts in reference to AGR and develop policies that address AGR in similar manner to other countries where improvement in quality and quantity of water has been proven from implementing AGR.

According to the (Government of Kenya, 2016b), a third entity, National Water Harvesting and Storage Authority (NWHSA), created by the new act, has national functions and a basic mandate for provision of water storage, flood control with formulation of appropriate accompanying policies. It is yet to be actualized and have its potential expanded mandate on water storage in aquifers defined. If AGR is considered storage it might need to be included with other rain harvesting functions vested in the NWHSA.

4.3 Clarity of roles of state agencies in management of AGR

One area that requires harmonization is roles and responsibilities of state agencies. Currently the boundaries between roles of relevant agencies are murky, despite broad objectives stated in their roles and responsibilities which should include AGR.

The clarity in roles between NEMA and WRA would be tested if AGR resulted in adverse deterioration in the quality of ground water. NEMA would be involved in the issue by its environmental concern. This would be despite not being involved in the initial permitting that is presently under WRA's jurisdiction. As the permit issuer WRA would correctly attempt to regulate and manage the situation as is in its' stated mission. A conflict of roles with NEMA, who currently do not have expertise in ground water would result.

4.4 NEMA's limitations

Registration of experts for both NEMA and Ministry of Water are done without consultation between them. This implies that groundwater investigations would always require approval from both parties. Apart from the extra fee burden to citizens in need of groundwater access, the environmental experts registered by NEMA are not required to be specialists in their field of investigations. This is a major handicap that will be reflected in 'expert' analysis of professional studies. NEMA should change its registration mode to allow only those lead experts registered by their professional bodies to carry out audit and impact assessment.

Impact assessment of groundwater from well/borehole construction in many instances lacks requisite data due to costs involved in appropriate data generation. This has been compounded lack of public awareness and qualified personnel with appropriate tools of assessment and investigations. Therefore, in most cases, with current information available, especially for individual groundwater applicants, impact assessments can only be extremely speculative due to inadequate required basic data and cost of investigations.

Apart from the technical challenges that may arise in implementation of AGR, the latter has not been mentioned in any of NEMA's role as an environmental watchdog. AGR is therefore unlikely to be adequately resolved due to the current lack of both expertise and decision making information on groundwater.

NEMA's role, as currently organized and resourced, will effectively reduce citizens access to groundwater, if impact assessment becomes a prerequisite to exploitation of groundwater and implementation of AGR. Environmental audit, one of NEMA's mandate for AGR would require funding and expertise in groundwater, currently both lacking. The inability of state agencies to meet their mandate of regulating and providing water, now declared a human right, will result in the collapse of groundwater sector.

NEMA's inadequacy has the potential to make the acquisition of impact assessment unattainable for a substantial number of groundwater users. Currently most of the wells are hand excavated without NEMA's input. This includes most of the wells excavated before the existence of NEMA and whose owners have not interest in additional permitting cost and bureaucracy.

In most cases environmental impacts can only be known after qualitative and quantitative tests have been carried out. These must be integrated with possible water uses and disposal techniques. Only identified aquifers whose properties have been determined can have their impacts assessed. So the request for impact assessment would be premature in the majority of cases, where information on aquifers are not available, and would only allow permit issuance on basis of an ad-hoc and non-technical reasons.

4.5 Appropriate technologies for AGR

AGR can be implemented from different sources of water and by different methods. The techniques can be found in many texts. (e.g Bouwer, 2002; UN-HABITAT, 2005; United Nations Environmental Program, 1997; United Nations Environment Programme & Division of Technology, 1997).

The main factors that affect groundwater quantity and quality in most Kenyan urban areas, are urban growth and failures in surface based water supply systems. Urban growth by increasing pavements reduce natural recharge, while failure of surface water supply systems to meet needs of urban dwellers fuels groundwater abstraction. Both these factors could be remedied by AGR where hydrological and geological characteristics are optimal.

The lack of viable and adequate options to urban water supply has the effect that thirsty citizens will go about making their own provisions of water. This include digging more unlicensed wells to satisfy this very basic human right.

Of the many recharge technologies available, the use of roof rainfall runoff as a source of groundwater recharge by its very nature has a better quality than other groundwater recharge sources. It would therefore require less stringent water quality legislation compared to the other water sources. Effective runoff can be achieved by a mechanism to allow initial runoff to be discarded.

4.6 Structured contributions to policy and appropriate legislations in AGR

Though some efforts had been made in 2016 in realizing the need of a policy on groundwater artificial recharge (Ministry of Water and Irrigation, 2016), further work in informing and involving key stake holders needs urgent attention. Public participation is now entrenched in most civil endeavours, however the point at which professionals/professional bodies contribute to regulatory and management policy is also an important factor of consideration. These professional bodies are important stakeholders whose *raison d'être* would be in jeopardy should they not make contributions as stakeholders.

Environmental management and co-ordination act (EMCA) (Government of Kenya, 1999) is the legislative document of NEMA. Apart from setting up the administrative framework for implementation of environmental regulations, the document include parts that deal with impact assessment and audit, (Part VI – Environmental Impact Assessment, Part VII – Environmental Audit And Monitoring) with listed areas of concern (Part V – Protection And Conservation Of The Environment) with related offenses outlined (Part XIII).

Despite NEMA's core function as indicated in Government of Kenya, (1999) of Coordination and supervision of lead agencies in conforming with the requirements of EMCA – 1999 act, and subsequent amendments (Government of Kenya, 2014a, 2015a) that cascade responsibility to county governments, conflict and overlap in roles, including oversight in duties with other lead agencies are unlikely to end soon.

As noted by Funder & Marani (2013), line agency staff and local government generally recognize the legitimacy of NEMA and their basic mandate as an environmental agency, however it remains a deeply contested issue where the limits in boundaries of “environment” end (and thereby NEMA’s mandate). Further it has been noted that relevant agencies normally carry out individual sectoral strategies and programmes and therefore NEMA as a coordinator with partial permitting authority and who may not have specialist personnel in areas of agencies competence, will unlikely be able to coordinate or supervise activities that may have potential environmental impacts by AGR.

Reforms in WRA and NEMA by various amendments to their acts of law have been noted to be driven mainly by the new constitutional order in 2010 which created new administrative structures and abolished some which the previous acts of law referred to.

Changes were made in EMCA by government legislation in 2015,(Government of Kenya, 2015b) and 2016, (Government of Kenya, 2016a) in relation to groundwater and are noted to have only resulted in distinction between low and medium risk groundwater endeavours, with the effect of lowering applicable impact assessment fees for community projects.

Amendments made to the water act-2002 in 2016 ((WRA, 2017) have had the WRA summarize their core functions as

- i) Improving the water resources knowledge base
- ii) Regulation and control of the use of water resources
- iii) Protecting the water resources from adverse impacts
- iv) Managing disaster risks induced by water resources

The above four functions make no mention of amelioration in quality and quantity of groundwater and therefore would require revision if AGR is to be considered as important aspect of meeting the water supply requirements and aiding in conservation of groundwater.

Despite Kenya's significant policy revision and restructuring of institutional roles by the water act of 2002 and decentralization of government in 2010 by the new constitution (African Ministers' Council on Water, 2011), little added value has been accrued from both, as the decentralized systems roles remain selling water to consumers with no input to conservation or investigation of future new sources.

In other countries e.g. South Africa, the Department of Water Affairs have procedures for the implementation of an artificial groundwater recharge projects that includes four stages, namely a pre-feasibility stage, a feasibility or testing stage, an implementation stage, and an operation, monitoring and maintenance stage (Murray, Tredoux, Ravenscroft, & Botha, 2007).

Murray, 2009, as cited in Steinel, (2012) identified legal and regulatory issues amongst the ten issues that should provide a criteria for selection of suitable AGR zones, apart from the others related to technical aspects.

Kenya has not carried out any of the four mentioned stages and presently there is no exhaustive legislation to support AGR endeavours. or stated policy goals to achieve Artificial recharge.

5. Conclusions

From the foregoing it is noted that Kenya lacks a national strategy on AGR despite being one of the important aspects of water management that can play a positive role in improving availability of both quantity and quality of water available for utilization in the country..

Inadequate evolution of rules on AGR has been noted along with lack of any sustained effort AGR's footprint in water resources management. There is also been rare mention of AGR, less than a paragraph, on any major water resource documents perused, including the national water masterplan 2030 (Japan International Cooperation Agency - Nippon Koei Co.. Ltd, 2013a) a key document which most water sector planning and implementation rely on.

Legislative acts for artificial groundwater recharge (AGR) after consideration of socio-political factors depend on hydrology and geological nature of aquifers. These considerations should define the framework and activities of the responsible bodies allowing them to regulate and manage their activities without conflict or overlap. The power to make rules would further allow them to elaborate on activities under their ambit.

WRA rules should encourage the public, individual persons and private sector entities to invest in AGR. As noted the wording of the above WRMA (now WRA) rules shifts the burden of implementation of AGR to persons other than WRMA. The latter is a state agency responsible for regulation and management of water resources.

Revenue earning from imposition of fines should however not create conditions that make corruption an alternative to obtaining permits. Permitting activities may become bottlenecks rather than incentives in management of AGR if not well considered.

The monetary and regulatory demands from the two bodies, NEMA and WRA, for fees before allowing individuals to meet their basic human right, requires them to understand and resolve the conflict between regulation and implementation.

If encouraged by legislation and policies citizens with wells/boreholes could play an important role by recharging aquifers from rainfall runoff in urban settings. This would increase access to improved water quantity and quality.

AGR requires a zoning strategy and criteria for evaluation in permitting to make compliance tenable, a consequence of different hydrological and geological backgrounds. AGR regulations when implemented should have adequate resources for monitoring in order to provide data necessary for its robust management.

Enacted AGR laws would also require public participation so that they can acquire legitimacy and allow majority compliance.

6. Recommendations

While noting that there may be cultural, political and technical challenges that must be surmounted to have relevant implementable water policies, AGR deserves more consideration than currently noted. Elaboration of the implementation time scale and quantities should be made on of AGR. This would ensure that the statement of intent “Policy Direction 6: The Government will put in place measures to promote the recharge of managed aquifers, especially Artificial Groundwater Recharge to enhance their beneficial use and promote environmental sustenance.”(Ministry of Water and Irrigation, 2016)• moves to actualization.

Water as basic need and now a right, requires strategies and plans that incorporate all interventions that include AGR. This would improve access to water of adequate quality and quantities, for a sustainable conflict free future.

Studies on AGR to enhance knowledge driven laws need to be carried out on different aquifer types to enable the enactment of robust legislation that will allow for the greatest benefit for water consumers with adequate environmental safeguards.

Lack of public participation and unreasoned AGR legislation can exacerbate the current water problems and future potential conflicts that will be encountered in allocations and abstractions of ground and surface waters. Contribution by stakeholders should also include registered professional organizations

Rainfall harvested water poses the least quality problems in AGR compared to other water sources. It could be encouraged with fewer cautions for improvement of water-quality in marginal aquifers. It would also ameliorate the water quality deterioration rate in urban aquifers. Currently and unknowingly these aquifers are

being recharged by sanitation water from soak pits and pit latrines. WRA's rules are in need of improvement to encourage rain harvested groundwater recharge.

Consideration on permitting fee waiver on AGR for urban centers would go a long way to encourage participation and compliance of household based recharge schemes.

County governments who are envisaged to undertake water sector implementation, if made aware could pass building by-laws and make it mandatory to harvest rainfall water from roofs in urban settings. This rainfall runoff could be channeled to recharge wells. The benefit of such action include

- Lessening the impact of flooding occasioned by rain storms which are frequently observed in many growing urban centers. Flooding is common where runoff storm is not planned or, simply, the implementation works dealing with runoff have not been implemented.
- Improvement in marginal water quality aquifers affected by seawater intrusion, secondary salinity and meteoric salinity.

The formulation of rules and regulatory guidelines for groundwater AGR should be made by borrowing from other countries already at more advanced level of implementation of AGR as a national policy. These include India (Cullet, 2012), Australia (Steinel, 2012), South Africa (Xu & Beekman, 2003) and countries of Europe (Sprenger et al., 2017).

Improvement in legislation should be made to encourage compliance with set standards of recharge.

The examined policies, strategies, rules, legislative acts and related literature indicate need for an integrated approach that ensures all sectoral players have defined roles leaving no gaps or overlap, thereby reducing chances of conflicts. Studies on the potential of artificial recharge ability of currently known aquifers may allow more appropriate new legislation to enhance AGR as one of the management tools to ameliorate declining aquifers and improve access to water.

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