An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa: A Suggested Strategy for avoiding the eminent International Water Wars

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Abstract

Using data from 16 West African countries, this paper examines the links between Per Capita Income, Trade and Financial indicators, Education and Freedom indicators. Others are Internet users, Broadband and Mobile Cell phone Subscribers. Mean while Fresh Water Supply (which is assumed as a bench mark public sector-led water resource management performance indicators) and Access to Safe Drinking Water (a bench mark private sector-led water resource management performance indicators) represents indicators of water resources management. The results show that income, ICT and government trade policies influence the efficient management of cross-country water resource. Freedom indicators strongly affect water resource management performance indicators (WRMPI). Moreso, Internet Users, Broadband Subscribers, and Mobile cell phones Subscribers have a positive association with WRMPI. Contrary to wide spread expectations, education does not influence WRMPI.

Key words: ICT, Water economics, water Resource Management, Nigeria, International Water Wars

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1.0 Introduction

The diffusion of information communication technology has led to greater integration of economies around the world. An assessment of cross-country data however reveals potential danger-countries will definitely engage each other in water wars in the nearest future. It is feared that increase in population, demand for fresh and safe drinking water will reinforce that tendencies between countries control more water was those who don not. There is a growing body of literature focusing on ICT tools, water Resource management and its impact on the economy. The arguments presented by Swinford, McIntosh and Jeffrey (2007), Krantz and Kifferstein (2009), Shirley (2006) and Ribando, Horan and Smith (1999) indicate that indicators of efficient water resource management has a significant positive impact on GDP growth in varying degrees across the countries on the continent. Using simple descriptive statistics based on questionnaires, numerous studies have shown that ICT tools have greatly contributed to greater strategic management of the nations' water resources without necessarily escalating cross boarder tension Van et al (2003), Komsky et al (2001), Swinford, et al (2007)

Based on these findings, it is plausible that in the era of the New Economy mew channels for assessing and improving water resource management is possible. Such a window may allow African countries to fast track good government in terms of cross country water resource and ensure more sustainable development. Thus it is important to conduct an economic assessment of the structural changes ushered in by the "New Economy" – a mantra for faster, better and cheaper alternatives systems and machines (Jorgenson, 2008) and its implication for African economies.

There is obviously a greater number of works on water economics, ICT and water resources and quality, relatively smaller work has been undertaken to understand in statistical terms impact of ICT and certain socio-economics indicators on water resources management, WRM, particularly in African countries. In focusing solely on African economies, this work can add to the body of literature by addressing this salient issue. First, is an econometric assessment of the certain ICT and socio economic variables on WRM. Secondly, the direction of causality will be formally ascertained. Third others variables such as policy, civic society, ICT and freedom can be crucial in this context.

Many papers have pointed out that water is plausible due to increasing demand on earth's water resources. More so, some other researcher have emphasized the catalyzing role of citizen participation the increased deployment of ICT (Moorhouse and Ellif (2002); Jamieson and Fedra (1996); Guimares et al (2003); European Union (2000), CET (2003) Alder and Jacobs (2000), Arnstein (1969) and CEC (2001a).

They argue that the increased participation of the public (through extensive use and deployment of ICT leads to more effective management of water resources as it broadens s and speed of access to information and knowledge that can result in greater participation of people in decision making process. In Baliamoune-Lutz (2003)'s words
"…a reduction in information asymmetry that enhances efficiency and access to knowledge for all would prevent one party from monopolizing opportunities … and at the same time allow participation of previously exclude groups."

However, the role of ICT in effectively combating cross-border challenges is yet to be empirically tested using data from African Countries. There, there are ambigiuos conclusions concerning the link between some economic variables, ICT and water resources challenges in African countries. Moreso, the issue of causality needs to be handled squarely. Can

efficiently deployed ICT coupled with effective policy engineering on government's part and an engaging civil society forestall the emergence of cross country water wars?

This paper examines the relationship between water resources management indicators, ICT and a set of time tested macroeconomic and policy variables for a sample of 53 African countries. These countries are listed in Appendix 1. Specifically, the paper explores the nature and direction of the links between WRM indicators and per capita income, trade and financial liberalization, literacy and education and freedom indicators including economic freedom, and liberties and political rights. The Fresh Water Supply, and Safe Drinking Water are used as indicators of WRM bench marks in a cross country these two basis performance indicators as well as the set of macroeconomic and policy variables mentioned above.

To do justice to the topic, the paper is organized thus: Section 2 describes data and outlines the methodology employed in the study. In Section 3 the estimates of the determinants of WRM performance indicators and the impact of ICT on selected economic and social development variables are discussed. Section4 presents concluding remarks.

2.0 Data and Methodology
In the words of Jorgenson and Stiroh (2002) "a new economy" is the mantra for technological and structural changes are individual (once excluded from mainstream events) capitalize on new technologies, new opportunities and national investments in computing, information and communication technologies. Quah (2001) includes intellectual asset, electronic libraries and databases and biotechnology (Carbon – based libraries and database). On the other hand Swinford et al (2007) identified broadly some ICT-oriented performance indicators for water resource management: measures of openness, civil participation, accountability and trust. This paper focuses only on: WRM performance indicators (WRMPI) such as Fresh Water Supply measured in KM^3/Yr across countries and the availability of Safe Drinking Water, ICT indicators such as Mobile phone subscribers per 100 inhabitants, Broadband subscription per 10,000 inhabitants and Internet users per 10,000 inhabitant. The data on these variables are for the period of 2007 unless otherwise stated are taken from the website of World Water.Org. Fresh Water Supply may be viewed as indicator of the state control fresh water resources within its political boundary, while Safe Drinking Water, the second performance indicator measures the access to bottle and sachet water usually private state controlled.

The model proposed is:

$$WRMPI_i = \alpha + g\prod + \varepsilon_i \qquad\qquad (1)$$

Where the vector $\prod$ contains all indicators.
That is:
WRMPI$_i$ = Fresh Water Supply/ Safe Drinking Water

I	=	per capita income
F	=	Index of Economic Freedom
R	=	Political Rights
L	=	Civil Liberties
SR	=	Secondary School Enrollment Rate
HI	=	Human Development Index
CI	=	Corruption Index
CPI	=	Consumer Price Index
BS	=	Broadban d Subscribers
IU	=	Internet Users
MCS	=	Mobile Cell Phone Subscribers

Model (1) represents an equation to be estimated and the assumption of FWS and SDW as performance assessment indicators is fairly standard and plausible on both theoretical and empirical grounds (Swinford, McIntosh and Jeffrey, 2007; Krantz and Kifferstein, 2009; Shirley, 2006; and Ribando; Horan and Smith, 1999). In general, the association between WRMP indicators and income is expected to be very weak. This seems to be the case given the significant correlation of 0.31 between access to Safe Drinking Water (Sachet/Bottle Water) and natural logarithm of per capita income. It is quite expected that income is not statistical significant with FWS as this is natural resource endowment that has no link to income status of an economy. It is still not significant to the ratio of Fresh Water Supply and Safe Drinking Water to population (Table 2.1). However, in areas where water resource management performance indicators of Safe Drinking Water exhibited strong correlation are: Secondary School enrollment rate (0.57), Fresh Water Supply with Consumer Price Inflation (0.78) and a fair correlation of Safe Drinking Water with Corruption Index. WRM performance indicator Safe Drinking Water corrects strongly with Internet Penetration Index (0.52) but had a weak one though statistically too with Broadband Subscriber (0.38)

Table 2.1: Correlation among ICT-Water Resource Management Performance Indicators[3]

	SDW/POP	In PCI	BS	IPI	FWS(KM^3/YR)	SER	PR	HDI	CPI	CI	POP	SDW
SDW/POP	1.000											
In PCI	0.212	1.000										
BS	0.382**	0.238	1.000									
IPI	0.656**	0.311*	0.408**	1.000								
FWS(KM^3/YR)	-0.138	-0.052	0.101	-0.221	1.000							
SER	0.306*	0.446**	0.461**	0.669**	-0.304*	1.000						
PR	0.215	0.120	0.059	-0.166	0.113	-0.170	1.000					
HDI	0.314*	0.072	-0.120	-0.456**	0.225	-0.362**	-0.057	1.000				
CPI	-0.076	-0.182	0.086	-0.148	0.776**	-0.175	0.033	0.164	1.000			
CI	0.210	0.386**	0.306**	0.470**	0.301*	0.496**	-0.387	0.015	-0.163	1.000		
POP	-0.211	-0.053	0.323*	0.010	0.301*	0.085	0.076	0.167	-0.057	0.057	1.000	
SDW	0.524**	0.305*	0.382***	0.524**	-0.322*	0.569**	0.275*	-0.362**	-0.177	0.473**	-0.127	1.000

Sources: Author's Computation, ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

This paper also uses freedom indicator namely Index of Economic Freedom published by the Heritage Foundation. It scores an average score of 10 indexes measured on a one to five scale with 5 indicating the lowest level of economic freedom. These variables also assess trade policy, monetary policy, capital flows and foreign investment, wage and price control, banking and bureaucracy, government intervention in the economy and the fiscal burden of the government (taxes and expenditure). Others are political rights and civil liberties. This paper is adopting approaches by Norris (2000) and Baliamoune-Lutz (2003). These two indexes are published by Freedom House and measured on a one to one seven scale with 7 indicating lowest degree of freedom. The correlation Safe Drinking water with Liberties and political rights are (SDW: PR = -0.28, and SDW: CL = -0.36). The signs on the coefficient are negative, implying that a fall in the index (an improvement) is associated with an increase in access to SDW.

According to Baliamoune-Lutz (2003), financial deepening is defined as the ratio of broad money (M2) to GDP is used as a proxy for financial liberalization. Eke (2007) and Baliamoune-Lutz (2003) argued that with increased financial deepening banks strive to make information available to their customer and generate additional income from service charge. There fore increased deepening would empower consumers more. Many economic opportunities would be explored. This implies that financial deepening should spur

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[3] * indicates significance at 0.1,** indicates significance at 0.05,*** indicates significance at 0.01

establishment of more bottling water firms, civic action initiatives on better water management policy and strategies. The correlation coefficient in Table 1 shows that there a negative (though not statistically significant correlation between financial liberation core WRM performance indicators. (FWS: FL = -0.042; SDW: FL = -0.11). This discovery could be that since (M2) and GDP where measured in dollars terms, most African countries have experience stiff decline (in dollar terms) over the years due to weakening exchange rates.The sensitivity of these countries water industry to trends in the international market was assessed using the net financial flows, (NFF), however, this is not statistically significant.

However, House (1999) observed the role of ICTs in enabling greater access to water related issues/information. More so, Baliamoune-Lutz (2003) argued that ICT also foster the development of NGOs and information and Knowledge based communities that are more capable (relative individual citizen) to cause institutional changes. Consequently we expected efficient management of our cross border water resources as our stock of ICT increases in depth and breath. ICT diffusion may also affect the degree of effectiveness of the civil society and structures of the water industry across African countries. For example, because water consumers have access to indexes and statistics of water coupled with market prices on World Wide Web, they can quickly organize around a problem, mount pressure and initiate a change process. The monopoly of knowledge by government *'for the people'* would have gone. Competition in the safe drinking water industry would amount to efficient use of resource and civic society watchful eyes through an active online community would act as a deterrent to waste and government excesses. The coefficient of collation bet between Fresh water supply, safe Drinking Water are weak and highly significant (table 2.1) this may reflect increased integration of these indicators.

3.0 Discussion of Empirical Results

Table 3.1, equation 1 results from the model exploring the factors that influence WRM performance indicators are represented in table 3.1 (Equation 1 - 4). To test the robustness of the model, four equations were estimated. Table3.1 displays the statistical results from estimating the model with Fresh Water as the relevant WRMPI variable. Equation 1 uses consumer price inflation, political rights, index of economic freedom, per capita income, human development index, corruption index, secondary school enrollment rate and civil liberties in equation 2 we excluded consumer price inflation and political rights. In equation 3 we excluded corruption index and brought in net financial flows while in equation 4, ICT indicators – Internet Users, Broadband Subscribers and Mobile Cell Phone subscribers were brought in. Only variable that exhibits high significance will be discussed and estimate of all models is estimated using SPSS (Version 11.00).

Table 3.1: An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa

Dependent Variable: FWS KM^3/Yr

Equations	1	2	3	4
Number of observations	53	53	53	53
Adjusted R²	0.651	0.160	0.129	0.661
Constant	35.366	23.008	-24.260	52.252
PCI	0.0005 (0.009)	0.0003 (0.014)	0.0009 (0.013)	0.0007 (0.009)
IEF	0.331 (0.290)	-0.0004 (0.435)	-0.0002 (0.432)	0.349 (0.301)
PR	10.665 (23.643)			0.588 (25.055)
CL	-8.000 (31.381)	18.669 (21.895)	23.364 (19.707)	-4.781 (32.682)
SER	-1.257 (0.911)	-1.208 (1.396)	-1.481 (1.239)	-1.642 (1.072)
HDI	0.009 (0.510)	0.706 (0.776)	0.575 (0.720)	0.0002 (0.542)
CI	-3.839 (28.718)	-19.157 (44.073)		-4.780 (31.906)
CPI	2.207 (0.278)			2.157 (0.295)
NFF			0.0005 (0.012)	0.0005 (0.009)
BS				0.0002 (0.292)
IU				-0.0004 (0.018)
MCS 2007				0.0002 (0.003)

Standard Errors in parentheses

Source: ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

Table 3.1, equation 1 displays the estimates using Fresh Water Supply as the WRMP indicators. The empirical results shows these variables are strongly significant policy variables, per capita income, political rights, and liabilities, human development index and corruption index. More so, Fresh Water supply is assumed to be in the government's exclusive control. The variables that returned as not significant are index of economic freedom and secondary school enrollment rates. Effective management of our water is done by experts and politicians probably. Secondary School enrollment rate, theoretically seen as crucial part, does not really add the needed value statistically. This is so because in most African Countries you do not need much education to get involve politics. However, finding of a negative effect may suggest there is a link.

Interestingly as expected all ICT indicators reported very significant (Table 3.1, equation 4) from the theoretical point view increased broadband subscribers should boost WRMPI. Having a negative effect could suggest that some members of the elite that have laptops and wireless web access are yet not actively involved in water issues. If the number of subscribers

surge in the future then there could be as expected a point effect the case of safe drinking water which in the is paper is assumed to be solely private sector controlled and compromising of bottle and sachet water companies, private water distributors, bore hole drilling firms, the R-squared is fairly low compared to Fresh Water which is very low. Access to safe drinking water appears to be most influenced by internet users.

Table 3.2: An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa[4]

Dependent Variable: SDW

Equations	1	2	3	4
Number of observations	53	53	53	53
Adjusted R^2	0.347	0.355	0.344	0.308
Constant	69.579	68.754	68.433	73.216
PCI	0.0006	-0.0006	-0.0006	0.0004
	(0.001)	(0.001)	(0.001)	(0.001)
IEF	0.002	-0.0002	-0.020	0.020
	(0.031)	(0.031)	(0.031)	(0.032)
SER	0.212	0.204	0.199	0.129
	(0.099)	(0.097)	(0.098)	(0.117)
HDI	0.008	-0.084	-0.086	-0.090
	(0.055)	(0.055)	(0.055)	(0.058)
CI	4.729	4.901	5.217	4.959
	(3.107)	(3.076)	(3.159)	(3.438)
CL	-4.088	-2.094	-2.075	-3.616
	(3.396)	(1.536)	(1.549)	(3.521)
PR	1.687			0.768
	(2.558)			(2.714)
CPI	-0.0002	0.007	-0.007	-0.003
	(0.030)	(0.029)	(0.029)	(0.032)
NFF			-0.0005	0.0001
			(0.001)	(0.001)
MCS 2002				0.0018
				(0.002)
MCS 2007				-0.0014
				(0.000)
BS				-0.046
				(0.047)
IU				0.0001
				(0.002)

Standard Errors in parentheses

In addition results indicate that factor such as secondary school enrollment rates, corruption index, civil liberties; human development index and political rights are not statistically significant. This is not surprising as corruption in the water sector is negligible. Pricing data and orders placed on the net or otherwise distributed are basically the essential ingredients that is expanding this industry in Africa. Competition is the order of the day in countries such as Ghana and Egypt. Since this is private sector led and statistics seems to solidly support the idea; market oriented variable such as per capita income index of economic freedom, consumer price inflation, net financial flows, political rights, mobile phone subscribers,

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[4] Source: ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

internet users were strongly significant.

If you compare the relevant variable in table 3.2 (private sector) to table 3.1 (public sector) you'll notice the difference in policy relevance even statistically. For instance, net financial flows and index of economic freedom were not significant variables in influencing Fresh Water Supply but were highly significant in influencing access to safe drinking water which within the domain of the private sector as against the former assumed to be exclusively controlled by the various African states. Also, comparing equations 1 to 4 in table 3.2, you notice that equation that has all policy (irrespective of the sector) provides the best results in terms of R-square, 0.481.

The impact of population dynamics on Fresh water supply informed the use of the ratio – FWS/POP. This indicates the tendency of nation states to go war on water issues due to pressures arising from population dynamics. Both equations capture the process and show corruption index the most influential. Others are index of economic freedom, human development index and civil liberties. But human development index has a wrong sign (though statistically significant). It simply shows that improvement in human capital in African countries does not necessarily translated into improving their water situation. This finding is similar to Broadband Subscribers notwithstanding, human capital and broadband subscribers must have positive roles in the effective management of fresh water supply but may be one possible reason for this anomaly. There could have been serious data measurement error.

In summary, the empirical results provide strong support for the role of ICT indicator as a major determinant of effective water resources management. This is consistent with the conclusion the studies of VAN et al (2003), Koinsky et al (2001) and Swinford, et al (2007). Similarly all freedom indicators namely civil liberties, political rights and index of economic freedom influence the performance of WRM.

Table 3.3: An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa[5]

Dependent Variable: FWS/POP

Equations	1	2	3	4
Number of observations	53	53	53	53
Adjusted R^2	0.135	0.153	0.153	0.078
Constant	28.821	35.095	34.002	38.063
PCI	0.006 (0.002)	-0.006 (0.002)	-0.006 (0.002)	0.006 (0.002)
IEF	0.03 (0.069)	-0.03 (0.067)	-0.03 (0.067)	0.030 (0.070)
SER	-0.662 (0.217)	-0.663 (0.215)	-0.663 (0.215)	-0.711 (0.255)
HDI	0.06 (0.122)	-0.07 (0.119)	-0.07 (0.119)	-0.070 (0.128)
CI	0.661 (6.639)	-0.150 (6.776)	-0.150 (6.776)	-0.328 (7.418)
CL		-0.655 (3.366)	-0.655 (3.366)	-1.0256 (3.615)
PR	0.371 (2.583)			
CPI	-0.008 (0.064)			
MCS 2002				-0.0008 (0.004)
MCS 2007				-0.00009 (0.001)
BS				-0.03 (0.089)
IU				0.0002 (0.004)

3.2 Impact of Selected Economic and Social Development Indicators on Water Resource Management

$$WRMPI_i = \alpha + \delta'Z_i + \varepsilon_i \tag{2}$$

Where the vector Z contains economic and social indicators and ε_i is white noise. Table 3.5 equation 1 report estimates of the impact of selected economic and social indicators as well as WRMPI on income (log transformation of per capita income). ICS, Inter Country Scale is a dummy variable for representing UNDP's classification based on HDI as High, Medium and Low. In our case, 1 stands for countries grouped as medium and 0 for those that were grouped low.

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[5] Source: ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

Table 3.4:An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa[6]

Dependent Variable: SDW/POP

Equations	1	2
Number of observations	53	53
Adjusted R^2	0.089	0.093
Constant	138.061	35.095
PCI	0.02	-0.006
	(0.009)	(0.002)
IEF	-0.258	-0.03
	(0.301)	(0.067)
SER	1.062	-0.663
	(1.085)	(0.215)
HDI	-0.361	-0.07
	(0.540)	(0.119)
CI	5.404	-0.150
	(31.816)	(6.776)
CL	-18.235	-0.655
	(32.584)	(3.366)
PR	0.08	
	(25.118)	
CPI	-0.04	
	(0.296)	
NFF	0.006	
	(0.010)	
MCS 2002	0.003	
	(0.020)	
MCS 2007	-0.004	
	(0.004)	
BS	-0.036	
	(0.433)	
IU	0.01	
	(0.020)	

Standard Errors in parentheses

The only significant variable (though moderate) is Fresh Water Supply followed by Internet Penetration Index that showed P value. Mean while equation 2 shows access to safe drinking water and internet penetration index returns significant. These results indicates that an effective management of cross border and intra border water resource in both sectors of the economy increase in the subsector of cyber and broadband application, would lead to higher per capita income. From our selection the variable that seen to influence income are secondary school enrollment rate, human development index and inter country scale. The is plausible as secondary school enrollment and HDI is grossly low in most African countries.

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[6] Source: ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

Table 3.5:An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa[7]

Dependent Variable: PCI

Equations	1	2
Number of observations	53	53
Adjusted R^2	0.374	0.377
Constant	3.038	2.504
IEF	0.008	0.008
	(0.001)	(0.003)
SER	0.031	0.027
	(0.010)	(0.010)
HDI	0.013	0.013
	(0.005)	(0.005)
ICS	1.513	1.413
	(0.889)	(0.900)
IPI	0.037	0.031
	(0.039)	(0.040)
SDW		0.099
		(0.014)

Standard Errors in parentheses

In theory education is expected to a positive influence on management on resources. As consumer of sachet and bottle water, for instance, have access to more learning (post primary) it should in turn have a huge impact on politicians who majorly are in charge and monopolize decision making processes. However, the empirical literature presents another picture. In most African countries school enrollment is quite low. More so, those that enroll do graduate. On the other hand having successful private sector led water firms may not necessarily mean that they are run by secondary school graduates. In many developing countries, most powerful politicians are ex military men with little or no formal education.

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[7] Source: ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

Table 3.6: An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa[8]

Dependent Variable: SER

Equations	1	2
Number of observations	53	53
Adjusted R^2	0.468	0.093
Constant	35.422	35.095
IEF	0.048	-0.03
	(0.045)	(0.067)
SER	1.062	-0.663
	(1.085)	(0.215)
HDI	-0.136	-0.07
	(0.072)	(0.119)
ICS	4.419	-0.150
	(13.410)	(6.776)
IPI	2.279	
	(0.486)	
FWS KM^3/yr	-0.019	
	(0.015)	

Standard Errors in parentheses

The results in table 3.6 seem to support this view. There is no empirical evidence in support of the influence of education on water resource management. Because economic freedom diffusion of ICT and efficient macroeconomic policies improves the changes of managing our water better thereby averting water wars, it is expected to foster economic development in an unprecedented scale as water permeates all facets of the society and economy. This is also supported in Table 3.7. This speed of changes resulting from higher exposure to globalization.

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[8] Source: ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

Table 3.7: An Economic Assessment of the Impact of ICT on Performance Indicators of Water Resource Management in Africa[9]

Dependent Variable: CL

Equations	1	2
Number of observations	53	53
Adjusted R^2	0.119	0.033
Constant	7.385	5.066
IEF	-0.012	-0.0009
	(0.003)	(0.003)
HDI	-0.007	-0.006
	(0.005)	(0.005)
ICS	1.247	0.851
	(0.894)	(0.033)
IPI	-0.034	-0.655
	(0.035)	(3.366)
SDW	0.034	
	(0.013)	
FWS KM^3/yr		0.0013
		(0.001)

Standard Errors in parentheses

4.0 Concluding Comments

This paper examined the relationship between selected social and economic development, information communication technology and water resource management performance indicators there are ICT is a major determinant of water resource management performance indicator. It influences civil society providing a veritable platform for actively sharing information and on a n international scale and engaging government agents to further entrench the culture of excellence and corporate governance. The government by answering accountability and transparency which are hallmarks of the ongoing anti water war campaigns. Secondly, there is a strong influence of macroeconomic policies on the sector. Third, freedom improves the water resource management. Fourth, empirical results shows that effective management of our water resource will indeed foster economic development as it enhances political rights and civil liberties. In African countries, education is not associated with effective water resources management.

The presents finding seems to offer some new strategies embedded in an ICT – oriented culture for managing our nation's water resources. There is ample evidence that managing our water resources effectively can provide an additional source of economic growth. On the other hand, this paper provides crucial insights about those ICT, economic and social development variables are important parts of WRMPI.

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[9] Source: ICT indicators are from International Telecommunication Union Website (2008); indexes for Civil Liberties and Political Rights are Freedom House website (2008); Economic Freedom index is from the Heritage Foundation website (2008); Education Index is from UNDP – Human Development Report 2008; Standard and Poor's Global Water Index website (2008); all other variables are from World Development Indicators CD-ROM (World Bank, 2008)

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