

WATER RESOURCE AND FOOD SECURITY: A CASE STUDY OF HOUSEHOLDS IN GAUTENG PROVINCE, SOUTH AFRICA

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ABSTRACT

South Africa is considered a 'food-secure' nation, producing enough calories to adequately feed every one of its 53 million people. However, the reality is that, despite some progress since the birth of democracy in 1994, one in four people currently suffers hunger on a regular basis and more than half of the population live in such precarious circumstances that they are at risk of going hungry. At national and country levels, South Africa exceeds most global benchmarks for amounts of food produced and exported. However, national figures hide the reality at the household level. Household survey was conducted in the Gauteng Province by the Agricultural Research Council (ARC) and Gauteng Department of Agriculture and Rural Development (GDARD) to establish the water resources and food security status. The following objectives were followed: (1) to identify and describe water resource availability in terms of wetness status and water sources. (2) to identify and describe food security status in terms of accessibility. A total of 1150 households' participated, quantitative, and qualitative designs were used as a questionnaire, stakeholder's discussion and field observations were part of the data collection. A purposive sampling technique was used and data was coded, captured and analysed using the Statistical Package for the Social Sciences (SPSS). Food security status was also in line with the fact that South Africa is food insecure at a household level in contradiction to the national level. At the same time, rainfall decreased significantly during the data collection period in Gauteng Province. The standardised precipitation index (SPI) showed that severe to extreme drought conditions were present over some parts of South Africa including Gauteng Province during data collection and currently the SPI showed the presence of mild to moderate drought conditions. 942/82% households had access to irrigation water with 208/18% households had no access to irrigation water. The large majority (881/77%) of households reported relying on municipal piped water for irrigating their gardens while few households reporting river or boreholes as sources of water. It was also emphasised by officials during focus groups discussions that households were encouraged to use rainwater harvesting and greywater. 876/76% Households across Gauteng Province indicated that water is available year round while 274/24% households did not receive water year round. This limited water resource had a negative impact on household food security as a whopping number of Gauteng Province households interviewed were food insecure (860/75%) as compared to households that are food secure (290/25%). This food security situation is worrying because 695/60% households go to sleep at night hungry because there was not enough food and about 395/34% households goes the whole day and night without eating anything. In terms of the impression of food availability across the Gauteng Province, most of the households (347/30% always, 159/14% often & 450/39% sometimes) indicated that their food runs out before they get money to buy more. Quite a number of households (371/32% never & 549/48% sometimes) cannot afford to eat enough food everyday. In terms of food accessibility, seven hundred and sixty seven (765/67%) households indicated that they lack resources for accessing food, while 385/33% households accessed food. The implications for this scenario can be that 765/67% households are food insecure due to lack of resources for accessing or producing food. This is because the households cannot afford to buy or produce preferred foods, thus they resorted to

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monotonous diets because it is all that they can afford. For instances, 1002/87% households have to eat fewer meals in a day, 1001/87% households have to eat a smaller meal, 991/86% households eat some foods that really did not want to eat, 1000/87% households have to eat a limited variety of food, 964/84% households have not be able to eat the kinds of food they preferred. This food access situation is worrying because 695/60% households go to sleep at night hungry because there was not enough food and about 395/34% households goes the whole day and night without eating anything. However, in Gauteng Province the situation is different as even households with access to piped water complained that the municipality water bill is too high to engage in household food production. The drought situation also added burden to the households' food security status. Other households have emphasised that they find it difficult to access irrigation water as most of the household were residing in informal settlements or areas where there is no service delivery. It is thus concluded that there is a need to integrate surface water and groundwater to ensure water sustainability to support food security. The Agricultural Research Council is also involved in water related research in Gauteng Province to address the challenges of food security. The survey recommended that households should use grey water, groundwater and encouraged to harvest rainwater to engage in household food production.

Keywords: Water Resource, Food Security, Household Food Production, Gauteng Province and South Africa.

1. INTRODUCTION

Water resource availability in South Africa varies: In terms of rainfall, the eastern side of the country receives considerably more rain than the dry western portion of the country. Rainfall varies from less than 50 mm in the extreme northwest to more than 3 000 mm in the mountains of the South Western Cape (ARC ISCW, 2019). In many of the water management areas in South Africa, there is currently a water deficit in that the demand outstrips supply. This is projected to become increasingly worse as the population continues to expand and water demand grows. According to Maponya et al., (2017) water is a significant resource constraint because South Africa is a water-scarce country experiencing huge variations in the temporal and spatial distribution of rainfall. According to a study by the 2030 Water Resources Group, South Africa is facing a 17% demand-supply gap by 2030. This situation poses as serious challenges as water is essential for the economic development of the country: the agricultural, manufacturing, energy, mining and residential sectors (WRG, 2012). This situation is further emphasised by Businesstech (2018) that South Africans use an average of 237 litres of water per person per day, as opposed to the global average of 175 litres. At the same time Gauteng Province households consumes over 300 litres of water per day, which is the highest in South Africa (Businesstech, 2018). The Gauteng Province population is also the highest in South Africa – 14, 7 million out of 57, 73 million South Africa population (StatsSA, 2018). The population is growing by almost 300 000 annually due to urbanization (StatsSA, 2018) and this situation is putting more strain on the province water resource and food security. So it become critical for households to engage in water conservation practices such as rainwater harvesting and recycling grey water to engage further in household food production.

Food security is the outcome of many interrelated factors, one of which being water, an essential resource for food production. According to Hubbart (1995) households access to water and the price of water, affects their food security. South Africa is considered a 'food-secure' nation, producing enough calories to adequately feed every one of its 53 million people. However, the reality is that, despite some progress since the birth of democracy in 1994, one in four people currently suffers hunger on a regular basis and more than half of the population live in such precarious

circumstances that they are at risk of going hungry. At national and country levels, South Africa exceeds most global benchmarks for amounts of food produced and exported. However, national figures hide the reality at the household level. As indicated by Maponya et al., (2018) limited water resources is one of the challenges Gauteng Province households will have to face and it could be a major threat to food security as it has a strong impact on food production, access and distribution. According to Maponya et al., (2018) due to household's low income, lower technological, capital stocks and lack of water resources, limited options to engage in household food security will occur. The Agricultural Research Council (ARC) and the Gauteng Department of Agriculture and Rural Development (GDARD) conducted a food security survey. The aim of the survey was to establish the status of water resource and food security in Gauteng Province. In order to address the survey aim, the following objectives were followed: (1) to identify and describe water resource availability in terms of wetness status and water sources (2) to identify and describe food security status in terms of availability and accessibility. The intervention period 2012-2016 was considered in order to render comprehensive assessments of the households in terms of their demographics, socio economic issues, area situational set up, food security status and water resource status.

2. METHODOLOGY

The study followed a participatory action approach in which the researcher, collaborators, extension officers, households and funder were actively involved in all phases to achieve deliverables. According to the method of participatory action research is most appropriate since people especially households benefit while the research is ongoing. The participatory action approach was also recommended by various researchers who emphasised that the participatory action approach is a good alternative to the traditional "transfer of technology" or "top - down approach" to agricultural research and extension. It is against this background that the approach was used to achieve the research aims, deliverables and phases. The research used quantitative and qualitative methods and purposive sampling from existing sample frame from GDARD database of Homestead Food Garden project. Sample size of the research was agreed with GDARD officials, but as per the rule of thumb, the sample size should be statistically significant at a minimum 10% of the total population. A detailed questionnaire written in English was developed as a quantitative data collection method and data was collected from 1150 households as follows: City of Tshwane Metropolitan (270), City of Johannesburg Metropolitan (319), Ekurhuleni Metropolitan (141), West Rand District (204) and Sedibeng (216). The questionnaire used both open and closed ended questions. Qualitative data collection methods included focus group discussions and field observations. The focus group discussions were conducted among 56 GDARD officials: City of Tshwane Metropolitan (24), City of Johannesburg Metropolitan and West Rand District combined (18), Ekurhuleni Metropolitan (7) and Sedibeng District (7). Data collected was analysed quantitatively using the Statistical Package for Social Sciences (SPSS) windows version.

Table 1. Gauteng Province Households visited and interviewed.

Province	Metropolitan or District	Number of Households
Gauteng	City of Johannesburg	319
Gauteng	City of Tshwane	270
Gauteng	Ekurhuleni	141
Gauteng	Sedibeng	216
Gauteng	West Rand	204
Total		1150

The following approach was used to conduct standard precipitation index (McKee et al., 1993)

The Standardized Precipitation Index (SPI) was developed to monitor the occurrence of droughts from rainfall data. The index quantifies precipitation deficits on different time scales and therefore also drought severity. It provides an indication of rainfall conditions per quaternary catchment (in this case) based on the historical distribution of rainfall.

The following approach was used to calculate rainfall deciles (ARC ISCW, 2019)

Deciles are used to express the ranking of rainfall for a specific period in terms of the historical time series. In the map, a value of 5 represents the median value for the time series. A value of 1 refers to the rainfall being as low or lower than experienced in the driest 10% of a particular month historically (even possibly the lowest on record for some areas), while a value of 10 represents rainfall as high as the value recorded only in the wettest 10% of the same period in the past (or even the highest on record). It therefore adds a measure of significance to the rainfall deviation.

3. RESULTS AND DISCUSSION

The majority of households interviewed were female (915) and the same trends is seen in metropolitans and districts. The results are also in line with Maponya and Moja (2012) study in Limpopo province which indicated that female households constitute a significant number of economically active populations and that the female-headed households usually fall within the vulnerable, marginal and food insecure categories. Most households fall in the age category > 56 (454) and very few households fall in the age category < 35 years (128). This shows an aging population of households which could be critical to household food security. The same age categories trends is seen in metropolitans and districts. This indicates the need for youth involvement in agricultural food production as any future agricultural development in the districts and metropolitans should be tailor made to attract youth. In terms of educational attainment, most households received secondary education (574) with a few receiving tertiary education (34). The level of education is consistent in all districts and metropolitans across Gauteng Province. According to Heckman (1999) education is key to poverty reduction, improve households food security and to improve the livelihoods of the poor. This is due to education ability to increase knowledge and skill which is supportive to household's employability and the fulfillment of households basic necessities.

Most households fall in the income level R1001 – R2500 and quite a number of households had no income (248) (Table 2). Most of the households were spending > R601 of the monthly expenditure on food. There was not much difference in household members in Gauteng Province. Most of the household's size fell between 1 – 5 members and the same trend is seen across districts and metropolitans. According to Ndobu (2013), the importance of household size as a major contributing factor of household agricultural production and hence food security, through labour supply, has been well documented globally. The majority of the households are experiencing challenges in terms of food accessibility (Table 2). Those households who responded yes as a response to food access as a challenge in the past 4 weeks are in majority as compared to households who responded no. According to Coates, et al., (2007) food secure households did not worry about food access; they rarely experienced anxiety about not having enough food. These are households that were able to have a full meal three times in a day without food running out, in the past 30 days.

One of the reasons for households not accessing enough food is the lack of resources. Seven hundred and sixty seven (67%) households indicated that they lack resources for accessing food, while 385(34%) households accessed food. The implications for this scenario can be that 765 (67%) households are food insecure due to lack of resources for accessing food. This is because the households cannot afford to buy preferred foods, thus they resorted to monotonous diets because it is all that they can afford. For instances, 1002 (87%) households have to eat fewer meals in a day, 1001 (87%) households have to eat a smaller meal, 991 (86%) households eat some foods that really did not want to eat, 1000 (87%) households have to eat a limited variety of food, 964 (84%) households have not be able to eat the kinds of food they preferred. This food access situation is worrying because 695 (64%) households go to sleep at night hungry because there was not enough food and about 395 (34%) households goes the whole day and night without eating anything. This is in line with the StatsSA (2017) latest statistics which indicated that poverty levels in South Africa have increased. These findings correlate with the results of a study conducted by FAO (2012) who concluded that some households eat less when confronted with a food shortage and goes to bed hungry. This also indicates that South Africa is making less progress on the sustainable development goals (SDG) especially SDG 2 (Zero hunger).

Table 2. Gauteng Province Household’s Food Accessibility (Households who said YES) R = Rarely (Once or Twice); S = Sometimes (Three to ten times); O = Often (More than ten times); T = Total (Those households who said YES).

An impression of food accessibility	R	S	O	T	
In the past four weeks, did you worry that your household would not have enough food?	24%	39%	17%	81%	
In the past four weeks, were you or any household member not be able to eat the kinds of you preferred because of lack of resources?		27%	38%	19%	84%
In the past four weeks, were you or any household member have to eat a limited variety of food due to lack of resources?	26%	38%	23%	87%	
In the past four weeks, were you or any household member have to eat some foods that really did not want to eat because of lack of resources to obtain other types of foods?	26%	37%	23%	86%	
In the past four weeks, were you or any household member to have to eat a smaller meal than you felt you needed because there was not enough food?	25%	39%	23%	87%	
In the past four weeks, were you or any household member have to eat fewer meals in a day because there was not enough food?	25%	38%	24%	87%	
In the past four weeks, was there ever no food to eat of any kind in your households because of lack of resources to get food?		21%	29%	16%	67%
In the past four week, did you or any household members go to sleep at night hungry because there was not enough food?	23%	21%	16%	60%	
In the past four weeks, were you or any household member go a whole day and night without eating anything because there was not enough food?	8%	8%	12%	34%	

A whopping number of Gauteng Province households are food insecure (860/75%) as compared to households that are food secure (290/25%) (Table 5). The results were

achieved and categorised through an approach used by Coates, et al., (2007): Food secure households did not worry about food access; they rarely experienced anxiety about not having enough food. These are households that were able to have a full meal three times in a day without food running out, in the past 30 days. Mildly food insecure households were anxious about not having sufficient food. They usually consumed inadequate diet, or ate food that they did not prefer. These households experienced food insecurity once or twice in the past 30 days. Moderately food insecure households began sacrificing quality on a continuous basis by consuming inadequate diet and eating less preferred food. They started reducing the quality of food intake by decreasing meal sizes. These households experienced food insecurity three to ten times in the past 30 days. Severe food insecure households experienced high incidences of food security. The condition of reducing meal sizes and the number of meals worsened each day. The three most severe conditions of going a whole day without eating, going to bed hungry or running out of food in the past 30 days occurred often. These households experienced food insecurity more than ten times in the past 30 days.

Table 3. Households Food Security Levels & Extent of Food Insecurity.

Variable	Category	Household	Percent
Food Security Level Food			
Secure		290	25%
	Food Insecure	860	75%
Extent of Food Insecurity			
	Mild	263	23%
	Moderate	367	32%
	Severe	223	20%

The Standardized Precipitation Index (SPI) was developed to monitor the occurrence of droughts from rainfall data (McKee et al., 1993). The index quantifies precipitation deficits on different time scales and therefore also drought severity. It provides an indication of rainfall conditions per quaternary catchment (in this case) based on the historical distribution of rainfall. As shown in Figure 1 by an arrow, the 24 SPI maps showed the extreme to mild drought conditions occurred at the longer time scale over some parts of Gauteng Province. The rainfall deciles as indicated in figure 2 by an arrow, also show the rainfall being low or lower than experienced in the driest 10% of March 2019. This situation is adding more strain to the Gauteng Province water resources and food security and it is a clear indication that this unpredictable climate conditions remains an ongoing concern and there is a prediction of a generally drier conditions with drought being more frequent and intense (ARC ISCW, 2019).

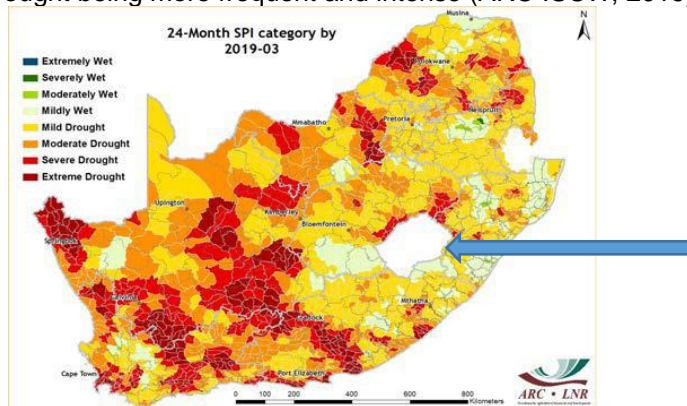


Figure 1: South Africa 24 Month Standardized Precipitation Index for March 2019.

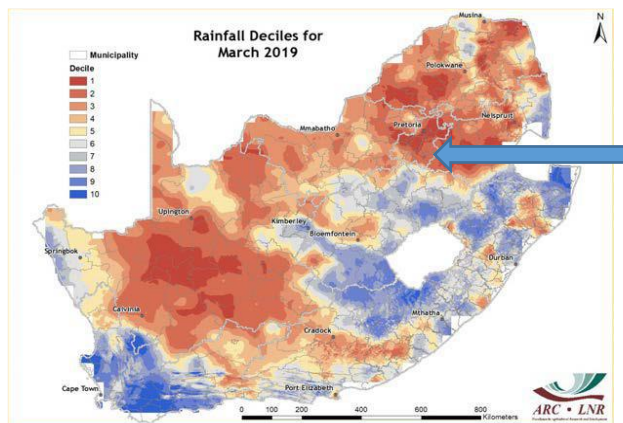


Figure 2: South Africa Rainfall Deciles for March 2019.

As indicated in Figure 3, 942 households had access to irrigation water with 208 households had no access to irrigation water. 172 City of Tshwane Metropolitan households have emphasised that they find it difficult to access irrigation water as most of the household were residing in informal settlements or areas where service delivery is still a challenge. Some households felt that the high water municipality bill is hampering their chances of engaging in household food production. Farmers in Gauteng Province are also experiencing the situation of limited access to irrigation water as Madima (2016) emphasised that most farmers in Gauteng Province have been severely affected by limited water resources, but smallholder farmers are worse off as compared to commercial farmers. Overall production went down. When supplies drop, prices went up, especially for vegetables (Madima, 2016). This has resulted in prices like potatoes going up by 95 percent, tomatoes 97 percent, onions by 41 percent (Madima, 2016).

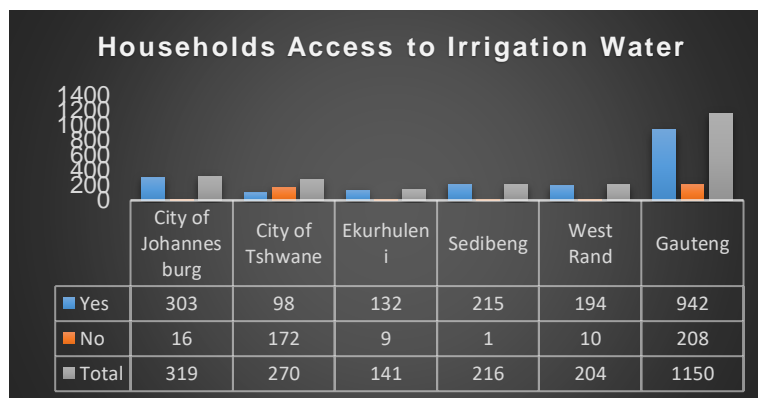


Figure 3: Households Access to Irrigation Water

According Maponya et al., (2017) ageing infrastructure, an absence of large-scale capabilities for harvesting rainwater and increased climate variability into the future are some of the Gauteng Province challenges for water supply. The situation was further supported by Businesstech (2018) that it is highly conceivable that Gauteng Province households could be “starved” of water because of limited water resource and failure of ageing infrastructure. According to Outlook Report (2017), Gauteng Province has 178 boreholes that are being monitored and deeper boreholes have to be created to access the water, suggesting the aquifer is being depleted faster than it can be replenished. This is extremely concerning as borehole water is often considered as an alternative to surface water resources, and it is used rather irresponsibly. As indicated in Figure 4, the large majority (881) of households reported

relying on municipal piped water for irrigating their gardens while few households reporting river or boreholes as sources of water. Some households felt that the high water municipality bill is hampering their chances of engaging in household food production. It is therefore expected that with water sources, households will engage in household food production to enable food security.

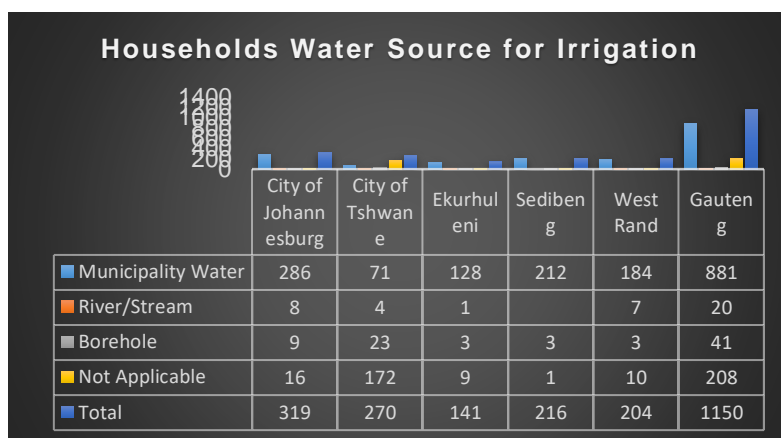


Figure 4: Households Water Source for Irrigation

4. CONCLUSIONS

Food security is highly dependent on the availability and supply of water. Increasing pressure on the supply and availability of water will adversely influence the food security status as seen in the Gauteng Province. Limited water resource is a recurring challenge and is affecting food security in Gauteng Province. In times of limited water resources, different coping strategies should be gathered, understood and shared amongst households as food production and agricultural productivity to mitigate against food insecurity is dependent on good water management practice. Households were advised to irrigate using tanks for rainwater harvesting, preferably connected to the roofs, mulching, introducing innovative water pricing systems and incentives and to integrate surface water and groundwater to ensure water sustainability to support food security. The Agricultural Research Council (ARC) is also currently investigating other possible sustainable sources of quality water, for example 'grey' water, as long as it is clean enough for use on vegetables. The results from the present research could be used as a baseline in understanding the consequences of limited water resource on food security and also to develop targeted interventions that will assist households to overcome limited water resource effects and be able to engage in household food production.

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