The Impact of the Recent Drought on the National Water Commission (NWC) Water Supply Services to Kingston & St. Andrew

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Abstract.

Water is life, however between May 2009 and present Jamaica was starved of the precious commodity. There was a significant reduction in rainfall intensity islandwide especially along the southern sections of eastern parishes (St. Thomas, Kingston, St. Andrew, St. Catherine and Clarendon). The National Water Commission (NWC), the state entity charged with the responsibility to provide water and Sewerage services was seriously challenged to adequately supply customers daily with reliable potable water.

To this end the NWC had to implement drastic measures such as supply restrictions to communities in order to ensure that the limited stored capacity was not completely depleted. Such austerity measures had and continue to have serious social, health, financial and economic implications for the NWC but more importantly to Jamaica on a whole.

This paper evaluates and discusses the impact of the drought experienced, and the lessons learnt in charting a path forward that could guide the process of securing the water supply needs of Kingston in particular, but more importantly the country on a whole.

A discussion is also presented on an appropriate institutional arrangement and a possible planning process that could be adopted in mitigating the severe impact from future drought incidence.

Introduction

Water is a precious resource, and this is never more apparent than in a time of drought. Drought is a natural feature of our climate, if our recent experience is anything to go by; this is something we may have to learn to live with. The National Water Commission (NWC) continues to remind us through its slogan that "Water is Life", if this phrase was ignored in the past, not so in recent times. It certainly resonates with the citizens of Jamaica, but mostly with those persons who by virtue of circumstances or choice either live or work along the southern section of eastern parishes. Throughout the year 2009 the rainfall frequencies and intensities have been less than sufficient to sustain the 24 hour potable water distribution from the National Water Commission's facilities especially those serving the Kingston and St. Andrew (KSA), the capital metropolis.

In fact the drought conditions being experienced are not peculiar to Jamaica, but have been noted as a regional phenomenon. The seriousness of the situation was brought into sharp focus in a meeting of the Twenty-first Inter Sessional Meeting of the Conference of Heads of Government of the Caribbean Community in Rosseau, Dominica, 11-12 March 2010. It was tabled that the less than normal rainfall through the Caribbean that emanates into droughts were triggered by what is known as El Niño Southern Oscillation (ENSO) events. This phenomenon as we have experienced are known to produce reduced rainfall and elevated temperatures across portions of the Caribbean. Jamaica and KSA in particular had such an experience.

The lack of available potable water, it will be shown had an integrated negative impact on Jamaica, but more significantly on KSA. This matter will be discussed within the context of an Integrated Water Resource Management (IWRM) framework and will consider how the lack of such an approach to IWRM threatens; a) Public Health of KSA, b) Social Well Being, c) Financial and Commercial activities, and d) Economic progress which translate into growth and improved standard of living for the populace. Importantly a review of the institutional arrangements will be discussed and its role in advancing progress for water security. This paper's primary objective is to document the impacts of the drought, highlighting any lessons leant and make appropriate recommendations that will inform improvement in activities and minimize the negative impact of such future occurrence.

Objectives

Kingston and St. Andrew has been experiencing drought conditions for the twelve month period spanning 2009 and 2010. For the first three months of 2010, January to March, the severity of drought condition becomes more acute. With such conditions there were significant consequences. Therefore the objectives of this paper are to;

a. Identify and highlight the severity of the drought on the geographical location KSA
b. Assess in a multi-dimensional way the impact of the drought on KSA and by large the operations of the NWC
c. Identify drought mitigation measures implemented by NWC.
d. Identifies lessons learnt and preventative mechanisms to mitigate future occurrence.
e. Recommend strategies for improvement in order to mitigate reoccurrence

Methodology

In determining the impact of drought on KSA, the methodology adopted a combination of reviewing existing literature and unpublished reports recorded over the period January 2009 to May 2010 in some instance. These reports were obtained internally from the NWC, Ministry of Health (MOH), Water Resources Authority (WRA) and the Meteorological Services of Jamaica.

Definition of Drought Conditions

According to Heinemann English Dictionary, *Drought* is defined as a long period of weather without rain. All types of drought originate from a deficiency of precipitation (Wilhite and Glantz, 1985). When this deficiency spans an extended period of time it is termed a M*eteorological drought.* Its existence is defined initially in terms of natural characteristics. However, there are other common drought types (agricultural, hydrological, and socioeconomic) placing greater emphasis on human or social aspects of drought, highlighting the interaction or interplay between the natural characteristics of the event and the human activities that depend on precipitation to provide adequate water supplies to meet societal and environmental demands. Exposure to drought varies spatially, and there is little, if anything, that can be done to alter drought occurrence.

Hydrological drought is even further removed from the precipitation deficiency because it is normally defined in terms of the departure of surface and subsurface water supplies from some average condition at various points in time.

Agricultural drought is defined more commonly by the availability of soil water to support crop and forage growth than by the departure of normal precipitation over some specified period of time.

Impacts Assessments of the Drought

According to the latest population census conducted 2001, the island of Jamaica has a population of 2.6 million persons. So when this little island paradise as we often calls it, is faced with water scarcity. There is absolutely no area of a citizen's daily life that will not be negatively impacted.

Meteorological Office Drought Assessment

For the period May 2009 to March 2010 the islands eastern and southern parishes were staved of its usual precipitations and the impact is illustrated in the map below for March 2010 recordings, supplied by the Climate Branch of the Meteorological Service of Jamaica (Met. Office).

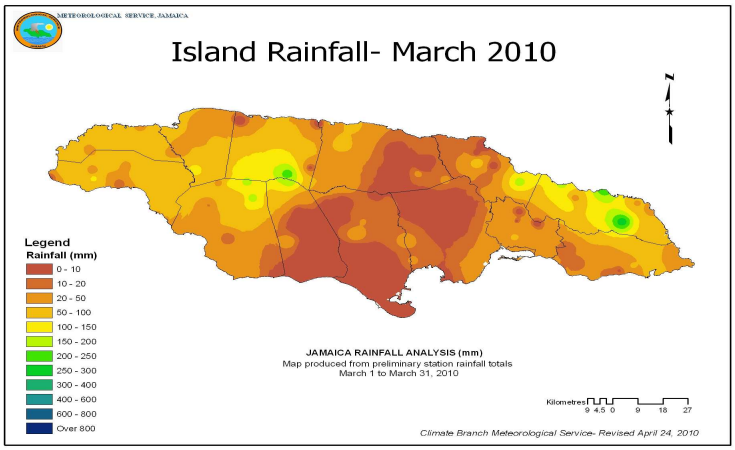


Figure 1: Island Rainfall Distribution March 2010

In determining the impact of rainfall on the water supply to KSA , the Met. Office reports between the periods August 2009 to March 2010 were reviewed in the context of the parishes with watersheds whose rainfall incidents should impact streamflows that directly supply water to KSA. The parishes that were considered are Kingston and St. Andrew, Portland, St. Mary and St. Thomas.

The data showed that all parishes received well below their normal thirty year average levels of rainfall for two comparative thirty year periods. An occurrence of this nature certainly would affect stream flows. Figures 2-5 below illustrates.

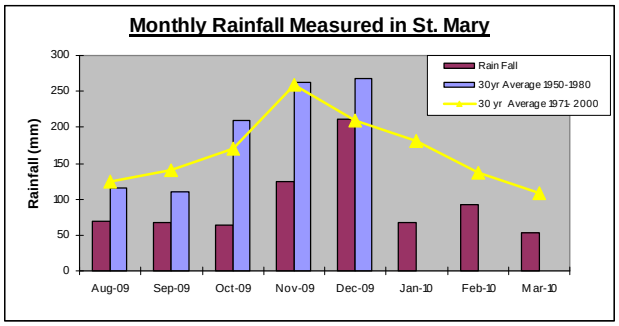


Figure 2: St. Mary Rainfall

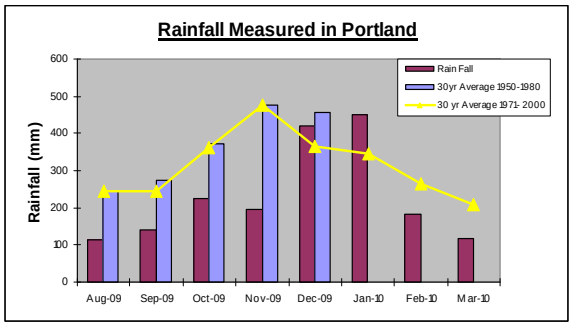


Figure 3: Portland Rainfall

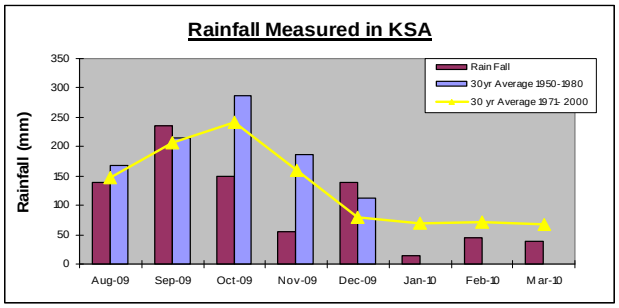


Figure 4: KSA Rainfall

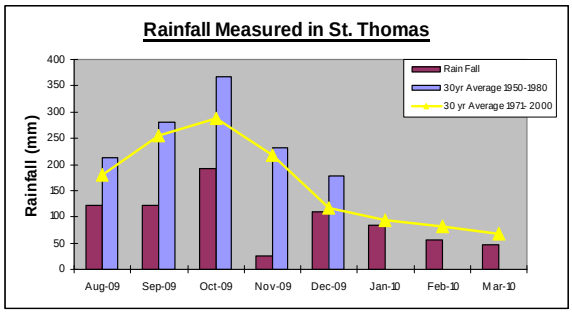


Figure 5: St. Thomas Rainfall

In their determination the Met Office assesses meteorological drought using a methodology that denotes a drought condition index. The methodology involves comparing the average rainfall over a period of two consecutive months with the 30-year historical averages (normal) for a similar bi-monthly period for each parish and the island. The percentage value generated is used to quantify the thresholds of the drought index Table 1.

Percentage of Normal for 2 Consecutive Months	Drought Condition or Status
20% or less	Extreme Drought
21% to 40%	Severe Drought
41% to 60%	Normal Drought
Above 60%	No Drought

Table 1: Meteorological Drought Index Adopted From Met. Office

In reviewing the Met Office reports for the period August 2009 to March 2010 the drought index calculated for the parishes under review are presented in Table 2 below.

	Extreme Drought	Severe Drought	Normal Drought	No Drought
August		Clarendon		
September		Clarendon	St. Mary & St. Thomas	
October			Portland, St. Mary St. Thomas	
November		St. Thomas, Clarendon, St. Mary, KSA and Portland		
December			St. Thomas	
January	KSA (New Castle)			
February			KSA	
March		Clarendon	St. Mary, St. Thomas & Portland	

Table 2: Drought Condition Indices of Eastern Parishes

The Met Office assessment suggests that the drought conditions were not severe for most months reviewed. It however confirms that some drought conditions were experienced in the parishes whose watersheds affects streamflows that supplies KSA's water needs.
The Met Office assessment of a parish condition is not entirely conclusive for effective decision making. There are factors which could sway the results of which there were no mention or consideration given to;

a. Spatial distribution of rainfall within a parish based on recording stations.
b. Temporal distribution of rainfall within a given month for a parish.
c. The report itself is dated in that it is not as timely, 3-4 weeks after the fact. More importantly long term projections are not commonly associated with the reviews provided.

Stream Flows Assessment

The Hermitage Dam is supplied by three sources the, Wag Water, Moresham and the Ginger River Pipeline which is supply from a series of small intakes. Although very conservative, comparative stream flow measurement of the Wag Water River between January to December 2009 shows a significant reduction when compared with the previous year's flow and the daily average discharge 1976-2009 respectively, figure 6, WRA 2010. On average the daily discharge from the Wag Water river is approximately two cubic meters per second ($2m^3$/sec), however for the period January to December 2009 the daily streamflows were significantly less in the order of point five cubic meter per second ($0.5m^3$/sec). While the measurement was only done on one stream, it provides an approximate assessment of the activities especially relating to rainfall incidence within the watershed, figure 2 and 4 rainfall data from the Met.Office.

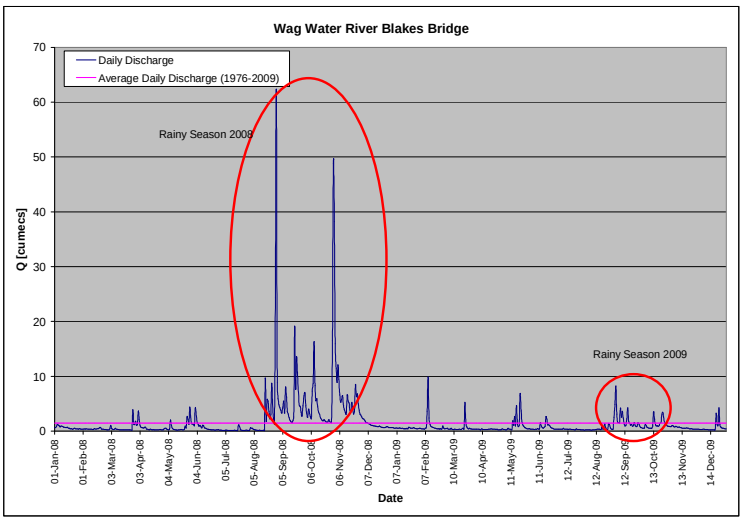


Figure 6: Streamflow Measurement Wag Water River

The Mona Reservoir like Hermitage is supplied from multiple sources, Hope River in St. Andrew and the Yallahs and Negro rivers in St. Thomas. The Hope River flows via the aqueduct into the Mona reservoir while flows from Yallahs and Negro Rivers on the other hand are diverted through a cross country transmission main to the reservoir. Stream flow measurements conducted by the WRA, 2010, at the Hope River showed that the average normal daily discharge of the Hope River is approximately $0.8m^3$/sec. However, this was significantly reduced last year to less than fifty percent of normal average flows, figure 7.
On the other hand though only spot measurements were conducted on the Negro and Yallahs Rivers the daily discharge from both rivers showed a decline and even more so when compared with the previous two years, 2008 and 2007 respectively as shown in figures 8.

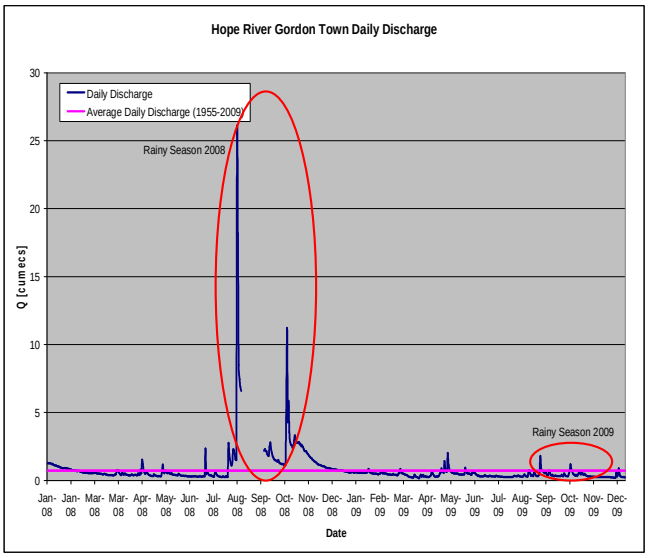


Figure 7: Streamflow Measurement Hope River

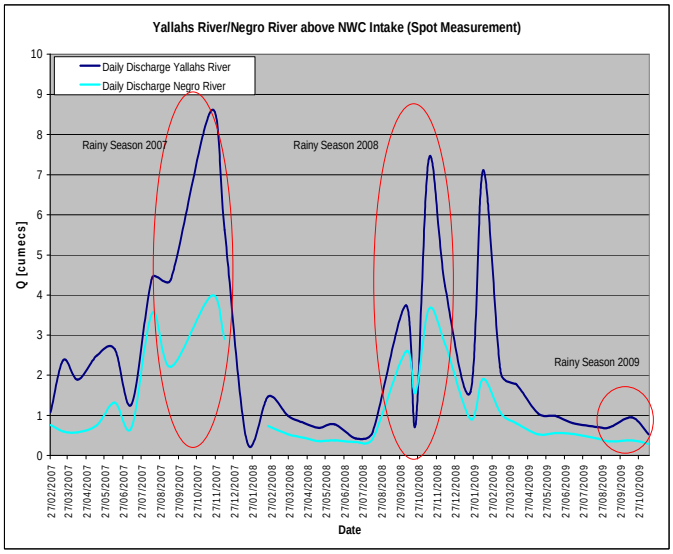


Figure 8: Streamflow Yallahs & Negro Rivers

When these streamflows are assessed closely the impact of rainfall or the lack thereof is quite evident. The less than normal rainfall during the usual rainy periods of May/June and September/October having significant negative impacts on the stream discharges, confirming that within the supply watersheds there was a hydrological drought. This translates into less volume of water reaching our storage facilities or treatment plants directly. Figures 3, 4 and 5 illustrates rainfall occurrence within the parishes whose watersheds contribute to these streamflows.

NWC's Impact Perspective

The south-eastern parishes of St. Thomas, Kingston, St. Andrew, St. Catherine and Clarendon were noticeably most affected, figure 9. However, when population centers become the focus, the capital city, Kingston and the wider Kingston and St. Andrew (KSA) metropolis were deemed to have experienced the worst water scarcity incidence in more than Twenty-five years (25yrs). KSA with resident population of 580,000 according to the 2001 population census report had all aspect of the city's life affected by the drought conditions in one way or another. Figure 10 illustrate the geographic impact of the drought condition on the capital city. Additionally, the day time population which is approximately Thirty thousand (30,000) more persons would cause an even greater strain on the scarce resources.

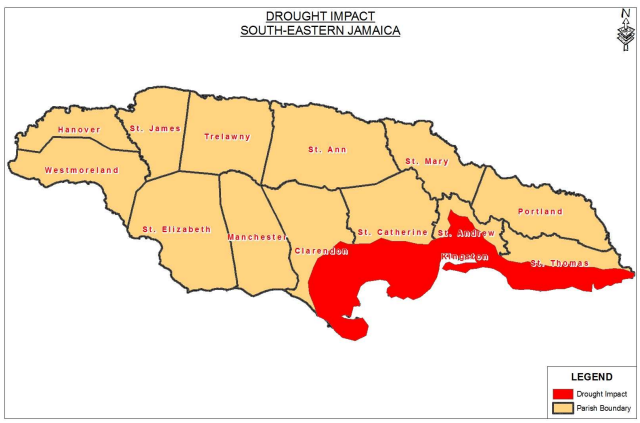


Figure 9: Map of Jamaica showing eastern parishes

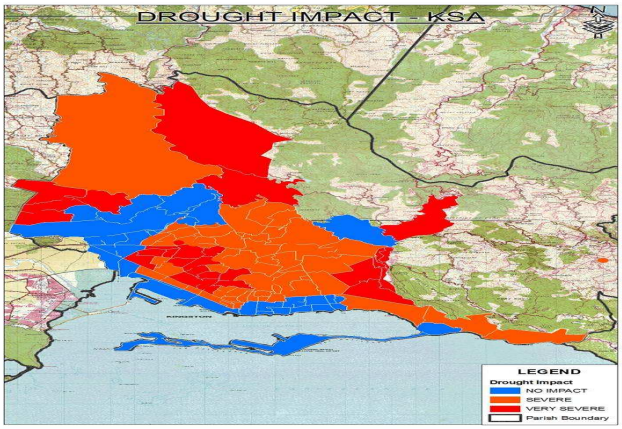


Figure 10: Impact of drought on KSA

Impact on Production

The National Water Commission is the responsible government agency for potable water supply to KSA. The sources for KSA water supply include surface (rivers), deep alluvial and limestone wells, and springs which serve rural communities. Water sources within KSA cannot satisfy the daily demand and as such water has to be imported to satisfy the demand from two locations. Raw water discharging into the Mona Reservoir is imported from St. Thomas in the East from the Yallahs and Negro Rivers at an average of 14.0mgd (63,645m^3/d). On the other hand treated water is imported from St. Catherine in the west through the Ferry system averaging 5.1mgd. The total daily volume of water produced and distributed within KSA on an average is 54.0mgd (24,5200m^3/d), figure 11. However, during the height of the worst drought conditions this is reduced to less than 33mgd (150,000m^3/d).

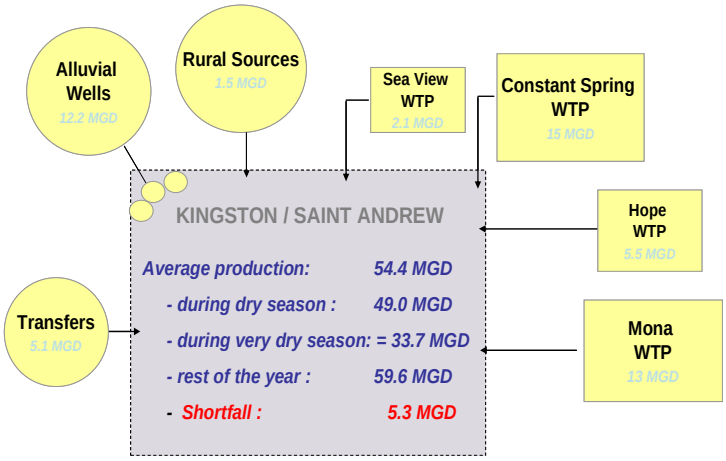
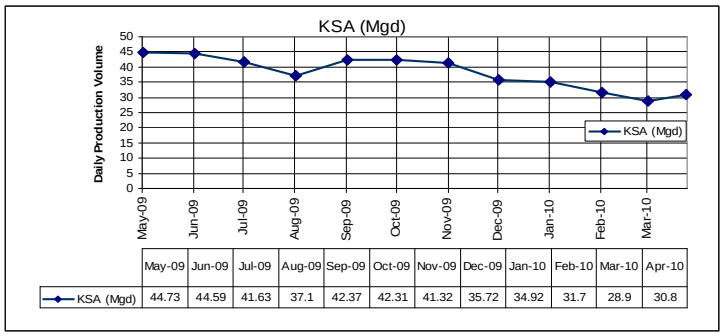


Figure 11: KSA Production Input

The drought being experienced has significantly reduced the volume of water available to maintain a reliable distribution regime and to satisfy basic water requirements. In some instances daily outputs from some facilities were reduce by as much as ninety percent (90%) below capacity, especially in rural areas. The cumulative daily production for the period May 2009 to April 2010 has shown a negative trend, with the lowest production output experienced in March 2010 as shown in figure 12.



	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10
KSA (Mgd)	44.73	44.59	41.63	37.1	42.37	42.31	41.32	35.72	34.92	31.7	28.9	30.8

Figure 12: Monthly Cumulative Production in KSA

There are four major treatment facilities supplying water into the KSA metropolis namely; Constant Spring Treatment Plant (CSTP) with production capacity of 20mgd (91,000m^3/d) Mona Treatment Plant (MTP) with capacity of 16mgd (73,000m^3/d), Hope Filter Plant with capacity of 6mgd (27,300 m^3/d) and Seaview Treatment Plant, capacity of 2.1mgd (9,550 m^3/d). The Hope and Seaview treatment plants are served directly from Hope River and the Ginger Rivers Pipeline respectively. Mona and Constant Spring received water predominantly from storage, the Mona reservoir capacity 809 million gallons (3.7million m^3), and the Hermitage Dam, capacity 393 million gallons (1.8million

m^3) respectively. Attention is drawn to the net effects of the drought on the total available stored water, changes in storage levels at both storage facilities as shown in the figure 13 below.

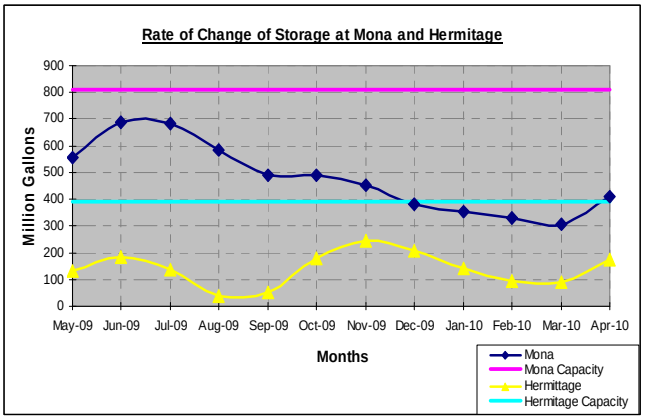


Figure 13: Rate of Change in Storage (Mona & Hermitage)

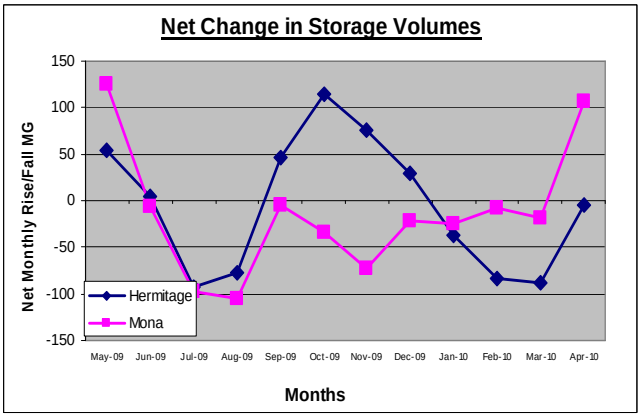


Figure 14: Net Rise/Fall in Storage

The depleting stream flows from surface sources, necessitating increased reliance on stored volumes from both the Mona reservoir and the Hermitage dam. Over the period net monthly storage fell by as much as one hundred million gallons for July 2009 and again in March 2010 at Hermitage Dam. Similarly at Mona there was similar trends, however for the period December 2009 to March 2010 the decision was taken to minimize the rapid fall in storage. This was achieved through reduction in production output as shown in figure 14.

Water Quality

The decline in water quality during droughts is both related to the high water temperatures and to low river discharges according to Zwolsman, et al, 2007. However, more significant to surface sources is the assessment of invertebrate population as a water quality indicator during a drought. According to Attrill, et al, 2000, there is ample evidence linking the deterioration of water quality with drought conditions. Ground water sources on the other hand should be expected to experience similar deterioration in water quality, specially relating to increase concentration of physiochemical components due in part to the low recharge rates and the high usage of onsite waste disposal systems in KSA. Raw water quality assessment by the NWC for the sources within KSA was limited and as such a determination of the impact on water quality could not be made. It is therefore inconclusive based on the actual data available how water quality was impacted.

Commercial Operations

The National Water Commission has island wide responsibility for the provision of potable water and wastewater services. The operations are divided into two operational divisions East and West. Each of these divisions is further divided into 4 operational areas. The focus of commercial impact discussion will be centered on the operational area of Kingston, St. Andrew and St. Thomas with emphasis on KSA. Kingston and St. Andrew has a customer base of approximately 110,000 connections, accounting for 35% on average of the overall monthly billed revenue of the NWC. The commercial impact of the drought on KSA will be evaluated within the context of;

a. Revenue and Collections
b. Operational Expenses
c. Customers no water complaints

The inability of the NWC to provide reliable production and distribution services had a negative impact on revenue. In reviewing the revenue billed for KSA for the period June 2009 to April 2010,

there was a declining trend over the period. The six months moving average billing over the period showed a high in December of J$520m, however this declined sharply to J$453m at the end of April. Actual billed revenue was at its highest in October 2009, but declined by approximately 36% at the end of April 2010, confirming the negative impact low distribution volumes had on billed revenue.

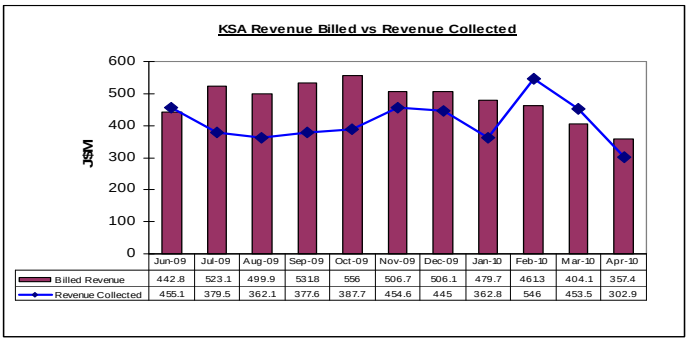


Figure 15: KSA Revenue Billed vs Revenue Collected

The collections on the other hand had a more cyclic trend and in most part lagged behind the billed revenue. On average the collection to billed revenue ratio is 86% over the period. This is a reduction over the corresponding period 2008 to 2009 when average ratio was 92%. The effect on the local economy of the global recession was initially blamed for this decline; however the drought has further compounded matters. Whenever KSA's billed revenue and by extension collection decline the overall financial health of the NWC is negatively affected. The magnitude of the impact on NWC showed a declining trend of an average J$200m in collection per month for eight months. In Figure15, two there were two distinct months of higher than billed revenue being collected, an unlikely circumstance during a drought, however two factors account for such higher than expected collections.

a. Government payment for outstanding rates owed from previous billing
b. Customers paying outstanding rates to become up-to-date, then later demanding trucked water.

With a reduction in revenue collected there was a corresponding difficulty meeting financial obligations. In fact operational expenses increased and this was evident as, trucking cost soared as shown in figure 16. Labour cost, overtime and allowances also increased due to increase manual operations of distribution restrictions. Overtime for operational staff steadily increased from J$1.2m in September 2009 to J$4.1m in March 2010, with the highest recorded overtime cost incurred between January and March 2010. Suggesing the drought worst financial impact was felt January to March 2010.

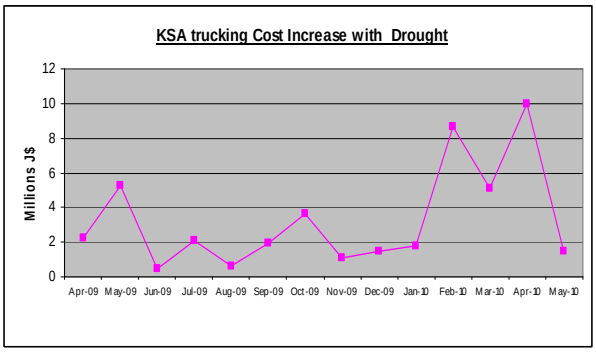


Figure 16: KSA Increased Water Trucking Cost

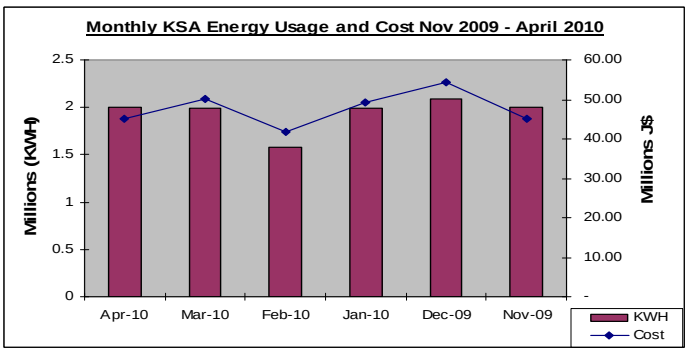


Figure 17: KSA Energy Consumption and Cost

It is also worthwhile mentioning that electricity accounts for approximately 30% of the NWC's monthly operating cost. For KSA there was no appreciable reduction in energy consumption, figure 17.

The simple reason, although not at full capacities, facilities have to be kept operating twenty four hours a day to treat the limited inflows.

Social Impact

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts that may be specified as economic and environmental have social components as well. The drought in KSA we believed based on our on the ground experience and also on the reaction of customers contacting our call centre and visiting our commercial offices was associated with these effects:

- Mental and physical stress which may resulted in anxiety, depression, loss of security or even domestic violence
- Affects learning in a significant way since schools had to be closed in some instances
- Reduced fire fighting capability.
- Reductions in nutrition (e.g., high-cost food limitations, stress-related dietary deficiencies)
- Risk to public safety from fires or any other accident that requires large volumes of water immediately.

Reduced quality of life, changes in lifestyle

- Increased poverty in general, economic displacement
- Temporary population migrations to undertake specific personal activities
- Loss of aesthetic value within communities
- Reduction or modification of recreational activities
- Potential for conflicts (Water user conflicts, Political conflicts, Management conflicts)

Economic Impact

It has been mentioned above that the impacts associated with a drought event are all interrelated and while the intention is to focus on the economic impact on the NWC, due to the fact that water is a commodity required to sustain living, any economic impact on the NWC associated with the drought will not only affect KSA but the wider society. Therefore, we will highlight the economic fallout to the NWC and as well highlight the economic impact on the civic society of Kingston and St. Andrew during the period drought

The NWC could not satisfy the water demand of KSA by the normal means through pipes, nor was the alternative of trucking sufficiently efficient to satisfy these demands. This represent lost economic opportunity for the NWC with corresponding increased cost as highlighted in figure16. As the drought situation got worst the focus of the NWC was to satisfy domestic customers, priority institutions-hospitals and other medical facilities, schools and government institutions. In most instances trucking was the only means of supplying water to those customers and institutions. There was less focus on our premium rated customers (commercial customers), who had to seek alternative arrangement for their water needs. These necessary actions came at an economic cost to the enterprise, more evident in the loss of water sales and declining billed revenue, figures 12 and 17.

It was not possible to ascertain exact data from the various sectors. However, our direct involvement in the day to day operations as well as field observations and the recorded numbers of reported trucking requests outside the normal schedule provides indication of the economic cost to the various sectors. The data showed that the drought was most severe for the months January to March 2010, the period of the greatest economic fallout.

Truck Request Nov 2009-May 2010	
Months	# Request
Nov. 2009	380
Dec. 2009	518
Jan. 2010	575
Feb. 2010	985
Mar 2010	864
Apr. 2010	490
May 2010	207

Table 3: Trucking Water Request Recorded in KSA

The degree of the impact on various sectors varied and depended on an individuals' ability to make their private arrangement for potable water.
During the period the following contributed to the economic cost to business activities within KSA:

- Some commercial enterprises purchasing water from private truckers daily to satisfy their business requirements at increase cost
- Some businesses who made no private arrangement had to reduce operating hours or on other occasions scale down operations all together
- Employees arriving late for work or on some occasions were absent
- Increased cost to householders who would normally do their laundry at home but had to seek alternate arrangement.

The drought had a negative economic impact on a wide cross-section of business interests in KSA. The economic fallout, though not quantified occurred in several areas such sectors as:

- The Banking and Financial Institutions
- Retail Sector
- Restaurants
- Beauty Palours (Hair dressers, cosmetologist, etc)
- Private Medical Facilities
- Schools and Higher education institutes

Some new entrepreneurs emerged. The proliferation of water truckers in KSA taking advantage of a situation that the NWC could not solve was very evident. Truckers were allowed to purchase water from NWC at designated facilities and they in turn sold this water to anyone in need. The price according to reports carried in the Sunday Gleaner March 14, 2010, ranged from J$5000 per 600 gallon container to J$15,000 per 1000 gallon. This cost nonetheless increased with the distance travelled and the perceived affluence of the recipient of the water.
Private individuals with wells cashed in on the opportunity by providing a source of supply to private truckers. With the serious water deficiency and the opportunity to fill the void unscrupulous persons as reported in the Sunday Gleaner March 14, 2010, resorted to collecting water from untreated sources and selling same to unsuspecting customers, clearly creating a greater health risk than what exist.

Public Health Impact

Water related diseases can be classified as, waterbourne, water-washed, water-based and water related insect vector. The first three are associated with the lack of improve domestic water supply both in terms of quality and quantity
Increased access to clean water and sanitation is one criterion identified in the UN Millennium Development Goals (MDG) that measures a states' development progress. When there is difficulty

accessing these two basic human requirements a nation's public health is compromised. Appropriately we attempt to determine any negative impact the drought conditions may have on public health in KSA. The indicator utilized in this assessment is the reported oral rehydration/diarrhoeal cases of children under five years (5yrs) as recorded by the Ministry of Health (MOH) through its Health Centres..

The Ministry of Health sub divides the KSA into geographic zones, which covers numerous health centres. These zones provide details on public health impact of; the lack of water has on these communities. The cases recorded by MOH shows that for the year 2008 there were a total of 33,000 cases of oral rehydration/diarrhoeal in children under 5yrs reported. When compared with 2009 there was 16% increase in the total number of cases reported, figure 18.

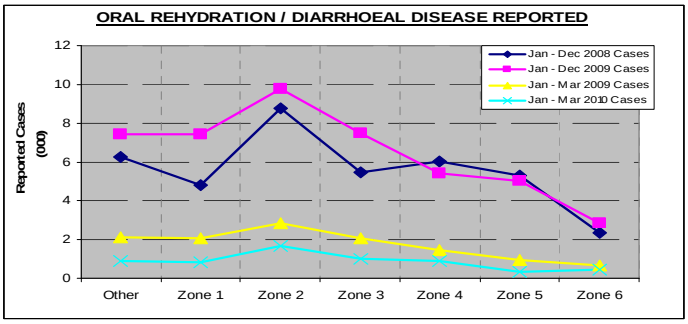


Figure 18: Summary of Oral Rehydration/Diarrhoeal Diseases

When the period January to March 2010 was assessed, the reported cases for the period showed a reduction in oral rehydration/diarrhoeal in children under 5yrs excluding cases recorded at Kingston Public Hospital (KPH) and Bustamante Children Hospital (BCH), (6981 cases). Notwithstanding total cases according to the MOH reports showed increases upward of 20% (12,708 cases) for the January to March 2010 period over the corresponding period the year before (10,106 reported cases). The drought experienced in KSA in 2009 to 2010 had a negative impact on public health.

There are however, unanswered questions on the health related impacts, requiring more detailed research and analysis, which could not be covered in this paper;

a. Were the increase cases due to poor water quality leaving the NWC network?
b. Were health-related low-flow problems (e.g., cross-connection contamination)?
c. What was the contributory impact from private operators and trucks had on public health?
d. Were the cases caused form poor onsite water safety practices (storage, hygiene and sanitation practices, etc)?

While economic benefits were derived by those operators and truckers, it was unregulated with greater potential for higher economic cost to Jamaica. The aggravation of the already serious health risk by selling poor quality water to consumers may have attributed to some gastroenteritis cases reported.

Institutional Arrangement

The water sector in Jamaica has a number of stakeholders, each responsible for different roles. What is however, certain is that the Ministry of Water and Housing has full responsibility for charting the policy direction for the water sector.

There are established institutions and legislative framework in place to begin the process of developing long term plans. Modifications to the institutional and legislative framework may be necessary in light of climatic, environmental and governance factors. Under the present arrangement there are six key government agencies involved in the water sector: Water Resources Authority (WRA) - for water

resources management; National Water Commission (NWC) - for potable water supply and wastewater management; National Irrigation Commission (NIC) - for irrigation water distribution to the agricultural sector; and the Office of Utilities Regulation (OUR) for tariff determination. Monitoring and enforcement of environment and public health regulations are the responsibility of the National Environmental Planning Agency (NEPA) and the Public Health Department respectively figure 19.

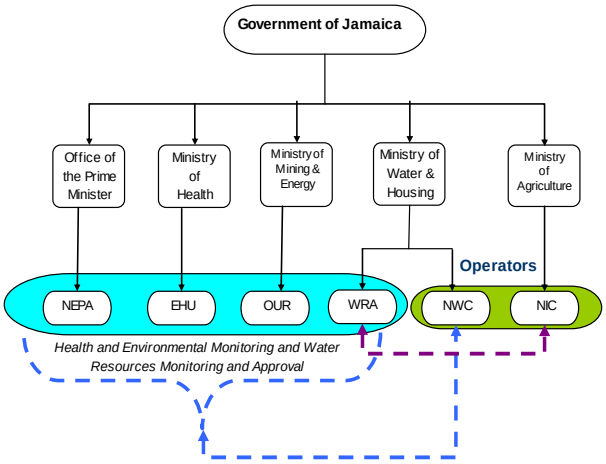


Figure 19: Existing Institutional Arrangement

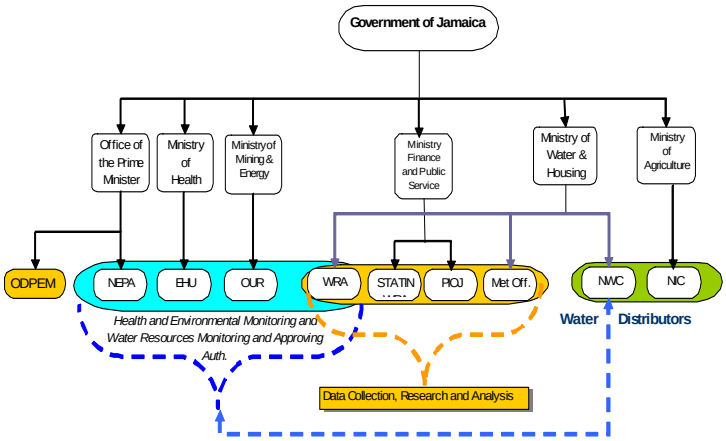


Figure 20: Proposed Institutional Arrangement

However while not exhaustive if a comprehensive drought mitigation is to be developed it is important in addition to the existing stakeholders, the involvement of the Statistical Institute of Jamaica (STATIN), Planning Institute of Jamaica (PIOJ), the Office of Disaster Preparedness and Emergency Management (ODPEM), and the Meteorological Service of Jamaica must all be included as stakeholders in developing a long term drought mitigation or minimization plan, figure 20.

It is an opportune time to design institutions that leverage science and technology to achieve sustainable development. According to Polsky et.al, 2005 there are multiple boundaries characterize the landscape of drought assessment, planning, and management, and that a key role institutions can play in reducing vulnerability is to better manage such boundaries. Some of the most fundamental boundaries identified is that between science and policy, in which actors on both sides of the boundary have an interest in maintaining the separation of the two arenas (Gieryn, 1995): "According to Polsky et.al, 2005 scientists have an interest in maintaining a boundary to ensure the credibility of their work. Politicians have an interest in maintaining a boundary to ensure their claims of representative legitimacy. It is therefore necessary to maintain this boundary in which scientists have an interest to have science contribute socially relevant information that can be used by policy makers and decision makers. Thus the challenge is *managing* the boundary, bridging where necessary, but maintaining it as a barrier as well. The institutions listed above though not exhaustive are deemed key stakeholders, who are well position to fulfil the requisite mandate of research, analyses and planning to achieve and implement a comprehensive drought management plan

Mitigation Measures

At the height of the drought conditions, the National Water Commission has been undertaking a number of initiatives which are inclusive of short, medium and long term water supply management actions to minimise the impact of the drought to KSA customers. The NWC was forced to immediately implement various measures to ensure the prolonged distribution of the limited supply of water.

When it became apparent that no improvement in the drought situation was envisaged the Ministry of Water and Housing took the lead to bring stakeholders together to develop appropriate strategies aimed at reducing the negative impacts. Stakeholders who took part in those discussions were NWC, Local

Government (who has responsibility for some rural water supply systems), Water Resources Authority (WRA), Meteorological Office of Jamaica (Met. Office), Office of Disaster Preparedness and Emergency Management (ODPEM).

Short & Medium Water Supply Management Measures

a. Reduction over time in water distribution from 24hrs to 8hrs daily
b. Alternate distribution, wherein different areas are on schedule for specific days of the week
c. Distribute water at lower than normal 60psi pressures to prolong available stored volume.
d. Increase in valving and regulations
e. Increased trucking of water to the higher elevated areas and to those that are most vulnerable
f. Established within KSA a drought management committee, focusing on maximizing water availability to KSA (including aggressively pursuing an increase transfer volumes from St. Catherine) and improved distribution efficiencies.
g. Increase Public Education campaign on proper conservation practices
h. Legal prohibition for wasting or excessive usage of NWC supplied water for non-essential purposes on all drought-affected systems
i. Actively undertaking measures for the reactivation and re-equipping of unused NWC wells to provide an additional volume of 6.5mgd to augment supply
j. The NWC contacted owners of private water supplies sources with adequate excess capacities capable of augmenting the deficit. Approximately 17.0mgd (77,284m^3/d) of additional flows were targeted. Quality of such sources was the main limited factor.

Long Term Water Supply Management Measures

The National Water Commission as a part of its Capital Development Progarmme at an advanced stage with the implementation of a number capital projects all aimed to reduce and address some of the major water supply deficiencies within Kingston and St. Andrew with impact as well on Spanish Town, Portmore in St. Catherine. The projects include:

a. Kingston Metropolitan Area Water Supply Rehabilitation Project
A US$85m project funded by Japan International Cooperation Agency (JICA). This project involves the rehabilitation of the Spanish Town Water Treatment Plant, main replacement, upgrading of Nineteen (19 No.) of water production facilities/wells, tanks and reservoirs. In addition three (3 No.) new well sources will be developed. The combined rehabilitation/expansion will provide an additional 8.4 MGD to the existing NWC production capacity when completed in September 2011, allowing more water to be exported to KSA.

b. Kingston Water & Sanitation Project – US$40M / IADB
The Kingston Water & Sanitation Project will include the upgrade and rehabilitation of the Mona & Hope Water Treatment Plants.
The exercise will also entail extensive rehabilitation of the twenty six (26 No.) water supply schemes including NRW related activities such as mains replacement.

c. Jamaica Water Supply Improvement Project - US$210 / BNP Paribas/Scotiabank/Vinci Grands Projects
This project is budgeted to cost US$210m and is scheduled to be completed within the next twenty four months. An additional twenty million gallons of water per day (20.mgd) will be provided to the KMA by this project. The main components of this project will include the

construction of a new 15MGD water treatment Plant, extensive rehabilitation and upgrade of the Constant and Sea view Water Treatment Plants, transmission and distribution mains replacement, drilling new wells and a comprehensive customer meter installation exercise. The project has already commenced and should be completed in two years.

d. Forestry Planting in Collaboration with the Forestry Department.
The NWC having recognized the importance of trees and there impact on water, collaborated with the Forestry Department of the Ministry of Agriculture to embark on a tree planting and maintenance exercise in the Hope Valley watershed. The NWC has so far spent J$1m on this project.

Recommendations

The assessment identifies deficiencies in our approach to drought management which must be addressed if improvement is to be realized in managing future incidence of drought. While it is the NWC much attention is focused mainly to deliver service, this should be regarded as the end of a more comprehensive process. What has been very evident is our failure to make strategic plans. This must change to involve a number of institutions, each with clearly defined roles and functions that feeds into a process, all working towards a common objective that will ensure:

a. long term goal for water security for all users
b. identification of vulnerabilities and the risk associated with such vulnerabilities on an ongoing basis
c. mitigating strategies to reduce risk or eliminate such risk.

While we focused on the effects of drought on the NWC, we must as an entity develop a habit for planning. However, considering the multi-dimensional impact of a drought any planning must resonate at the national level. The recommended drought planning exercise must be so designed to cover not only the operations of the NWC and KSA in particular, but must involve a multi-sectoral approach for stakeholder involvement. Wilhite, et al 2005 detailed a framework approach in developing a drought preparedness plan. The plan outlined ten point planning process which can be adopted for our local environment was developed by The National Drought Mitigation Center, University of Nebraska, figure 21, and is a plan we can model to suit our needs.

In brief, Steps 1–4 focus on making sure the right people are brought together, have a clear understanding of the process, know what the drought plan must accomplish, and are supplied with adequate data to make fair and equitable decisions when formulating and writing the actual drought plan. Step 5 describes the process of developing an organizational structure for completion of the tasks necessary to prepare the plan. The plan should be viewed as a process, rather than a discrete event that produces a static document. A risk assessment is undertaken in conjunction with this step in order to construct a vulnerability profile for key economic sectors, population groups, regions, and communities. Steps 6 and 7 detail the need for ongoing research and coordination between scientists and policy makers. Steps 8 and 9 stress the importance of promoting and testing the plan before drought occurs. Finally, Step 10 emphasizes revising the plan to keep it current and evaluating its effectiveness in the postdrought period. Although the steps are sequential, some maybe addressed simultaneously under the leadership of a drought task force and its complement of committees and working groups.

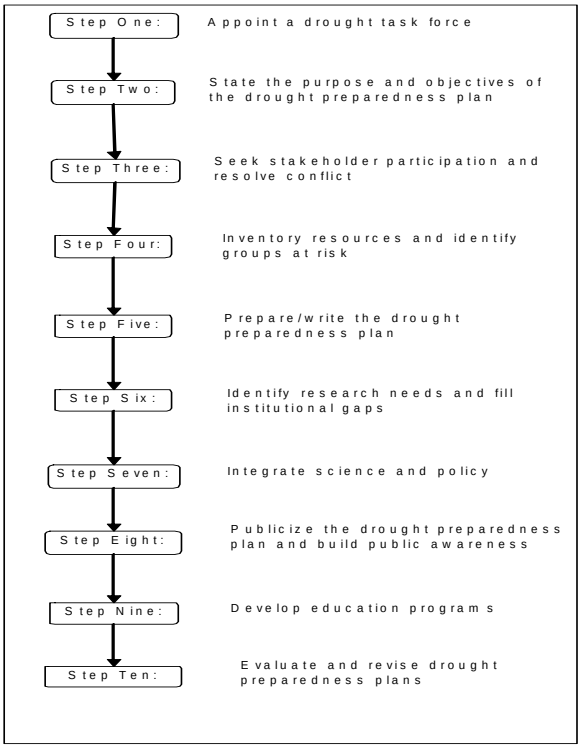


Figure 21: Planning Process Adopted from University Nebraska

The recommended approach above, if implemented would help to better manage incidence of drought if and when they occur. There is an immediately urgent need to develop long term plans not just to ensure access to the commodity but also reliable access. The drought has given us if never before cause to undertake a review of our present approach to water safety and security planning. The revised planning approach should involve:

a. The full considerations of the effects of climate change on rainfall frequencies and intensities
b. The full recognition of wastewater effluent as a water resource and as such promotes it proper treatment and reuse in those sectors that require large volumes of water. Thus making more fresh water available for higher consumptive uses.
c. More structured city planning, wherein development must only be allowed in specified areas, where access to water is readily available.
d. Maximise the use of ground water, the Liguanea plain aquifer for example has a large reserve of water but this is unusable due to contamination. Such planning must review sewage disposal so as not to further compromise this water resource.
e. A structured approach for capital injection to replace aged infrastructure, thus reducing waste through leaking pipes.
f. A structured approach for capital injection to maintain optimum capacities at the Mona reservoir and Hermitage Dam and as so require the development of such plans to expand storage capacities in line with population growth and the economic development of KSA.
g. Continued exploration and expansion of production capacities to meet future projected demands.

Conclusion

For the most part, the responses to previous drought have been reactive, in fact every year it is expected there will be distinct months when inflows will be low. This represents the crisis management approach. This approach has been ineffective (i.e., assistance poorly targeted to specific impacts or population groups), poorly coordinated, and untimely. More importantly, it has done little to reduce the risks associated with drought. In fact, the economic, social, and environmental impacts of the drought are significant and will get worst in subsequent years.

In concluding the following must be highlighted from the drought experienced in KSA between 2009 and 2010.

- Firstly Kingston and St. Andrew experienced both a Meteorological and Hydrological drought.
- There was no long term drought mitigation plan that assesses, and manages vulnerability risk associated with a drought.
- Institutional responsiveness were disjointed, adhoc and only reactive during the drought incident.
- Coordinated response though reactive, meetings were mainly with NWC operational staff, the input from all key functional areas was not well coordinated and mainly focused on short term operational strategies.
- The large geographic areas that were severely affected by the drought had negative social impact on the entire city.
- There was increased public health vulnerability especially in children caused form the drought.
- The widespread closing of businesses was at an economic cost to KSA and Jamaica on a whole.
- There were negative socio-cultural impacts from the recent drought
- Improvement in raw water quality assessment from all sources is required especially considering KSA and Jamaica's vulnerability to droughts. Development of and execute a sample regime for raw water must be pursue
- Billed revenue for KSA fell by an average J$50m, while the overall NWC lost revenue on average J$200m monthly due to low sales.
- Production cost especially electricity is not a function of the volume of water treated, since such cost remain relatively constant.
- There was increased trucking activities and cost over the period.
- Public education campaign was not as penetrative as could be to influence consumers behavioural patterns

World Wide Web

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