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Impact of infrastructure on income and work of rural households, women and the landless in the Northwestern Region of Bangladesh

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Outline

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1. Introduction

- Infrastructure is one of the key inputs entering into the “production function” of MDGs.
- Achievements of many of the goals starting from eradication of poverty and hunger to environmental sustainability may well depend on physical and communication infrastructure.
- For instance child mortality may depend on availability of clean water, and attainment of universal primary education for girls may crucially depend on access to piped water facilitating girl child school attendance (Leipziger et al 2003).

1. Introduction

- Infrastructure usually consists of large capital intensive structure. Three types of *physical infrastructures* that are considered here are roads and highways, telephones, and electricity.
- Interactions between rural and urban areas and integration of goods, labor and capital markets are important for income and work.
- The general barriers to urban-rural interactions and integrations are high costs of transport or communications, and information asymmetries between rural and urban areas.

1. Introduction

Objective:

- To examine the causes, impacts, and implications of changes in infrastructure in the northwestern region of Bangladesh as they relate to rural income and poverty, particularly in the context of women and the landless.

1. Introduction

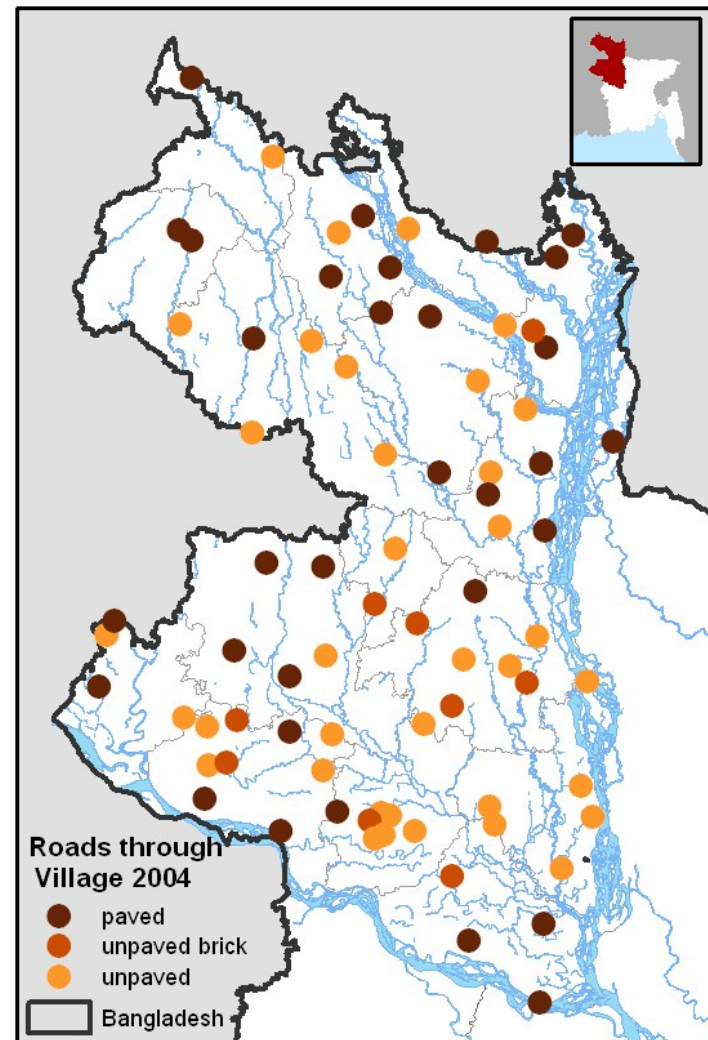
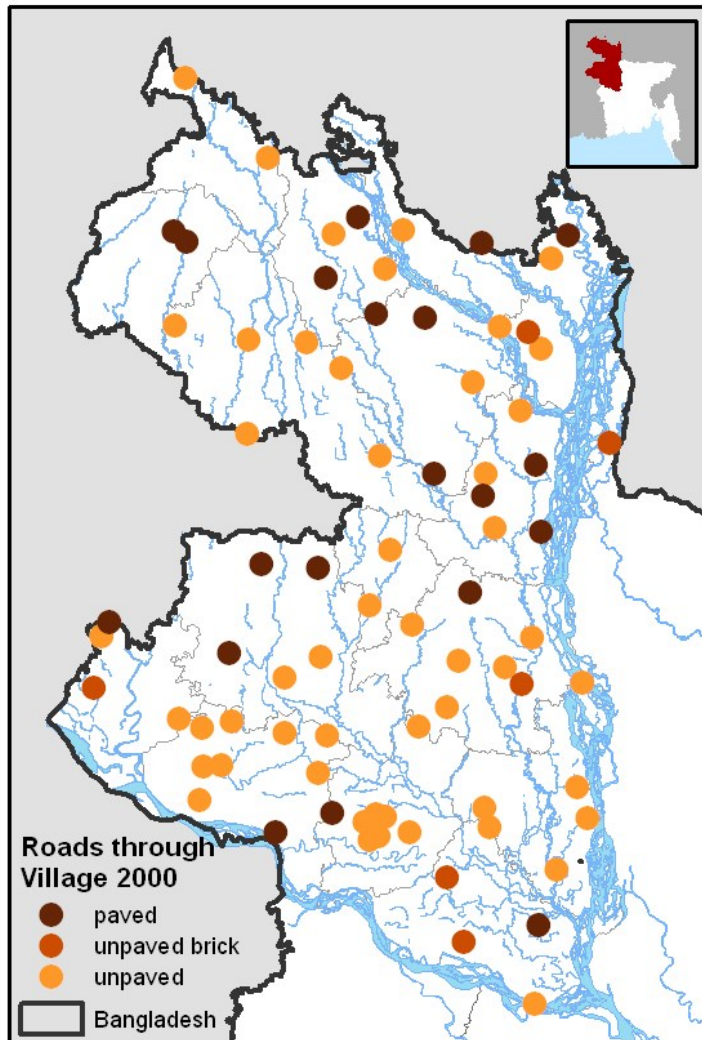
Why Northwest?

- It has the highest concentration of poverty in Bangladesh.
- The region has experienced a significant change in infrastructure development during the last two decades or so.

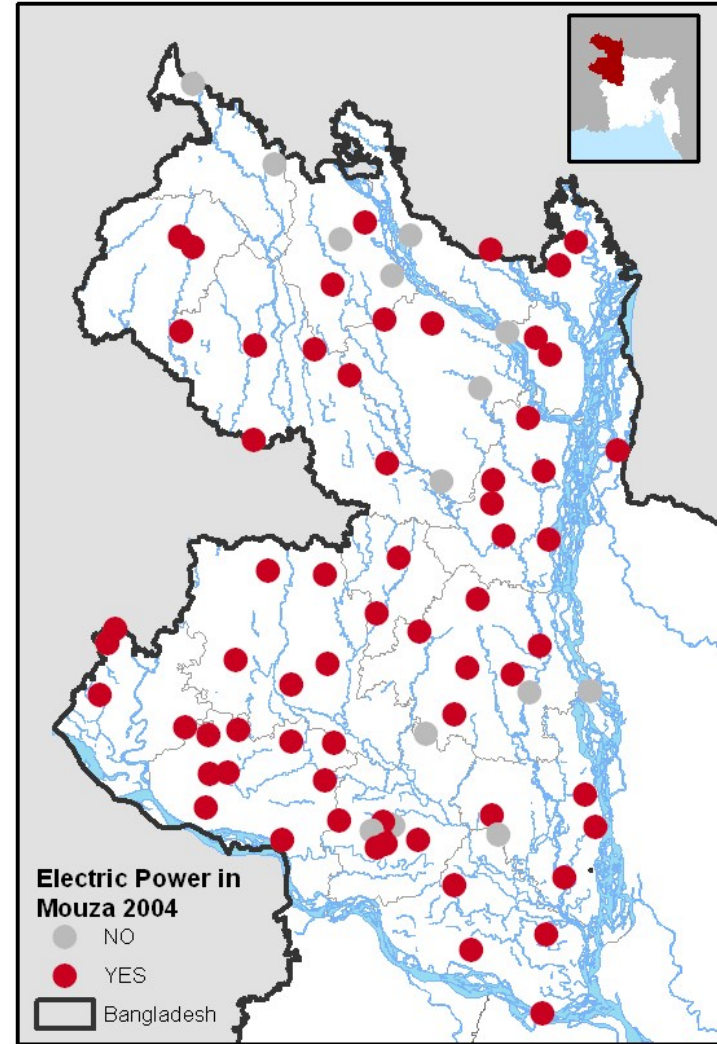
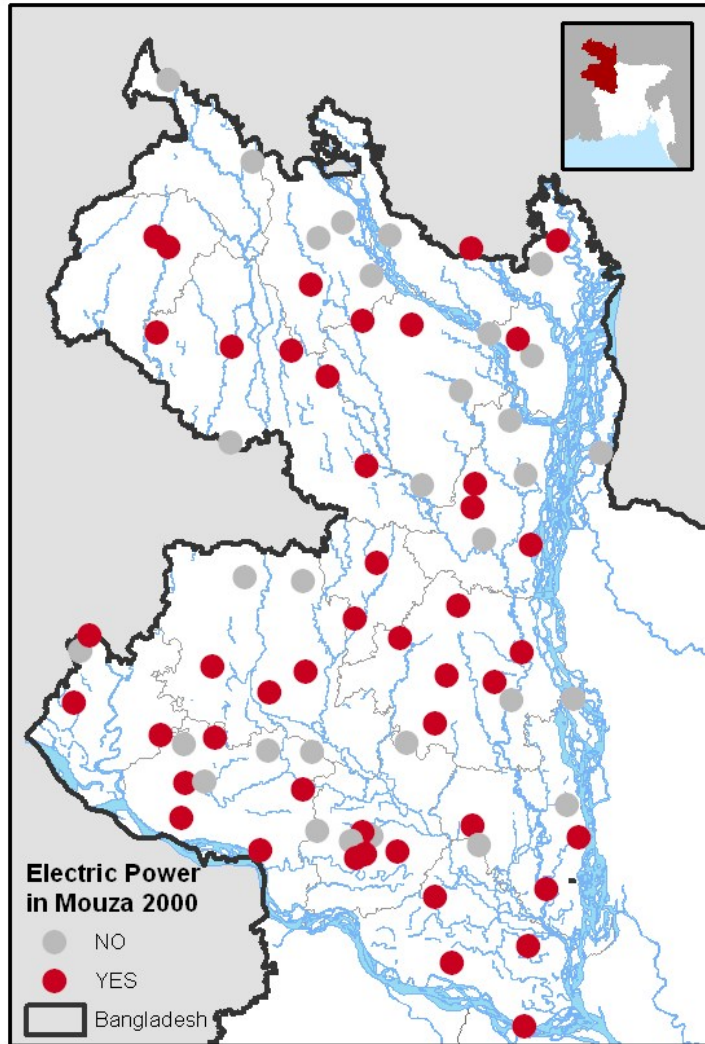
2. Changes in infrastructures

	National		NW	
	2002-03	Growth, 1991-2003	2002-03	Growth, 1991-2003
Roads:				
Roads, paved (% of total roads)	78	3.07%	91	2.73%
Roads, total network (km)	22,360	4.88%	4,443	3.85%
Roads (km) per square kilometer	0.16	5.00%	0.13	3.70%
Electricity:				
Electric power consumption (kwh per capita)	144	19.57%	na	
Total number of households connected	7,100,000		na	
Total number of rural households connected	4,700,000		1,098,722	
Fixed Telephone:				
Telephone mainlines (per 1,000 people)	7.2	18.94%	3.2	25.00%
Telephone mainlines in rural area (per 1,000 people)	0.6	4.55%	0.4	9.09%
Total number of subscribers	962,294	22.06%	105,435	28.67%
Total number of rural subscribers	123,729	17.02%	58,279	72.32%
Mobile Telephone:				
Total number of subscribers	3,210,358	18316%	na	
Total number of rural subscribers	100,000		na	
Mobile phones per 1000 people	21.91	14890%	na	

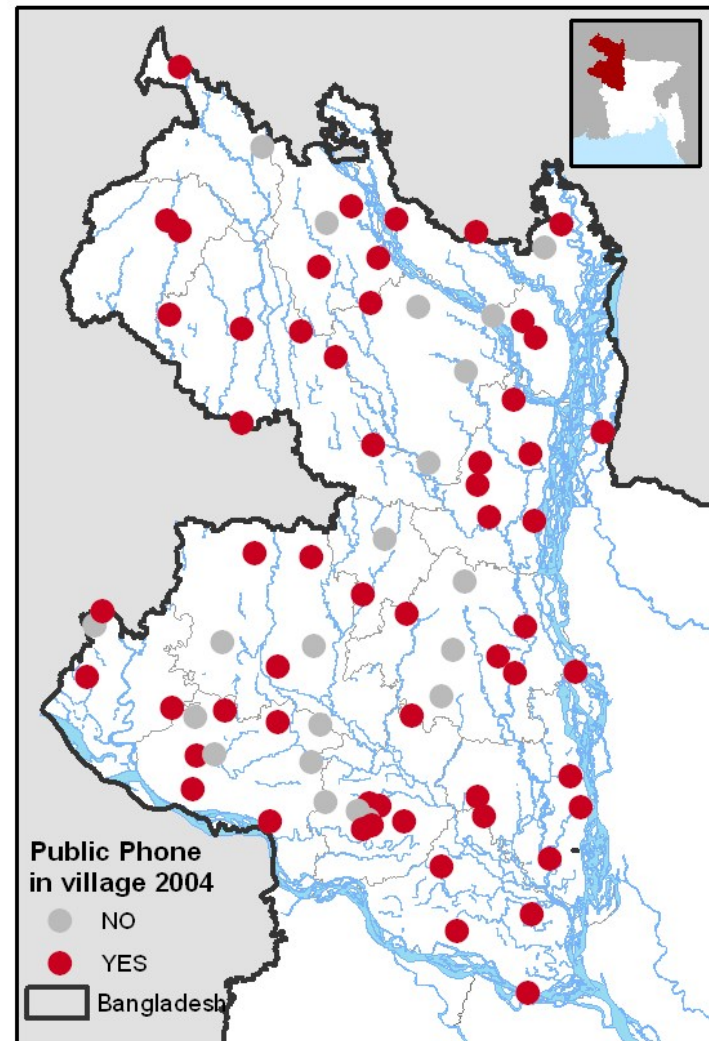
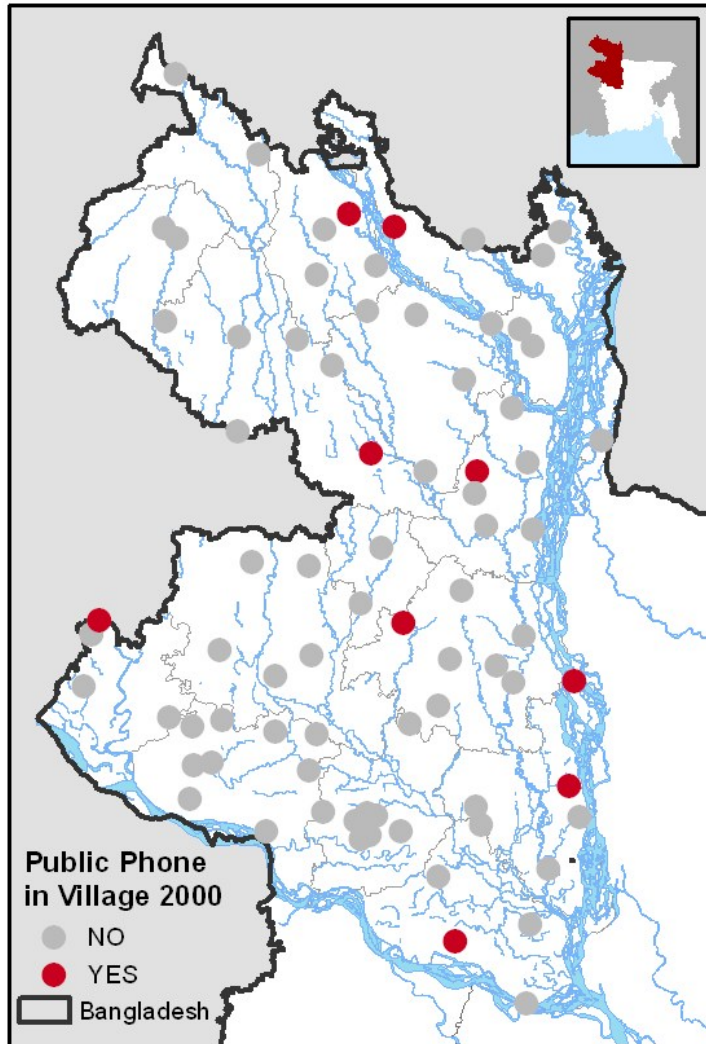
2. Changes: Road



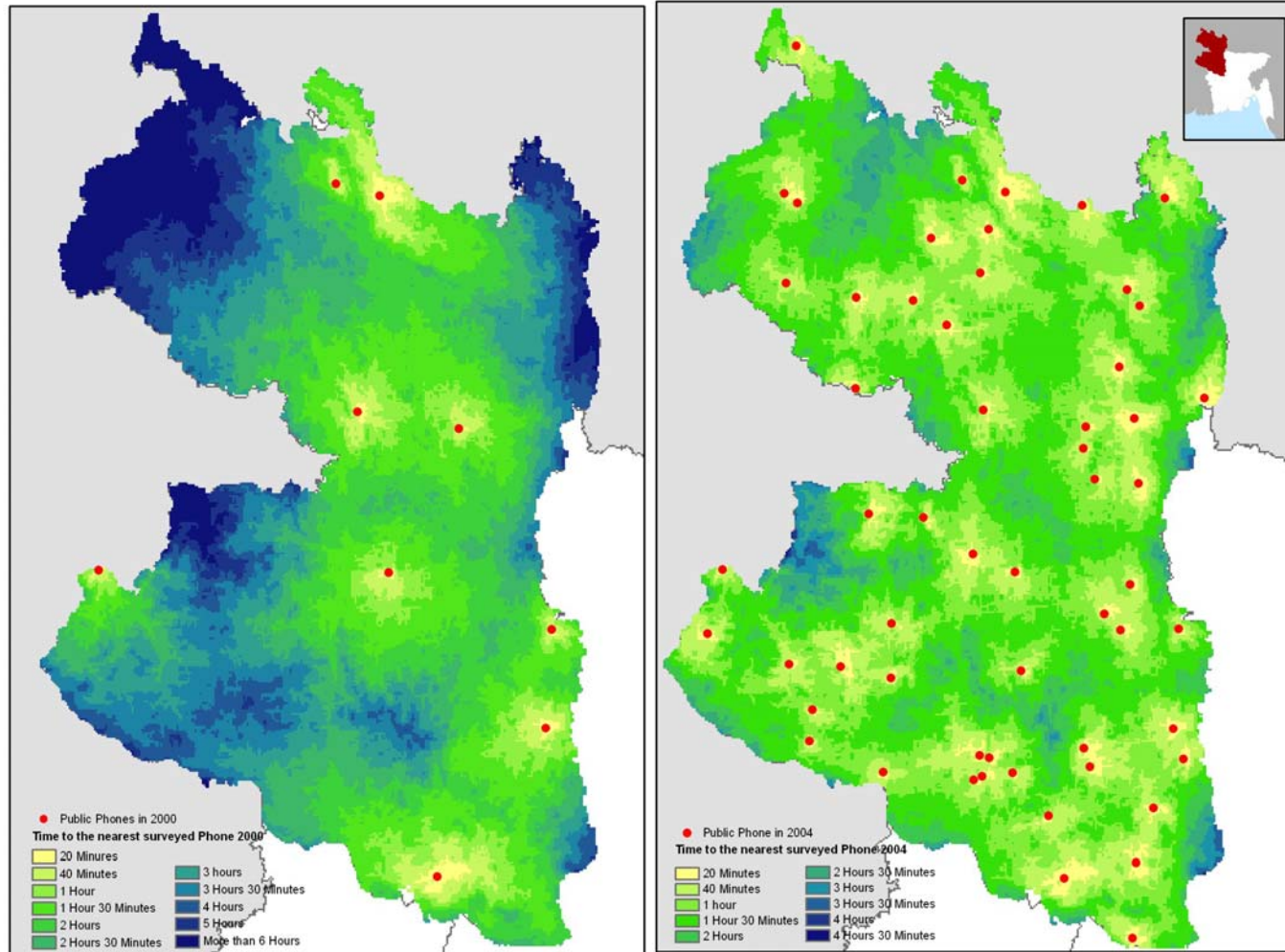
2. Changes: Electricity



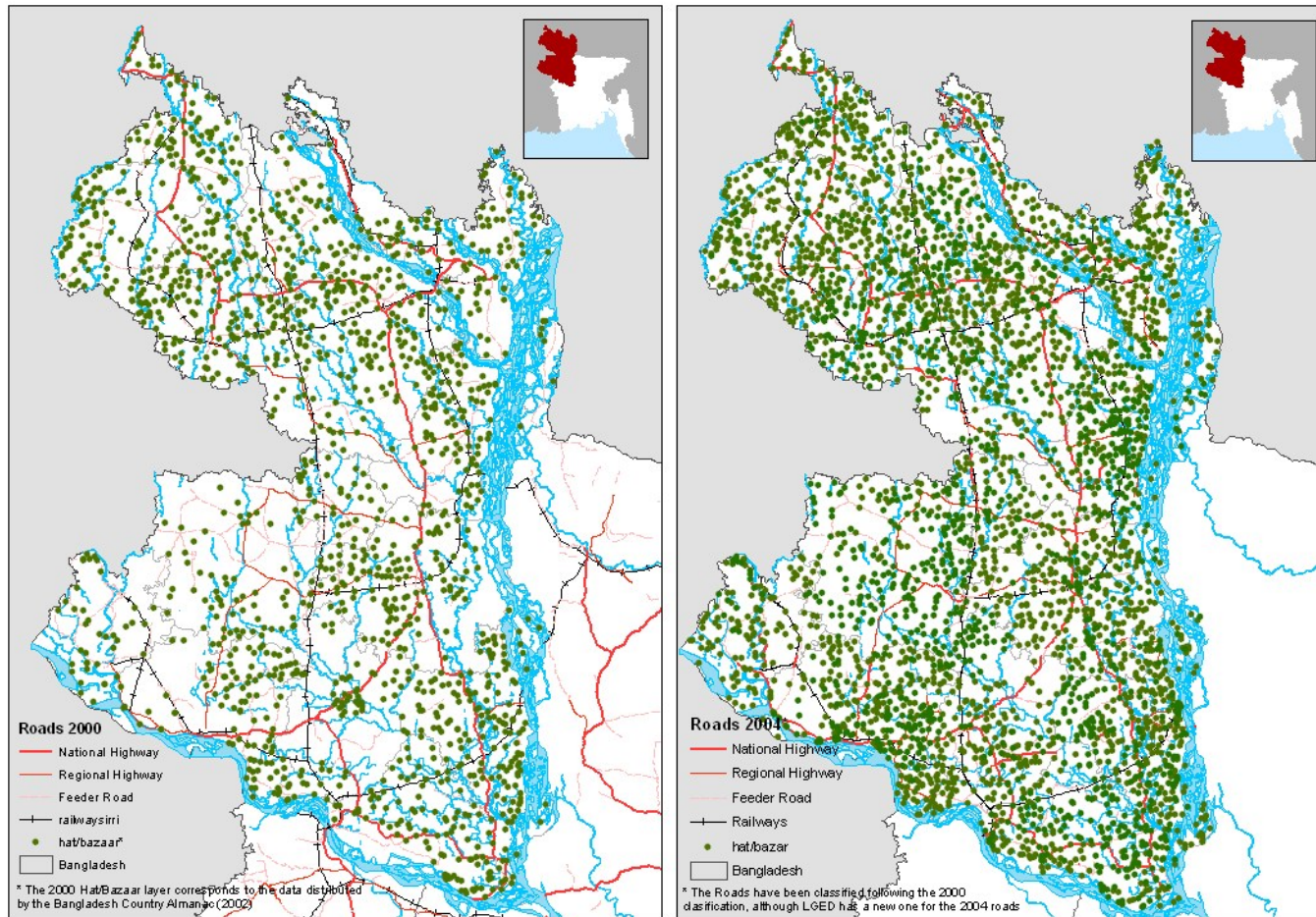
2. Changes: Telephone



2. Changes: Accessibility to Telephone



2. Changes: Hat/Bazaars



2. Changes in infrastructures: Summary

- Global changes: 1990-2004
 - NW has more paved roads than the national average
 - Telephone connection grew at a faster rate in the NW
 - Electricity connection has also made substantial progress
- Changes in HH Access: 2000-2004
 - Road: Not much changes in access to road;
 - Electricity: Small changes in access to electricity;
 - Telephone: Significant changes in access to public telephone;

3. Empirical Estimation

$$\Delta Y = \left[\sum_{i=1}^n \Delta S_i \left(\frac{y_i}{l_i} \right) \right] L + \Delta L \left[\sum_{i=1}^n S_i \left(\frac{y_i}{l_i} \right) \right] + \Delta L \left[\sum_{i=1}^n \Delta S_i \left(\frac{y_i}{l_i} \right) \right]$$

Change in the proportion of time for activity "i"

Change in the total number of hours worked by the household

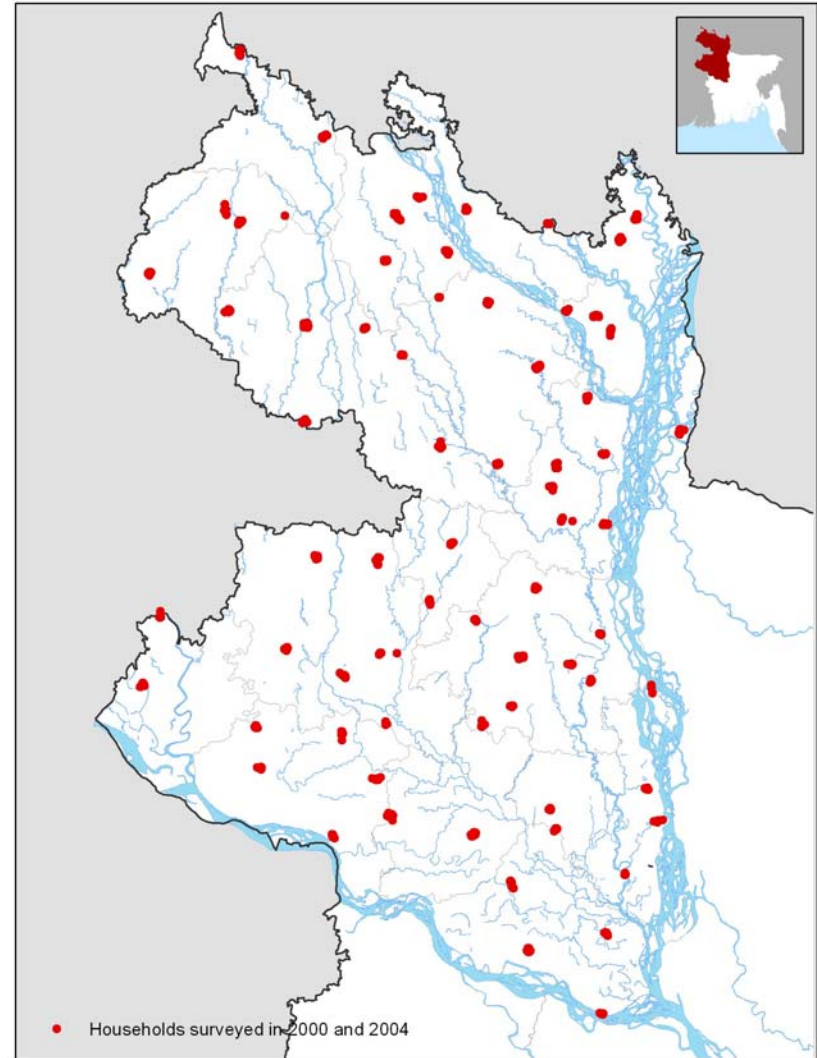
Interaction effect

3. Empirical Estimation

- We use regression and matching methods to identify the impact of infrastructure
- Within matching methods:
 - Matching based on propensity scores
 - Sensitivity with different ways matching
 - Difference in difference estimations when panel data available
- Qualitative techniques

3.1 Data

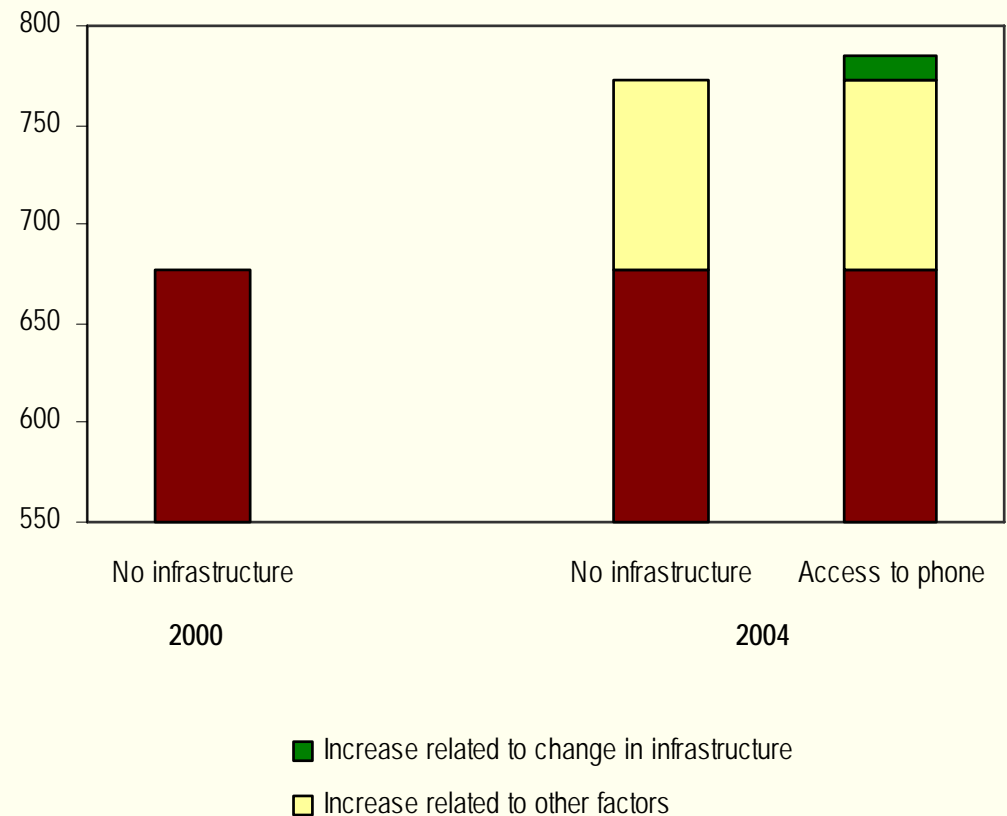
- Household Income and Expenditures Survey 2000.
- IFPRI survey 2004-05.
- Focus group and key informant interviews.
- GIS data from LGED.



3.2. Impact on rural households

- Mr. Jammirudin is 49 years old, married and lives in the Gaibandh district of Bangladesh.
- His family didn't have access to public phones, roads or electricity in 2000.
- Between 2000 and 2004, his household got access to a public phone.
- How much did Mr. Jammirudin's income, hours worked and proportion of non agricultural activities changed between those years.
- How much of that change can be attributed to changes in infrastructure?

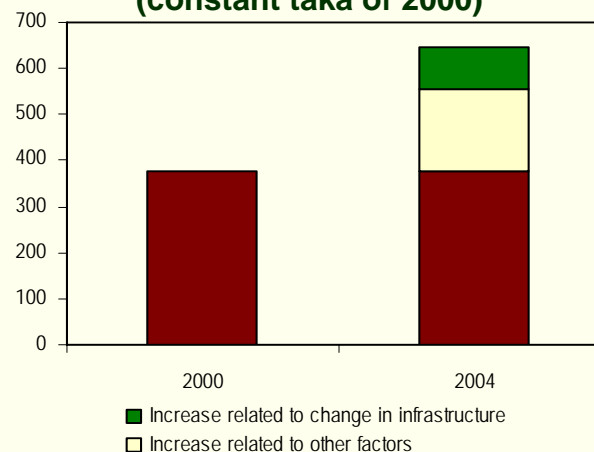
Changes in per capita household expenditure
(constant taka of 2000)



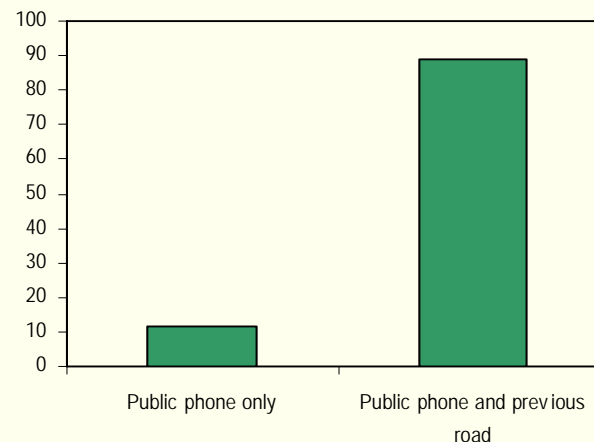
Impacts on income and complementarities

- Would there be any difference if the household previously had other infrastructures?
- Consider the case of Mr. Aminul Islam (44 years old) in the district of Kurigram.
- In 2000, Mr Islam's family had access only to a paved road.
- Between 2000 and 2004, he got access to a public phone.
- Is there any difference from the impact on Mr. Jamirudin?
- Is there any difference due to access to two infrastructures and not just one?

Changes in per capita household expenditure (constant taka of 2000)



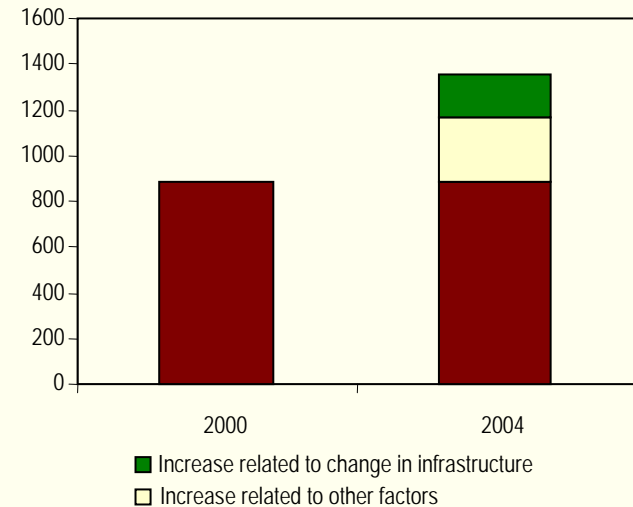
Increase in per capita household expenditure, related to infrastructure (constant taka of 2000)



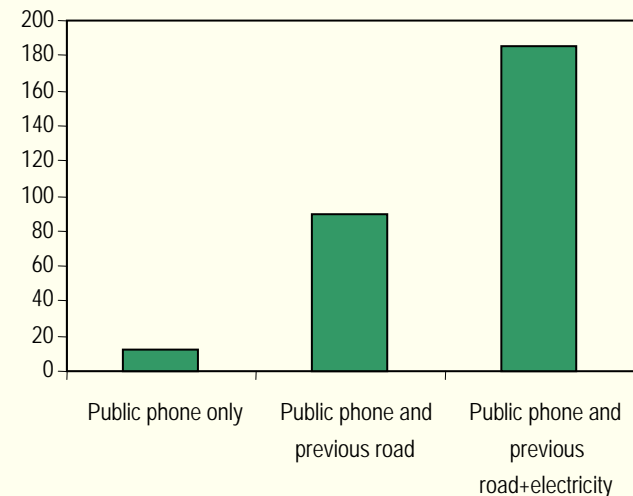
Impacts on income and complementarities

- Mr. Afsar (60 years old, district of Gaibandha) had access to roads and electricity.
- Between 2000 and 2004, he also got access to a public phone.
- Is there any difference relative to the other two cases?

Changes in per capita household expenditure (constant taka of 2000)



Increase in per capita household expenditure, related to infrastructure (constant taka of 2000)



Summarizing the impacts of infra. on income

Difference in difference in per capita expenditure 2000-2004, control does not change his assets *

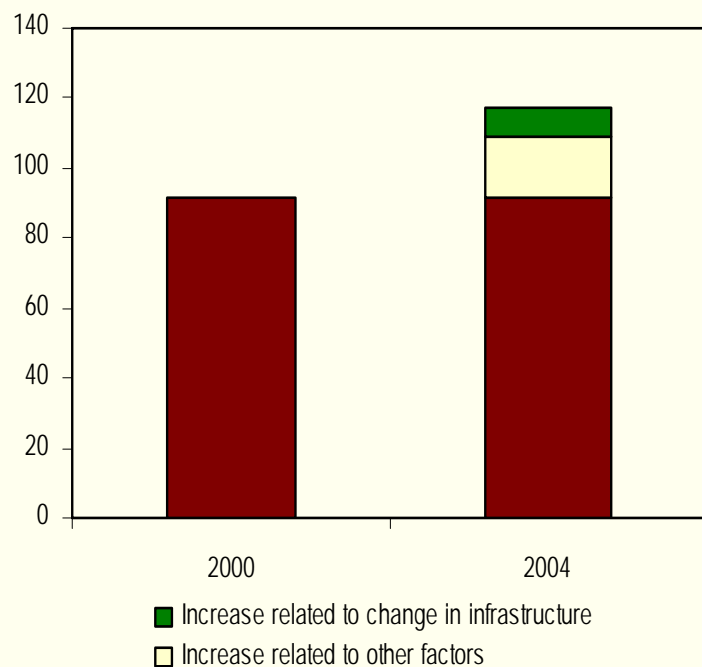
	Treatment	Control	ATT	St. Error	95% conf interval	
Kernel matching						
Treatment from 0 to 1 type of infrastructure	311	415	11.7	32.8	-60.3	57.9
Treatment from 0 to 2 types of infrastructure	183	380	45.2	42.31	-94.4	120.3
Treatment from 1 to 2 types of infrastructure	244	394	89.0	49.1	4.4	168.1
Treatment from 1 to 3 types of infrastructure	50	338	337.6	162.2	139.8	899.7
Treatment from 2 to 3 types of infrastructure	38	264	184.7	86.0	-31.5	276.2

Source: HIES 2000, and IFPRI Survey 2004-2005.

Note: ATT refers to average treatment effect on the treated.

Total hours of work of the household

Changes in weekly hours of work of the household

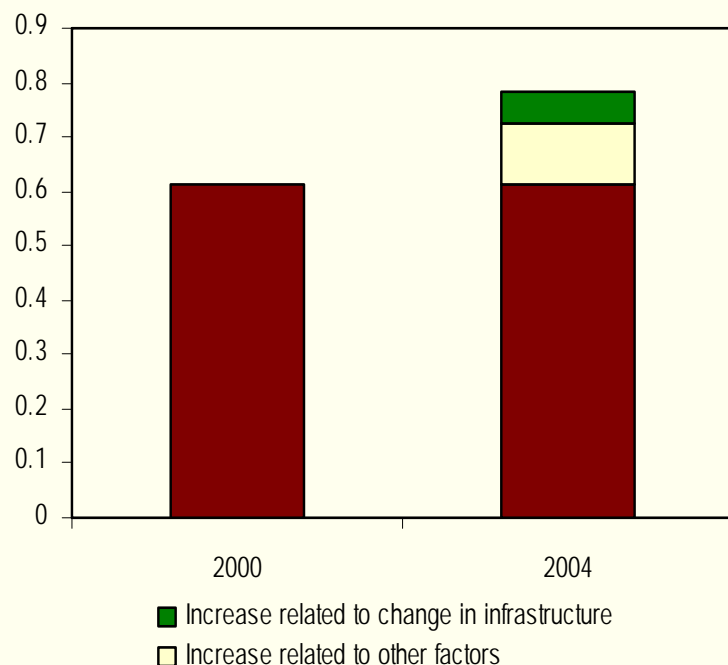


Kernel Matching, control does not change his assets

Treatment	ATT+Bias	S.E.	95% Conf Interval	
From 0 to 1 type of infrastructure	4.6	3.7	-1.6	12.5
From 0 to 2 types of infrastructure	1.2	10.8	-7.8	36.0
From 1 to 2 types of infrastructure	-0.5	5.0	-12.6	6.2
From 2 to 3 types of infrastructure	11.2	11.1	-14.8	30.4

Proportion of hours on non-agricultural activities

Changes in proportion of non-agricultural hours of work of the household



Kernel Matching, control does not change his assets

Treatment	ATT+Bias	S.E.	95% Conf Interval	
From 0 to 1 type of infrastructure	0.1%	3.6%	-7.9%	6.8%
From 0 to 2 types of infrastructure	-14.0%	12.1%	-44.2%	-1.4%
From 1 to 2 types of infrastructure	-0.7%	5.0%	-8.0%	12.0%
From 2 to 3 types of infrastructure	4.8%	10.8%	-20.2%	23.2%

Proportion of hours on non-agricultural activities

Impact of Infrastructure on Agricultural / Non agricultural activities in household ^{a/}.

	Share of hours in non ag	HH in non-ag activities	HH only in ag act	HH in ag & non-ag act	HH only in non-ag act
	Tobit	Probit ^{b/}	Multinomial logit ^{b/}		
Electricity only	-0.0184 (0.1150)	-0.0147 (0.0843)	0.0242 (0.0859)	0.0007 (0.0889)	-0.0250 (0.0402)
Phone only	0.1599 (0.0575)***	0.1132 (0.0402)***	-0.1112 (0.0414) ***	0.0965 (0.0446) **	0.0146 (0.0240)
Road only	0.0563 (0.0790)	0.0426 (0.0559)	-0.0346 (0.0570)	0.0185 (0.0618)	0.0161 (0.0386)
Electricity + phone only	0.2243 (0.0741)***	0.1121 (0.0511)**	-0.1193 (0.0513) **	0.1385 (0.0546) **	-0.0193 (0.0240)
Electricity + road only	-0.0147 (0.1344)	-0.0241 (0.0985)	0.0355 (0.1005)	-0.0386 (0.1049)	0.0031 (0.0518)
Phone + road only	0.3088 (0.0602)***	0.1503 (0.0403)***	-0.1446 (0.0416) ***	0.0781 (0.0481)	0.0666 (0.0335) **
Elect + phone + road	0.2714 (0.0779)***	0.1362 (0.0520)***	-0.1340 (0.0529) **	0.0973 (0.0604)	0.0367 (0.0394)

Impacts on prices of agricultural products

$$IAP_{it} = \frac{\sum_{i=1}^n P_{it} * Q_{it}}{\sum_{i=1}^n Q_{it}}$$

Treatment	Control	N treatment	N control	ATT	S.E.	95% Confidence Interval	
1 infrastructure	0 infrastructure	301	377	0.5307	0.2313	0.0174	0.9526
2 infrastructures	1 infrastructure	216	338	0.2231	0.3494	-0.4774	0.8282

3.3. Impact on Women

Infrastructure and women's off-farm works

	Incidents of off-farm works		Total hours worked	
	Coeff.	SE	Coeff.	SE
Age of female spouse	0.122	(0.068)*	0.053	(0.025)**
Spouse age squared	-0.002	(0.001)*	-0.001	(0.000)**
Years of education of female spouse	0.133	(0.076)*	0.088	(0.036)**
Spouse education squared	-0.0013	(0.0000)*	-0.00008	(0.000)**
Paved road ran through the village in 2000 (0,1)	0.372	(0.23)	0.159	(0.12)
Village had access to electricity in 2000 (0,1)	0.586	(0.37)	0.14	(0.14)
Village had public telephone in 2000 (0,1)	1.414	(0.415)***	0.316	(0.179)*
No public phone in 2000, phone in 2004 (0,1)	0.965	(0.403)**	0.35	(0.137)**
Time required to reach the nearest growth center	-0.001	(0.000)***	-0.00016	(0.000)**

Infrastructure and women's unpaid works

Table: Infrastructure and unpaid works

Dependent variable: Time female spouse spends on unpaid works

Method: IV (Two-stage least square) regression

Hours female spouse spent for paid work	-0.348	(0.114)***
Hours male spouse spent for unpaid work	0.056	(0.075)
Household size	-0.367	(0.047)***
Monthly total household expenditurex10^3	0.0438	(0.000)**
Number of girls (<=14 years)	0.622	(0.077)***
Number of boys (<=14 years)	0.681	(0.082)***
Access to tube well water within the house (0,1)	-0.553	(0.344)*
Household ha electricity connection (0,1)	-0.386	(0.151)**
Constant	9.423	(0.402)***
Observations	1285	
R-squared	0.3	

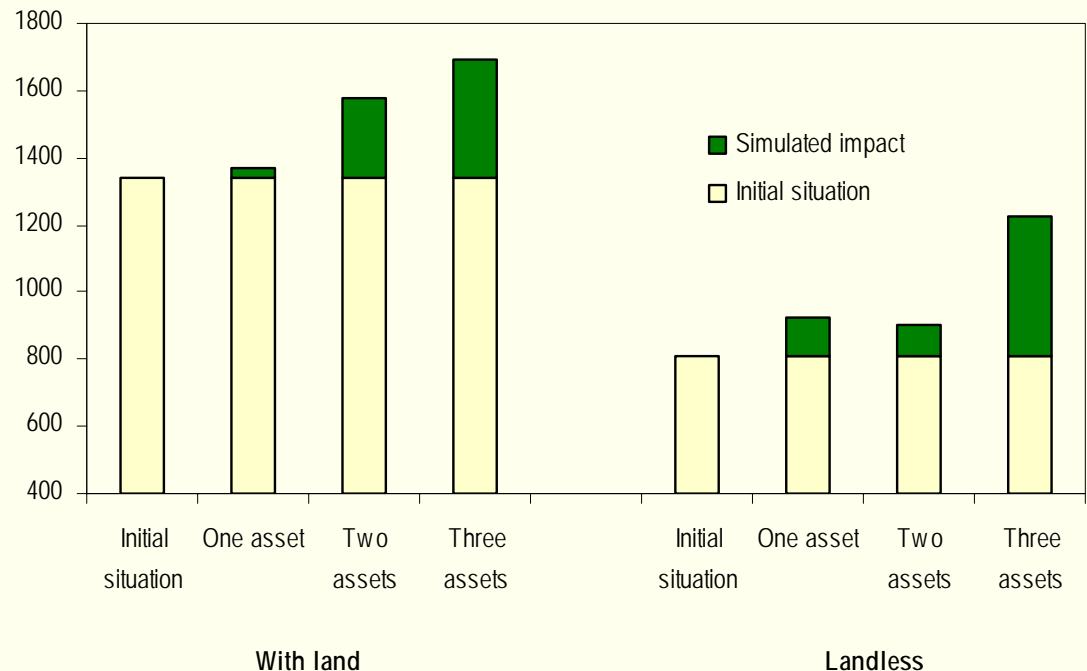
Non-economic effects on women

- **Spatial mobility** of women has increased
 - Construction and improvement of roads brought new transportation facilities.
 - Time to markets and cost of transportation reduced.
- **Social visits** of women have increased
 - Within a village due to electricity and outside due to transportation
- **Better communication** of women with migrate family members
 - Palli Phone and other public phones are allowing to contact migrated members easily.
- Time on **entertainment** has increased
 - Due to electricity, women are spending more time on watching television.

3.4. Impact on landless households

- Mr. Mohandra Nath Roy (62 years old, district of Dinajpur) owns 958 dec of land.
- How would access to assets affect his household?
- In contrast, Mr. Satish Haksda (59 years old, also living in Dinajpur) does not own any land.
- Does infrastructure have a different impact among landless households?

Changes in per capita household expenditure related to infrastructure and land possession (current taka of 2004)



Impact on labor allocation

$$Diff - in - diff = \left[Y_{treatment}^{landless} - Y_{control}^{landless} \right] - \left[Y_{treatment}^{not-landless} - Y_{control}^{not-landless} \right]$$

Matching		Diff - in - diff			S.E.	95% Conf Interval	
Treatment	Control	Observed	Bias	Obs+Bias			
Hours of non-farm work							
1 infrastructure	0 infrastructure	1.0552	0.0000	1.0551	0.0052	1.0452	1.0655
2 infrastructures	0 infrastructure	1.0520	-0.0001	1.0519	0.0062	1.0401	1.0642
3 infrastructures	0 infrastructure	-0.0911	0.0001	-0.0910	0.0127	-0.1158	-0.0661
More than 1 inf	0 infrastructure	0.8786	0.0000	0.8786	0.0064	0.8660	0.8909
Total hours of work (farm + non-farm)							
1 infrastructure	0 infrastructure	-0.0781	0.0000	-0.0781	0.0049	-0.0880	-0.0685
2 infrastructures	0 infrastructure	0.1704	0.0000	0.1704	0.0062	0.1583	0.1826
3 infrastructures	0 infrastructure	-1.6285	0.0001	-1.6284	0.0113	-1.6507	-1.6066
More than 1 inf	0 infrastructure	-0.1134	0.0001	-0.1134	0.0061	-0.1257	-0.1015
Proportion of non-agricultural hours of work (farm + non-farm)							
1 infrastructure	0 infrastructure	0.1824	0.0000	0.1824	0.0008	0.1809	0.1839
2 infrastructures	0 infrastructure	0.2074	0.0000	0.2074	0.0010	0.2054	0.2094
3 infrastructures	0 infrastructure	0.1579	0.0000	0.1579	0.0017	0.1545	0.1612
More than 1 inf	0 infrastructure	0.1961	0.0000	0.1961	0.0010	0.1941	0.1980

4. Conclusions

Infrastructure Developments:

- A lot has been achieved. However,
- Regulation remains at an infant stage.
- Private sector participation:
 - Road: Limited to toll collection, and maintenance services.
 - Electricity: Limited mostly to generation;
 - Telephone: Limited mostly to mobile telephony;

4. Conclusions

- Infrastructure increases welfare of households, the major effect is through higher farm prices.
 - Roads show a positive relation, although not a significant impact because the road network was already in place in 2000.
 - Phones show a very positive impact which is explained by the benefits. Also a critical mass and network externality are helping too.
 - Electricity also show an important positive impact although not as much as phone.
- Significant positive complementarities of all infrastructure.

4. Conclusions

- When decomposing the impact of infrastructure on income we found:
 - Total hours of work remain the same
 - Share of non-farm activities increases although the change is not statistically significant.
 - Prices received by farmers increase

4. Conclusions

- **Specific Impact of Infrastructure:**
- **On Women:**
 - Infrastructure increases off-farm work for women.
 - It also increases women time spent on entertainment and social activities.
- **On Landless:**
 - Returns to infrastructure is higher for landless.
 - Allocation of labor to non-farm activities increases.

4. Policy Recommendations

- **On Poverty alleviation:**
 - Provision of infrastructure should be used as an instrument to alleviate poverty.
- **On access:**
 - Although there is a significant improvement in access, there are still areas where access to infrastructure, specifically electricity at home, is very limited.
 - Two possible alternatives:
 - Areas where market can work but is not working properly there is a need to correct market inefficiencies to increase access
 - Areas where infrastructure can not be provided at current technology costs, there is a need to identify some sort of public intervention to close this gap.

4. Policy Recommendations

- **On Complementarities:**
 - There is a need to coordinate investment in infrastructure to realize the linkages and complementarities of infrastructure investment.
- **Women:**
 - Government should give more emphasis on gender sensitive infrastructure, e.g., tube well, sanitation, etc.
 - Community based daycare facilities to give more flexibility for women to work more hours should be considered.