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A COMPARATIVE STUDY OF SOCIO-ECONOMIC BENEFITS FROM MICROGRIDS, SHS AND THE GRID IN RURAL SOUTH ASIA

Narasimha D. Rao (IIASA), Anjana Agarwal,
Davida Wood

Research Objectives

What are the socio-economic impacts of small-scale electricity (SME) systems on rural communities in South Asia?

Focus:

Service conditions

Income

Women/health

Children/education

Business decisions



Site Selection

Selection Criteria

- Technology
- SME Vintage

West Champaran, West Bihar

Technology: Biomass (husk)
Vintage: 0-6 years

All districts

Technology: SHS
Vintage: 0-12 years

Kavre/Sindhuli, Nepal

Technology: Microhydro
Vintage: 2-12 years

Nepal Map

Bihar(बिहार)Map

Araria, East Bihar

Technology: Biomass (crop)
Vintage: 2-10 years

Sample Breakdown

Household surveys

	No elec	Grid	Small-scale energy system			
			Biomass	Microhydro	Solar	
Nepal	14	81		90	53	238
W. Bihar	77	99	94		45	315
E. Bihar	134	95	77*		0	306
	225	275	171	90	98	859

*includes 60 HH who had microgrid supply. Some don't anymore, switched to Grid.

SME surveys

	Retail	Mechanical	Electrical	Hotel/ Restaurant	Others	
Nepal	12	10	3	7	10	42
Bihar	18	1	6	5	4	34



Research Design

- Quantitative
 - Cross-sectional, controlled comparison of outcomes across 3 groups
 - Using Propensity Score Matching
 - Data: household surveys
- Qualitative
 - Livelihood impacts (location choices, income effects)
 - Data: Small-business interviews
- Literature review



Supplier Context

- **Household supply** – dominates micro-hydro plant use but biomass plants need “anchor”
- **Supply hours** – households benefit in **evening**, commercial customers use grid or microgrid during the day
- **Financial barriers** – electricity connection cost plus costs of end-use equipment – **restrict commercial use** of off-grid systems



Estimate of Daily Supply Hours

Mean (std dev)	Grid	Microgrid
Nepal	18 (2)	15 (5)
W. Bihar	6 (5)	4 (2)
E. Bihar	4 (4)	3 (2)

Microhydro availability >
Biomass microgrid availability

In India, hours of grid supply inversely proportional to distance of village from paved road. Greater homogeneity in grid supply in Nepal

Grid: Higher availability vs. Lower Reliability

Electricity Prices

Exp Group	Average Prices (Rs/kWh)				Electricity Expenditure Share				Monthly Costs			
	India		Nepal		India		Nepal		India		Nepal	
	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid
0-249	20.8	44.0		8.4	7%	10%		3%	146	122		63
250-499	21.9	56.1	4.1	15.4	6%	4%	5%	4%	184	107	102	74
500-999	40.5	94.1	4.5	12.3	5%	2%	2%	3%	218	111	77	78
1000-1999	29.3	67.2	4.1	13.1	3%	2%	1%	2%	234	136	78	80
2000+	36.6	53.1	4.0	10.8	1%	1%	1%	1%	198	139	119	79

Impacts on Income and Livelihoods

- No discernable difference based on hours of supply and system type
- Small sample with high standard deviation



but → started 78 add yrs back, stopped when plan

Impact on Women and Health Benefits

- **Electricity access → Shift in time use – from household chores to leisure, more time for income generating activities**
- **Kerosene use is significantly reduced with SHS**



Impact on Children's Education

	Disagree	Agree	Agree (%)
Grid	42	196	82%
Microgrid	4	164	98%
Solar	2	67	97%
None	27	244	90%

Small Scale Businesses

- Electricity is essential, cost less of a factor
 - Reliability paramount: preference for more stable micro-grid
 - Poor supply constrains **(latent) demand**
- Electricity enhances SME customer base (e.g., TVs)
- With present supply, electricity is **not a primary determinant** of business choice/location
 - Nepal: road access dominates
 - Bihar: family, supplement to farm

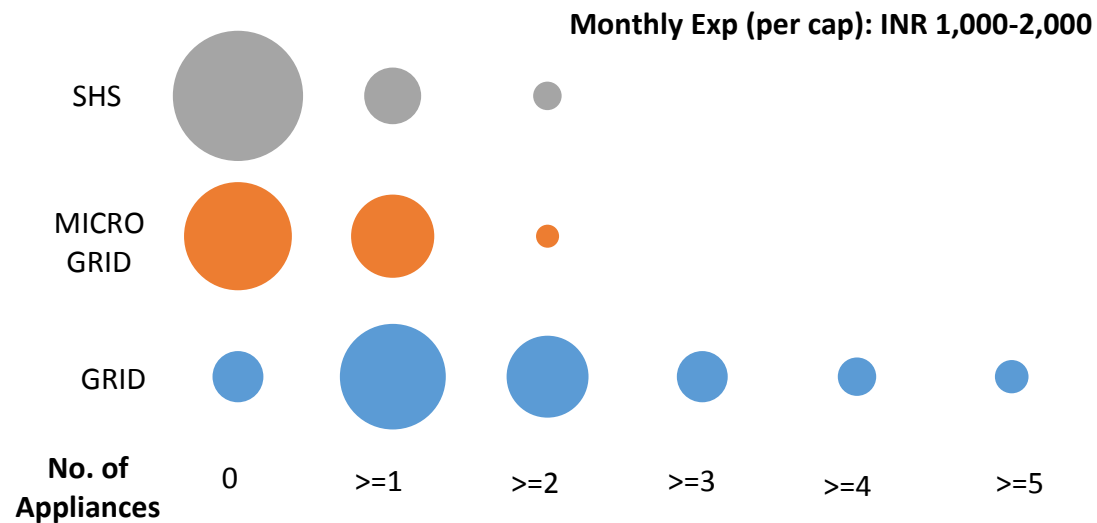
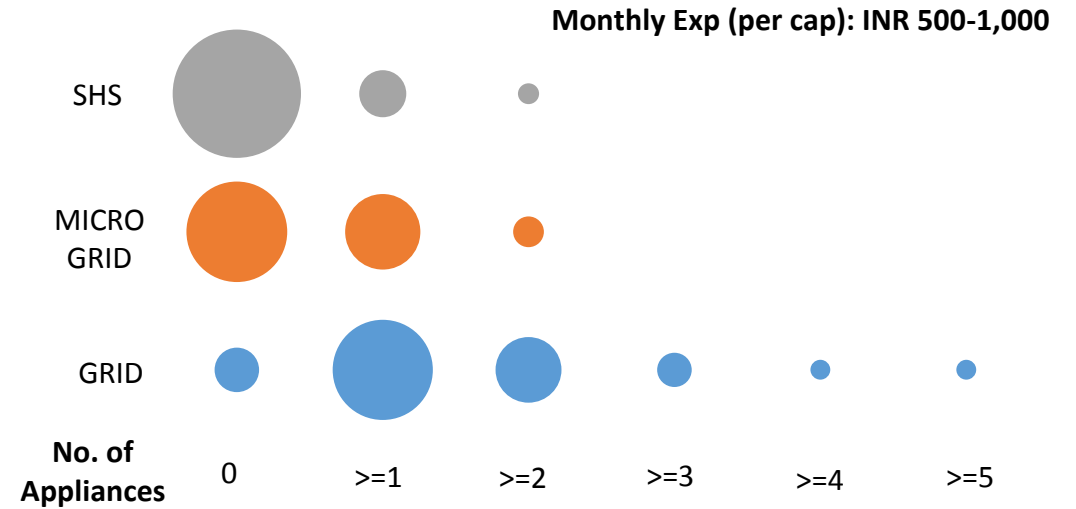
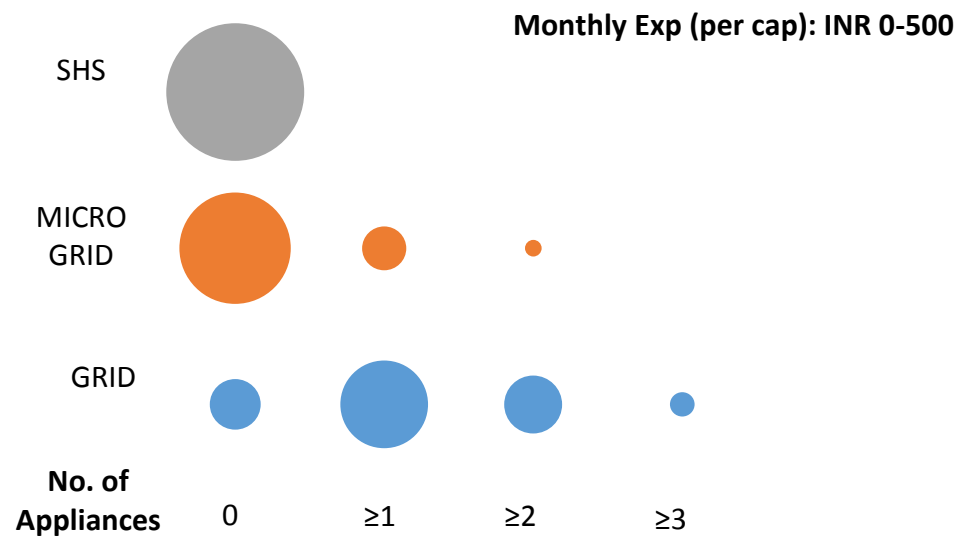




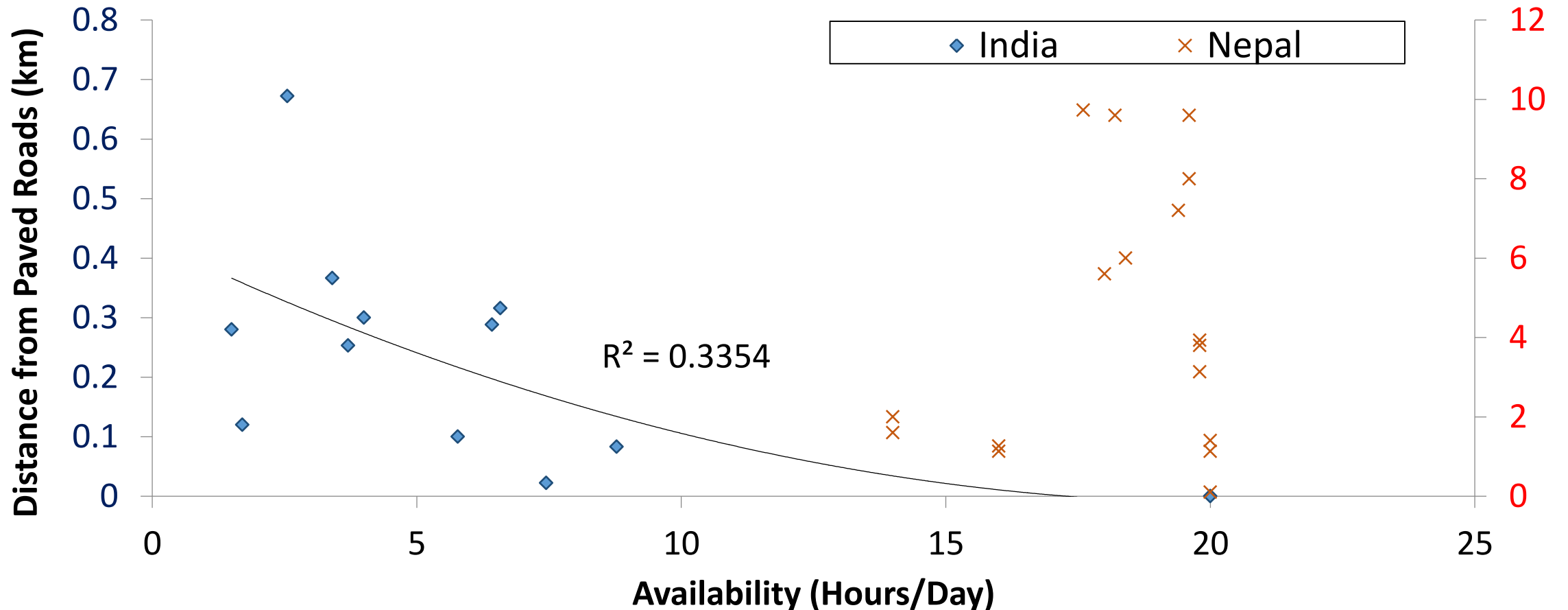
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Thank you!

Determinants of Appliance Ownership



Village mean grid supply availability and distance from paved roads



Determinants of Appliance Ownership

DV: Total appliances per cap	Coefficient	t-stat
Microgrid Dummy	-1.82***	(4.72)
SHS Dummy	-2.32***	(3.30)
Nepal Dummy	2.21***	(3.41)
Age of Elec Connection	0.25***	(7.05)
HH exp ('000 Rs/cap)	0.33**	(2.13)
Head of HH Education (1-4)	0.54***	(2.77)
Distance from paved road (km)	-0.07**	(1.99)
Hrs per day (30 day recall)	0.16***	(4.16)
R ²	0.39	
N	498	

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Reference Country is India, supply system is Grid

