5. Addressing inequality in access to infrastructure: a focus on rural roads

Summary

- There has been substantial progress in narrowing the gap in access to roads, water, and reliable lighting, during 1997-2004, across the board. Despite the progress, considerable disparities remain between urban and rural sectors, and between rich and poor within each sector.

- Isolation or geographic remoteness is a key factor in perpetuating poverty and income inequality. Provision of infrastructure such as roads improves connectivity, and helps reduce both poverty and inequality.

Chapter 2 found that remoteness due to poor access to infrastructure such as rural roads is a correlate of poverty and hence a factor behind disparity and inequality. As explained in Chapter 2, one measure to lower inequality is to reduce poverty, through raising income or consumption of the bottom segments of the population to close the income gap. This chapter focuses only on road investments. Roads are publicly provided in Cambodia. By helping to connect the isolated segments of the population, the Government can enhance the rural population's opportunities to participate in the broader and more diverse economy. Roads integrate communities into regional and national networks of production and trades. Especially in rural areas, additional and improved roads reduce transaction costs, expand access to markets and enhance rural income. Investments in roads can also enhance the vitality (e.g., growth in trading and commercial activities) and expand diversity (e.g., growth in services) of the rural economy itself. It is estimated that nearly two-thirds of African farmers are effectively insulated from national and world markets because of poor roads. In contrast, substantial investment in Indonesian roads throughout the previous 30 years enabled the poor to participate in the market economy (World Bank 2005 p. 169).

Economic opportunities are shaped by access to infrastructure and especially roads (the focus of this chapter). As shown in Chapter 2, lack of access to roads is a factor contributing to poverty, and hence, inequality Access to roads also has a well-being dimension, i.e., a non-money metric aspect of living standard, as roads bring people closer to goods and services and improves one's daily existence. Furthermore, many of the rural roads in developing countries are labor intensive public works, creating jobs for unskilled labor.

This Chapter first analyzes the distributions of infrastructure such as access to (i) market; (ii) roads; (iii) electricity; (iv) piped water; and (v) lighting, in order to understand the extent of disparity or inequality within urban and rural areas and between these two domains. The second section presents the distributions of access to (i) access

markets; (ii) roads; (iii) piped water; and (iv) lighting for years 1997 and 2004 for comparable samples, based on the 1993 sampling frame to assess progress, if any, in closing the disparity between the rich and the poor, and between rural and urban areas. The third section shows the importance of rural roads for economic outcomes, measured by total household revenue, net cultivation income or crop profit, non-agriculture revenue, and wage income.

Distributions of infrastructure

This section presents the distributions of access to infrastructure for Cambodia's population in 2004, separately by regions and for rural and urban sectors, starting with a presentation of the distributions of populations within various zones (regions) and sectors according to their positions or rankings in the national consumption distribution.

These distributions in Table 5.1 provide information about the relative welfare levels of populations in various zones. For example, 87 percent of Phnom Penh's population belongs to the top two richest quintile groups of the national consumption distribution, whereas only 20 percent of rural Plateau/Mountain population made it to the top two quintile groups. Between 40 percent (of the urban Plateau/Mountain population) and 64 percent (of urban Plains) of other urban residents belonged to the country's richest 2 quintile groups. The richest urban zone was Plains, followed by Coastal, Tonle Sap and Plateau/Mountain. Similarly in the rural areas, the richest zone was Plains, followed by Coastal rural areas, and the poorest rural zones were Tonle Sap and Plateau/Mountain. About 62 percent of rural Plateau/Mountain populations (c. 720,000) and half of rural Tonle Sap (c. 1.7 million) belonged to the poorest 2 quintile groups in the national consumption distribution.

The following Tables then present the proportions of populations within each quintile with access to various public amenities and infrastructure. The population is ranked by its consumption level, within zone (region) and sector, into respective quintile groups in the zone and sector.

Table 5.2 shows the distribution of access to an improved water source, as defined by households with access to water pipes or public tap. Improved water is widely available in Phnom Penh, and for over half of the richest quintile groups in urban Plains and urban Coastal regions. Even among the richest quintile in rural areas, such access is extremely limited.

Table 5.1 Population distribution by national per capita consumption quintile and by region and region*sector

	Quintile					
Region	**1**	**2**	**3**	**4**	**5**	**Totals**
Cambodia	20.0	20.0	20.0	20.0	20.0	100.0
Phnom Penh	2.5	2.7	7.5	21.1	66.1	100.0
Plains urban	5.1	10.0	21.2	24.8	38.9	100.0
Tonle Sap urban	16.2	14.2	17.3	20.1	32.2	100.0
Coastal urban	10.3	15.6	18.7	21.3	34.0	100.0
Plateau/mountains urban	14.9	19.6	24.2	19.9	21.4	100.0
Plains rural	16.9	22.0	22.4	23.3	15.5	100.0
Tonle Sap rural	28.3	22.4	20.8	16.3	12.1	100.0
Coastal rural	14.6	23.6	23.6	22.5	15.7	100.0
Plateau/mountains rural	38.0	24.1	16.6	11.6	9.6	100.0

Source: CSES 2004 (15-month sample).

Table 5.2 Percentage of population in dwelling with water piped or from public tap

	Quintile					
Region	**1**	**2**	**3**	**4**	**5**	**Totals**
Cambodia	1.7	2.5	4.0	10.5	34.7	10.7
Phnom Penh	65.6	55.1	54.8	70.2	89.6	81.3
Plains urban	7.8	9.1	9.2	20.6	57.7	30.8
Tonle Sap urban	3.1	5.4	11.0	18.9	30.4	16.8
Coastal urban	0.0	10.7	16.6	28.2	48.6	27.3
Plateau/mountains urban	3.2	7.7	9.1	15.9	39.4	15.8
Plains rural	2.0	2.7	1.8	3.8	5.8	3.1
Tonle Sap rural	0.4	0.0	0.6	0.6	3.4	0.7
Coastal rural	0.0	0.0	0.0	1.6	4.3	1.0
Plateau/mountains rural	0.0	0.0	1.5	0.1	12.6	1.5

Source: CSES 2004 (15-month sample).

Table 5.3 presents the distribution of population with access to battery- or generator-powered lighting in their dwellings. Almost everyone in Phnom Penh and among the richest quintiles in other urban areas has lighting. The proportions of populations with access to lighting fall monotonically as we move from richest to poorest quintile groups. While in Phnom Penh as much as 98 percent of its population had battery- or generator-powered lighting in their dwellings, only 46 percent of the urban Plateau/Mountain zone had such access; half in rural Plains; and a quarter in other rural zones.

Table 5.3 The distribution of population in dwellings with lighting, powered by city power, generator or battery

	Quintile					
Region	**1**	**2**	**3**	**4**	**5**	**Totals**
Cambodia	18.4	30.3	41.7	56.6	80.3	45.5
Phnom Penh	93.5	86.4	91.8	97.4	99.2	97.8
Plains urban	49.7	60.5	82.5	82.6	98.2	84.8
Tonle Sap urban	12.1	34.0	52.8	77.4	94.3	61.8
Coastal urban	18.2	24.0	53.1	67.3	91.1	60.9
Plateau/mountains urban	9.8	25.6	40.7	59.7	81.6	45.7
Plains rural	29.1	40.1	49.8	58.9	72.6	49.8
Tonle Sap rural	9.2	17.5	25.4	35.5	61.2	25.0
Coastal rural	9.8	16.2	21.3	40.4	55.8	28.1
Plateau/mountains rural	14.8	22.9	26.8	35.2	59.4	25.4

Source: CSES 2004 (15-month sample).

There is a similar pattern in access to electricity (Table 5.4). In Phnom Penh and urban Plains, about 80 percent of their populations have access to electricity. In contrast, only 10 percent of rural Plateau/Mountain region, and between 18 and 25 percent of populations in rural Plains, Tonle Sap and Coastal areas had access. Within each zone and sector, the proportions of populations with access declines monotonically as one moves from the richer to the poorer quintile groups. For example, only a third of the poorest quintile in urban Tonle Sap population had access to electricity compared to 93 percent of the richest quintile in the same urban zone. The disparity is just as wide between the richest and the poorest quintile group in other zones with lower average access rate. For example, 6 percent of the poorest quintile group, compared to 30 percent of the richest quintile group in rural Plateau/Mountain region had electricity access.

Table 5.4 The distribution of population with access to electricity (%)

	Quintile					
Region	**1**	**2**	**3**	**4**	**5**	**Totals**
Cambodia	13.6	18.8	24.8	36.0	57.9	30.2
Phnom Penh	89.4	85.2	79.3	84.0	83.3	83.4
Plains urban	56.9	61.5	72.3	80.2	94.2	80.9
Tonle Sap urban	32.5	64.4	71.7	86.1	92.7	73.8
Coastal urban	66.5	57.0	71.2	72.6	96.0	77.2
Plateau/mountains urban	32.5	31.7	45.0	52.4	69.5	47.3
Plains rural	9.6	13.2	15.9	23.1	29.6	18.0
Tonle Sap rural	13.9	20.3	24.0	32.0	45.5	24.2
Coastal rural	12.5	17.3	18.1	32.6	45.0	24.6
Plateau/mountains rural	6.3	6.6	10.0	9.4	29.6	9.6

Source: CSES 2004 (15-month sample).

Table 5.5 presents the average distances to the nearest all-weather road. In Phnom Penh and urban Tonle Sap, just about every village has all-weather roads, and hence the average is zero km in every quintile group. Except for Plateau/Mountain, all other urban zones have good access to all-weather road, averaging 1.5 km for Plains and Coastal. In urban areas, average distance to roads falls monotonically from poorer to richer quartiles. The average distances to roads were several times higher among the rural populations. The distance differential between the richest and the poorest in rural areas was rather small and in rural Tonle Sap and Coastal regions, the richest quartiles had on average greater distance to travel to the nearest roads than the poorest quartiles.

Table 5.5 Average distance to nearest all-weather road (in km)

	Quintile					
Region	**1**	**2**	**3**	**4**	**5**	**Totals**
Cambodia	4.82	3.55	3.21	3.09	2.03	3.34
Phnom Penh	0.00	0.00	0.00	0.01	0.03	0.02
Plains urban	4.94	2.06	2.64	1.24	0.24	1.41
Tonle Sap urban	0.18	0.47	0.33	0.01	0.01	0.16
Coastal urban	3.32	2.62	2.34	1.54	0.34	1.62
Plateau/mountains urban	14.83	3.55	2.75	0.29	0.36	3.85
Plains rural	6.12	3.66	3.75	3.31	1.86	3.75
Tonle Sap rural	2.46	3.41	3.05	4.86	6.58	3.68
Coastal rural	3.40	4.70	3.58	3.82	8.58	4.71
Plateau/mountains rural	8.20	4.37	3.42	3.60	1.24	5.31

Source: CSES 2004 (15-month sample).

With regards to market access, Table 5.6 presents the average distance to the nearest permanent markets, which is approximately 1 km in Phnom Penh, and 2km in the urban Plains, Tonle Sap and Coastal regions. The urban Plateau/Mountain region is more

isolated, averaging 6km, with a huge gap between the richest and poorest quintile groups. The poorest quintile group has to travel as far as 12km, compared to 3 km for the richest quintile group, in urban Plateau/Mountain region, to reach the nearest market. On average, distances are several folds longer in rural areas, even among the richest quintiles.

Table 5.6 Average distance to permanent market (in km)

	Quintile					
Region	**1**	**2**	**3**	**4**	**5**	**Totals**
Cambodia	10.86	9.54	8.07	7.13	4.22	7.97
Phnom Penh	0.68	1.40	1.51	1.32	0.77	0.96
Plains urban	5.19	4.23	4.17	2.76	1.10	2.67
Tonle Sap urban	4.54	3.28	2.55	1.45	0.80	2.21
Coastal urban	5.27	3.75	2.65	1.84	0.38	2.15
Plateau/mountains urban	12.26	5.27	7.32	4.32	3.28	6.19
Plains rural	9.40	8.84	7.77	7.19	5.73	7.85
Tonle Sap rural	12.27	10.32	8.50	9.36	7.14	9.95
Coastal rural	6.04	6.89	7.00	7.26	8.38	7.11
Plateau/mountains rural	14.33	16.61	17.52	17.17	13.43	15.66

Source: CSES 2004 (15-month sample).

Access to improved water, electricity, lighting, roads, and markets are distributed relatively equally distributed among residents in Phnom Penh Consumption-based inequalities in access to infrastructure appears to be much lower within the capital than in other realms. In other urban areas, access to these infrastructure and amenities is more limited than in the capital city but nonetheless significantly better than in rural areas. In rural areas, some amenities (such as water from an improved source) are non-existent even to the better off households. With the exception of Phnom Penh, in every zone and sector, access to infrastructure and amenities increases monotonically from poorest to richest quintiles. Thus, the disparities between rich and poor, especially in rural areas, and inequality between urban and rural households in accesses to infrastructure, utilities, and public amenities are substantial.

Substantial progress in closing the rich-poor gap

Despite large disparities remaining, Cambodia had made noticeable progress in closing gaps in access to infrastructure. For example, investments in roads have shortened significantly the average distance to the nearest motor road. Table 5.7 shows the average distance to motor roads by quartile groups in rural and urban areas in years 1997 and 2004. In rural areas, the poorest quartile group in 1997 on average traveled 2.8km to get to the nearest motor road. By 2004, the average distance was less than 1 km. In urban areas, there was also improvement. The poorest quartile group in 1997

traveled on average 0.53km to get to the nearest motor road, and by 2004, the distance was halved. While there is absolute progress in better access to roads across the distribution, the rich-poor gap is actually now larger. It is unclear whether this reflects a bias from the changes of the definition of roads (i.e., from all-motor road in 1997 to all-weather road in 2004).

Table 5.7 Average distance (in km) to motor roads by quartile, 1997 and 2004

Rural	poorest quartile	second quartile	third quartile	richest quartile
	0-25%	25%-50%	50%-75%	75%-100%
1997	2.810	2.949	4.085	2.625
2004	0.875	0.738	0.499	0.378
Urban	**poorest quartile**	**second quartile**	**third quartile**	**richest quartile**
	0-25%	**25%-50%**	**50%-75%**	**75%-100%**
1997	0.535	0.581	0.301	0.129
2004	0.204	0.095	0.008	0.026

Sources: CSES 1997; CSES 2004 (15-month sample)
Note: there is no information collected for motor roads in 2004, and thus the above estimates of 2004 are derived from information collected for all-weather roads. Al-weather-road is a more expensive and more durable than all-motor roads.

Table 5.8 presents the distributions of utilities and other public amenities, e.g., markets, improved water, and reliable lighting for years 1997 and 2004. The results suggest that there have been remarkable improvements for all income groups, in both rural and urban areas. Especially in rural areas, the increases in access to these amenities and utilities were most substantial among the poorest quartile and thus the disparities between rich and poor have shrunk during this period. Among the poorest quartile in rural areas, the proportions of population with access to a permanent market in their villages rose 3-fold from 3.4 percent to 9.1 percent; those with access to improved water jumped 20-fold from 0.1 percent to 2.2 percent; while the percentages with access to reliable lighting increased 4-fold from 4.7 percent to 18 percent. With increases in the numbers of permanent markets in villages, the average distance to market also improved during this period. In rural areas, the average distance fell from 7.13km in 1997 to 6.87km in 2004. In urban areas, the average distance improved from 2.26km in 1997 to 1.45km in 2004.

Table 5.8 Distributions of utilities and amenities by quartile, 1997 and 2004

Rural		Quartile Groups			
		poorest 0-25%	second 25%-50%	third 50%-75%	richest 75%-100%
% with a permanent market	1997	3.4	7.1	9.8	10.6
in the village	2004	9.1	8.5	9.8	15.2
distance to the nearest	1997	8.36	7.45	7.08	5.65
permanent market (km)	2004	8.55	8.24	6.85	5.77
% with clean water	1997	0.1	1.7	5.3	2.7
(piped or public tap)	2004	2.2	1.5	1.9	5.1
% with reliable lighting	1997	4.7	7.8	11.9	9.5
(by city grid, battery, generator)	2004	18.2	29.0	39.3	55.9
Urban		**Quartile Groups**			
		poorest 0-25%	**second 25%-50%**	**third 50%-75%**	**richest 75%-100%**
% with a permanent market	1997	16.9	22.3	27.2	31.7
in the village	2004	16.1	25.7	29.3	29.9
distance to the nearest	1997	3.26	2.81	1.65	1.31
permanent market (km)	2004	2.78	1.38	0.77	1.41
% with clean water	1997	13.4	26.4	45.4	68.1
(piped or public tap)	2004	19.5	45.1	67.4	78.1
% with reliable lighting	1997	35.8	56.0	75.0	87.2

Sources: CSES 1997; CSES 2004 (15-month sample)

Note: Only comparable samples, from both surveys, based on the identical (1993) sampling frame are used in the analyses.

The most remarkable public investments involved the construction of schools. Across the country, increased access to schools, at all levels, has been notable between 1997 and 2004. Table 5.9 shows that the distances to primary school and secondary schools have fallen precipitously, by bringing schools closer to the populations. In rural areas, the average distance to the nearest primary school fell from 5.6km in 1997 to 1km in 2004; and the average distances to lower and upper secondary school fell 10-fold from 49km to 4km, and from 118km to 10km, respectively. Similarly in urban areas, the average distances have fallen about 9-10 fold as well.

In 2004, there was little disparity in distances to primary school between the richest and poorest quintile groups in many regions of the country. For example, the average distance to the nearest primary school within rural areas in the Plateau/Mountain zone was 2.5km for the poorest quintile, and was 2.0km for the richest quintile. In urban areas within the coastal region, the distance was 0.52km for the poorest quintile, and was 0.50km for the richest quintile (Table 5.10).

Table 5.9 Average distances (in km) to schools, 1997 and 2004

Rural	**distance to nearest primary school**	**distance to nearest lower secondary school**	**distance to nearest upper secondary school**
1997	6.59	49.0	118
2004	1.02	3.99	9.55
Urban	**distance to nearest primary school**	**distance to nearest lower secondary school**	**distance to nearest upper secondary school**
1997	4.72	19.5	28.5
2004	0.47	1.73	3.01

Sources: CSES 1997; CSES 2004 (15-month sample)

Table 5.10 Average distances to primary schools, 2004

	Quintile				
Region	Poorest	Next poorest	Middle	Next richest	Richest
Cambodia	2.25	1.79	1.94	1.60	0.93
Phnom Penh	0.35	0.32	0.42	0.39	0.54
Urban	0.46	0.42	0.55	0.43	0.48
Plains urban	0.34	0.53	0.33	0.44	0.45
Tonle Sap urban	0.45	0.31	0.32	0.34	0.22
Coastal urban	0.52	0.73	1.15	0.38	0.50
Plateau/mountains urban	0.43	0.29	0.40	0.39	0.26
Rural					
Plains rural	1.22	1.22	1.73	1.04	0.67
Tonle Sap rural	3.23	1.80	2.17	2.09	2.38
Coastal rural	5.05	2.99	3.58	5.80	1.49
Plateau/mountains rural	2.49	4.59	3.69	4.73	1.96

Sources: CSES 1997; CSES 2004 (15-month sample)

Disparity of outcomes from the disparity of access to roads

Chapter 2 showed that there are noticeable differences in welfare due to differential access to infrastructure. Mean real consumption in remote areas was lower than that in connected areas, and poverty rate was higher in isolated villages than better connected villages. This section presents the differences in additional economic outcomes between rural households with access to all-weather roads and those without. We focus on rural areas because despite significant progress in closing the gap during the last decade, the rural majority are still considerably less well-connected, compared to the urban population.

In addition to consumption differences which were observed in Chapter 2, there are also significant differences in other outcomes. Table 5.11 presents provincial averages of annual total household revenue, crop profits, non-agriculture revenue, and wage income for 2 categories of households. One category consists of households with all-weather road in the village. The other category of households do not have an all-weather

road in the village. Except for Kompong Chnang and Pursat, the means of total household revenue of all other provinces are significantly higher[1] among households connected to an all-weather road in the village. An examination of profit from crop cultivation shows that mean averages are not necessarily higher among the connected households in every province. About half of the provinces have higher average crop profits among households without all-weather road in the village than the average of households with all-weather road in the village. The bottom half of Table 5.11 presents provincial averages of non-agriculture revenue and wage income. With the exception of Kompong Chnang and Pursat, all other provinces have significantly higher average non-agriculture revenue among households connected to a road. Similarly, with the exception of Kompong Speu, wage incomes on average are significantly higher among connected households in all provinces.

The results suggest that access to infrastructure such as roads raises household income primarily through the provision of better access to non-farm opportunities. Total household revenue is higher among those with access to roads than those without. However, revenue from cultivation or crop profitability is not systematically higher among those with better road access. It would be expected that roads facilitate access to input and output markets, lowering costs and enhancing revenue. However, there is no systematic pattern of higher agriculture revenue linked to access to roads. On the other hand, access to roads improves access to other non-farm opportunities, e.g., facilitating small enterprise businesses, as seen with systematically higher non-agriculture revenue among those with access to roads. Lastly, access to road facilitates connectivity to wider employment opportunities in other villages or in urban areas. Waged income among households with access to roads is significantly higher.

[1] The significance refers to 1 percent level or 99 percent confidence interval.

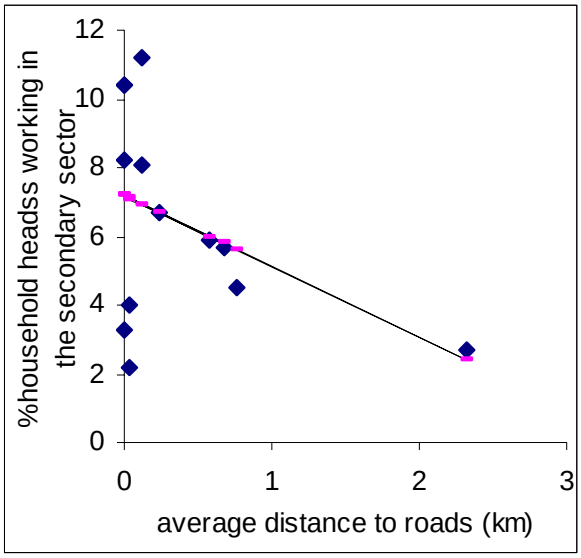
Table 5.11 Provincial averages of total household revenue, crop profits, non-agriculture revenue, and wage income, by existence of all-weather road in village, (annual, in Riel)

	average total household revenue			average profit of crop cultivation		
	connected to road	without road	differences in mean	connected to road	without road	differences in mean
Kompong Cham	7,057,633	3,477,119	3,580,514	568,475	284,463	284,012
Kandal	9,412,447	3,811,877	5,600,570	236,998	-241,174	478,172
Prey Veng	3,829,271	3,106,895	722,376	406,470	145,524	260,946
Svay Rieng	2,904,427	2,696,480	207,947	263,736	918,992	-655,256
Takeo	5,481,193	4,629,359	851,834	474,940	-281,745	756,685
Banteay Meanchey	8,674,462	3,447,005	5,227,457	560,648	363,837	196,811
Battambang	11,594,940	6,112,980	5,481,960	1,407,561	1,572,887	-165,326
Kompong Thom	4,918,124	3,056,538	1,861,586	476,226	606,672	-130,446
Siem Reap	12,598,708	2,863,314	9,735,394	462,508	286,844	175,664
Kompong Chhnang, Pursat	7,447,693	9,409,218	-1,961,525	372,531	388,189	-15,658
Kampot	5,166,382	2,334,716	2,831,666	550,960	282,502	268,458
Sihanoukville, Kep, Koh Kong	22,189,763	8,698,686	13,491,077	270,592	334,010	-63,418
Kompong Speu	4,030,935	3,109,317	921,618	419,710	568,778	-149,068
Other Plateau Mountain provinces	5,064,413	2,687,803	2,376,610	562,839	633,388	-70,549
	average non-agriculture revenue			**average household wage income**		
	connected to road	without road	differences in mean	connected to road	without road	differences in mean
Kompong Cham	4,091,138	1,100,222	2,990,916	796,789	641,101	155,688
Kandal	5,098,629	1,136,973	3,961,656	1,910,707	1,440,174	470,533
Prey Veng	1,441,157	1,096,272	344,885	475,443	412,523	62,920
Svay Rieng	773,121	208,697	564,424	526,925	223,327	303,598
Takeo	2,740,933	2,426,512	314,421	615,540	479,726	135,814
Banteay Meanchey	5,229,444	1,489,450	3,739,994	1,268,491	375,283	893,208
Battambang	7,071,883	2,110,211	4,961,672	1,119,217	407,162	712,055
Kompong Thom	2,224,397	913,975	1,310,422	840,040	348,801	491,239
Siem Reap	8,639,408	602,423	8,036,985	1,256,086	299,704	956,382
Kompong Chhnang, Pursat	4,881,231	5,161,625	-280,394	520,959	374,913	146,046
Kampot	2,242,902	486,869	1,756,033	535,698	101,203	434,495
Sihanoukville/Kep/Koh Kong	15,474,791	4,272,164	11,202,627	2,841,474	595,305	2,246,169
Kompong Speu	1,549,583	282,366	1,267,217	678,726	754,396	-75,670
Other Plateau/Mountains	2,375,261	463,780	1,911,481	571,756	186,098	385,658

Sources: CSES 1997; CSES 2004 (15-month sample)

Figure 5.1 plots the provincial average of distance to the nearest all-weather road and provincial proportion of households with heads working in the secondary sector. The plot shows that there is a negative relationship between the distance to an all-weather road and the proportion of household heads being engaged in a secondary sector of employment. Thus, with closer proximity to roads, one has lower transportation costs and greater ease to access other economic opportunities beyond agriculture and outside of his village.

Figure 5.1 access to road and employment in the secondary sector



Sources: CSES 2004 (15-month sample)