Scientific African 10 (2020) e00602

Contents lists available at ScienceDirect

Scientific African

journal homepage: www.elsevier.com/locate/sciaf

Demographic and socio-economic factors influencing water governance in the Okavango Delta, Botswana ☆

Reniko Gondo*, Oluwatoyin Dare Kolawole, Joseph E. Mbaiwa, Moseki R. Motsholapheko

Okavango Research Institute-University of Botswana, Private Bag 285, Maun, Botswana,

ARTICLE INFO

Article history:
Received 2 March 2020
Revised 8 October 2020
Accepted 15 October 2020

Keywords:
Cultural
Customary
Commodification
Demographic
Water management
Water governance

ABSTRACT

Demographic and socio-economic factors influence water resources governance at the household level particularly in rural areas of developing countries where culturally assigned gender roles in water governance hold sway. Rooted in the institutional bricolage and the Mass-elite theories, this paper analyses demographic and socio-economic factors influencing the dissonance of customary and statutory institutions in the governance of water resources in the study area. Employing a homogenous purposive sampling technique, three villages (that is, Shakawe, Tubu, and Shorobe) were selected for this study. Four hundred and fifty-five household heads were randomly selected to elicit pertinent demographic and socio-economic data through an interview schedule and expert purposive sampling technique was adopted to select 9 key informants from whom in-depth information was obtained. Statistical Package for the Social Sciences (SPSS) version 25 was used to analyse descriptive and inferential statistics. Content analysis was used to analyse qualitative data. The results also reveal that there was a gender imbalance in water collection and water consumption was relatively higher in small households than in large ones. However, there was no evidence that age affected water consumption. Findings also revealed that affordability, distance to water sources and the intended use of water are a factor of access to water. Results further show that income is a key determinant of the amount of water consumed by the respondents. The paper concludes that there is need for an integrated water governance model that serves to enhance the demand and consumption of water resources in local communities.

1. Introduction

Water governance denotes a range of political, social, economic and administrative systems meant to develop and manage water resources as well as the delivery of water services at different levels of society [14,67,79,85]. While water governance

☆ The word Motswana (singular) and Batswana (plural) denotes a person and the people who live in the study area, respectively

* Corresponding author.
E-mail address: rgondo@ub.ac.bw (R. Gondo).

https://doi.org/10.1016/j.sciaf.2020.e00602

focuses on decisions making on water allocation amongst stakeholders, this article shows how demographic and socio-economic variables influence decision-making on water consumption.

There is a consensus both among academics and policymakers that decisions on water management are shaped not only by infrastructure and price but also by demographic and socio-economic factors [37]. Based on the findings of Kujinga *et al.* [46], there is no national demographic and socio-economic water relationship data base in Botswana. This is because water situations differ from one local area to another. To understand how demographic and socio-economic factors engender the dissonance existing between customary and statutory institutions in the governance of water within the Okavango Delta, data on demographic and socio-economic as well as cultural variables have to be elicited from various case studies in different localities in the area. For instance, the assumptions that women are the main household water collectors and decisions on water management are made only by men in traditional societies [78] have been proved wrong in a study by Hawkins and Seager [37] who found that although rural Mongolian men are at the forefront in water management decision-making process, they also play prominent roles in water collection.

Based on Bich-Ngoc and Teller [6] the assumption that an increase in water prices would lead to a decrease in water consumption is true if and only if water behaves like a *normal* economic good. Water is not like any other economic good. For instance, Savenije [71] argues that as most water uses are essential and irreplaceable, the market theory cannot simply be applied to domestic water consumption. Studies have shown that domestic water consumption is price inelastic; a sharp rise in water price generally leads to insignificantly low or no change in domestic water consumption [23,56]. However, it is noteworthy that the price elasticity of water demand varies among different end uses. Whereas the price mechanism does not make a difference in domestic water consumption, it significantly influences outdoor water uses such as leisure activities, gardening or filling swimming pools [6].

There is a large body of literature on gender and water governance (see [8,17,38,58,84,86]). While the case studies that comprise this literature are diverse, one major issue that emanates from them suggests that women are responsible for domestic water provision and are denied decision making roles in customary institutions. While good water governance prescribes that women and men negotiate equally over water allocation [78], literature shows that decisions on water management are made by males. This is despite the fact that men and women do not have similar interests on water [58]. While this is a culturally assigned gender roles [59,63], some scholars argue that it overlooks and constrains women's ability to make decisions on water management [13].

The age of an individual is also worth considering when studying water governance. The findings linking age of an individual to water are less clear as some researches show that elderly people consume less water but make significant decisions on water at the household level [34] while others [50] believe that children consume more water than the elderly people. This implies that further research is needed on this subject especially under varying conditions. The objective of this paper is to assess demographic and socio-economic variables influencing dissonance between customary and statutory water management institutions in the governance of water resources in the Okavango Delta.

2. Theoretical framework

This paper is rooted in the institutional bricolage theory proposed by Frances Cleaver in 2001[11] and the mass-elite theory as conceived by Gaetano Mosca (1858-1941). Cleaver's [12]) institutional bricolage theory is premised on the notion that common-pool resources (CPRs) are subtractable, which means the withdrawal by one consumer or a group of consumers reduces the number of such resources left for other users [62]. The consequence of use is either overexploitation or depletion if precautionary measures are not taken. To overcome this problem Cleaver [12] suggested a bricolage approach to natural resources management and governance where both formal (statutory) and informal (customary) institutions are hybridised to permit, forbid or incentivise certain human behaviour which is locally oriented and understood [16,42,57,61,62]. Bricolage is the process of patching together institutional arrangements to encompass the aspirations, views and technology of local people. It covers the acceptance of both customary and statutory institutions in the management of local natural resources. The notion is based on the logic of dynamic adaptation to the local conditions [12]. Thus, bricolage theory calls for the hybridisation of customary and statutory institutions by the stakeholders (bricoleurs) to come up with rules and laws which take into cognisance the local conditions and the level of understanding of the indigenous people who are the custodians of such resources. Thus, the bricolage concept underscores the aspect of involving the local stakeholders who are of a cross-cultural origin in the formulation of rules that govern local resources.

On the other hand, elitism is about the notion that individuals who form an elite (a select group of people with an intrinsic quality, high intellect, wealth, special skills or experience) are more likely to be constructive to society as a whole and, therefore, deserve greater influence or authority in policy development than those of others. This paper thus investigates the demographics and socio-economic attributes of respondents in relation to how they influence water governance. The main tenet of the mass-elite theory is that every society is stratified and, therefore, comprises the elites and masses [64]. While the elites refer to the educated, those in authority or influential people in general [52], the masses comprise the hapless majority who have neither power nor authority within the society [64]. Based on the theory, policies, legislations as well as taboos, norms, and values are crafted by the elites and, therefore, largely reflect their interests rather than those of the masses [28,35]. It is presumed that all institutional arrangements are biased towards the achievements of the

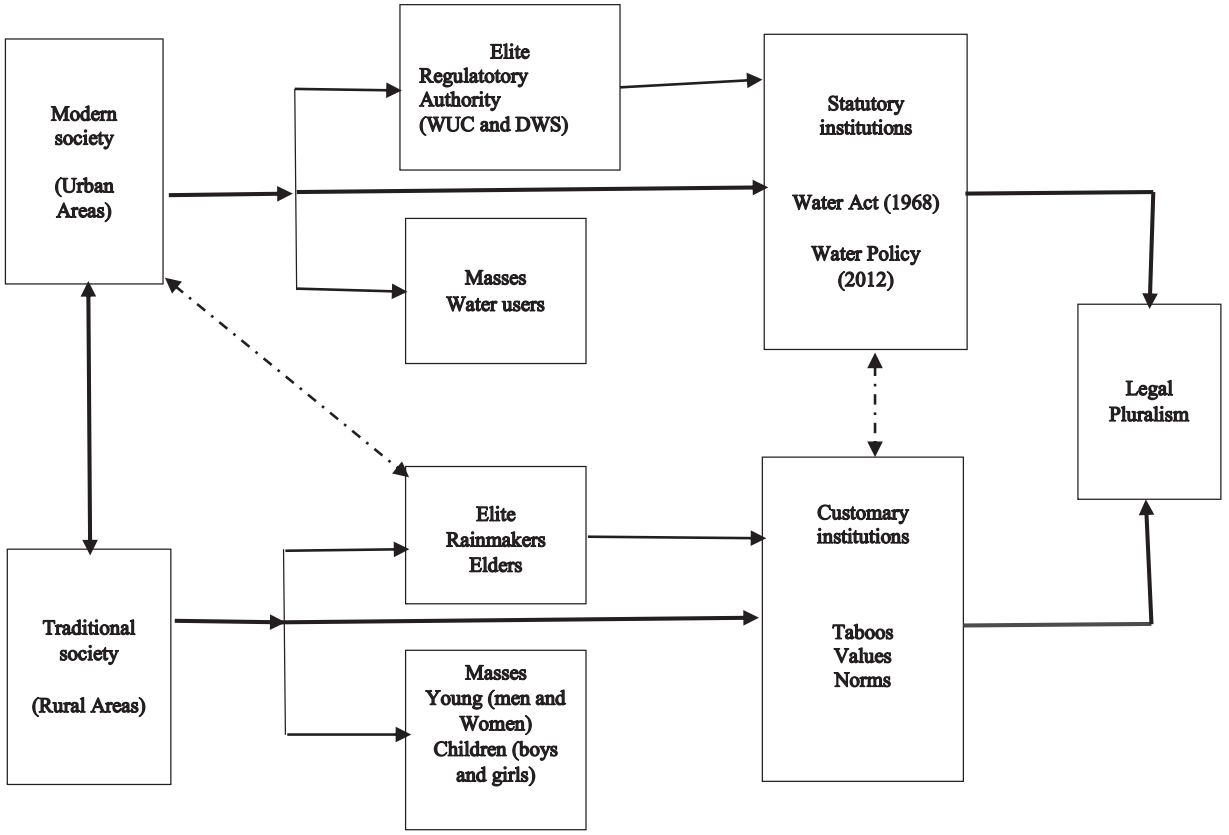

Fig. 1. Theoretical framework on water resources management. adapted from [31].

objectives of the elites at the expense of the masses [31,72]. Inevitably, suggestive of a top-down approach to policies, Acts (statutory institutions) or rules, taboos and norms (customary institutions) within the jurisdictions of the two categories of institutions.

Fig. 1 is an illustration of the mass-elite theory as applied in the governance of water resources in the study area. It shows that there are elements of modern and traditional water governance institutions within the study area. On the one hand, there are elites in a modern society comprising the regulatory authorities such as Department of Water and Sanitation (DWS) and Water Utilities Corporation (WUC) among other modern entities. On the other hand, there are masses which include all water users who are not a part of the statutory institutions. Elites are so conceived in this manner because they have the (modern) expertise and are knowledgeable in terms of water law and policy formulation as compared to the masses, who do not have such modern knowledge. In traditional society, the elites comprise chiefs, rainmakers and all the elderly people who are experts in the indigenous knowledge and utilise it in water resources management and governance at the household level. The masses in traditional societies comprise individuals who do not enjoy privileged positions and are also not well versed in the knowledge of local taboos and norms of water use. Privileged individuals are conceived as those who have better demographic and socio-economic statuses within the society. Thus, this theory presumes that laws and policies as well as taboos, values and norms, which govern water management, are designed by the elites to regulate the activities and conduct of the masses in water management. It is noteworthy that there is a dissonance between customary and statutory institutions in the governance of water resources in the study area. The contradictions arise because the statutory institutions label the customary institutions as old fashioned [26] and out of touch with reality in the modern days [15]. On the other hand, customary institutions in-turn feel alienated from their cultural ways of water management [55] as a foreign culture is imposed on them [26].

In this regard, the model suggests the fusion of the two institutions to produce legal pluralism (a hybrid institutional arrangement), which embraces the perceptions of both the masses and the elites operating within both institutions. Such a fusion fits well with the institutional bricolage theory which emphasises the consideration and cooperation of the local conditions when crafting rules and laws that govern natural resources management. The adoption of legal pluralism institutional arrangement is likely to assist in resolving the existing dissonance between customary and statutory institutions in the governance of water resources within the study area and perhaps elsewhere.

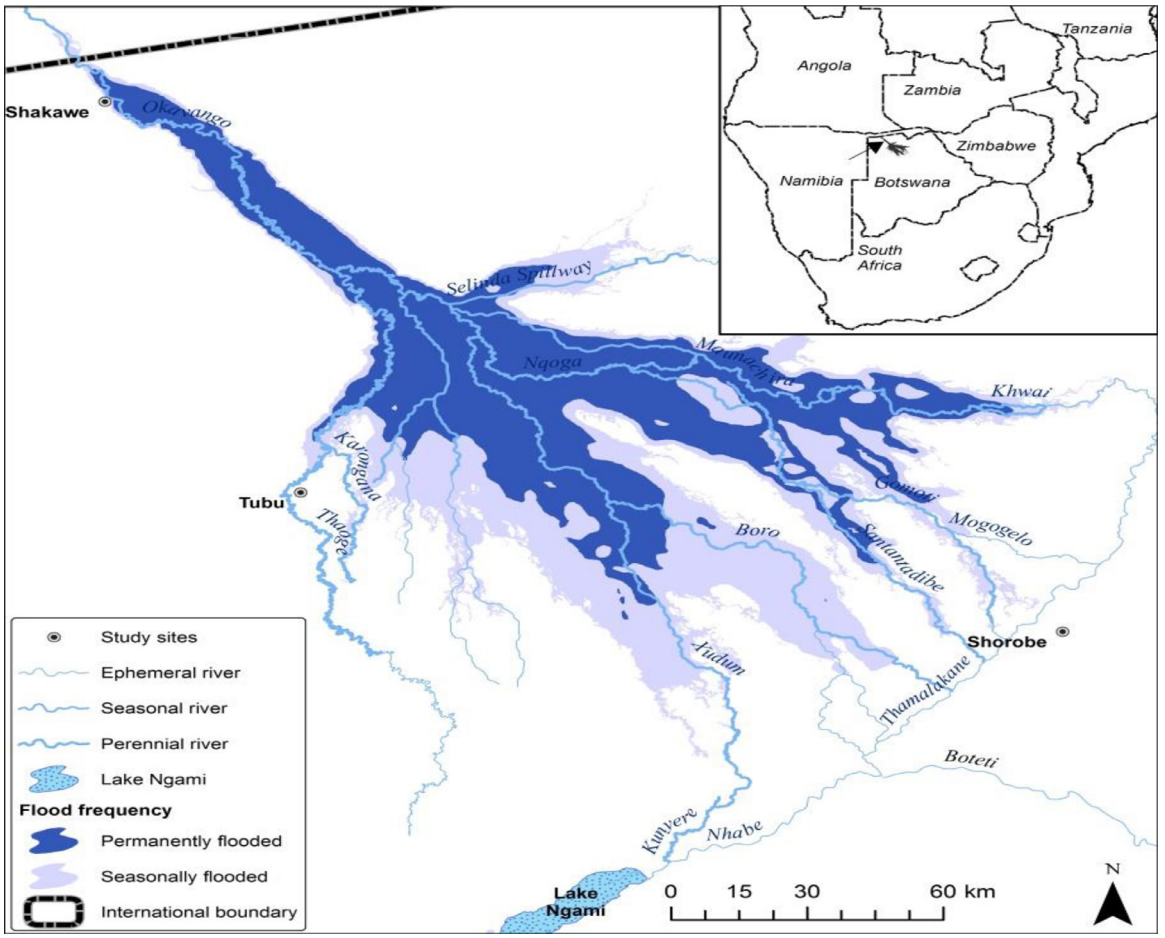

Fig. 2. Okavango Delta map showing study sites. Source. ORI, GIS Lab, 2019.

3. Methodology

3.1. Study area

This study was carried out in three villages of Shakawe, Shorobe and Tubu in the Okavango Delta (Fig. 2). This is a large inland alluvial wetland delta characterised by a very low level of anthropogenic transformation in the semi-arid north-western Botswana [51]. Across its 15,000 square kilometres, the Okavango Delta is very flat, varying just two metres in height. The Okavango Delta has more than 150,000 islands[18]. Some are just a few metres wide while the large islands are over 10 kilometres in length. It covers an area of 22 000 km^2 and is one of the world's largest inland deltas [36,51]). The delta's inflow of water is supplied by two rivers namely Cuito and Cubango from the 1300 mm per year summer rains which fall between November and March in the Central Angolan highlands [53,51]; [53]). The Okavango Delta consists of five ethnic groups each with its own identity and language [7]. These are BaSarwa, BaYeyi, BaMbukushu, BaTawana and Ba-Herero [19]. The largest ethnic group are the BaYeyi [19], who migrated into the area from Zambia ([47], 1977). The BaYeyi settled on river islands and they brought canoes and fishing nets into the Okavango Delta. BaYeyi generally maintained good relations with the BaSarwa [19]. The HaMbukushu came from Angola due to colonial and civil war in the 1970s. They settled around Etsha villages south of Ikoga. HaMbukushu and BaYeyi lived in spatially separated family units in scattered communities and both were very mobile ([44,48,76]. The BaTawana and BaHerero migrated from Namibia and were responsible for the introduction of cattle in the area. The BaTawana and BaHerero arrived in Ngamiland at the end of the 18th Century and became politically dominant in the region [76]. Highlights on the ethnic groups are provided in this subsection to underscore the cultural diversity of the respondents and how this affect water management in the study area. Shorobe, Shakawe and Tubu villages were suitable for this study because of the availability of several ethnic groups which makes this study more relevant because different ethnic groups had various beliefs regarding water management. Furthermore, the choice of the villages was done based on their remoteness and the water-related forms of livelihoods which make it imperative to

Table 1
Villages, total number of household heads, target and actual sample sizes

	Village	Total number of household*	Target sample size $n = \frac{N}{1+N(e)^2}$	Actual sample**
(i)	Shorobe	64	55	55
(ii)	Shakawe	1487	315	314
(iii)	Tubu	118	91	86
Total		1669	461	455

* Source: Statistics Botswana, 2011
** Field survey, 2018.

harmonise customary and statutory water management institutions. Water supply in these villages was erratic [43]); hence villagers at times obtain water for domestic use directly from rivers.

The thrust of the article is to understand the influence of demographic and socio-economic variables interfacing both customary and statutory water institutions in the selected grassroots communities.

3.2. Sampling

According to Statistics Botswana [32]), while Shakawe has 1487 households Tubu and Shorobe have 118 and 64 households, respectively. Taro Yamane's formula (see Table 1) was used to sample (in proportion to size) a total of 461 household heads from Shorobe (55), Shakawe (315) and Tubu (91).

A discrepancy was found in Shakawe where the sample size target was less 1 household, and in Tubu where it was less 5 households As such, a total of 455 (instead of 461) interview schedules were administered to households by five well-trained degree holder, research assistants. The respondents were interviewed using the local language. Specifically, the selection of the household was done using random number table. This method was adopted because it reduces bias by ensuring that all households in the three villages had equal chance of being sampled [21]. Firstly, the households were numbered from 1 to 64 because there were 64 households in Tubu village. Secondly, the criteria for selection were set. Any number below 0 and above 64 was omitted and lastly, repeated numbers were ignored. For example, the first 20 households in Tubu village were selected horizontally based on the randomness of the numbers considering the cut off numbers as set in the criteria. As such, households 20; 17; 42; 01; 33; 55; 58; 60; 49; 04;27;56;11;63;31;05;64;26;07; and 23 were selected because they fell within the range of the set criteria. The same approach was used to select samples in Shorobe and Shakawe communities. Thus, randomness ensures that every household in the three villages had an equal chance of being selected as part of the sample [45].

3.3. Data collection

Data collection tools comprised household interview schedules, key informant interview and focus group discussion (FGD) guides. Household interview schedules were designed to capture demographic, income and socio-cultural variables and were administered by five well trained research assistants who spoke the local language. Interview schedule was used to elicit information from household heads because the population were largely non-literate; the tool yields data within a very short space of time [25]; the data are easily analysed using computer programme such as SPSS [75]; the data obtained are in the respondent's own words and the tool allows for probing for additional alternatives [68]. Using interview guide, one key informant was interviewed from the Water Utilities Corporation (WUC) while eight were interviewed from the Department of Water and Sanitation (DWS). Three focus group discussions (FGDs) comprising a minimum of 12 participants per session were held. Each of the FGD sessions comprised village elders (three chiefs, three deputy chiefs) and government officers (DWS and WUC) who had a vast knowledge of water management. A FGD is used to gain a deep understanding of issues that remain unclarified during a household survey [54] and it also meant to add meaning to the existing knowledge or getting at the why and how of the issues under study [60]. Thus, FGDs provided a platform for clarifying demographic and socio-economic factors influencing the dissonance between customary and statutory institutions in the governance of water resources in the study area. To ensure reliability and validity of the, data collection tools were pre-tested at Matsaudi village, which is a village outside the study sites but with similar features as the three villages where the actual study took place. This was also done to ensure that the interview instruments accurately measured the variables that were investigated in the study and ascertain the timeliness of answering the questions embedded in them.

4. Results and discussions

4.1. Customary and statutory institutions perceptions on water

This section begins by highlighting stakeholders' perceptions on the roles of customary and statutory institutions and the contradictions existing between them in the governance of water resources. In the study sites, water governance is

Table 2
Customary and statutory institutions dispositions on water governance in the Okavango Delta (n= 455).

Customary institutions	Statutory institutions
i. Water is a free resource	Water is a commodity and needs to be sold and bought
ii. Water cannot be bought or sold	Water should be bought and sold.
iii. Women basically collect water	Primitive belief
iv. Men only maintain water facilities	WUC and DWS maintain water infrastructures
v. Lack of formal recognition	Formally recognised
vi. A spiritual relationship with water	Myths are backward and primitive
vii. Water bodies are sacred	Myths are backward and primitive
viii. No-one can be denied access	Those who fail to pay water charges are denied access

Source: Fieldwork, 2018.

regulated by the Water Act (1968) and the Water Policy (2012). The Water Act (1968) is the major legislation on water governance in the entire country. The interview with the DWS officials clearly indicated that water is held in trust by the state on behalf of Batswana[1]. In statutory institutions, water is recognised as a scarce resource and, therefore, a public good with a value for which consumers need to pay to sustain its supply. This is contrary to customary institutions' ideals which underscore water as a non-tradable item or commodity but conceived as an abundant and living part of nature [3]. Thus, water is a sacred entity which belongs to nature and cannot be owned by anyone (UN, 2018). Recognising the significance of water, the Government of Botswana drafted a Water Bill [33] in order to do away with riparian rights and to ensure that commercial uses of water are only fulfilled in line with social and environmental needs. Judging from the perspectives of the two institutions, there is a value conflict in water management in the study sites; the statutory institutions prioritise market forces at the expense of cultural values. One participant during a FGD in Shakawe had this to say:

> Conflicts in water management between customary and statutory institutions in the Okavango Delta arise from the cultural assimilation forced upon us; we (the old people) are told water should be bought and sold. This is what we have never experienced since we started living in this area long back in the 1950s.

The results support the mass elite theory, which postulates that a powerful few make decisions on public policy while the powerless majority do abide by the rules and regulations crafted by the elites. The elites whom are associated with statutory institutions allocate values on water governance while the masses are at the receiving end of public policy on water issues. Regardless of the status quo in the study area, the best approach in water governance is to apply the institutional bricolage theory which emphasises that the locals' water needs should be included in the overhaul water management system [11]. Participants who were sympathetic towards customary institutions during one of the FGD sessions revealed that water should be enjoyed as a free resource, accessed through wells, rivers and streams. This contrasts statutory institutions' position, which emphasises on the need to demand a nominal fee from consumers in order to maintain water supply infrastructure, which indeed was misconstrued as a full cost recovery by respondents in the study area. Based on Akpabio [2] viewpoint, the way people perceive water shapes their attitudes to management issues. Table 2 is a summary of how adherents of customary institutions (mostly old, with low formal education individuals) and those of statutory institutions (mostly young, educated and government employees) perceived water governance.

While variations in ontological perceptions exist between customary institutions and statutory institutions in relation to the values attached to water, the point of departure is that water needs to be frugally managed [1,5]. For customary institutions, frugal management of water comes to bear in the use of taboos and the idea that there are deities living in water who instil fear into people so that they do not degrade and wastewater. The approach in the statutory institutions with its peculiar monetised economy is to apply the user pays principle in which the cost of water supply needs to be borne by the user. This approach aligns well with Cleaver's [12] institutional bricolage theory, which postulates that natural resources management needs to consider local factors that affect resources use. Cognisant of Cleaver's [12] theoretical postulations, it is important to acknowledge that solutions to water management, which are devised and perpetuated by local people, stand a better chance of long-term success.

4.2. Age of respondents and water management

Age of respondents is a crucial variable in understanding water governance and consumption [27]. The results show that the average age of household heads was 42.5 years with a standard deviation of 16.24. A majority (26%) of the respondents belonged to the age group of 20-29 years. Approximately 25% of the respondents aged between 30-39 years. While 18.7% of them were between 40-49 years, 13.8% constituted those that belonged to the age category of 50-59 years. The elderly (60 years and above) constituted 16.3% of the respondents. Using SPSS version 25, a Kruskal–Wallis test was performed to determine the difference in the perceptions of water management by different age groups. The results revealed that there was no significant difference ($X^2 = 8.2$, $p = 0.09$) in the way respondents of different age groups perceived water

[1] The word Motswana (singular) and Batswana (plural) denotes a person and the people who live in the study area, respectively

management in relation to customary and statutory institutions. The type of water source used by households was also not influenced by age of household head ($X^2 = 214.3$, df = 264 $p < 0.99$) given that there was no significant association between the two variables.

4.3. Water as a social or economic good in the context of water management

Decision-making on water is a pervasive aspect of water management. While in statutory institutions, water governance employs secularised economic principles to push cost recovery [34], customary institutions adopt a spiritual approach [29] within the context of which non-tangible spirits are perceived as enabler of clean water [31]. Despite the divergent perceptions existing between customary and statutory institutions, only statutory aspirations are adhered to owing to statutory institutions having autonomous power over water use and management [29,31]. This is a scenario situated in the context of the mass-elite theory. Whereas the results revealed that only 12% of the young people (40 years and below) agreed that, "[t]here are spirit beings in water sources", the majority (71.5%) of the elderly (60 years and above) affirmed this assertion. The results also revealed that 90% of the key informants in the study area believed that there were souls of human beings in water sources. The belief was emphasised in customary institutions and among the elderly than the young people. For instance, it was revealed during FGD in Tubu and Shakawe that the fear of getting drowned, which has a spiritual connection, is linked to the belief that water is the habitation of spirit beings, and which in turn, assists in instilling fear in people to refrain from activities that degrade water resources. An interview with key informants in the two communities also revealed that 80% of the elderly people believed that: "[h]uman souls are embodied in aquatic animals like crocodiles and frogs". This perception implies that water pollution becomes inimical to those lives and thus the human souls embodied in them. While both institutions had a common understanding that water pollution is objectionable, the approach used by them to combat this problem differs. While in customary institutions water pollution leads to drowning of the perpetrator as a punishment from water spirits, statutory institutions relied on fines to curb the vice as prescribed in the Water Act (1968)

The notion that *water is a gift from nature* was widespread amongst elderly people within the study area. While statistical analysis showed that there was no significance difference in perceptions amongst people of different age groups, literature revealed that elderly people usually favour customary institutions than the younger generation who are sympathetic towards statutory institutions [4,10,41,80]. The discord in the results could be attributed to the relatively small sample size of this study as compared to studying the whole communities in the delta. According to Akpabio [4], the notion that water is a gift of nature enables it to be enjoyed as a free resource, accessible through different water facilities including well, streams and ponds. An elderly man during the FGD in Shakawe pointed out that "[w]ater comes from God and that is what I know since birth and this idea that people should pay for water is new to us". In addition to this, the elderly regarded bodies of water as homes of deities. A confirmation of this proposition was made by one elderly respondent during the FGD session at Shakawe:

> To tell you the truth, I only drink from Okavango River and nowhere else. This is because this is what our ancestors drank and used over many years and they survived. So why should we change? It is all this change that is making the gods to be annoyed and which have led to many problems in our society.

The perception of water as a free resource makes the residents avoid using the water supplied by the DWS but would prefer to obtain it from rivers and dugout wells. Asked whether it was possible to provide free water to poor people in this village, one key informant in the DWS responded thus:

> *It is possible, in principle, to provide a minimum amount of water for free for the underprivileged people. It is, however, often considered more sustainable to ask for a nominal connection fee or charge at a subsidised rate to enable us to provide them with proper service.*

While the DWS is willing to supply water to residents especially the less privileged, its position was that the imposition of a nominal fee was essential to enable the organisation to recover some processing costs for the purpose of sustaining water supply to the residents.

4.4. Reliability and sources of water in the study area

Fig. 3 illustrates the sources of domestic water in the study area. The majority (85%) of the respondent's fetched water from standpipe taps and the least (0.7%) obtained water from dug out wells.

Fifteen percent of the respondents who elaborated on their decision to collect water from rivers and wells indicated that the availability of alternative water sources coupled with high cost of water from standpipes were the main reasons for making the decision to collect water for drinking and bathing from different sources. It was a commonplace to notice that those who collect water from rivers and wells were the old women. This implies that women are most probably burdened with water collection task in rural setups and usually do have insufficient income to afford water bills. Participants revealed that they spent less money on water as they draw the bulk of the water from rivers and wells and only fetched water for drinking from the standpipes. The results concur with those of Elliott et al. [22] and Kelly et al. [42] in Zambia, Ghana and Kenya rural communities, which confirmed that households often use more than one source of water to meet their daily water needs, with sources selected according to use, and which often change across seasons.

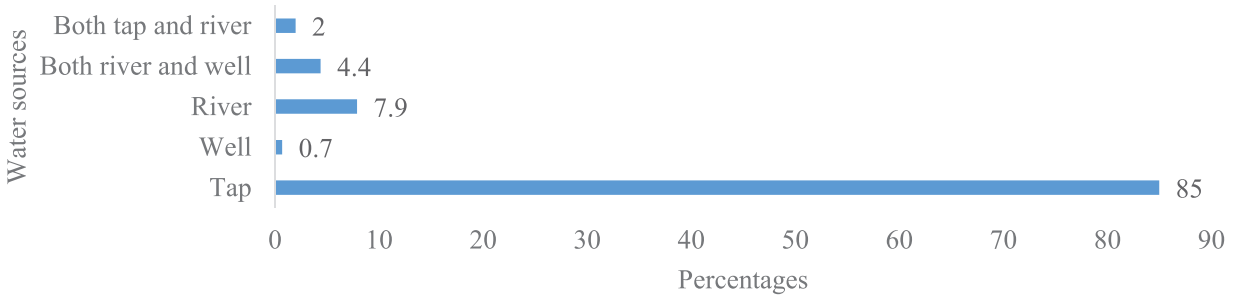

Fig. 3. Sources of water in the study area (n = 455). Source. Field survey, 2018.

Table 3
Reasons for fetching water from sources other than tap in the study area (n = 455).

Reasons	Frequency (%)
(i) Tap water could be unavailable for 1-2 weeks	22.6
(ii) Water is always available though it is black or brown	3.3
(iii) Tap water is always available but with very low pressure	1.5
(iv) Tap water could be unavailable for over 3 weeks and up to a month	20.1
(v) Taps are dry for one or two hours daily.	13.4
(vi) We experience water cuts every day	3.3
(vii) Water is always available at night and early morning hours only	5.5
(viii) The tank is too small to supply enough water since the population has grown	3.7
(ix) We started experiencing water supply problems when WUC took over from DWS	4.8
(x) Water shortage is a daily problem in our village	5.2
(xi) We always rely on river and well water	16.6

Source: Field survey, 2018.

Responding to the interview schedule question on how reliable their water sources were in terms of the time period during which water was available, study participants provided reasons why they obtained water from unimproved sources even though treated pipe borne water was supplied through standpipes. Table 3 summarises these reasons and their frequency (in percentages).

To mitigate the problems of intermittent water supply, households adopt coping strategies including resorting to river and shallow well water. One key informant in Shakawe affirmed that "[a]t times, residents wash their clothes and kitchen utensils along the riverbank instead of taking the water home". The findings revealed some disparities in water supply within the study area and that the interruptions lasted for longer periods in some villages than others. For instance, households in Tubu village indicated that water could be unavailable for over a month as opposed to Shorobe and Shakawe where water could be unavailable for only one to two days. It was also noted that affluent households had better coping strategies including installation of water storage tanks and could afford transportation of water from faraway places. Such a scenario was witnessed in Tubu where households were bringing water to Tubu from Gumare, which is about 20 kilometres away. The results also suggested that low income households were more affected by the interruptions of water supply than their high-income counterparts who had flexible coping mechanisms.

4.5. Gender and water governance

As earlier observed in the paper, gender plays a prominent role in water governance discourses. Fig. 4 reveals that there were more female than male respondents. Overall, literature has shown that in customary institutions the norm is that men in rural areas are less involved in water collection. Based on literature men are engaged in water collection when the distance to a water source is long [84] and the technological requirement to collect water is high [84].

Data from this study differ from the one conducted by Hawkins and Seager [37] on gender and water in Mongolia where they found that although men and women share responsibility for water collection in rural areas, men were the majority in water collection. However, the results of this study show that rural women in the study area played a dominant role in manual water collection. The results also indicate that elderly women who were not directly involved in water collection instructed young women in the household to collect water.

As water consumption varies between people of different sexes [39], gender becomes a vital variable in decision-making for water management at the household level [82]). Females are perceived as high-water consumers than males [39]. This is because they carry out more water-related activities than their male counterparts [39]. While Jordán-Cuebas *et al.* [39] study shows that females take long showers than their males counterparts, that of Fink [24] on gender roles indicates that women have a high level of knowledge on water conservation than men who are less frequently engaged in water conservation programmes. A Mann–Whitney U test was performed to determine the difference in the perceptions of male and female

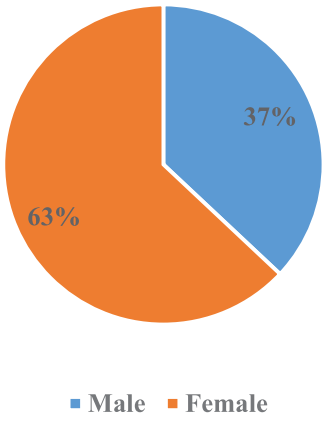

Fig. 4. Gender of respondents (n = 455). Source: Field survey 2018.

respondents on water management practices in the Okavango Delta. The results revealed that there was no statistically significant difference (U = 23860, p = 0.82) in the perceptions of males and females on issues surrounding water consumption in the Okavango Delta. As gender draws attention to the behaviours, values and attitudes that a society considers appropriate for males and females [74], the findings of this study might imply that men and women in the Okavango Delta had similar perceptions about their individual roles in water collection.

The results indicate that 69% of men at Tubu collect water than the other two villages. The preponderance of men in Tubu than in other villages in terms of water collection deserves scrutiny. The majority (69%) of men fetched water at Tubu because its availability was erratic such that whoever was available when the tap began to run performed the role of water collection. This opportunistic water fetching can best be explained by one of the Chief who remarked that: *[m]en collect water while women are working, preparing dinner or caring for the family.*Also, this uncommon gendered profile in rural areas might reflect the recent transition of Tubu from a village to a semi-urban area [46]. Thus, the transformation of the village resulted in the near disappearance of men's traditional role of animal herding and hunting, giving them enough room to engage in water collection obligations. (Personal communication with the Chief at Tubu, September 2018). Another explanation is that *[T]ubu does not have its stand-alone water supply system but rely on water from Gumare village which is 20 kilometres away* (DWS at Tubu, September 2018). This situation compels men to use animal-drawn carts to fetch water. An observation made during data collection by the researchers revealed that donkey drawn carts were the commonest water collection technology in Tubu.

4.6. Household size and water management

Household size is a vital variable for understanding water management at the household level [20]. Fig. 6 shows that the average household size was 6.6 members with a standard deviation of 3.9. On the average, results also revealed that a 6-member household consumed 80 litres of water per day. While the trend of the data obtained from the study shows that an increase the amount of water consumed did not increase in proportion to the number of household members, findings however, revealed that a household having one member consumed relatively more water as compared to a household having 6 or more members.

Based on Renwick and Archibald [66], household size is a vital factor in explaining water consumption and governance. A Pearson product-moment correlation coefficient showed a strong and positive correlation (r = 0.85; p = 0.01) between water consumed per day and household size. Van Zyl et al. [83] found that although large households used more water than small households, the former had a high propensity to save water by being able to optimize consumption levels than the latter. However, it is unclear whether the intention to save water is as a result of the desire to develop a conservation attitude [49] or the tendency to adjust the family budget, which invariably would lead to a reduction in water consumption in large households. This concurs with the observation of Sarabia-Sánchez and Rodríguez-Sánchez [70] who said that: *[a] large household size implies great consumption, though consumption per capita is not proportional to the number of people since there are economies of scale at work*. Thus, in a single-person household, water consumption is higher than in those with more persons.

4.7. Education and water management

Fig. 6 shows that most (76.3%) of the respondents had formal education and that the rest had non-formal education.

Results show that a relatively small percentage of the respondents (23.7%) had never attended formal school and all key decisions on water management were made by them. The educational achievement of an individual determines how one has access to improved water. An individual with a low level of education has limited opportunities to demand better

facilities from the authorities and they are less empowered to demand better services [30]. From the customary institutions' perspective, inadequate water facilities also affect the educational achievement of rural children (most especially girls) as they bear the burden of water collection [55]. However, data indicated that most (76.3%) of the respondents had acquired formal education; they had enough knowledge on water consumption. While the group that perceives water as a *gift from nature (23.7%)* was predominantly the holders of non-formal education, the majority (76.3%) of those who acquired formal education perceived water as a priced commodity. An independent samples t-test was conducted to compare participants' perceptions of water management between customary and statutory institutions among the people with formal and non-formal education. There was a significant difference ($t = 18.2$, $p = 0.00$ (two-tailed) the magnitude of the difference in the means was very large (eta squared = 0.42). This implies that education had a significant influence on how respondents perceived and managed water within the study area. Based on Akpabio's [4] study, traditional water governance institutions play a major role in individuals' daily relationship with water through the enforcement of various norms. It is noteworthy that people with informal education often comply with such norms to avert punishment [9]. We observed that people with some measure of higher education tended to favour water management through statutory institutions than people who had a low level of education and who tended to favour customary institutions.

4.8. Income and water management

Household expenditure, which is a proxy of household welfare, is the principal factor in household water management [46]. It, therefore, presupposes that households with low income are more likely to rely on unimproved sources of water because it is affordable [3]. Corroborating the findings of this study, Lawrence *et al.* [50] claimed that even in cases where improved water sources are provided, people may remain water-poor because they are income-poor and hence cannot afford potable water. This supports the opinions of 40 percent of the respondents from the interviews and FGDs conducted in Shakawe and Shorobe where they said:

> Okavango River is the source of water that is used the most. This is because, without money, pipe-borne water cannot be bought. This also explains why we use pipe-borne water for drinking and water from the river for everything else.

WUC is responsible for water supply to residents in the study area especially the less privileged. However, its position is that a nominal connection fee or charge at a subsidised rate is essential for sustainable water supply to consumers. Table 4 shows WUC potable water tariffs, which came into effect on the 1st of January 2013 to 31st December 2015. It shows three Blocks (Block 2, 3 and 4). In Block 2, the minimum amount payable per month per household was BWP20.00. In each block an additional amount of water consumed attracts a higher charge. It is also noteworthy that there is no provision for free basic water. This is because whether one consumes water or does not one still has to pay a fixed BWP 20 per month. High water consumers pay more.

Table 5 shows a breakdown of water supply charged per kilolitre in Botswana Pula (BWP). The tariff structure shows that potable water in the study area is priced in blocks and that the more water a household consumes, the more they pay in terms of water charges. This implies that household use other sources of water such as rivers and wells to access water for washing and bathing while water from standpipes is reserved for cooking and drinking. Thus, the cost of water influences the decision on which source of water to use.

Table 4
Domestic potable water tariff 2013-2015

Block	Min	0-5kl	>5-15kl	>15-25kl	>25-40kl	>40kl
2	BWP20.00	BWP2.00	BWP8.00	BWP13.00	BWP20.00	BWP25.00
3	BWP20.00	BWP2.00	BWP8.00	BWP13.00	BWP20.00	BWP22.00
4	BWP20.00	BWP2.00	BWP6.00	BWP11.50	BWP15.50	BWP22.00

Source: Water Utilities Cooperation Annual Report, 2017. (Kilolitres = 1000 litres)

Table 5
Domestic potable water tariffs (2017-date)

Block Tariff category (kilolitres)	Exc. VAT Revised 1st April 2017	Incl.VAT Revised Tariff 1st April 2017
Minimum charge	BWP0.00	BWP0.00
(i) 0-5	BWP3.50	BWP3.92
(ii) >5-15	BWP10.40	BWP11.65
(iii) >15-25	BWP18.20	BWP20.18
(iv) >25-40	BWP28.00	BWP31.36
(v) >40	BWP35.00	BWP39.20

Source: Water Utilities Cooperation, 2017.

Table 6
A water bill for 45 kilolitres of water consumed per month

Potable water		VAT @ 12%	Total
(i) First 5 kilolitres @ BWP3.50	BWP17.50	BWP0.00	BWP17.50
(ii) Next 10 kilolitres @ BWP10.40	BWP104.00	BWP12.48	BWP116.48
(iii) Next 10 kilolitres @ BWP 18.20	BWP182.00	BWP21.84	BWP203.84
(iv) Next 15 kilolitres @ BWP28.00	BWP420.00	BWP50.40	BWP470.40
(v) Above 40 kilolitres @ BWP35.00 (last 5 kilolitre)	BWP175.00	BWP21.00	BWP196.00
Total	**BWP898.50**	**BWP105.72**	**BWP 1004.22**

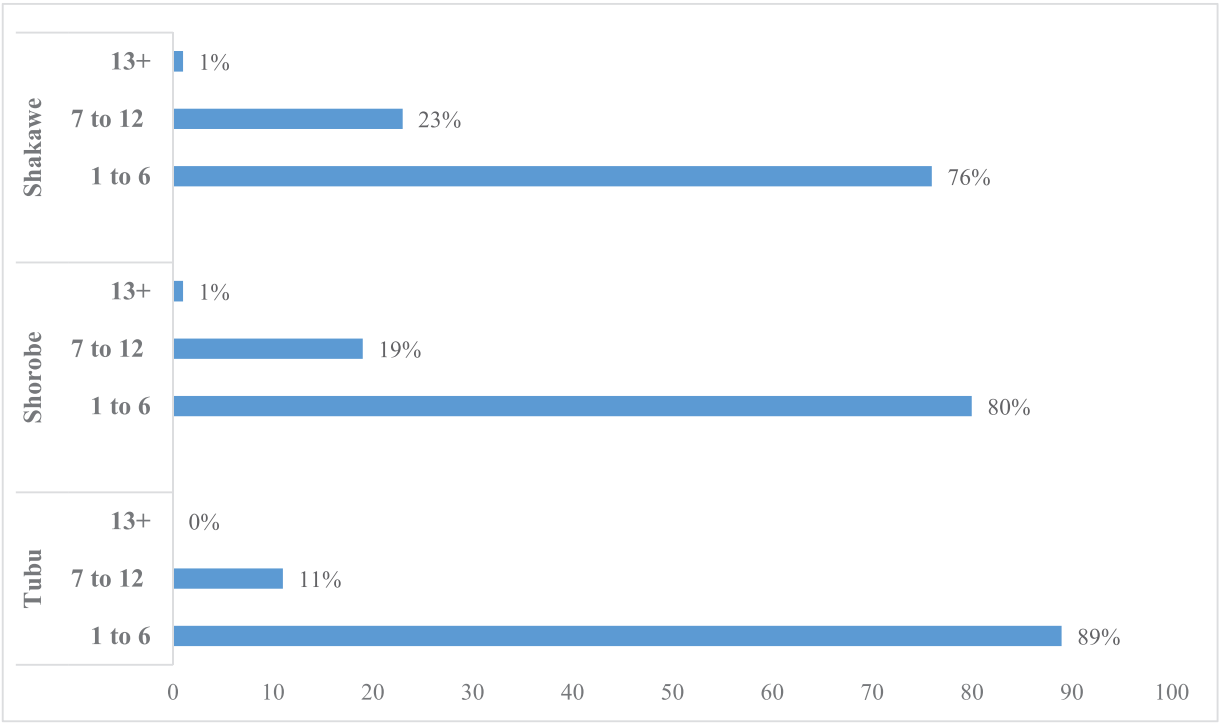

Fig. 5. Household size in the study area (n = 455). Source: Field survey, 2018.

Table 6 shows the amount of money that a household which uses 45 kilolitres of water pays at the end of one month. Given that the majority (90.5%) of the households earn less than BWP1500 per month, paying BWP 1004.22 towards water is too high and as such households could not afford it.

A standard connection fee of up to 50 metres connection distance and WUC digging trenches and providing connection materials costs BWP2000.00. However, this Fig. is reduced to BWP1500.00 if the customers dig the trenches and WUC providing materials and labour. Fig. 7 illustrates the income which respondents earned per month (in Pula) in the study area. Data showed that the average monthly income was P603.96 with a standard deviation of P695.05. The majority (90.5%) earned P1500 or less per month (Fig. 5).

Fig. 8 shows an average consumption rate of 75.4 litres of water per household per day with a standard deviation of 37.3. The results also show that most (54%) of the respondents consumed an average of 80 litres of water per day per household. Based on Cleaver's [12]bricolage theory, institutional arrangements need to be cognisant of existing local conditions to enhance the incorporation of the views and aspirations of the local people in natural resources use. In the study sites, the majority (90.5%) of the people earn less than BWP1500 per month and most (54%) of them consumed over 80 litres of water per day per household. The inference is that most people in the study area were unable to pay for water even though they were willing to pay.

Based on United Nations' (UN) report (2019), one member of the household needs at least 50 litres of water daily. An analysis of the results of this study shows that 21.1% of the respondents lived in households where they used less water than the prescribed amount per day. This implies they used less water than the minimum recommended by United Nations. A study by Rostapshova *et al.* [69] reveals that almost two in three people lacking access to clean water survive on less than US$1 a day. People living in rural areas pay 5 to 10 times more for water than those living in high-income areas [65]. Thus, the reason why 21.1% of the respondents consumed less than the minimum volume of water required per day might

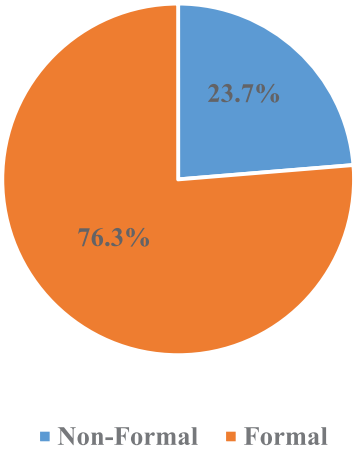

Fig. 6. Distribution of household heads by education type (n= 455). c Source: Field survey, 2018.

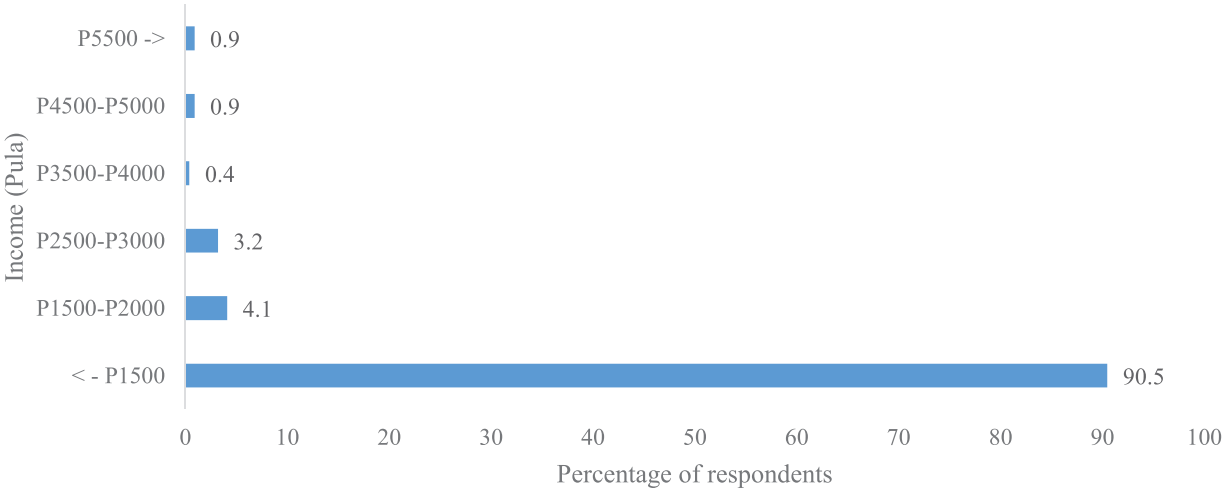

Fig. 7. Monthly household income (n= 455). Source: Field survey, 2018.

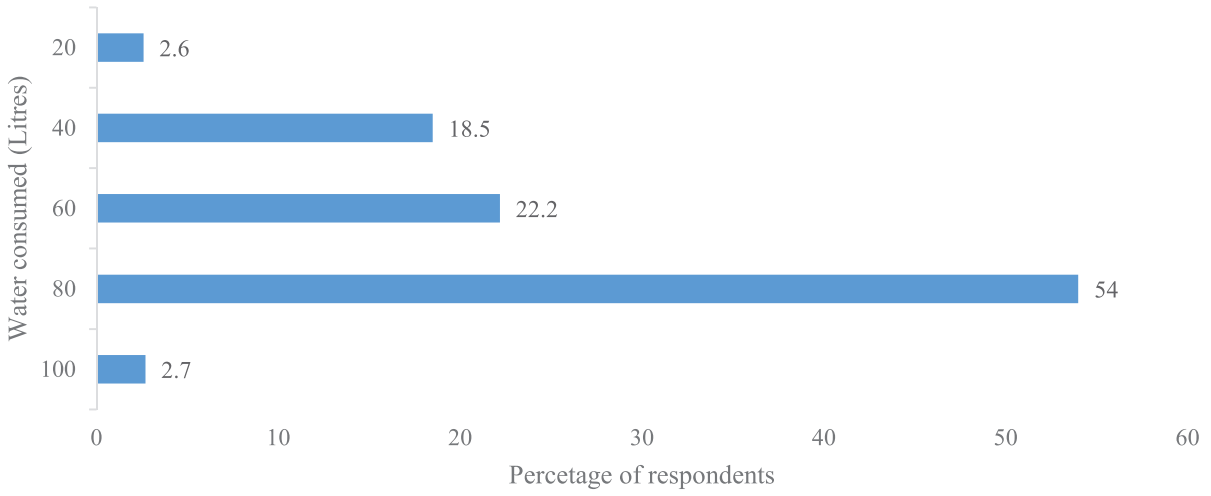

Fig. 8. Daily water consumption in the study area (n = 455). Source: Field survey, 2018.

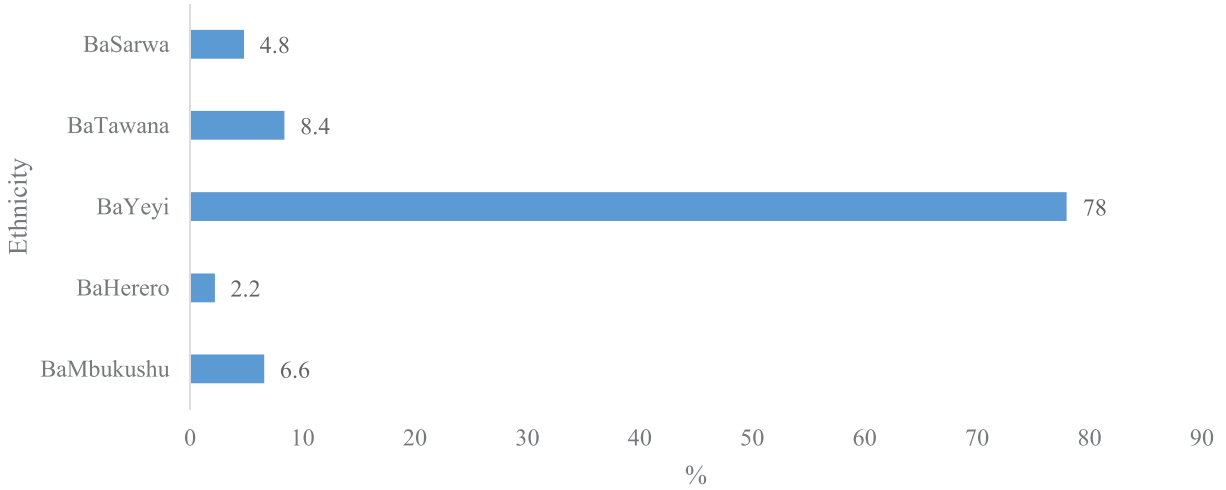

Fig. 9. Ethnicity of household heads in the study sites (n = 455). Sources: Field survey, 2018.

be that they could not afford to pay for more water. In such instances, the customary institutions standpoint is that there is a tendency that the meaning of water as a common good might be completely eroded.

4.9. The relationship between religion, ethnicity and cultural perceptions of water management

Ethnicity is a social classification of people based upon their shared cultural characteristics and heritage [9]. The identity of a certain ethnicity is based upon characteristics of beliefs, values, language, religion and traditional experiences of an individual [9]. Based on Smith and Ali [77] it is extremely unwise to exclude social-cultural variables in the endeavour to understand factors affecting water governance. Findings revealed that there were five ethnic groups (see Fig. 9) and three main religions in the study area. A Chi-square test (X^2) for independence was used to determine the association between the ethnicity of respondents and their religions. The results indicated that there was no association ($X^2 = 9.96$, phi = 0.15) between ethnicity and religions in the study area. A Kruskal-Wallis test was performed to test if there was a difference in perceptions on cultural issues on water management among household heads of different religions in the study area. The results, however, indicated that there was no significant difference ($X^2 = 0.87$, p = 0.25) in their perceptions.

The meaning of water from a religious point of view has practical implications on how it is governed [4]. In many religions e.g. ATR, water is considered a gift from God and is therefore conceived as a community resource to which everybody has access [3]. The ATR position is that it is forbidden to buy or sell water. Personal communication with an adherent of customary institutions in Shakawe agreed with Akpabio's [4]point of view as he says:

> Considering that water as a gift from God has an impact on how people handle it. I should honour and not waste it; if it is a gift to me, then it is also a gift to my neighbour, and I should not deprive him of access.

Thus, the symbolic value of water in religion serves as a concrete motivation for managing water in the study area. Table 7 shows how ethnicity and religion intersect each other. The table shows that 4.8% of the respondents were BaSarwa who participated in this study and that amongst them 3 were affiliated to ATR and 19 were Christians. In total, there were 41 BaTawana who participated in this study, 7 of which belonged to ATR, 34 being Christians and none belonged to Islam and other religions. The majority (355) of the participants were BaYeyi and 54 of them were affiliated to ATR, 295 were Christians, 3 belonged to Islam and other 3 were of other religions outside those listed. Only 1 MoHerero was affiliated to ATR, 5 were Christians and no one belonged to other religions. A total of 31 BaMbukushu took part in this study and

Table 7
Ethnicity-Religion Cross-tabulation (n = 455)

Ethnicity	Religion			
	ATR	Christianity	Islam	Others	Total
BaSarwa	3 (0.7%)	19 (4.1%)	0 (0%)	0 (0%)	22 (4.8)
BaTawana	7 (1.5%)	34 (7.5%)	0 (0%)	0 (0%)	41 (9%)
BaYeyi	54 (11.9)	295 (64.8%)	3 (0.7%)	3 (0.7%)	355 (78.1%)
BaHerero	1 (0.2%)	5 (1.1%)	0 (0%)	0 (0%)	6 (1.3%)
BaMbukushu	4 (0.9%)	25 (5.5%)	0 (0%)	2 (0.44%)	31 (6.8%)
Total	69 (15.2%)	378 (83.1%)	3 (0.7%)	5 (1.1)	455 (100%)

Source: Field survey, 2018.

amongst them, 4 were affiliated to ATR, 25 were Christians and 2 were of other religion other than those listed in the instrument.

The incidence of rituals at water places was indicative of the beliefs in the spiritual importance of water bodies in the study area. A village chief commented that "[w]ater rituals are performed in the dark hours on an individual basis but can be performed at any time when the entire community is involved" (Personal communication, September 2018). The findings are like the results of a study conducted by Shoko and Naidu [73] in Zimbabwe where they found that the ATR holds water as sacred.

4.10. Conclusion

The study used the institutional and mass elite theories to investigate demographic and socio-economic factors influencing water governance in the study area. The results indicated that while the young people showed allegiance to statutory institutions, the elderly upheld customary institutions. Findings also showed that women were responsible for water collection but their control over the water was limited because of customary laws and practices prescribing men as the heads of household and the decision-makers in public spheres. There is a need to consider women's role in water management issues. This will enable the trickling down of reforms that affect ordinary women's access to water and ensure their participation at all levels [81].

Socio-economic variables such as household income and water price have an impact on who decides and how much water to use within a household. The results showed that high-income households consume more water than their low-income counterparts. From the statutory institutions' standpoint, water tariff needs to cover minimal costs. Although the minimum tariff imposed on consumers was unaffordable for the people in the study, tariff is meant to ensure a sustained water supply that the challenge with unaffordability lies is premised on the findings that a majority (85%) of the respondent were unemployed and most (90.5%) of them were surviving on less than BWP1500 per month. Therefore, the government needs to introduce social safety nets, which target women and indigent households to ensure that they can access water at affordable rates. The size of a household also affects the decision on the amount of water consumed. In terms of education and income, households with high education tend to be within the high-income bracket and often had strong intentions to manage water consumption. This is indicated by their desire to install water-efficient appliances. Nevertheless, in terms of actual water use, households with low education and income use less water than their counterparts because they have few water-consuming facilities and gadgets. As water has the attributes of both social and economic good, it is imperative that the government minimises consumer costs by putting measures which ensure that affluent consumers pay more than their underprivileged counterparts (see, [29]). This paper points attention to the need for statutory institutions to acknowledge and adopt the bricolage notion of crafting institutions that are cognisant of contextual local conditions. While there is need for socialisation on onward transmission of customary institutions to young children on the governance of water, policy makers would need to ensure a water governance model that takes cognisance of the complementarity of both customary and statutory institutions. This can be achieved if statutory institutions set the nominal fee, which is within the affordability levels of the rural poor. Given that water from communal standpipes was free prior to 2013 [40], there is need to have communal standpipes from which people could access water free of charge within the study area.

Declaration of competing interest

None

Funding

This study was funded by the Office of Research and Development (ORD) of the University of Botswana, Round No.32.

References

[1] I. Abdullayev, F. Nurmetova, F. Abdullaeva, J. Lamers, Socio-technical aspects of water management in Uzbekistan: emerging water governance issues at the grass root level, Central Asian Water (2008) 42–48.
[2] E.M. Akpabio, "Water is God's": Commonality View and the Challenges of State Institutions in Nigeria, in: Proceedings of the 13th World Water Congress, 2008.
[3] E.M. Akpabio, Water and people: perception and management practices in Akwa Ibom State, Nigeria, Soci. Natural Resources 24 (6) (2011) 584–596, doi:10.1080/08941920903496945.
[4] E.M. Akpabio, Water meanings, sanitation practices and hygiene behaviours in the cultural mirror: a perspective from Nigeria, J. Water, Sanitation Hygiene Devel. 2 (3) (2012) 168–181.
[5] J.R. Allan, C. Kormos, T. Jaeger, O. Venter, B. Bertzky, Y. Shi, J.E. Watson, Gaps and opportunities for the World Heritage convention to contribute to global wilderness conservation, Conserv. Biol. 32 (1) (2018) 116–126.
[6] N. Bich-Ngoc, J. Teller, A review of residential water consumption determinants, International Conference on Computational Science and Its Application (2018) 685–696.
[7] J. Bock, Economic development and cultural change among the Okavango Delta peoples of Botswana, Botswana Notes & Records 30 (1) (1998) 27–44.
[8] S. Buechler, A.M.S. Hanson, A political ecology of women, water and global environmental change, Routledge, 2015.
[9] N. Castree, A. Rogers, R. Kitchin, A Dictionary of Human Geography, Oxford University Press, 2013.
[10] C. Chikozho, J. Latham, Shona customary practices in the context of water sector reforms in Zimbabwe, International workshop on African Water Laws: Plural Legislative Frameworks for Rural Water Management in Africa, 2005.

[11] F. Cleaver, Moral ecological rationality, institutions and the management of common property resources, Dev. Change 31 (2) (2000) 361–383.
[12] F. Cleaver, Institutional bricolage, conflict and cooperation in Usangu, Tanzania, DS bulletin 32 (4) (2001) 26–35.
[13] F. Cleaver, K. Hamada, 'Good'water governance and gender equity: a troubled relationship, Gender Dev. 18 (1) (2010) 27–41.
[14] N.J. Cooper (2016). *Covenants, Constitution & Commons: International, constitutional and community responses to achieve access to sufficient water for everyone* (Doctoral dissertation, University of Sheffield).
[15] D. Craig, E. Gachenga, The recognition of indigenous customary law in water resource management, Water Law 20 (5/6) (2010) 278.
[16] S.E. Crawford, E. Ostrom, The recognition of indigenous customary law in water resource management, Am. Political Sci. Rev. (1995) 582–600.
[17] B. Crow, F. Sultana, Gender, class, and access to water: three cases in a poor and crowded delta, Soc.Natural Resources 15 (8) (2002) 709–724.
[18] M.B.K Darkoh, J.E. Mbaiwa, Okavango delta – a kalahari oasis under environmental threats, J. Biodiversity Endanger Species 2 (2014) 138, doi:10.4172/2332-2543.1000138.
[19] R. DeMotts, T. Haller, P. Hoon, R. Saum, Dynamics of common pool resource management in the Okavango Delta, Botswana, Development Southern Africa 26 (4) (2009) 569–583.
[20] S. Dolnicar, A. Hurlimann, B. Grün, Water conservation behavior in Australia, J. Environ. Manage. 105 (2012) 44–52.
[21] C. Dura, I. Drigă, D. Niţă, Statistical landmarks and practical issues regarding the use of simple random sampling in market researches, Ann. Univ. Petrosani Econ. 10 (2) (2010).
[22] M. Elliott, T. Foster, M.C. MacDonald, A.R. Harris, K.J. Schwab, W.L. Hadwen, Addressing how multiple household water sources and uses build water resilience and support sustainable development, NPJ Clean Water 2 (1) (2019) 1–5.
[23] M. Espey, J. Espey, W.D. Shaw, Price Elasticity of Residential Demand for Water: A Meta Analysis, Water Resour. Res. 33 (6) (1997) 1369–1374.
[24] H.S. Fink, Promoting behavioral change towards lower energy consumption in the building sector, The Eur. J. Social Sci. Res. 2 (2011) 7–26.
[25] B.B. Flynn, S. Sakakibara, R.G. Schroeder, K.A. Bates, E.J. Flynn, Empirical research methods in operations management, J. Oper. Manage. 9 (2) (1990) 250–284.
[26] E.W. Gachenga, Integrating Customary Statutory Systems Water Governance Sustainable Development. The Case of the Marakwet of Kenya Published PhD thesis, University of Western Sydney, 2012.
[27] X. Garcia, A. Ribas, A. Llausàs, D. Saurí, Socio-demographic profiles in suburban developments: Implications for water-related attitudes and behaviours along the Mediterranean coast, Appl. Geogr. 41 (2013) 46–54.
[28] R. Gondo, O.D. Oluwatoyin, Institutional factors engendering dissonance between customary and statutory institutions in water access in the Okavango Delta, Botswana, Sustain. Water Resour. Manage. 6 (2020) 99, doi:10.1007/s40899-020-00458-9.
[29] R. Gondo, O.D. Kolawole, 'They don't read metres, they only bring bills': Issues surrounding the installation of prepaid water metres in Karoi town, Zimbabwe, South African Geograph. J. 103 (3) (2019) 356–371.
[30] R. Gondo, O.D. Kolawole, Institutional factors engendering dissonance between customary and statutory institutions in water access in the Okavango Delta, Botswana, Sustain. Water Resour. Manage. 99 (6) (2020), doi:10.1007/s40899-020-00458-9.
[31] R. Gondo, O.D. Kolawole, J.E. Mbaiwa, Dissonance in customary and statutory water management institutions: issues of cultural diversity in the management of water resources in the Okavango Delta, Botswana, Environ. Devel. Sustain. 21 (3) (2018) 1091–1109.
[32] Statistics Botswana, Population and Housing Census, Government Printer, Gaborone, 2011.
[33] Government of Botswana, Botswana Draft Water Bill, Government Printers, Gaborone, 2005.
[34] G.D. Gregory, M.D. Leo, Repeated behaviour and environmental psychology: the role of personal involvement and habit formation in explaining water consumption 1, J. Appl. Soc. Psychol. 33 (6) (2003) 1261–1296.
[35] M. Grindle, J. Thomas, Public Choices and Policy Change: The Political Economy of Reform in Developing Countries, John Hopkins University Press, 1991.
[36] T. Gumbricht, T.S. McCarthy, C.L. Merry, The topography of the Okavango Delta, Botswana, and its tectonic and sedimentological implications, S. Afr. J. Geol. 104 (3) (2001) 243–264.
[37] R.H. Hawkins, J. Seager, Gender and water in Mongolia, The Professional Geographer 62 (1) (2010) 16–31.
[38] D. Hemson, Accelerated delivery? Rural women and water, Agenda 16 (45) (2000) 54–65.
[39] F.J. Jordán-Cuebas, U. Krogmann, C.J. Andrews, J.A. Senick, E.L. Hewitt, R.E. Wener, … D. Plotnik, Understanding apartment end-use water consumption in two green residential multistory buildings, J. Water Resour. Plann. Manage. 144 (4) (2018) 04018009.
[40] K. Kadisa (2013) Willingness to pay for improved water supply services in Phaleng ward, Shoshong, Botswana: application of contingent valuation method (CVM) MSc in integrated water resources management faculty of engineering department of civil engineering University of Zimbabwe Master Thesis, December 2013, Mount Pleasant Harare.
[41] F. Kapfudzaruwa, M. Sowman, Is there a role for traditional governance systems in South Africa's new water management regime? Water SA 35 (5) (2009).
[42] E. Kelly, K.F. Shields, R. Cronk, K. Lee, N. Behnke, T. Klug, J. Bartram, Seasonality, water use and community management of water systems in rural settings: qualitative evidence from Ghana, Kenya, and Zambia, Sci. Total Environ. 628 (2018) 715–721.
[43] D.L. Kgathi, G. Mmopelwa, B. Mashabe, K. Mosepele, Livestock predation, household adaptation and compensation policy: a case study of Shorobe Village in northern Botswana, Agrekon 51 (2) (2012).
[44] M. Kirkels, Change in agriculture along the Okavango River in Botswana, in the particular under the influence of government policies. Agrarian Change in Ngamiland Communal Second Development Area, Western Part., Utrecht the Netherlands. (1992).
[45] A.N. Kolmogorov, On tables of random numbers, Sankhyā (1963) 369–376.
[46] K. Kujinga, C. Vanderpost, G. Mmopelwa, P. Wolski, An analysis of factors contributing to household water security problems and threats in different settlement categories of Ngamiland, Botswana, Phys. Chem. Earth, Parts A/B/C 67 (2014) 187–201.
[47] T.J. Larson, The hambukushu migrations to Ngamiland, African Soc. Res. 11 (1971) 27–49.
[48] T.J. Larson, Kinship terminology of the Hambukushu of Ngamiland, Botswana Notes Records 9 (1977) 85–89.
[49] M. Loh, P. Coghlan, Domestic water use study in Perth, Western Australia 1998-2001, Water Corporation (2003) In http://www.energyrating.gov.au/library/pubs/wa-wateruse.pdf . Accessed: 17/05/2019.
[50] A.A. Makki, R.A. Stewart, C.D. Beal, K. Panuwatwanich, Novel bottom-up urban water demand forecasting model: revealing the determinants, drivers, and predictors of residential indoor end-use consumption, Resour. Conserv. Recycl. 95 (2015) 15–37.
[51] W.R. Masamba, M.J. Gondwe, M. Murray-Hudson, Physicochemical controls of diffusive methane fluxes in the Okavango Delta, Botswana, Wetlands Ecol. Manage. 23 (4) (2015) 617–635.
[52] I. McAllister, Party elites, voters and political attitudes: testing three explanations for mass-elite differences, Can. J. Politic. Sci./Revue canadienne de science politique 24 (2) (1991) 237–268.
[53] C. Milzow, L. Kgotlhang, P. Bauer-Gottwein, P. Meier, W. Kinzelbach, Regional review: the hydrology of the Okavango Delta, Botswana—processes, data and modelling, Hydrogeol. J. 17 (6) (2009) 1297–1328.
[54] L. Mishra, Focus group discussion in qualitative research, TechnoLearn 6 (1) (2016) 1–5.
[55] T. Muyambo, R.S. Maposa, Linking culture and water technology in Zimbabwe: reflections on Ndau experiences and implications for climate change, J. Afr. Stud. Devel. 6 (2) (2014) 22–28.
[56] C. Nauges, A. Thomas, Privately operated water utilities, municipal price negotiation, and estimation of residential water demand: the case of France, Land Econ. (2000) 68–85, doi:10.2307/3147258.
[57] D.C. North, A transaction cost Theory of Politics, J. Theor. Politics 2 (4) (1990) 355–367.
[58] H. Nguyen, N. Biskupska, S. Mortensen (2019). Exploring gender dimensions of water insecurity and governance in the Lower Mekong Region.
[59] L.K. Nkonya, Customary laws for access to and management of drinking water in Tanzania, Law Env't and Dev. J. 2 (2006) 50.

[60] S. Nurmasitah, A. Faridi, A.B. Utomo, P. Astuti, in: The efficacy of focus group discussion in teaching ESP speaking skill for prospective vocational school teacher. In *AIP Conference Proceedings*, Vol. 1941, AIP Publishing LLC, 2018.
[61] E. Ostrom, Governing the commons: The evolution of institutions for collective action, Cambridge university press, 1990.
[62] E. Ostrom, W.F. Lam, M. Lee, The performance of self-governing irrigation systems in Nepal, Hum. System Manage. 13 (3) (1994) 197–207 Vanderlinden J. (1989). Return to legal pluralism: twenty years.
[63] O. Owomoyela, Culture and Customs of Zimbabwe, Greenwood Publishing Group, 2002.
[64] J. Pakulski, The development of elite theory, in: The Palgrave Handbook of Political Elites, Palgrave Macmillan, London, 2018, pp. 9–16.
[65] J. Panthi, K.R. Khatiwada, M.L. Shrestha, P. Dahal, Water poverty in the context of climate change: a case study from Karnali river basin in Nepal Himalaya, Int. J. River Basin Manage. 17 (2) (2019) 243–250.
[66] M.E. Renwick, S.O. Archibald, Demand-side management policies for residential water use: who bears the conservation burden? Land Econ. (1998) 343–359.
[67] P. Rogers, A.W. Hall, *Effective water governance* (Vol. 7), Stockholm: Global Water Partnership, 2003.
[68] Y. Roh, G. Heo, S.E. Whang, A survey on data collection for machine learning: a big data-ai integration perspective, IEEE Trans. Knowl. Data Eng. (2019).
[69] O.L.G.A. Rostapshova, D.A.N.A.E. Roumis, M.I.K.E. Duthie, J. Alwang, Impacts of an urban water system investment on health, well-being and poverty, Social Impact, World Bank, 2018.
[70] F.J. Sarabia-Sánchez, C. Rodríguez-Sánchez, Attitudes towards saving water, household structural characteristics and water consumption, Psychology 4 (2) (2013) 115–137.
[71] H.H. Savenije, P. Van Der Zaag, Water as an economic good and demand management paradigm with pitfalls, Water Int. 27 (1) (2002) 98–104.
[72] W. Shan, Community, Leadership, and Mass-Elite Relations: An Investigation into Political Leadership in the Chinese Villages in the Reform era, Texas A&M University, 2007.
[73] E. Shoko, M. Naidu, Peace-based informal practices around shared communal water resources in Tyrone village of Mhondoro-Ngezi, Zimbabwe, Int. J. African Renaissance Stud.-Multi-, Inter-Transdisciplinarity (2018) 1–15, doi:10.1080/18186874.2018.1533383.
[74] E.R. Silver, S.B. Chadwick, S.M. van Anders, Feminist identity in men: Masculinity, gender roles, and sexual approaches in feminist, non-feminist, and unsure men, Sex Roles 80 (5-6) (2019) 277–290.
[75] L.J. Simms, K. Zelazny, T.F. Williams, L. Bernstein, Does the number of response options matter? Psychometric perspectives using personality questionnaire data, Psychol. Assess. 31 (4) (2019) 557.
[76] T. Tlou, A history of Ngamiland 1750 to 1906: the formation of an African state, Macmillan Botswana, Gaborone, 2000.
[77] A. Smith, M. Ali, Understanding the impact of cultural and religious water use, Water Environ. J. 20 (4) (2006) 203–209.
[78] C. Tortajada, Professional women and water management: case study from morocco: a water forum contribution, Water Int. 28 (4) (2003) 532–539.
[79] H. Tropp, Water governance: trends and needs for new capacity development, Water Policy 9 (S2) (2007) 19–30.
[80] R.M. Tshimanga, Traditional values and uses of water along the upper Congo River (Chapter Two: 23–54), in: T. Oestigaard (Ed.), Water, culture and identity: Comparing past and present traditions in the Nile Basin Region. Nile Basin Research Programme. BRIC, Bergen: University of Bergen, 2009.
[81] B. Van Koppen, R. Namara, C. Safilios-Rothschild, Reducing Poverty through Investments in Agricultural Water Management: Poverty and Gender Issues and Synthesis of Sub-Saharan Africa Case study Reports, 101, IWMI, 2005.
[82] B. van Koppen, B. Schreiner, Viewpoint-A Hybrid Approach to Statutory Water Law to Support Smallholder Farmer-Led Irrigation Development (FLID) in Sub-Saharan Africa, Water Altern. 12 (1) (2019) 146–155.
[83] H.J. Van Zyl, J.E. Van Zyl, L. Geustyn, A. Ilemobade, J.S. Buckle, Water Research Commission Report, Water Research Commission Report, 06, 2007 1536/1).
[84] Water Utilities Cooperation (2017) Potable water and waste water tariffs review www.wuc.bw wuc-content > our-tariffs- Accessed on 16 July 2020
[85] A. Wiek, K.L. Larson, Water, people, and sustainability—a systems framework for analyzing and assessing water governance regimes, Water Resour. Manage. 26 (11) (2012) 3153–3171.
[86] X. Yu, R. Ghasemizadeh, I. Padilla, J.D. Meeker, J.F. Cordero, A. Alshawabkeh, Sociodemographic patterns of household water-use costs in Puerto Rico, Sci. Total Environ. 524 (2015) 300–330.