

# Understanding Regulation of Non-Utility Water Supply Systems from the Household Perspective

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## Research Article

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# Abstract

## Purpose

The article seeks to examine the understanding of regulation of Non-Utility Water Supply Systems (NUWSS) from perspective of water users in households, the behavioural dimensions of regulation and aspects of the non-utility water supply system that can be regulated.

## Research Method/Design

The theory of planned behaviour was used to identify determinants to regulatory compliance across the groups of indicators identified for the regulation of water supply systems. To understand household perception of regulation, interviews were conducted, with questions put to water users in households. A qualitative research approach was adopted, using interviews, and focus group discussion with water users in households.

## Findings

The findings indicate that households hold varied perceptions on regulation across the components of the water supply system. Specifically, regulatory compliance by households was influenced by crucial elements such as preferential compliance to regulation within specific aspects of the water supply system.

## Limitations and implications

The inference from this research is based on households from one state in Nigeria. Further exploration of this research in multiple cities and states would widen the applicability of the findings in different contexts.

## Originality/value

The study examines regulation and regulatory compliance from the perspective of households who predominantly use Non-Utility Water Supply System (NUWSS) in sub-Saharan Africa.

## 1. Introduction

The concepts of regulation, regulatory compliance and governance, has been a focus for research and practice in water supply for many years and the relationship between governance and sustainable water supply has been adjudged as important (Tropp 2007; Tortajada 2010a, b; Grigg 2011a, b; Tortajada 2014; Kayaga and Smout 2011). A key component of water governance regimes is regulation, which often is understood as control measures from government (Rouse 2013). However, the synthesis on over 109 articles in the literature by Koop and Lodge (2015), indicates the understanding of regulation in water supply seems to be biased towards public water supply. It is on the premise of this biased understanding

of regulatory governance and non-inclusion of alternative supply sources that understanding regulation and its compliance in Non-Utility Water Supply System (NUWSS) is advocated in this research.

The perception of regulation in NUWSS involves the water users in households being offered a greater degree of responsibility and held to accountability throughout the water supply system. Regulation targets changing individual or organisational behaviour towards outcome such as solving societal and economic problems (Coglianese 2012). However, from descriptions of NUWSS (Sutton 2009; Butterworth et al. 2013), achieving expected outcome such as improved and sustainable water supply in NUWSS seems to contrast with processes, techniques and control emphasised in utility water supply.

To enable regulation and its compliance in UWSS, certain characteristics within the UWSS which may be applicable for NUWSS have been identified as relevant. Notably responsible stakeholders in water supply need to understand the quality of service, economic and financial regulation, competition, demography and customer, and environmental aspects of water supply (Marques 2010; Rouse 2013; Alegre et al. 2017). Also, the stakeholders place emphasis on the need for quality, reliability of service, customer service, sustainability, and economic efficiency (Alegre et al. 2017). Although achieving regulatory compliance through inclusion of households using NUWSS can be challenging it is argued that such inclusion is relevant for sustainable water supply (Fisher 2018), especially in NUWSS.

The advantages of regulatory compliance are well documented with regulatory compliance enabling regulators to pressure utilities to raise efficiency and transparency (Alegre et al. 2017). In this paper, regulatory compliance implies adherence by stakeholders to guarantee that water supply system meets certain threshold for potable water consumption in households. Alegre et al. (2017) claim that regulatory compliance of water users in households is imperative to achieve sustainable water supply, and the International Water Association identified how regulatory compliance could influence the assessment of operators of water supply system. Also, Bandura (2006) suggested self-efficacy offers more relevance mainly when the tools for self-regulation are not yet developed, especially in 'low- and middle-income countries', such as those in Sub-Saharan Africa. The current trend in water supply in sub-Saharan Africa has raised the need to focus on NUWSS and address the issues on regulation in the form of systems from source to supply, which offers a form of applying regulation with an understanding of the context of NUWSS (Ikpeh et al. 2017).

Whereas there are immense advantages of regulatory compliance to utility water supply systems operators, regulators and governments, the subject of regulation and regulatory compliance still appears to be poorly understood concept within the context of NUWSS (Ikpeh et al. 2017). The aim of this research is to examine the understanding of regulation and its compliance in Non-Utility Water Supply Systems from perspective of households. The paper explores attitudes, subjective norm, and self-efficacy of households towards regulation and regulatory compliance. The paper will focus on the behavioural dimension of regulation and on household perception of regulatory compliance from their current practice and anticipation of a regulatory policy. An approach employing interviews and focus group discussions was adopted for this study. The remaining part of the paper presents the perspectives,

research method, findings, and discusses the findings to draw conclusions and implication for regulation and regulatory compliance in NUWSS.

## **2. Theoretical Perspectives On Regulatory Compliance In Non-utility Water Supply System**

Literature has seen varied definitions of regulation. Stigler (1971) referred to regulation as a range of policy instrument, Mitnick (1980) considered regulation as an administrative policing of a private activity concerning a rule set in the public interest, Selznick (1985) stated regulation as sustained and focused control by a public agency over activities valued by a community, while the perception of regulation by Majone (1996) as a tool of governance has probably prompted more focused definitions. These definitions identified regulation as a measure of controlling deficiencies mostly in commercial or public settings, and the government or state as a significant stakeholder in the process of regulation.

Further, despite the synthesis on over 109 articles in the literature by Koop and Lodge (2015), they were silent on the case for the regulation of individuals as opposed to the private sector and public sector. This exclusion might reflect a lack of interest on real-world problems of considering regulation and governance of individual activities as a criterion for research. For instance, would individual regulating practices be relevant or needful? Kitching et al. (2015) cautioned that regulation is a dynamic force that could enable, as well as constrain performance or generate contradictory performance effects. These cautions suggest the need for a dynamic model of regulation that is both responsive and coherent to the activities to be regulated in settings such as NUWSS.

An understanding of the relationship between the ability and intention of households towards compliance to regulatory arrangements in non-utility water supply in theory and practise appears to be limited. Meanwhile, regulatory compliance is hypothesised to relate to internal capacities of the individual and external influences of the environment, linked by the socialisation process (Sutinen and Kuperan 1999). Also, cognitive and social learning theories which focus on the individual, stages of development, and conditioning effects of the environment explain the socialisation process (Bandura 1969). For instance, self-efficacy theory has been expounded as cognitive-social learning framework useful in treatment of abnormal conditions in several contexts, with self-efficacy described as perception of capabilities and efforts of an individual towards a goal (Bandura 1997). Expanding on variables that influence behaviours, Ajzen and Fishbein (2010) suggested that as long as attitude, subjective norm and perceived behavioural control or self efficacy were compatible with intention under consideration, accurate prediction of behavioural intention can be achieved. However, the application of these theories in relation to regulatory compliance in NUWSS remains elusive among scholarly articles.

Regulatory compliance appears to be unevenly studied in literature covering water supply and especially in NUWSS. Many previous attempts on studies related to regulatory compliance appears to be limited to economic activities, and to utility water supply system. Regulatory compliance has focused on deterrence or control model which seeks to determine compliance through sanctions, but this only offers partial

explanation for regulatory compliance (Sutinen and Kuperan 1999; Grigg 2011a). Majorly, the focus on such compliance has assumed compliance within the water quality aspect of the water supply system. More assessments and research on compliance in other aspects and requirements of the water supply system such as personnel, sourcing, financing is critical in understanding and implementing regulatory compliance at household level.

### **3. The Household Perspective On Regulatory Compliance**

Most households in Nigeria meet their demand for water from NUWSS such as boreholes installed in their premises. This scenario raises concerns for the safety of supply, and sustainability of the water supplied from such sources. While previous studies have examined regulatory compliance in utility water supply from the household perspective, the empirical investigation of regulatory compliance has generally emphasised regulator and operator perspectives (Sutinen and Kuperan 1999; Clark and Finley 2007; Grigg 2011a). Few articles examined regulatory compliance in households using NUWSS, but they focused on deterrence or control model which seeks to determine compliance through sanctions (Sutinen and Kuperan 1999; Grigg 2011a), conservation behaviours at the source (Clark and Finley 2007) and environment issues (Workneh et al. 2012).

Regulations cover diverse aspects of the water supply system and aim to guarantee that water supply system meets certain threshold for safe and potable water consumption in households. Most regulatory criteria in water supply have focused on; quality of service, economic and financial regulation, competition, and environmental aspects of water supply (Marques 2010; Rouse 2013; Alegre et al. 2017). However, given that regulatory compliance in household is essentially a behavioural matter it is necessary to assess regulatory compliance by asking households if they can self-regulate and comply, rather than relying on the opinions of regulators and utility operators. Compliance is essential to achieve expected outcomes, and a better understanding of compliance to regulatory arrangement could improve such outcomes (WHO and UNICEF 2012). As such, governments and regulatory agencies need operators of water supply systems to comply with requirements for water supply.

It is probable that regulators, utility operators and households will offer separate perspectives on the meaning and benefits of regulatory compliance, and therefore offer different dimensions to the understanding of the issues around the concept. While it is evident that regulatory compliance is a behavioural issue (Clark and Finley 2007), this paper focuses specifically on the perceptions of regulatory compliance from the perspective of the household, exploring the contextual factors in order to add detailed insight on this perspective. Moving away from the utility focused regulation perspective towards a focus on NUWSS aids closer examination of the meaning and benefits of regulatory compliance for households. This would fill the knowledge gap in regulatory compliance by households using NUWSS. Undertaking specific examination of this behavioural perspective can facilitate an understanding of the household perceptions of regulatory compliance in NUWSS.

### **4. Research Methods**

The methodology used in previous studies in regulatory compliance have tended to draw inferences from quantitative and qualitative research based on perspective of the operator or regulator (Grigg 2011a, b); Akpabio and Ansa 2013; Rouse 2013). When inferences are drawn from households, it has been limited to water quality or payment of bills to operators (Marques 2010). Similar to the utility supply system, NUWSS involves sourcing, treatment, storage, distribution, and consumption. The study thus considers regulation of NUWSS as requiring compliance in aspects such as: quality, personnel, financial transactions, physical assets, and maintenance. Examining a social issue as regulatory compliance in NUWSS using the case study method seems appropriate as the issue is a contemporary phenomenon, a case-based inquiry and the techniques to study the cases are not limited by intellectual boundaries and includes both quantitative and qualitative methods (Schwandt and Gates 2018; Yin 2003). It has been argued that adopting qualitative research methods in this empirical study would lead to an understanding of regulatory compliance in NUWSS.

The qualitative research method involved semi-structured interviews and focus group discussions. The households were not required to self-regulate, neither were there relevant laws and regulations introduced during the data collection stages. The study thus examines households' perspectives of regulatory compliance in their non-mandatory and non-obligatory state. All households using NUWSS was considered for data collection, and households were selected to reflect tenure on property. The properties selected were examples for households using NUWSS. Households selected own storage tanks, submersible pumps, and pipe connections from the pump to the property. Adult individuals in these households were data sources for the households. In framing a population without a list, with an estimate of the size of the population, sampling frame can be drawn from appropriate number from the population (Blair et al. 2014). The households were purposively selected from a mixture of bungalows, storeyed buildings, flats, terraces and mansions.

The respondents for interviews consisted of water users in twenty-nine (29) households (20 landlords, 9 tenants). Information on tenure on property was obtained with landlords as owners of the property and occupied by themselves for which no rent is paid, and tenants as residents in households who are renting the property from a landlord. For the focus group discussion, respondents consisted of seven (7) households. These data collection methods were necessary to correlate perception of households in NUWSS to regulatory arrangements within the setting. The questions asked during the interview covered a variety of; quality of service, personnel, water resources, personnel, physical assets, operational, and economic and financial aspects of regulation. The initial list of questions was used in a pilot interview for improvements before conducting the interview. The questions are presented in Appendix 1. The researcher reiterated the aim of the research and explained the need for information sought from the interviewee and requested permission from interviewees to record the interview on a portable mobile device. Interviews lasting approximately 20 to 30 minutes was conducted with households who own or use water from NUWSS and who accepted to be interviewed.

In addition to the interviews with households, a focus group discussion was held with households, the agenda is in Appendix 2. Essence of the focus group was to triangulate the information obtained from

the interviews. Analysing qualitative data after transcribing verbatim was approached in two ways using NVIVO version 12 software. Deductively using a theoretical perspective as guide to formulate structural coding plan, and inductively using the thematic analysis model to aggregate themes and dimensions (Yin 2018; Guest et al. 2012; Thomas 2006) to capture perception of water users in households on regulation.

## 5. Findings

### 5.1 Attitudinal Relevance of Regulations

The findings indicate the attitudinal relevance that households placed on the regulation of NUWSS as requiring compliance in aspects such as: quality, personnel, financial transactions, physical assets, and maintenance of their NUWSS. Instituting and detailing regulations to cover the unique parts of the NUWSS can play a crucial role in regulatory compliance. Findings from the households indicate that one of the significant constraints to regulatory compliance was the perception of lack of the regulations covering the different parts of the NUWSS. The attitude arising from perception of lack of regulation and agencies supervising the regulations seem to influence regulatory compliance on aspects such as: treatment, maintenance, re-use, and obtaining of licences among others. The consequence of lack of regulation was indicated by a respondent citing:

*Because there is no regulation, anything that comes out is believed to be good and people drink it...I don't drink the water, I use it for other domestic cores.*

The lack of regulation or the perception of it being ambiguous can influence regulatory compliance by households irrespective of self-efficacy or tenure. If the households feel the regulations are not compatible with NUWSS, the non-compliance with regulations then becomes a constraint to the overall aim of the regulatory agencies. When the question on the relevance of regulation on water quality was put to the households using NUWSS, majority of households perceived the regulation of water quality in NUWSS as relevant. This perception could be as a result of existing regulations and guidelines on utility supply or sachet water production which focuses on quality of the water. The positive perception of households was confirmed with comments such as:

*Yes, it is good. Quality control is very important. Some of these boreholes they are not properly drilled so it is important to also monitor what we generate from the borehole.*

The positive perception of regulation on quality even across tenures on the property seemed to stem from the consensus held by both groups on the health of households as can be seen in their responses. Conversely, the households that perceived regulation on water quality as not relevant hinged such perception on fear of either: excessive taxation, lack of capacity by the government, or just wanted the government agencies to act only on advisory roles with no enforcement or control. The perception of households was confirmed with comments such as:

*For now, I don't think it is necessary because of the situation in the country. Because I know if Government come to regulate, they will impose some taxes on us...I may say the Government may advise if we are not doing the right things. If it is the real borehole that is tested, done by the professionals, maybe they say we should be using filter or whatever. But any other thing, I don't think there is need for it.*

When the relevance of regulation on physical assets like storage tanks, taps, location of water supplied from boreholes was put to the households using NUWSS majority of households indicated they would support such regulation in NUWSS. The positive perception of households was confirmed with comments such as:

*Most of the storage tanks are not good, like the ones they use iron sheets which later rust, and is not good for drinking or consumption, but water tanks that can stand the test of time should be the type that should be in use, although it may be costly. But government should really effect some regulations so these types of tanks should be used for the health or having in mind the health of the people that are using the borehole.*

Conversely, the households that perceived regulation on physical assets as not relevant hinged such perception on outright rejection of regulation, absence of guidance, intrusion, concern it would not be enforced across income levels, and lack of capacity to enforce it. Such perception of households was confirmed with comments such as:

*I think that one is private, it should be left for the owners to carry out because all hands are not equal. If they set up a standard now say assets like tank stand should be 20 meters above the ground, not everybody will be able to carry out such projects...That may not be necessary. The storage tank is domestic property of the one who has it. They should regulate the borehole because of environmental issue. They should leave the domestic part of it.*

When the question on the relevance of regulation on maintenance was put to the households using NUWSS, majority of households indicated they would support such regulation in NUWSS. The positive perception of households was confirmed with comments such as:

*I think they should be maintained and for the regulations, users have to be sensitised on how to maintain it as it is important...I think there is relevance because many owners of borehole don't know how to monitor it. Sometimes when it breaks down, they don't know what to do.*

Conversely, the households that perceived regulation on maintenance as not relevant hinged such perception on maintenance being an individual household prerogative, outrightly unnecessary, the extent of challenges is beyond remedy, and excessive dictation from the government. The negative perception of households was confirmed with comments such as:

*I will think it is a personal thing, but if there are minimal and all these facilities are available to people, I think those regulations will work for that one. Because if you have your own thing, you want to do what you like... No because I can do that on my own.*

When the question on the relevance of regulation on personnel aspects especially training was put to the households using NUWSS, majority of households indicated they would support such regulation in NUWSS. The positive perception of households was confirmed with comments such as:

*Training is proper if it will be implemented. You train them, while you monitor them to implement those simple things you train them on.*

Conversely, the households that perceived regulation on personnel aspects such as training as not relevant hinged such perception on training to be: the choice of an individual, not a good idea, and not too vital an area to require regulation on it. The perception of households was confirmed with comments such as:

*People that own boreholes should be able to take care of it by themselves, it doesn't really require training...I do not think that it's too vital on training. Because in my house, if I have a borehole, and I pump my four tanks and they are filled, I put off my borehole. Now the reason is this, you have your borehole and if it gets burnt, you will use your money to fix that...So self-discipline comes in handy, the government cannot go house by house and tell you when and when.*

However, when the question on the relevance of regulation on financial aspects especially paying for drilling license and monitoring was put to the households using NUWSS, there was no clear support of households for the regulation of financial aspects in NUWSS. Across classifications such as tenure on the property, there was still no clear distinction of perceptions. For landlords, attitudes on relevance of regulation on financial aspects were expressions of expectations held on the regulation as a tool of control for government to detect the incompetent service providers as well as the genuine ones; expression of need to align licensing for NUWSS with other personal items such as cars; and decried if licensing becomes too much levy or unaffordable. For tenants, those that found it relevant linked licensing as a tool for the government to generate income. The mixed perception of households was confirmed with comments such as:

*I think to avoid indiscriminate drilling and for the purpose of ecology that is the effect of drilling on our ecosystem, the Government should. I will welcome the idea that before boreholes are drilled, the site should be inspected and the owners licenced... The monitoring, I feel there should be regulation for that. Even though somebody has drilled it, there should be regulation on monitoring it and seeing it is up to standard.*

Conversely, the households that perceived regulation on financial aspects as not relevant hinged such perception on; rejection of such regulation, the perception that drilling should be free, NUWSS is a personal thing and not for the government to be interested. Furthermore, the households believed they are already helping the government sort its inefficiency, and as such should not be tasked on a further financial obligation to the government. The perception of households was confirmed with comments such as:

*I think that drilling boreholes should be free. You cannot pay for drilling boreholes because it doesn't stand as source of income...reason is the government did not provide drilling machine for me free of charge. I had gone to buy that, and I drilled the borehole by myself. When you have the regulations, it comes in when the government has given you all of these things...So if people are providing water, they shouldn't be taxed, they shouldn't be bothered after all they are helping the government to ameliorate the inefficiency of governance.*

It was noticed that households occupied by tenants are where most found regulation on financial aspects as not relevant, castigating government's inability to provide water, and seeing it as an intrusion.

## **5.2 Misconceptions**

Evidence of misconceptions which indicates limiting beliefs about what regulatory compliance covers in NUWSS, was identified. The households through their comments showed the level of misconceptions in different aspects of NUWSS. The misconceptions on regulatory compliance based on belief about abundant underground water include:

*We don't because we have water in abundance...we don't lack the water and it is free. Even when we dispose it, it is still going underground, so it filters it and goes back to the reserve. So, we don't see need for that...I think it's basically the general availability of water in the area...We always believe that we have enough water under the bed of the whole community in Nigeria.*

Further, the misconception was identified on perceptions about the quality of water from groundwater sources. The households both tenants and landlords believed the soil and rock formations would have filtered the water and eliminated contamination from the water. Thus, regulatory compliance in water treatment seemed neglected as households are just after fetching the water with no consideration to purification. For instance,

*It is believed to be pure and drinkable since it is coming from lower the ground... I believe that the water is clean.*

Also, the misconception was identified on the reuse of water in NUWSS. Here, aesthetics, hygiene, and outright rejection of reuse because of the constant flow of water drove the beliefs about the reuse of water in NUWSS. Thus, reuse was considered:

*No, we don't. I don't reuse. Once water is used, I want to believe such water is not good again for re-usage... The water I use for bathing? No... No, it is not necessary because I have constant water running, I cannot use the waste one.*

Further misconceptions are held about the use of water meter in NUWSS. Most households, both tenants and landlords indicated that use of meters in NUWSS was not necessary either because of cost and

durability or as NUWSS served only an individual household. As such, use of meter was only considered an individual decision and only necessary in a multi-occupier property. As such, comment like:

*I don't think it is necessary for water meter... No, I don't use water meter. I don't think it is useful... Since it is my borehole. Unless it is Government borehole where they can come and give us a bill. But this one, we are not billing anybody, it is something we built for ourselves. Therefore, we don't need any meter.*

Misconceptions appeared to be held in other activities of NUWSS such as cleaning of tanks where the misconception was that only human beings physically going into the tanks to clean was the means of cleaning tanks.

## 5.3 Promoting Compliance

On the practice of promoting compliance, households indicated prerequisites are required before the households can engage in recommendations from promotions. Both tenants and landlords expressed the essence of having as prerequisites; bye-law specifying exactly what regulations of the lot available in the water supply that is specific to NUWSS, the enforcement of the by-law, leadership commitment from the government on compliance, and awareness such as regulatory bodies giving information to households. Information such as those on training, water monitoring and licensing that can improve the quality of water obtained from the NUWSS. Promoting compliance was captured in comments such as:

*if the regulatory organisations are going to work, they need to license these installations so they can be able to regulate it properly.*

Besides these strategies, landlords also suggested the introduction of initiatives to assist households even before the boreholes are drilled. Initiatives such as requirements for drillers to be licensed before engaging in drilling for water. Moreover, initiatives for subsequent processes such as when to treat the water, as these will give the assurance on the water quality. Also, initiatives such as those applicable to automobiles:

*And I think the government should have regulated bodies with strict step by step guide on how to procure, drill, test and also maintain the borehole.*

However, promoting regulatory compliance seemed to be influenced by perceptions of water as abundant in the area.

Motivations and constraints gleaned from respondents indicated a willingness by households to comply to regulations provided there is the corresponding action by another stakeholder. The reciprocal motivation was evident in three distinct ways; collaboration on regulatory compliance, initiating support from government, and role of other stakeholders. The constraints reported included additional cost for compliance, institutional constraints such as absence of regulation and limited capacity, as well as resistant to change.

## 5.4 Findings on Water Governance in Uyo, Nigeria

The findings reported in this section were reported under policies and institutions. In terms of guiding policy for water supply, the Akwa Ibom State Government at the moment does not have any policy on water supply at the moment. Regulations governing water supply in Nigeria, as well as in Uyo, is fragmented under different agencies. As with the Federal Government, the Government of Akwa Ibom State sought to amend the State Water Resources Policy, with a bill sent to the National and state legislatures for passage into law. However, unlike other bills initiated at the beginning of the administration, the bills on water sector were not passed into law at the end of the legislative period 2015-2019 by both the National and State Assemblies. Currently, some policies and periodic guidelines developed by Ministries, Departments and Agencies are in use in the water sector. Examples of the policies and guidelines include the Nigerian Standards for Drinking Water Quality (NSDWQ) (SON2007), National Water Supply and Sanitation Policy 2000 (FMWR 2019), National Framework for Monitoring and Evaluation for Water Supply and sanitation, and Regulatory Handbook for Water Supply Services. The Water Supply Sanitation and Hygiene (WASH) policy has remained in draft since 2016.

In terms of institutions, several Ministries, Departments and Agencies seems to be involved in the water sector in Akwa Ibom State, Nigeria, though at various degrees. However, there is no stability in responsible agency for water supply. Over the course of this research, responsibility for supervision of water sector has been moved over different Ministries. First, responsibility was delegated to Ministry of Agriculture and Rural development. Next, responsibility for supervision was moved to Ministry of Special Duties, then Bureau of Political, Legislative Affairs and Water Resources, and recently to Ministry of Lands and Water Resources.

Based on these descriptions by the households, insights on regulating NUWSS can be gained. The findings highlighted the extent to which regulation is understood by households. It appears households would welcome NUWSS to be regulated as the findings reported pointed to attitudes mediating on certain factors that could influence regulation and regulatory compliance in NUWSS.

## 6. Discussion

The relevance of understanding regulation by households and influence of such understanding on regulatory compliance in water supply has been emphasised in previous studies (Clark and Finley 2007; Koop and Lodge 2015). This paper explores the concept of regulation and regulatory compliance from the perspective of households using NUWSS. The focus is on behavioural aspects of regulation and regulatory compliance by exploring the attitudinal relevance that household place on aspects of NUWSS to be regulated. By emphasising the behavioural aspects, the understanding of regulation and regulatory compliance is possible from the household perspective in a holistic approach rather than relying on reports from regulators. However, it is worth stating that findings presented in this paper covers households from one particular state in Nigeria and subsequent research may explore these issues from other perspectives, location and context.

The focus on household in this study on regulatory compliance offers an alternative perspective to the notion that research on regulation of water supply should be based on utility water supply, and perspective of operators and regulators of such system in sub-Saharan Africa. Using a qualitative approach enabled the households to articulate their understanding of regulation and regulatory compliance from their perspective. This is especially noteworthy as the term regulation and regulatory compliance appears not applicable to households in the sense used for utility water systems.

The importance of household involvement in improving regulatory compliance in UWSS has been emphasised in the literature (for instance, Clark and Finley 2007). This research explored understanding of regulatory compliance of Non-Utility Water Supply System (NUWSS). As challenges in water governance is said to be less technical and more due to governance and management lapses (Grigg 2011a, b; Kayaga and Smout 2011; Tropp 2007; Tortajada 2010b), the focus at household level appears to be related to behaviours. As such, there is focus on behavioural factors influencing regulatory compliance from the perspective of the households, and whether the households understand the relevance of regulatory arrangements in NUWSS.

Based on the aspects of NUWSS such as; quality, personnel training, financial transactions, physical assets, and maintenance, qualitative data collection sought to know how households identified with regulatory arrangement in NUWSS. Besides the requirement to perform financial transactions, respondents overwhelmingly acknowledged the relevance of regulation on water quality, physical assets, maintenance, and training to use their NUWSS. In a preliminary study, Ikpeh et al. (2017) reported households had very low level of awareness of existing institutional arrangements on NUWSS. Despite acknowledging relevance of regulation on aspects of NUWSS, disaggregation of the level of relevance showed that institutional arrangement across the aspects of NUWSS was required to support regulatory compliance by households.

Further, findings showed the frequent changes to the Government ministry that supervises water supply has only increased the uncertainty among stakeholders. As forms of regulation are mostly derived from instruments laid out by Governments (Kitching et al. 2015), such uncertainty arising from frequent changes in government ministries was not helpful for households to identify regulations in their NUWSS. The findings indicate that the households do not recognise the term “regulation”, nor do they reference the term “compliance” in relation to the NUWSS on their property. Most households could not identify responsible agency for the aspect of regulation in their NUWSS. Also, existing regulations are mostly focused on utility supply, while the guidelines relevant to households only focus on quality of the water. In order to influence regulatory compliance in NUWSS, households using NUWSS need to understand the main aspect of a water supply system to be regulated.

In understanding regulation and regulatory compliance in NUWSS, a relevant definition of NUWSS is timely. Perhaps drawing from the definition for UWSS and recognising the context of NUWSS would clarify grey areas in understanding regulatory arrangements in NUWSS. NUWSS in this research is viewed as water supplies independent from utilities which include water supplied from boreholes whether in

commercial or private property. It is worth noting that the definition set above is not exhaustive but represent an addition to definitions in literature which point to a cross-cutting theme: the notion that the water in sub-Saharan Africa is mostly not supplied from a utility. However, in contrast to the existing definitions, this research clarifies any ambiguity to the definition of household water supply system by using the term “non-utility water supply system”. This term NUWSS not only clarifies the boundaries for the research, it also simplifies the understanding of the term to both professionals and importantly the water users in households.

In the context of water supply, and particularly NUWSS, the social control perspectives in the definitions become more highlighted, and as such, this research approached regulation as efforts by stakeholders to intervene with mechanisms to influence behaviour in non-utility water supply system. This definition seeks to broaden regulation beyond the notion of public or government agency controlling private activity by extending the notion of private activity beyond economic considerations of private companies and corporations to private as in individuals such as households. The adopted definition is in recognition of the finding that distinct types of intervention might be required for regulating NUWSS. This line of thought aligns with a suggestion by Koop and Lodge (2015) about need for broader conception of regulation that incorporates direct and indirect forms of intervention.

Lastly, the adherence by stakeholders to guarantee that water supply system meets certain threshold for safe and potable water consumption in households may then be regarded as regulatory compliance. However, the non-passage of National Water Bills by both the Federal and State governments in Nigeria does not signal support for compliance in NUWSS by the governments. This clearly suggests that water sector and especially water supply from NUWSS is not considered a political priority by the government and policy makers. As such, misconceptions on use of meter, reuse, among others may continue to shape the norms on regulatory compliance in NUWSS. Other challenges noted by Ginley and Ralston (2013) on UWSS such as maintaining ageing infrastructure, addressing water quality, and being prepared for emergencies and business continuity still hold for NUWSS though at a smaller scale. These may be adjusted to characterise regulatory compliance for NUWSS.

## **7. Conclusion**

Regulation as presented in current literature reviewed is an important component in achieving sustainable water supply. It was found that literature on NUWSS has dwelt on understanding access to water supply via NUWSS, with little consideration for regulation and regulatory compliance across the aspects of NUWSS from source, treatment, and up to operations and maintenance during consumption. However, to understand regulation, and regulatory compliance in NUWSS in sub-Saharan Africa, we need to begin at the household level. This paper offers a thematic analysis of households’ perspectives to increase understanding of what regulation and regulatory compliance means to the households through a focus on the behavioural dimension.

Further conclusion drawn from this study showed that households hold varied perceptions on regulation across the components of the water supply system. The varied perception was inferred as preferential compliance to regulation within specific aspects of the water supply system, where the households got to pick and choose aspects of NUWSS that could be regulated and those that should not be regulated. On the component aspects of the NUWSS such as water conservation, households occupied by landlords had strong inclinations to comply with regulations on their NUWSS than those occupied by tenants. This discrepancy in regulatory compliance due to tenure on property was termed as preferential compliance in this research. Overall, in this research, the influence of household characteristics on regulatory compliance in NUWSS is not so substantial as behavioural factors.

The findings from this points to the fact that regulatory compliance in households using NUWSS in most developing countries will not be full compliance, instead, it will likely be preferential compliance. In addressing regulatory compliance in NUWSS, the study has complemented understanding of regulatory compliance in utility water supply system perspective that is dominant in literature. Also, this research offers a reference for researchers interested in understanding, identifying, and characterising regulatory compliance in NUWSS.

While the findings from this research are significant in that they address the bias in studies on behaviours in management of water supply in NUWSS, it is possible that in a context where rule of law is upheld, and the institutions to uphold these rules are functioning effectively, households may not need to develop efficacy on most components of the NUWSS. Moreover, the utility system would be a preferred means of supplying water with expectations for regulatory compliance passed on to managers of such water utility companies. Further research is needed to fully understand the influence of mediators to the variables moderating regulatory compliance in NUWSS.

Concluding, the evidence of NUWSS as the prevalent source of water supply in sub-Saharan Africa suggests that regulations to use of water and compliance to such regulations may no longer be neglected. Further, the current focus on increasing access to water supply without compliance to regulations could increase threats to sustainable water supply. Also, the misconceptions reported in the findings point to the fact that there is misunderstanding of what really constitutes regulation, and regulatory compliance as related to water supply using NUWSS. If sustainable water supply is to be achieved as advocated by recurrent paradigms from international bodies such as the United Nations, it might be worth aligning accessibility and sustainability and addressing the challenges to regulatory compliance.

## **8. Declarations**

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## **Conflict of Interest/Competing Interests**

The authors have no conflicts of interest to declare that are relevant to the content of this article.

## **Availability of data and material**

All data and materials as well as software application was in line with field standards for data collection and storage stipulated by Loughborough University research policy and repository.

## **Code availability**

Not Applicable

## **Author's contributions**

Authors for this article are: IJ Ikpeh; R Soetanto; A Anvuur.

All authors contributed to the study conception and design.

IJ Ikpeh: was primary investigator and responsible for material preparation, data collection and analysis. The first draft of the manuscript was written by IJ Ikpeh.

R Soetanto commented on previous versions of the manuscript. Supervised.

A Anvuur commented on previous versions of the manuscript. Supervised.

All authors read and approved the final manuscript.

## **Ethical approval**

In line with Loughborough University research policy, ethical approval was obtained from the Ethical Committee of School of Architecture, Civil and Building Engineering.

## **Consent to participate**

Informed consent forms were passed on to the key respondents to obtain their permission before the commencement of interviews.

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