

STARVING IN THE MIDST OF ABUNDANT ENERGY: WHAT CAN BE DONE?

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Introduction

- The UN SDG 7 aims at ensuring access to clean, affordable, reliable, sustainable energy for all by 2030
- Globally, about 1.1 billion people have no access to electricity (IEA, 2017).

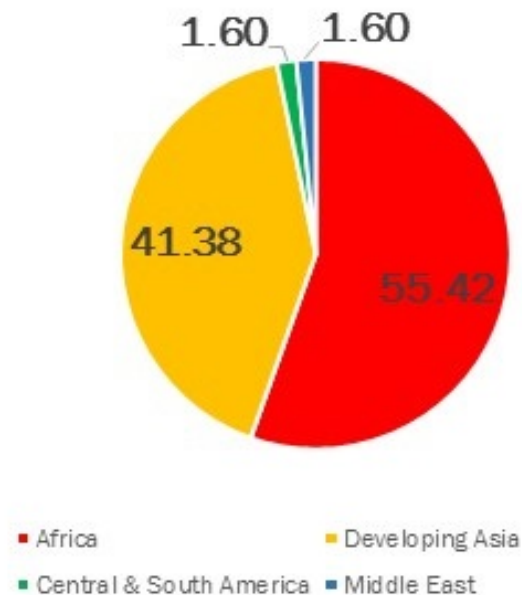


Figure 1: Regional Population Without Access to Electricity (%)

Nigerian Context

- About 74 million people out of 186.6 million lack access to electricity

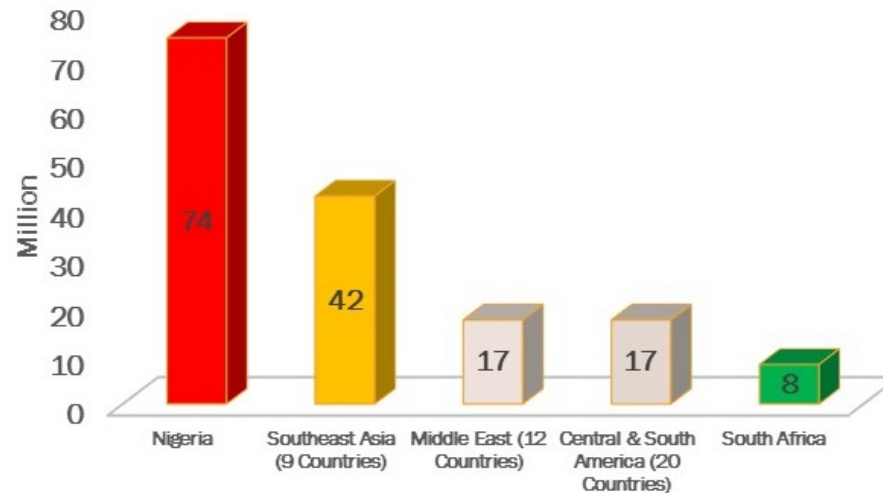
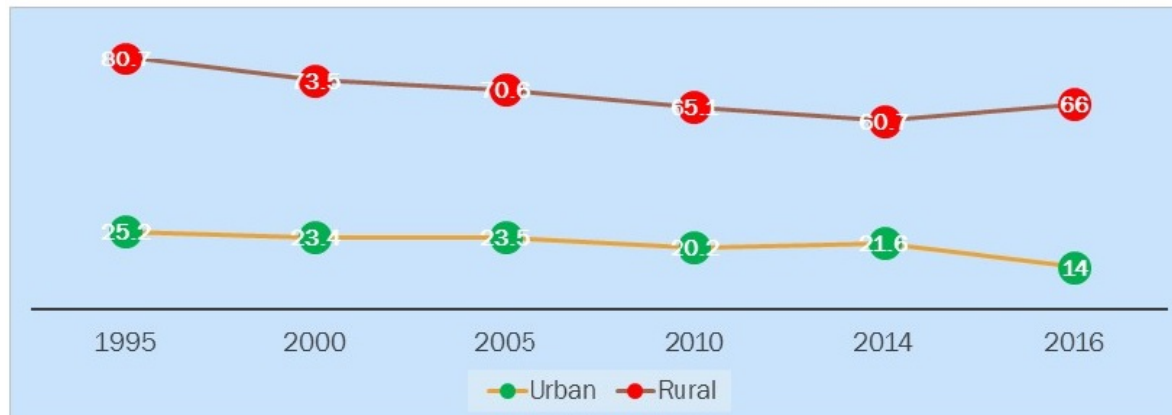


Figure 2: Comparing Nigeria with other Regions' Pop without Access to Electricity



Nigerian Context cont'd

- About 58% and 28.7% of the total households use kerosene for lighting and cooking respectively. 57% rely on fire wood for cooking (IEA, 2017; World Bank, 2018; Nigeria Data Portal, 2018).

Kerosene-powered locally-made lamps (Mpa n'ka)



Battery-powered small hand-made LED torch (after NEPA)



Palm tree biomass (Ori-oku)



Kerosene-driven Lantern



Three-stone fires



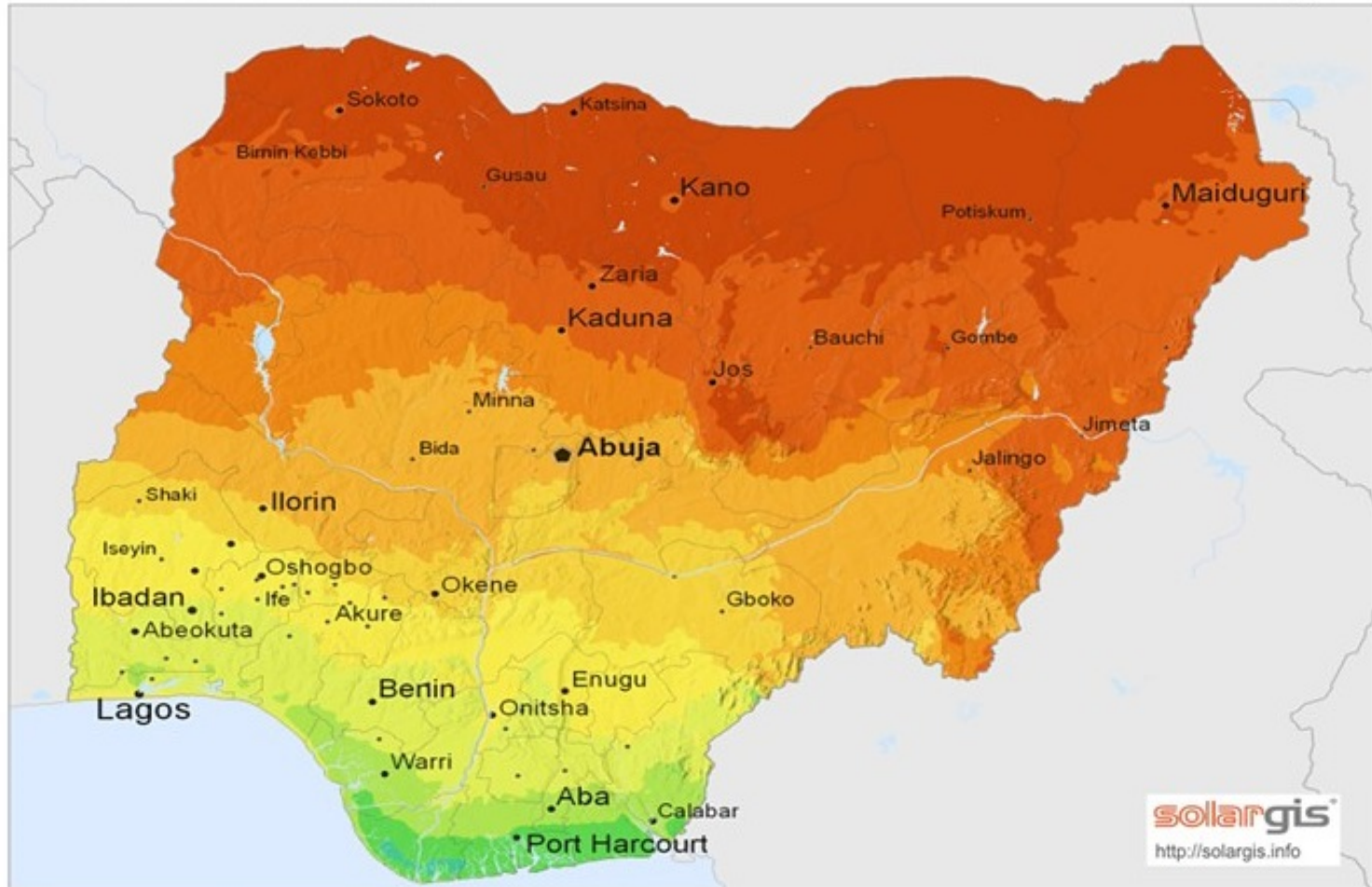
Mud cookstove



Renewable Energy Resources

Global horizontal irradiation

Nigeria



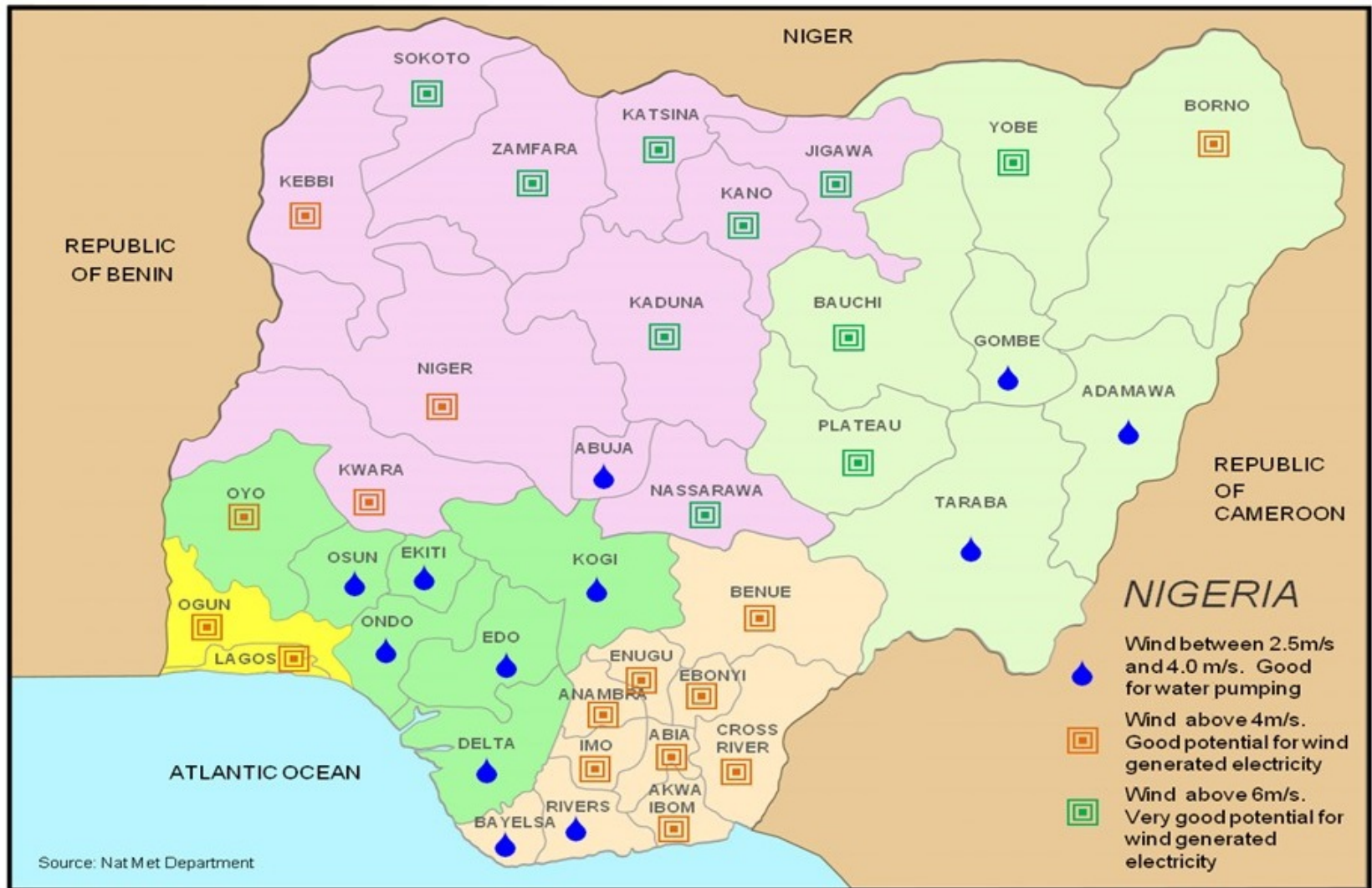
Average annual sum (4/2004 - 3/2010)



0 100 200 km

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Renewable Energy Resources cont'd



Renewable Energy Resources cont'd



Government Policies

- Private sector-driven renewable energy projects
- Gradual increase in percentage share of electricity from renewable sources excluding hydro

Table 1: Planned Increase

Year	2015*	2025	2030
Proportion	13%	23%	36%

Table 2: Status Quo

Sources/Year	1995	2005	2010	2015*
Fossil Fuels	65.3%	67.0%	75.6%	82.4%
***Hydro	34.7%	33.0%	24.4%	17.6%
Other	0%	0%	0%	0%
Renw				

Constraints to Change in Energy Status Quo

- The Dutch disease syndrome
- Underdeveloped private sector
- Weak institutions
- Infrastructure problem
- Business syndicates
- Initial cost and limited awareness

Proposed Change for Rural Households

Proposed change



Research Questions

1. What is the expected monthly willingness to pay (WTP) for these alternative energy sources?
2. What factors affect WTP for them?
3. Is it feasible to invest in them?

Brief Literature Review

- Roy & Jana (1998) report that 32% of Indian rural households are willing to pay for solar lantern, while 68% prefer to get it on lease.
- Meanwhile, Yoon et al. (2016) argue that Indian rural households do not find solar lantern valuable as indicated by their low willingness to pay of \$0.50 (35.14 rupees) for it.
- Bangladeshi rural households indicate \$0.432/kWh willingness to pay for mini off-grid RE (Alam & Bhattacharyya, 2017.)

Literature Review Cont'd.

- About 80% Bangladeshi households & 90% Burkinabé households are not willing to pay for improved cookstoves, but prefer to receive them free (Rosenbaum et al., 2015; Bensch et al., 2015).
- In contrast, close to 100% rural households in Senegal are willing to pay for improved cookstoves (Bensch & Peters, 2015).

Theoretical Framework

- The contingent valuation (CV) study is anchored on the indirect utility function (Hanemann, 1984):

$$v = v(y, p, q, z, e) \quad (1)$$

$$v_1(y - B, q_1, z, e_1) = v_0(y, q_0, z, e_0) \quad (2)$$

- If $q_1 > q_0$ then q_1 is an improved environmental good
- Thus, the probability of a randomly selected household saying a "yes" to the CV question is

$$pr[v_1(y - B, q_1, z, e_1) > v_0(y, q_0, z, e_0)] \quad (3)$$

$$WTP_i = X_i' \beta + \epsilon_i \quad (4)$$

$$E(WTP_i) = -\frac{\alpha}{\beta} \quad (5)$$

The Survey Design

- A referendum type questionnaire was used to elicit households' WTP for the technologies in the South East Nigeria.
- Two enumerators were trained and used for the survey.
- A focus group and pilot study were conducted before the main study
- A total of 218 households were randomly selected and interviewed via face-to-face

Results: Descriptive Stat.

Table 3: Definition of Variables

Variable	Definition	Percent/Mean	Std. Error	Min.	Max.	Obs.
bid1	Bid for Pico-PV	£0.87	.452	£0.21	£1.48	218
bid2	Bid for ICS	£0.67	.250	£0.32	£1.06	218
t1(PPV)	Pay the bid(1=yes, 0 otherwise)	92%	.276	0	1	218
t2(ICS)	Pay the bid(1=yes, 0 otherwise)	82%	.388	0	1	218
income	(1=at least £38.09, 0 otherwise)	32%	.466	0	1	218
sex	1=female, 0 otherwise	53%	.500	0	1	218
age		44.90%	15.373	23	78	218
education	(1=at least basic, 0 otherwise)	41%	.333	0	1	218
married	1=yes, 0 otherwise	90%	.296	0	1	218
employment	full emply.(1=yes, 0 otherwise)	90%	.302	0	1	218
own PPV	Own a PPV(1=yes, 0 otherwise)	5%	.219	0	1	218
kero-lantern	Use kero lant.(1=yes, 0 otherwise)	63%	.483	0	1	218
lantern cost	Monthly expenditure	£2.50	1.703	£0.53	£7.40	137
own 3-stone-fires	Use 3-sf(1=yes, 0 otherwise)	94%	.246	0	1	218
stove cost	Monthly expenditure on 3-sf	£4.92	2.888	£2.00	£16.9	205
num_children	Number of children	5.42	3.523	1	26	215
RE Knowledge						
	very poor	45%				218
	poor	30%				218
	average	18%				218
	good	5%				218
	excellent	2%				218
ICS knowledge	(1=yes, 0 otherwise)	8%				218

Welfare Estimates

Table 4: Monthly mean WTP with Covariates

PPS	Parametric Models			
	Unt. logit	Trun. L.	Unt. Probit.	Trun. P
E(WTP)	£2.20	£2.30	£2.20	£2.40
S.E	(1.031)	(.954)	(1.019)	(.959)
95% C.I.	£0.10-£4.20	£0.40-£4.10	£0.20-£4.20	£0.50-£4.30
LL.	-47.154	-47.003	-47.154	-47.154
ICS				
E(WTP)	£2.10	£2.20	£2.10	£2.30
St. Error	(.823)	(.907)	(.838)	(.992)
95% C.I.	£0.50-£3.70	£0.40-£3.90	£0.50-£3.80	£0.40-£4.30
LL.	-93.238	-93.154	-93.238	-93.154

Regression Results

Table 5: Results of PPV

	Logit Model	Probit Model
Variable	Estimates 1	Estimates 2
Bid	-.003** (.002)	-.0012** (.001)
Income	16.123*** (1.239)	5.44*** (.842)
Sex	-16.809*** (.747)	-5.387*** (.405)
Age	-.038** (.016)	-.021** (.008)
Married	1.056** (.518)	.602** (.297)
Education	.270 (1.508)	.158 (.559)
Employment	.360 (.809)	.207 (.429)
PPV Own	-2.140** (.916)	-1.221** (.560)
Sex*Inc	-16.484*** (1.514)	-5.480*** (.987)
Sex*Edu	16.484*** (.746)	5.305*** (.503)
Sex*Emplmt	-16.889*** (1.416)	-5.537*** (.584)
Constant	21.179*** (2.044)	7.801*** (.877)
LL.	-47.154	-47.003

Table 6: Results of ICS

Variable	Logit Model	Probit Model
	Estimates 1	Estimates 2
Bid	-.003** (.002)	-.002** (.0008)
Income	.649 (.735)	.432 (.395)
Sex	-.667* (.355)	-.368* (.198)
Age	-.039*** (.014)	-.022*** (.008)
Married	-1.225* (.714)	.716* (.414)
3-sf expen	.00009** (.00003)	.00005*** (.00002)
Children	.119 (.087)	.069 (.049)
Constant	4.34*** (1.440)	2.432*** (.755)
LL.	-98.238	-93.154

Cost-Benefit Analysis

Table 7: CBA Result

	Pico-PV	ICS
Discount rate (%)	NPV	NPV
14	£351,038,330.33	£389,163,719.06
15	£336,026,248.60	£372,521,212.93
16	£321,785,136.13	£356,733,409.14

Note: We used Sun King Pro solar lantern @ £38.42 & Zoom Versa Charcoal & firewood ICS @ £30 with 5 years lifespan respectively.

Conclusion

- About 75% of rural households lack knowledge about renewable energy
- After learning about it, an overwhelming 92% showed WTP for electricity from renewable energy sources,
- while 80% indicated WTP for ICS
- On average, rural households are willing to pay £2.30 and £2.20 for the technologies every month
- It will take about 18 months for them to complete the payment
- Thus, 18 months are sufficient for investors to recoup over and above the cost of investment
- Going forward, to scale up renewable energy access, policies should be geared towards creating enabling environment for the private sector to thrive.

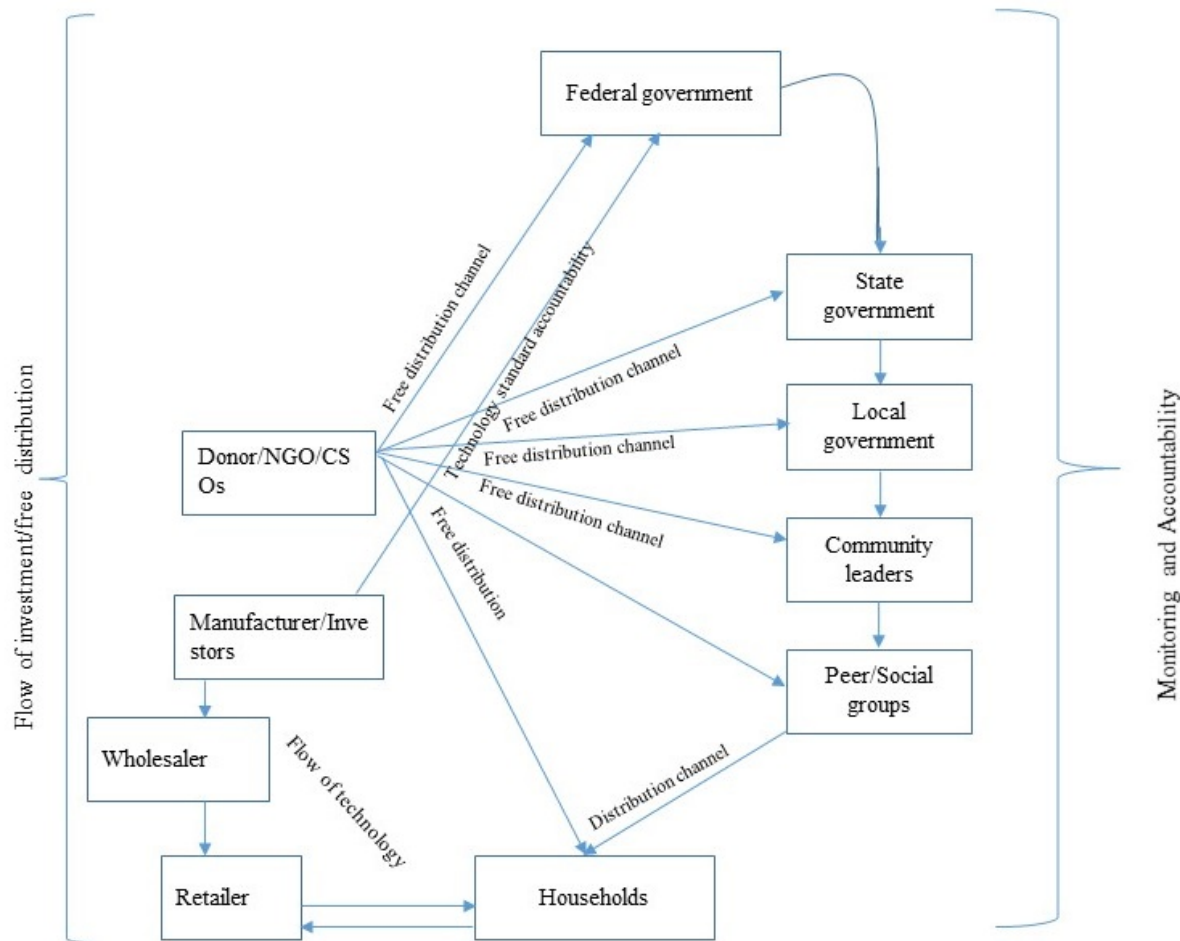
Conclusion cont'd

“Since I spend more on kerosene & firewood than I can pay monthly, I prefer to have the PPV and ICS to improve my lifestyle even though aged and poor. Please get me ICS & PPV soon!”



Conclusion cont'd

- However, investors might be sceptical due to risks associated with progress payment in developing countries



Concluding Remarks

THANK YOU FOR LISTENING