

Benchmarking Assessment of ICT Ecosystem in Sudan

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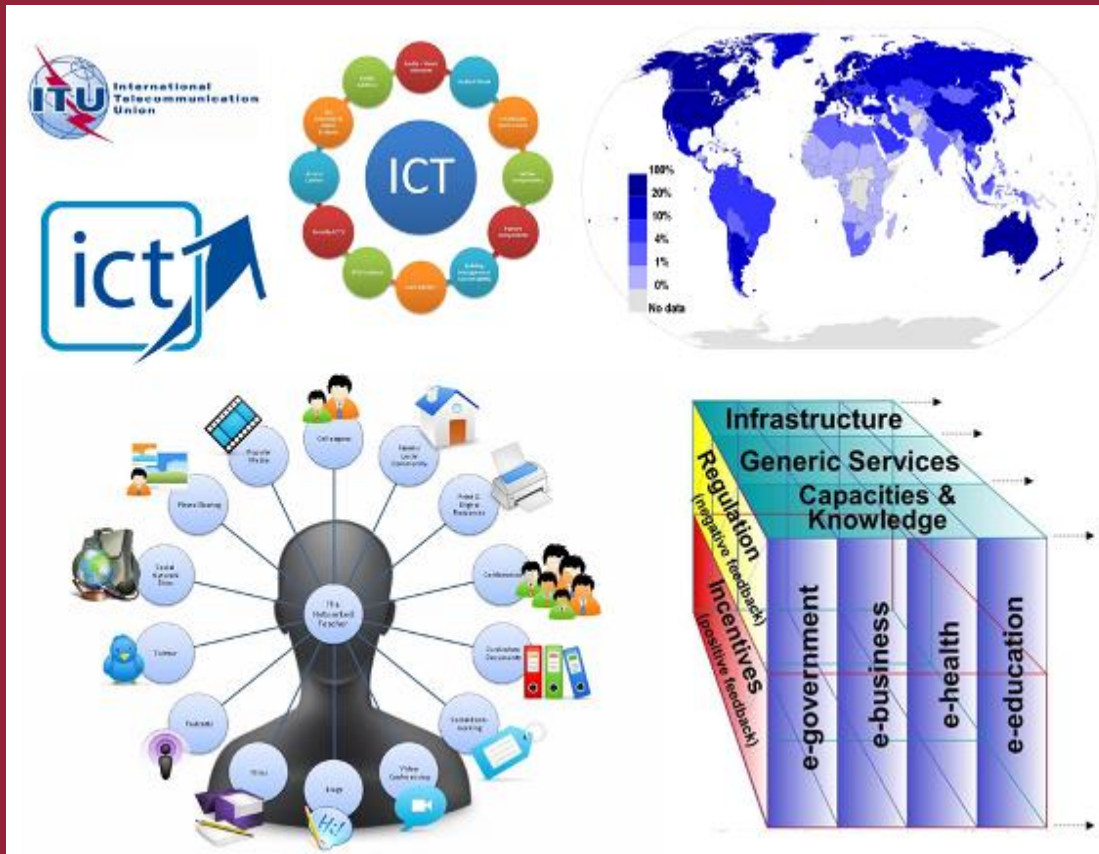
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Khartoum, Sudan**

Motivation: ICT Socio-economic benefits



Motivation:

ICT Socio-economic benefits cont.

- Directly attributed to maturity and development of ICT infrastructure and solutions
- economic benefits = international market +regulatory interactions + efficiency improvements + cost savings + ...etc for developing countries in particular
- In developed nations more than 50% of the GDP come from information-driven industries such as ICT
- Data ...> Information ...> Knowledge
- ICT services ...> Digital Economy ...> Knowledge economy ..> Development!!

Such strong link between ICT , growth and productivity is not evident in developing countries (Pohjola, 2001)

Do we understand why?

What is the current [status](#) and [trend](#)?

Where are we [heading](#)?

Motivation:

Tool-and-Effect link of ICT

- 'digital divide' driven ICT interventions in in poor countries ≡ economic benefits
- Benefits happen at varying rates of growth between developed and developing countries
- Differing dynamics and characteristics of the ICT ecosystem among comparative developing countries with similar characteristics and development environment

To the best of my knowledge, there exist No comparative Study of ICT service in Sudan among countries with similar socio-economic environment

Motivation:

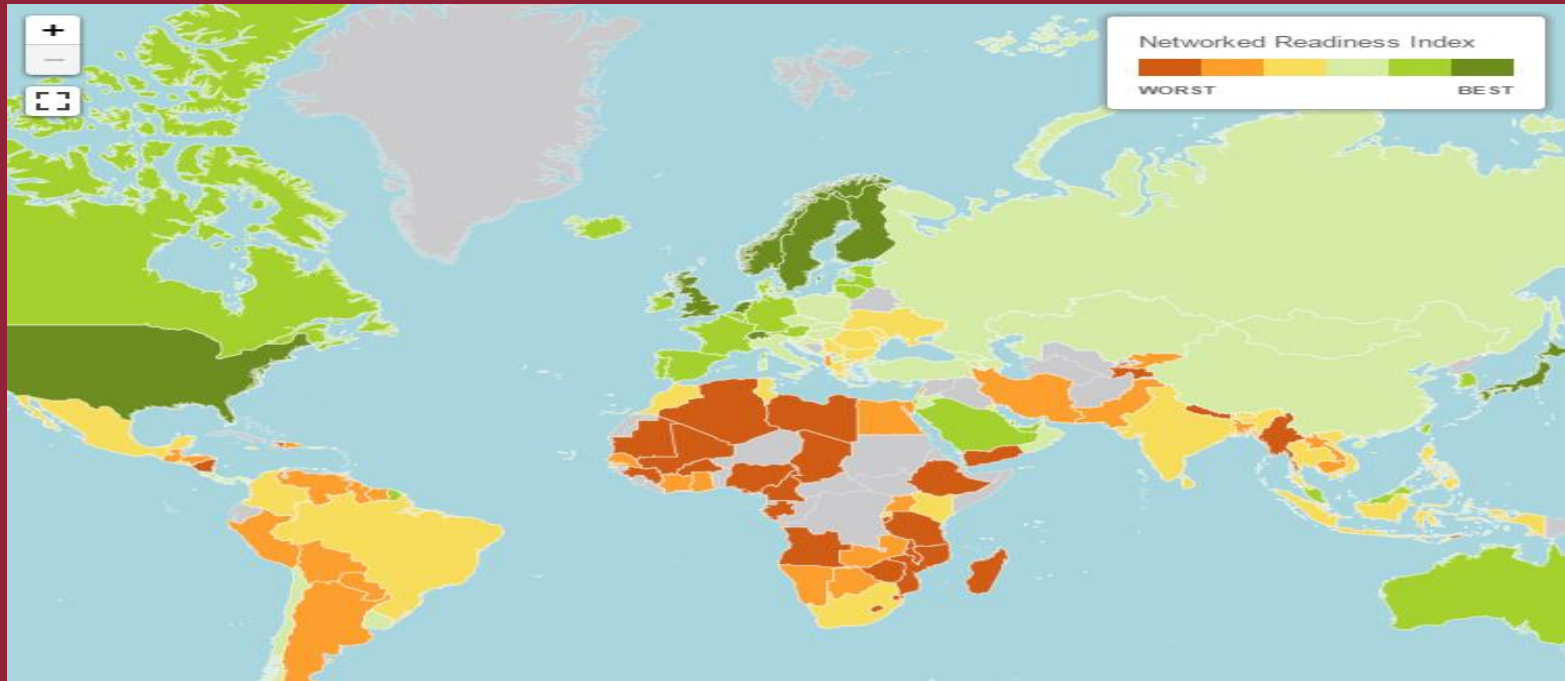
Focus on Sudan's ICT contributions

- Infrastructure contribution to economic growth (transport, water and sanitation, power, ICT, irrigation) is 1.75% to the per capita Gross Domestic Product (GDP) in 2011 (ICT ~1.6%)
- Spending in Infrastructure and ICT (in particular) was 7% in 2011 (before South secession) (80% goes to water and transport) while a high percentage is lost due to inefficiencies (~2.7% of GDP in year 2015)

ICT contributions must be quantified within the realm of an ecosystem due to inter-relation to other infrastructure services and social and economic activities

Network Readiness Index (NRI)

- i) Measure of diffusion of ICT component and services
- ii) Covers factors affecting the quality of ICT services and applications and the overall ecosystem
- iii) Measures existing capacity of ICT and its 'readiness' or 'capability' that result in progressive development of various sectors of the society



Methodology

- 1. Cluster world countries(188) into clusters with similar socio-economic conditions
- 2. A set of 19 social and developmental data is collected
 - Economic : e.g. GNI per capita, GDP per capita, economically active population
 - Demographic:. e.g. age groups, percentage of urban population, mean year of schooling (male and female)
 - Developmental : e.g. Human Development Index (HDI), percentage of internet users, fixed telephone subscriptions, efficiency measures, global competitive index)
- 3. A clustering technique (K-means) from the machine [learning and data science](#) field is utilized for identifying the clusters(Sudan's cluster)
- 4. Analyse ICT indicators data ([12](#) commercial, [10](#) financial, [7](#) technological and [6](#) traffic utilization Key Performance Indicators (KPIs)) in the Sudan clusters

Social and Developmental data

C	D	E	F	G	H	I	J	K
CA	OPEX	CAPEX	Revenue	SM Index	ARPU	Unique Subscriber	Penetration	Ratio
					NA	NA		1.51
12.7%	18.2%	18.2%	1.55	9.951	3775	0.78662829	1.1488354	2.87
12.7%	17.7%	18.2%	1.4	9.118	2879	0.747696937	0.9145284	3.04
11.7%	19.5%	22.4%	1.76	5.045	3405	0.66028297	1.16317158	3.49
	NA		1.45	10.889	3860	0.64462125	0.96553119	2.54
13.75%	NA	24.43%	1.4	6.3341	5082	0.561754982	1.00282538	3.8171
31.98%	65.70%	11.21%	1.99	9.4827	3314	0.54842664	0.92974123	3.2309
13.4%	76.12%	NA	1.73	9.2133	7742	0.54741171	1.06443105	3.5
12.7%	13.85%	43.56%	1.49	2.7881	2947	0.52910287	0.79399789	3.1721
32.72%	33.05%	23.13%	1.36	4.863	4252	0.51034492	0.72292577	3.2436
31.0%	67.93%	15.13%	1.42	5.9124	3778	0.50082657	0.81197582	2.967
34.69%	65.70%	32.96%	1.61	6.5844	3757	0.49387383	0.81776565	2.99
32.72%	10.52%	10.52%	1.56	8.4658	4671	0.47223205	0.66166589	3.003
17.10%	56.64%	36.70%	1.58	5.949	3482	0.42078803	0.665771027	NA
21.97%	75.40%	87.18%	1.60	8.2336	3878	0.38400537	0.41336792	2.5313
15.84%	51.43%	17.71%	1.35	7.7153	6666	0.30840517	0.35689266	2.5313

Data Analytics (DM,ML,BI)

Sudan Cluster

Data Analytics Chain

Source Data

[illegible]

Source Tabulated Data

Exploratory Data Analysis (EDA)

Feature Transformation

Data Mining

Transformed Input Features

Optimum Number of Clusters

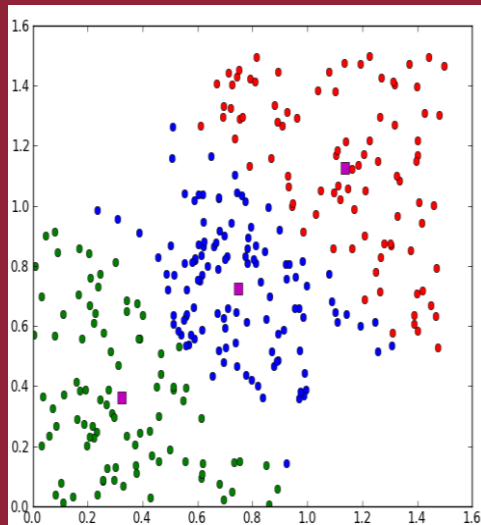
Country clusters

Cluster Validation

Class Labels

Voronoi Vectors (Centroids)

K-means clustering Algorithm

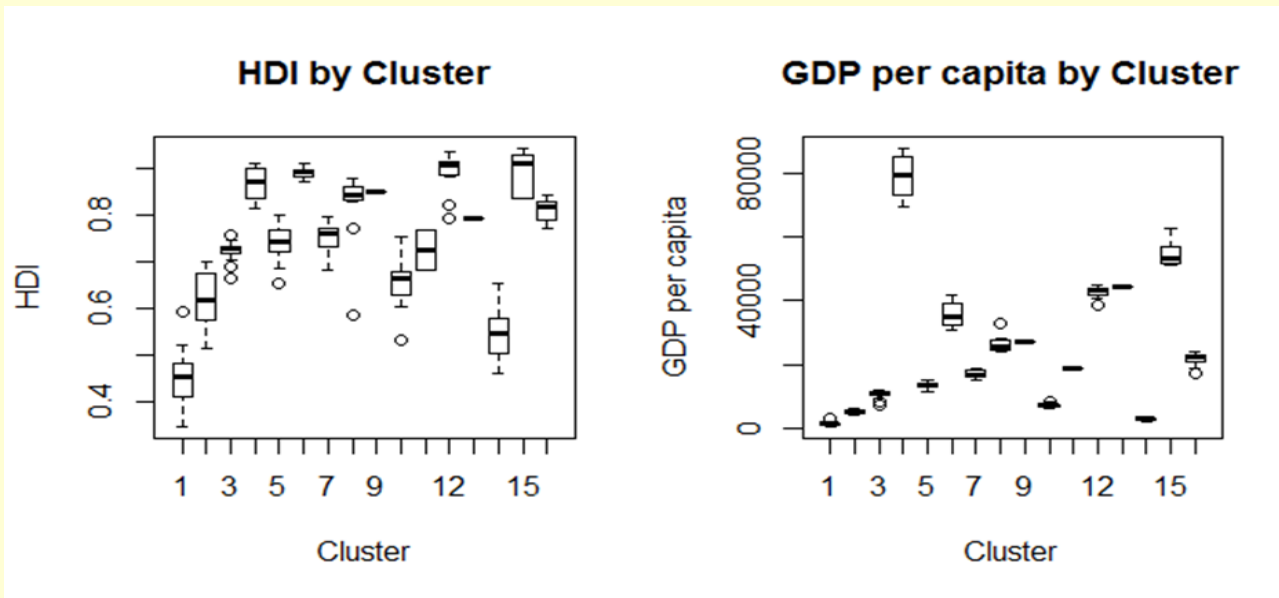


Typical output of
K-means clustering algorithm
on PCA dimensions

1. start with K clusters
 - determine optimum K using WSS
2. choose k centers far away from each other as possible
3. iterate over data points and assign to the nearest cluster
4. calculate the Within sum of squares (WSS) to see how close the identified countries data features are close to Each other
5. Repeat 4. until No centres stops moving
6. clusters of countries are obtained
7. Get cluster for Sudan

Clustering Results

HDI and GDP across clusters



- **Clearly visible the grouping in Development and Economics**

ICT Indicators benchmarking

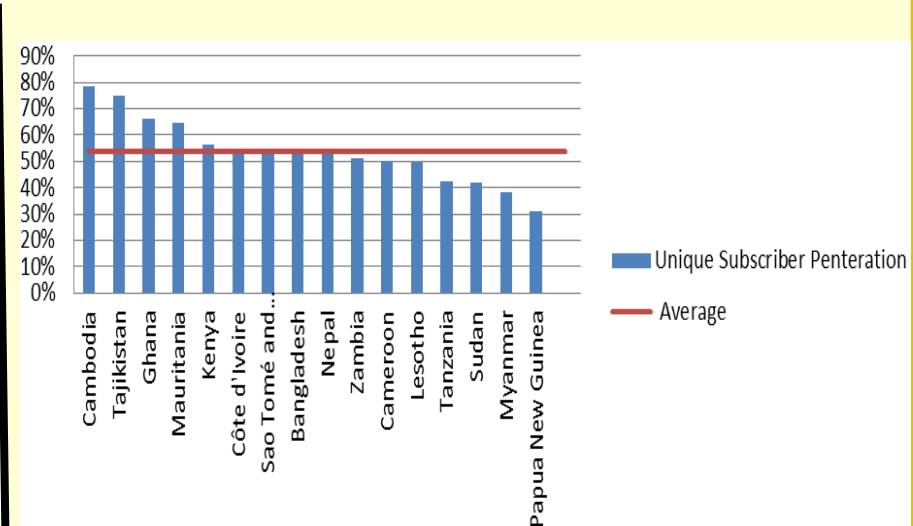
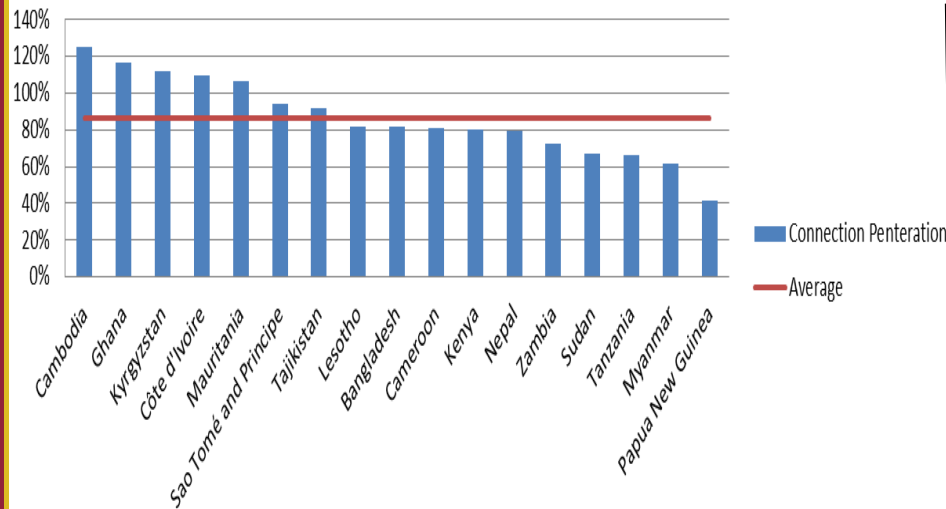
results

Sudan underperforms in SIM Index, ARPU but outperforms in Data revenue and phone adoption

Measure	Highest	Lowest	Average	Sudan's value
Smart phone adoption (%)	66.4 -Maynamar	17.54 - Kenya	27.70	29.44
HHI	7742-Sao Tomé and Principe	2632- Tanzania	4186.19	3,468
SIM index	1.9893- Côte d'Ivoire	1.2229- Tajikistan	1.57	1.58
ARPU	10.8869-Mauritania	2.7881-Bangladesh	6.817588	5.9459
Data Revenue (%)	17 - Côte d'Ivoire	1 - Nepal	13	16
NRI	3.82 - Kenya	2.58 - Mayamar	3.07	-

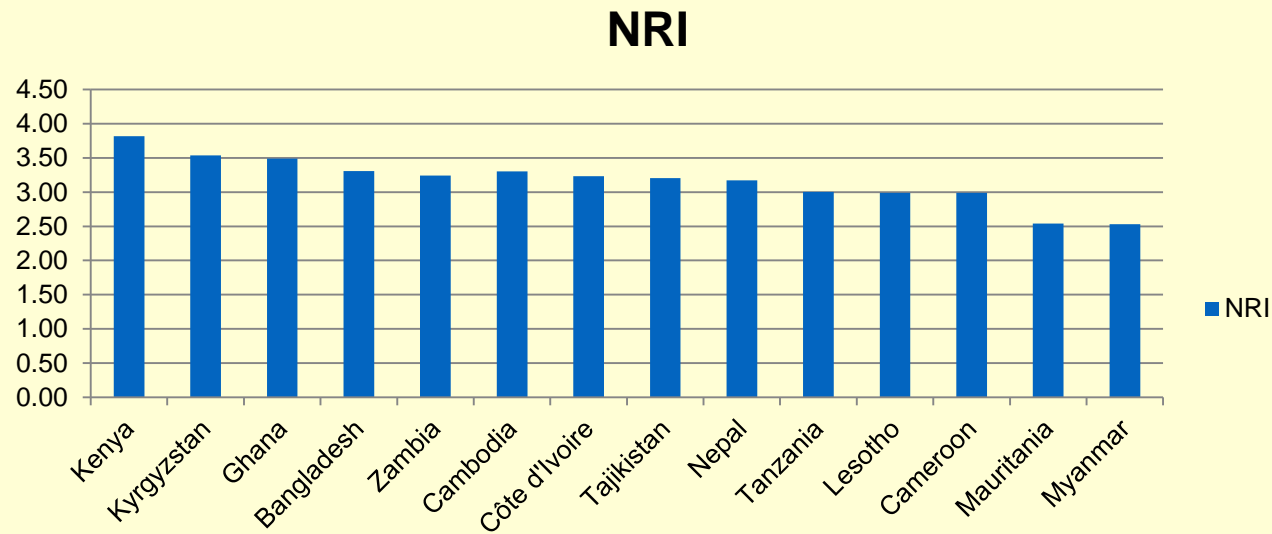
1. Smart phone adoption = Drives mobile connection growth
2. Large SIM index = potential unsustainable short-term bundles and pricing offer
3. slight less than average APRU =Inflation effects
4. Sudan's HHI is below average =mix market power dynamics (Large HHI~=monopoly)

Mobile Connection Penetration



- Real mobile connection penetration in Sudan is lower when SIM index ratio is considered
- Mobile penetration can be improved with subscriber mobility and adoption of new services with competition+ change in regulatory environment

NRI



Sudan's has No data and is estimated to lag the clusters

Conclusions

ICT policies should be guided/influenced
by Socio-economic and human
development improvements

Good

1. Financial KPIs (EBITDA margin, OPEX/revenue, CAPEX/revenue (47.10% 58.64 % and 30.70%).
2. Smart phone adoption, mainly for data usage (30%)
3. Data revenues (16%)

Warning

1. relatively high EPPM (0.1203)
2. lower mobile connection penetration (67%) and lower unique mobile subscriber penetrations (40%)
3. population coverage gaps across different mobile operator companies (89%).
4. high SIM index leading to 5. and 6.
5. potential unsustainable short-term bundles and pricing offer
6. It seems that the services and their quality fail to satisfy needs

Bad

1. No NRI data.> more efforts & to be included within ICT regulatory policy plans



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Thank you



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Q&A

Please email us your questions. I love to have been
able to attend in person

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