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Initial Studies on Health Inequalities in the Rufiji River Basin, Coastal Tanzania:

Evidence from a Demographic Surveillance System

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Introduction

Efforts to improve health in developing countries face many problems. These include high incidence of infectious and communicable diseases, growing burdens of chronic and non-communicable diseases, weak health systems, and inadequate human and material resources. There are also unquantified and poorly understood inequalities in access to health services within and between various population groups. Little is known of the factors that determine these inequalities and the mechanisms through which they operate in various sub-groups.

The relationship between socio-economic differentials and health status in developing countries has been documented in several studies (Caldwell, 1979; Cochrane, et al, 1982, Rutstein, 1984, Bicego and Boerma, 1993; Gwatkin, et al 2000; Woelk, 2000). Using a study of 20 DHS surveys from developing countries Bicego and Ahmad (1996) found that mortality risks of under fives born to uneducated women were more than twice as high as to those born to women with a secondary education. Gwatkin et al (2000) using DHS data from Tanzania described differentials between the poor and the least poor in mortality, nutrition and treatment of illnesses. Woelk and Chikuse (2000) in Zimbabwe showed that stunting, underweight and occurrence of diarrhoea varied according to the socio-economic status noting that being in the lowest socio-economic status increased the risk of being underweight for children by about three times compared to those in the highest socio-economic group.

The purpose of the work reported here is to provide an initial description of socio-economic differentials in relation to health status and health service access by using data from demographic surveillance survey systems (DSS). The major objective of the study was to explore the utility of DSS as a source of equity monitoring data. This entailed conducting an asset survey nested into a DSS survey and using principal components analysis to build an asset-based wealth index. This was used to determine the relationship between household socio-economic characteristics and inequalities of access to health interventions, and to health outcomes in rural Tanzania. Specifically this initial study examined how proxies for socio-economic status (e.g. ownership of assets, housing quality and sanitation) relate to infant, child and under five mortality as well as ownership of bed nets. The data obtained is intended to assist programme or policy makers to recognize health system inequities in order to improve the health status in the rural areas.

Methods

The Rufiji Demographic Surveillance System (DSS) commenced field operations in November 1998. The DSS approach involves continuous monitoring of households and members within households in cycles or intervals, known in the Rufiji DSS as ‘rounds’ of four months each. The Rufiji DSS collects information on demographic, household, socio-economic and environmental characteristics of the population from 31 villages located in Rufiji District along the coastal area of Tanzania, south of Dar es Salaam in the Rufiji River basin. The Rufiji DSS was established as one of the four major components of TEHIP. Its aim is to provide data to the district health authorities and the Ministry of Health to inform evidence based planning and resource allocation as well as to quantify the burden of disease and document impact of health system interventions and innovations.

Rufiji is one of the six districts of Coast region with an estimated population of about 187,000. The Rufiji River cuts the district roughly into half. The surveillance area was

selected by purposive sampling and is situated on the northern side of the river floodplain. Rufiji DSS employs the Household Registration System (HRS) (Indome *et al*, 1995), which involves collecting and documenting data on births, deaths, causes of death, marriages, in and out-migrations and socio-economic status. Full details have been reported elsewhere (Mwageni et al. 2002).

The data for this study come from routine core demographic information and socio-economic data collected by the Rufiji DSS for the years 1999 and 2000. Specifically for this report, data comes from 16,260 active households. Of these about 14,440 had data required for assets and housing conditions, and 12,604 (about 77.5%) had data required for both assets, housing conditions, water and sanitation variables sufficient to create a household wealth index. Socio-economic data was collected in the October 2000 - January 2001 Rufiji DSS round coinciding with the end of the two-year mortality data set. The data collected included: asset ownership, housing conditions, source of energy for cooking, water & sanitation. The socio-economic questionnaire was developed through reviewing multiple sources such as common assets owned by the community, standard lists of assets from previous studies within the country and from multi-country studies such as the DHS and those done by World Bank. Appendix 1 lists the assets included in this asset survey.

Routine Rufiji DSS data has been analysed using HRS software (Phillips and MacLeod, 1995). Principal Components Analysis (PCA) using Stata 7.0 (Stata Corporation) was applied to the socio-economic data to obtain an index as a proxy for household socio-economic status.

PCA involves breaking down assets (e.g. radio, wrist watch) or household service access of a household (e.g. water, electricity) into categorical or interval variables. The variables are then processed in order to obtain weights and principal components. The results obtained from the first principal component (explaining the most variability) are usually used to develop the asset index based on the formula:

$A_j = f_1 \times (a_{ji}-a_1)/(S_1) + \ldots\ldots f_N \times (fa_{jN}-a_N)/(s_N)$ (Filmer and Pritchett, 1998)

where f1 is the scoring factor or weights for the first asset, x is the variable (asset or service), aj is the value for the assets, and a1 and s1 are the mean and standard deviation of assets respectively. Based on this equation wealth indices of households were assigned to the residents of those households, and the resulting population was divided into wealth quintiles that then represent proxies for socio-economic status. Wealth quintiles are thus expressed in terms of quintiles of individuals of the total population at risk for all measures.

Three statistical indicators of inequality were measured. One was the poorest / least poor ratio which is the rate ratio comparing the rate prevailing in the poorest quintile with the rate in the least poor quintile. This method ignores information contained in the middle three quintiles. The second measure used was the concentration index calculated by the method of Kakwani et al. (1998). This measures the extent to which a variable is distributed unequally across all five wealth quintiles, i.e. the concentration of inequality. The closer the index is to zero, the less concentrated the distribution of inequality (Gwatkin et al., 2000). The third was a trend test (Chi Square) to determine the significance of any gradient in the inequality.

Analysis and Discussion

Socio-economic status index
The final index was based on household assets, housing quality, water and sanitation. The asset index approach has been used and recommended by many studies (Filmer and Pritchett, 1998; Bonilla-Chacin and Hammer, 1999; Wagstaff and Watanbe, 1999; Gwatkin et al, 2000; Sahn and Stiffel, 2000). In a study conducted in several states of India, Filmer and Pritchettt (1998) found that the asset index produces comparable results with other measures. The authors noted that the asset index significantly correlated with the state headcount index as well as the domestic product per capita distributions.

Complete results of the PCA are summarised in Table 1. There are 49 principal components and the first component accounts for 12.9 % of the total variance. The second largest component explains 5.0 % of total variance of all the variables. The Eigenvectors of the first component have been used as scoring weights for each of the asset and service items as shown in Table 3. Table 3 also presents PCA results of the variables related to socio-economic status of the Rufiji DSS area. According to Table 3, the variance in the first component is explained by asset ownership (39.8%) and housing conditions (39.0%).

Table 1: Eigenvalue Proportions accounted for by 49 Components

Component	Eigenvalue	Difference	Proportion	Cumulative
1	6.94955	4.22573	0.1287	0.1287
2	2.72382	0.11096	0.0504	0.1791
3	2.61286	0.68314	0.0484	0.2275
4	1.92972	0.15601	0.0357	0.2633
5	1.77371	0.10268	0.0328	0.2961
6	1.67102	0.22818	0.0309	0.3270
7	1.44285	0.09271	0.0267	0.3538
8	1.35014	0.04161	0.0250	0.3788
9	1.30853	0.06326	0.0242	0.4030
10	1.24527	0.04275	0.0231	0.4261
11	1.20253	0.02433	0.0223	0.4483
12	1.17820	0.02767	0.0218	0.4702
13	1.15053	0.00525	0.0213	0.4915
14	1.14528	0.03778	0.0212	0.5127
15	1.10750	0.02659	0.0205	0.5332
16	1.08090	0.03107	0.0200	0.5532
17	1.04983	0.02909	0.0194	0.5726
18	1.02074	0.00614	0.0189	0.5915
19	1.01460	0.01949	0.0188	0.6103
20	0.99511	0.02172	0.0184	0.6288
21	0.97339	0.01585	0.0180	0.6468
22	0.95753	0.01337	0.0177	0.6645
23	0.94417	0.02941	0.0175	0.6820
24	0.91476	0.00518	0.0169	0.6989
25	0.90958	0.02230	0.0168	0.7158
26	0.88728	0.00942	0.0164	0.7322
27	0.87786	0.03258	0.0163	0.7485
28	0.84529	0.01679	0.0157	0.7641
29	0.82850	0.03475	0.0153	0.7795

30	0.79374	0.00957	0.0147	0.7942
31	0.78418	0.01562	0.0145	0.8087
32	0.76855	0.01131	0.0142	0.8229
33	0.75724	0.04653	0.0140	0.8369
34	0.71071	0.01423	0.0132	0.8501
35	0.69648	0.01783	0.0129	0.8630
36	0.67865	0.01509	0.0126	0.8756
37	0.66356	0.00432	0.0123	0.8879
38	0.65924	0.00453	0.0122	0.9001
39	0.65471	0.05160	0.0121	0.9122
40	0.60311	0.01602	0.0112	0.9234
41	0.58709	0.01957	0.0109	0.9342
42	0.56752	0.02079	0.0105	0.9447
43	0.54673	0.00568	0.0101	0.9549
44	0.54105	0.01330	0.0100	0.9649
45	0.52776	0.00743	0.0098	0.9747
46	0.52033	0.02974	0.0096	0.9843
47	0.49059	0.15015	0.0091	0.9934
48	0.34044	0.32320	0.0063	0.9997
49	0.01724	0.01724	0.0003	1.0000

Table 2: Total variance accounted for 1st principal component and associated weights

Variable	% of variance accounted for	Scoring weights	Variable Mean	Variable Std.dev	Scoring weights /Std. Dev	Min	Max
Ownership of assets							
Bicycle	0.42	0.065	0.425	0.494	0.131	0	1
Car	0.39	0.062	0.003	0.057	1.094	0	1
Motorbike	0.17	0.042	0.003	0.053	0.791	0	1
Radio	1.43	0.120	0.523	0.499	0.239	0	1
Refrigerator	1.51	0.123	0.008	0.091	1.347	0	1
Television	1.38	0.118	0.006	0.077	1.529	0	1
Clock/watch	2.21	0.149	0.411	0.492	0.302	0	1
Land	1.87	-0.137	0.906	0.292	-0.468	0	1
Sofa set	4.98	0.223	0.050	0.219	1.020	0	1
Bed	0.00	-0.004	0.973	0.161	-0.022	0	1
Iron	3.99	0.200	0.112	0.315	0.634	0	1
Video	1.95	0.140	0.008	0.090	1.560	0	1
Matress	4.72	0.217	0.323	0.468	0.465	0	1
Wardrobe	4.97	0.223	0.076	0.266	0.839	0	1
Water pump	0.40	0.063	0.003	0.053	1.184	0	1
Livestock	0.89	0.094	0.020	0.140	0.673	0	1
Sewing machine	1.32	0.115	0.026	0.159	0.722	0	1
Poultry	0.30	-0.054	0.506	0.500	-0.109	0	1
Bednet	3.29	0.181	0.190	0.392	0.463	0	1
Satellite dish	0.28	0.053	0.002	0.047	1.129	0	1
Fan	3.36	0.183	0.019	0.136	1.344	0	1
Subtotal	**39.85**						
Housing conditions							
Owning house	2.63	-0.162	0.833	0.373	-0.434	0	1
Number of Rooms	0.08	0.028	2.534	1.268	0.022	0	8
Earth floor	8.35	-0.289	0.841	0.366	-0.791	0	1
Wooden floor	0.03	0.017	0.003	0.056	0.308	0	1
Tiled floor	0.01	0.008	0.004	0.065	0.120	0	1
Cement floor	8.12	0.285	0.111	0.315	0.905	0	1
Other floor	0.55	0.074	0.040	0.196	0.377	0	1
Stone walls	5.51	0.235	0.063	0.242	0.968	0	1
Bricks wall	0.41	0.064	0.020	0.140	0.457	0	1
Galvanised wall	1.16	-0.108	0.744	0.437	-0.247	0	1
Grass wall	0.32	-0.057	0.068	0.252	-0.225	0	1
Other wall	0.02	-0.015	0.105	0.307	-0.047	0	1
Tiled roof	0.02	0.012	0.002	0.040	0.310	0	1
Asbestos	6.04	0.246	0.263	0.440	0.558	0	1
Thatch roof	5.77	-0.240	0.700	0.458	-0.524	0	1
Other roof	0.01	0.008	0.035	0.185	0.041	0	1
Subtotal	**39.02**						
Source of energy for cooking							
Electric energy	0.06	0.025	0.003	0.058	0.423	0	1
Firewood	7.29	-0.270	0.887	0.316	-0.853	0	1
Kerosene	6.05	0.246	0.076	0.265	0.928	0	1
Residue energy	0.01	0.012	0.001	0.031	0.388	0	1
Other energy	1.08	0.104	0.033	0.177	0.586	0	1
Subtotal	**14.49**						
Water and sanitation							
Piped into residence	0.61	0.078	0.002	0.045	1.719	0	1
Private well	0.25	0.050	0.003	0.057	0.885	0	1
Public well	2.10	-0.145	0.965	0.183	-0.791	0	1
Public tap	0.09	0.030	0.002	0.047	0.637	0	1
Vendor	1.63	0.128	0.019	0.135	0.944	0	1
River	0.00	0.002	0.007	0.086	0.025	0	1
Flush toilet	0.06	0.025	0.000	0.013	1.978	0	1
VIP	0.35	0.060	0.003	0.057	1.046	0	1
Pit	0.14	0.037	0.924	0.265	0.140	0	1
Bush	0.23	-0.048	0.044	0.206	-0.232	0	1
Neighbour	0.05	-0.023	0.028	0.166	-0.136	0	1
Time to water source (minutes)	1.13	-0.106	13.761	12.488	-0.009	0	303
Subtotal	**6.64**						
Total	**100.00**						

Table 3: Distribution of assets and housing conditions by quintiles (%)

Variable	Quintiles (Per cent of Population)						
	Poorest 1st	*2nd*	*3rd*	*4th*	*Least Poor 5th*	*Average*	*Poorest/Least Poor Ratio*
If household has ….							
Bicycle	12.0	38.0	55.0	52.0	55.0	42.0	**0.22**
Car	0.0	0.0	0.0	0.0	2.0	0.0	**0.00**
Motorbike	0.0	0.0	0.0	0.0	1.0	0.0	**0.00**
Radio	10.0	50.0	64.0	61.0	76.0	52.0	**0.13**
Refrigerator	0.0	0.0	0.0	0.0	4.0	1.0	**0.00**
Television	0.0	0.0	0.0	0.0	3.0	1.0	**0.00**
Clock/watch	4.0	28.0	52.0	50.0	72.0	41.0	**0.06**
Land	99.0	98.0	93.0	89.0	73.0	91.0	**1.36**
Sofa set	0.0	0.0	0.0	2.0	23.0	5.0	**0.00**
Bed	99.0	97.0	97.0	96.0	97.0	97.0	**1.02**
Iron	0.0	0.0	5.0	14.0	37.0	11.0	**0.00**
Video	0.0	0.0	0.0	0.0	4.0	1.0	**0.00**
Matress	0.0	6.0	29.0	46.0	81.0	32.0	**0.00**
Wardrobe	0.0	0.0	0.0	5.0	33.0	8.0	**0.00**
Water pump	0.0	0.0	0.0	0.0	1.0	0.0	**0.00**
Livestock	0.0	0.0	1.0	2.0	8.0	2.0	**0.00**
Sewing machine	0.0	0.0	1.0	2.0	1.0	3.0	**0.00**
Poultry	57.0	59.0	55.0	46.0	36.0	51.0	**1.58**
Satellite dish	0.0	0.0	0.0	0.0	1.0	0.0	**0.00**
Fan	0.0	0.0	0.0	0.0	9.0	2.0	**0.00**
Owning house	99.0	94.0	88.0	80.0	55.0	83.0	**1.80**
Three sleeping rooms	17.0	24.0	26.0	24.0	21.0	22.0	**0.81**
Four sleeping rooms	6.0	13.0	15.0	21.0	15.0	14.0	**0.40**
Earth floor	100.0	100.0	100.0	93.0	28.0	84.0	**3.57**
Wooden floor	0.0	0.0	0.0	0.0	1.0	0.0	**0.00**
Tiled floor	0.0	0.0	0.0	1.0	1.0	0.0	**0.00**
Cement floor	0.0	0.0	0.0	2.0	54.0	11.0	**0.00**
Other floor	0.0	0.0	0.0	4.0	16.0	4.0	**0.00**
Stone walls	0.0	0.0	0.0	2.0	29.0	6.0	**0.00**
Bricks wall	0.0	0.0	1.0	3.0	7.0	2.0	**0.00**
Mud /stick wall	78.0	75.0	80.0	85.0	54.0	74.0	**1.44**
Grass wall	16.0	9.0	5.0	2.0	0.0	7.0	**0.00**
Other wall	5.0	15.0	14.0	8.0	10.0	11.0	**0.50**
Tiled roof	0.0	0.0	0.0	0.0	0.0	0.0	**0.00**
Asbestos	0.0	0.0	6.0	47.0	79.0	26.0	**0.00**
Thatch roof	100.0	99.0	89.0	45.0	17.0	70.0	**5.88**
Other roof	0.0	1.0	5.0	8.0	4.0	4.0	**0.00**
If household uses...							
Electric energy	0.0	0.0	0.0	1.0	1.0	0.0	**0.00**
Firewood	100.0	100.0	100.0	94.0	49.0	89.0	**2.04**
Kerosene	0.0	0.0	0.0	2.0	36.0	8.0	**0.00**
Residue energy	0.0	0.0	0.0	0.0	0.0	0.0	**0.00**
Other energy	0.0	0.0	0.0	3.0	14.0	3.0	**0.00**
If household water source is							
Piped into residence	0.0	0.0	0.0	0.0	1.0	0.0	**0.00**
Private well	0.0	0.0	0.0	1.0	1.0	0.0	**0.00**
Public well	100.0	99.0	98.0	97.0	88.0	97.0	**1.14**
Public tap	0.0	0.0	0.0	0.0	1.0	0.0	**0.00**
Vendor	0.0	0.0	0.0	1.0	8.0	2.0	**0.00**
River	0.0	0.0	1.0	1.0	1.0	1.0	**0.00**
If household's toilet is ...							
Flush toilet	0.0	0.0	0.0	0.0	0.0	0.0	**0.00**
VIP	0.0	0.0	0.0	0.0	1.0	0.0	**0.00**
Pit	80.0	95.0	95.0	96.0	97.0	92.0	**0.82**
Bush	14.0	3.0	3.0	2.0	1.0	4.0	**14.00**
Neighbour	6.0	2.0	2.0	2.0	2.0	3.0	**3.00**

Further analysis of Table 2 reveals that there is a consistency in the way the socio-economic variables behave. For example, ownership of assets like radio, fridge, wristwatch, sofa set, iron and mattress provide positive scores, while owning poultry, land and house give negative scores. This observation conforms with expectation where the better off will have access to the former items while the latter are more likely to be owned by the indigenous and not the salaried, non-indigenous traders, craftspeople and professionals (this being a rural area). The consistency of the scores is also noted for the housing conditions (negative for mud floor, grass walls and thatched roof, positive for cement floor, and tile or asbestos roofs), source of energy and sanitation conditions. Better off households are expected to have better housing conditions and access to sanitation conditions than the poor.

The scores for each asset increase (if positive) or decrease (if negative) the household asset index. For example, from Table 2 a household that owns a water pump has an asset index higher by 1.1 units than the one that does not have one. Conversely a house with earth floors lowers the index by 0.8 units and using firewood for cooking lowers by 0.8 units.

The asset scores are then used to assign and index value to each household. Eventually households are assigned into quintiles (the lowest 20 %, second 20%, third 20%, fourth 20 % and the highest 20 per cent) based on the value of the asset index. For the purpose of this analysis the lowest quintile will be considered as a socio-economic status proxy for the poorest and the highest quintile represents the least poor households.

Distribution of the index components by socio-economic status

Table 3 presents the proportion of households possessing a given characteristic according to the socio-economic status of that household. In general the poorest are below average in most of the items or services to which the better off have access. For example, in terms of asset ownership 12% of the poorest have a bicycle compared with 55% of the least poor, four times more. The same applies for radio, sofa set, mattress and wardrobes. Thus, as expected, the better off are more likely to own more assets than the poorest. The exception is for land and poultry where the poor have more than the better off. These observations are consistent with the directions of the scores discussed earlier. Like asset ownership, housing conditions tend to reflect the economic status of the household. A similar pattern is noted for the sources of energy for cooking and sanitation. Households that ranked lower in the index are more likely than the better off to use firewood and water from public well. The congruence between the socio-economic status index and variables from which it was generated provides evidence of internal consistency of the index developed.

Wealth ranking and health status

The relationship between socio-economic status and health has been an area of increasing interest (Gwatkin et al 2000; Filmer, 2000; Koenig et al, 2000). The health status indicators used by this study were mortality of children under five years of age (infant, child and under five mortality) and the household ownership of bed nets. Examining the relationship between the index proposed and health indicators serves as a way of testing the consistency of the index with other data that are possibly related with socio-economic status. Differentials in health indicators according to socio-economic groupings would imply that the index measures the differences otherwise it would indicate that there is no association.

Wealth Ranking and Health Outcomes: Mortality of children under five years of age

About 2,099 deaths were registered in the study area between 1999 and 2000, of these 705 deaths were for children below five years (491 for infants and 214 for children over one year). Table 4 and Figure 1 show data on how infant mortality is distributed across the different socio-economic groups. The findings generally show that the infant mortality rate declines with increase in the socio-economic status of the household. According to the data the children in the poorest households are about 50% more likely to die at infancy than those in the better off. If the socio-economic status of the poorest households were improved to the level of the better off, then about 37 lives per 1,000 infants could be saved annually (rate difference).

Table 4: Infant mortality by socio-economic status

Quintile	Infant Person Years Observed (PYOs)	Infant Deaths	Infant Mortality Rate/1000 PYOs
1st (Poorest)	835.5	91	108.9
2nd	830.6	83	99.9
3rd	843.3	69	81.8
4th	828.7	69	83.3
5th (Least Poor)	862.3	62	71.9
Poorest – Least Poor Ratio			**1.51**
Concentration Index			**-0.0816**

Table 5 and Figure 2 present the relationship between socio-economic status and child mortality (deaths to children between age one and four years). Like in the relationship shown in the infant mortality, socio-economic status has some association with child mortality, with poorest households having higher probabilities of losing their children than the better off. Contrary to the relationship shown to the infant deaths, the pattern is not consistent between the second to the fourth quintiles. In actual fact those in the second quintile have lower mortality than those in the middle or fourth. The reasons for this inconsistency are not known for the time being. In a study that used DHS data in Tanzania, an inconsistent pattern was also noted between health, nutrition, and population indicators for the second to fourth quintiles (Gwatkin et al, 2000). The poor–least poor ratio obtained for children in Table 5 suggests that children 1-4 are 78% more risk of death than the least poor children in the same area. If the socio-economic status of the poorest households were improved to the level of the better off, then about 6.2 lives per 1,000 children 1 to 4 years of age could be saved annually (rate difference).

Table 5: Child mortality by socio-economic status

Quintile	Person Years Observed	Deaths 1-4 yr	Child Mortality Rate
1st (Poorest)	2605.1	37	14.2
2nd	2630.3	22	8.4
3rd	2549.8	28	11.0
4th	2595.4	39	15.0
5th (Least Poor)	2507.4	20	8.0
Poorest–Least Poor Ratio			**1.78**
Concentration Index			**-0.0396**

The relationship between socio-economic status and overall under-five mortality is summarised in Table 6 and Figure 3. The data presented indicate that under-five mortality is higher in the poorest quintiles and lower for the rest of the quintiles. Its pattern is very similar to that of the infant and child mortality. This indicates the differentials noted at infancy have shaped the relationship between socio-economic status and under-five mortality. If the socio-economic status of the poorest households were improved to the level of the better off, then about 13.5 lives per 1,000 children under five could be saved annually (rate difference).

Table 6: Under-five mortality and socio-economic status

Quintile	Under 5 Person Years Observed	Deaths 0-4 yr	Under 5 Mortality Rate
1st (Poorest)	3424.4	128	37.4
2nd	3437.2	105	30.5
3rd	3410.2	97	28.4
4th	3444.9	107	31.1
5th (Least Poor)	3472.1	83	23.9
Poorest– Least poor Ratio			**1.56**
Concentration Index			**-0.07**

Wealth Ranking and Health Intervention access: The case of bed net ownership

Consistent use of insecticide treated bed nets has been shown to protect individuals from insect bites, especially mosquitoes, to reduce the transmission of mosquito related diseases, such as malaria in children, and to substantially lower the risk of both malaria morbidity and all cause under five mortality (Lengeler, 1998). In Tanzania and in the study area, bed nets, are not available free of charge. They are sold at either commercial or social market prices. As there is a cost component involved in the purchase of bed nets, the most socially disadvantaged groups may not have as much access to the protective effect of the bed nets. The Rufiji DSS conducted a net owner and user study in the September 2000-January 2001 round at the same time as the general asset survey. The objective was to measure the coverage of bed net and treated bed net use within households especially among children under-five years of age. In addition, the study wanted to assess whether the bed nets used are impregnated with insecticides and are done so at the recommended intervals.

Table 7: Bed net ownership by socio-economic status

Quintile	No. With Bed Nets	No. of Households per Quintile	% Population in Quintile	% of Quintile Population with Bed Nets
1st (Poorest)	165	2888	19.97	5.7
2nd	288	2888	19.97	10.0
3rd	418	2888	20.05	14.5
4th	611	2888	20.03	21.2
5th (Least Poor)	1392	2887	19.97	48.2
Poorest– Least Poor Ratio				**0.12**
Concentration Index				**0.39**

The relationship between socio-economic status and bed net ownership is presented in Table 7 and Figure 4. The results indicate consistently that ownership of bed nets is positively associated with the wealth quintiles. While in the poorest household only 8% own nets, for the better off the proportion is more than six times higher. The poor–least poor ratio of 0.16 reveals that there is a large inequality between the poorest and the better off in terms of bed net ownership in the study area. Since the bed nets are sold one can postulate that the poorest are unable to purchase them at the prices offered in 2000 (approximately $3.00-4.00 USD) possibly due to their low purchasing power coupled with their low access to information. This result is slightly better than the poor-least poor ratio of 0.13 found by a district-wide, randomised household survey of health behaviours conducted in Rufiji District in the previous year, 1999 (Schellenberg et al, 2000) suggesting that inequalities are slowly being addressed but accelerated progress is urgently required before this ratio can approach 1.0.

Conclusions

This report has shown a relationship between socio-economic status and health indicators with particular focus on the differentials between the poorest and the better off. PCA was applied to a set of asset and service variables that have some relationship with socio-economic status. The first principal component, accounting for most of the variance among the asset and service variables was employed to obtain an index as a proxy of socio-economic status of the households. Based on the value of the asset and service variables as well as using the scoring weights obtained for these variables each household was assigned to a specific quintile.

The study also attempted to check the internal consistency of the index developed by looking into its distribution against the quintiles of the household variables that have been used for its creation. The results revealed expected patterns on how the asset and service variables change with the quintiles. This was noted for variables such as bicycles, radio, sofa set, wardrobes, use of firewood and access to water. The exception is for land, poultry and owning a house where the poorest have more access than the better off. Most of these assets, being a rural area, are likely to be owned by the indigenous and not the new comers most of whom are employees. In general the index developed appears to be useful in capturing some form of material well-being at household level.

Using quintiles generated from the PCA, the report has shown that the poorest and the better off have different mortality rates with the former having higher rates than the latter. In addition the report has revealed that bed net ownership is wholly inadequate in the poorest households and that there are profound inequalities in access to this particular protection against malaria morbidity and mortality as delivered in the Rufiji District.

The findings call for more attention to strategies or approaches for reducing health inequalities. These could include reforms in the health sector to provide more equitable resource allocation, improvement in the quality of the health services offered to the poor, and subsidising costs for bed nets to target the poor. Such proactive measures will be important if health equity goals at community level are to be achieved.

Finally, the study shows that DSS operations can host manageable asset surveys and that a PCA approach to such data is surprisingly sensitive to differences in wealth sufficient to predict differences in health outcomes such as child mortality, as well as access to health interventions, even though the source population might appear to be broadly homogeneous with regards to poverty. This study sets the stage for more detailed equity research. The next stage of equity work in the Rufiji DSS will attempt to understand the determinants of these inequalities and will start by conducting spatial analysis of the distribution of households across quintiles, and their physical access to health services. Global satellite positioning of all households has now been completed and staff have been trained in geographic information systems analysis. Intersectoral studies are being developed to extend the range of determinants under study (e.g. food insecurity). The long term aim is to develop a platform for longitudinal, intersectoral studies to support and monitor progress in poverty alleviation and health development interventions.

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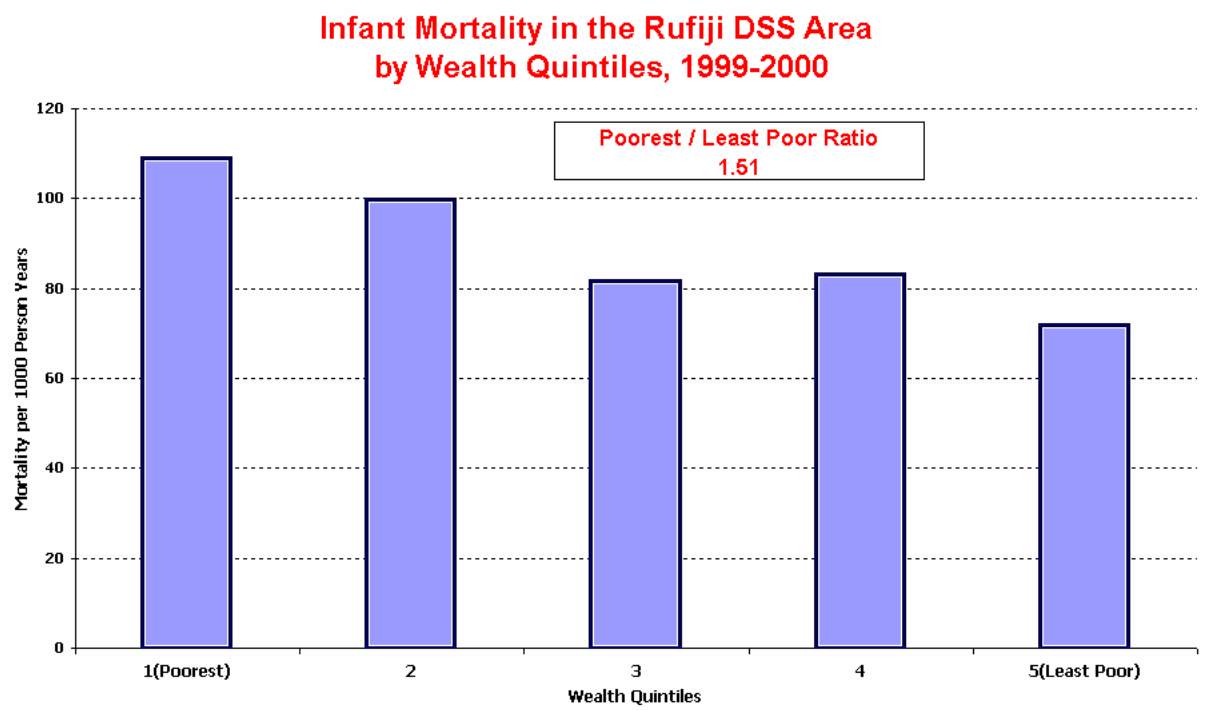

Figure 1. Infant mortality in the Rufiji DSS Area by wealth quintiles, 2000.

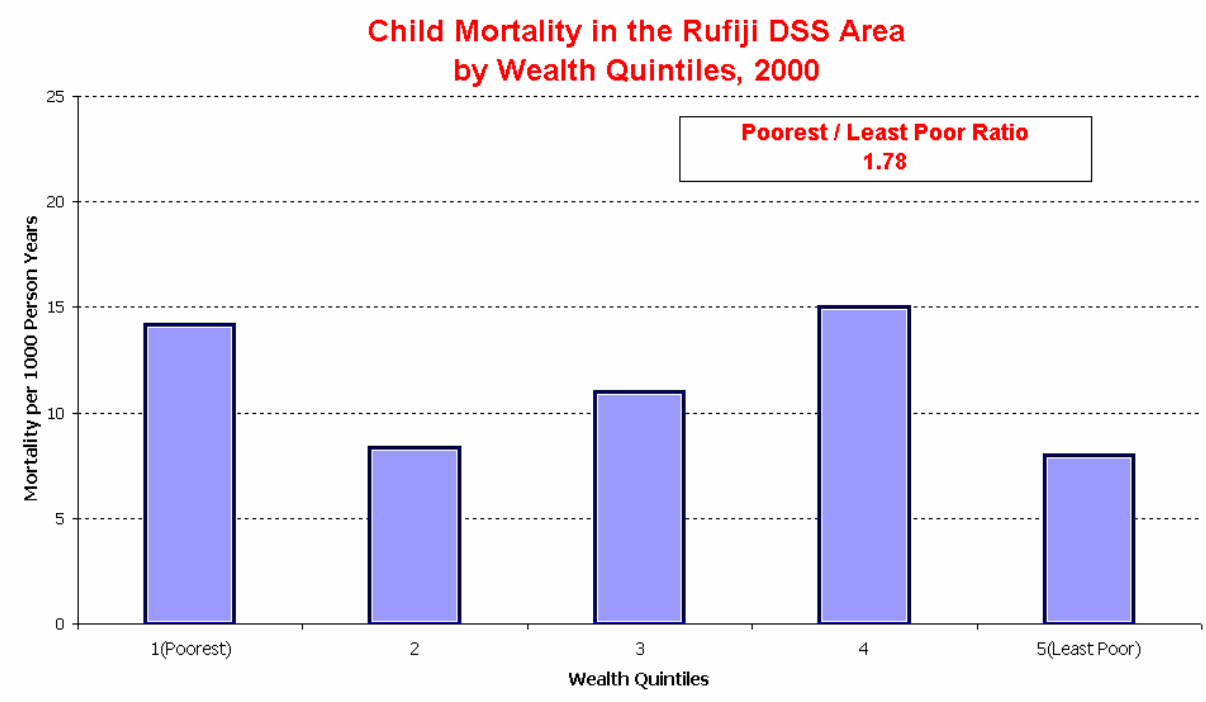

Figure 2. Child mortality in the Rufiji DSS Area by wealth quintiles, 2000.

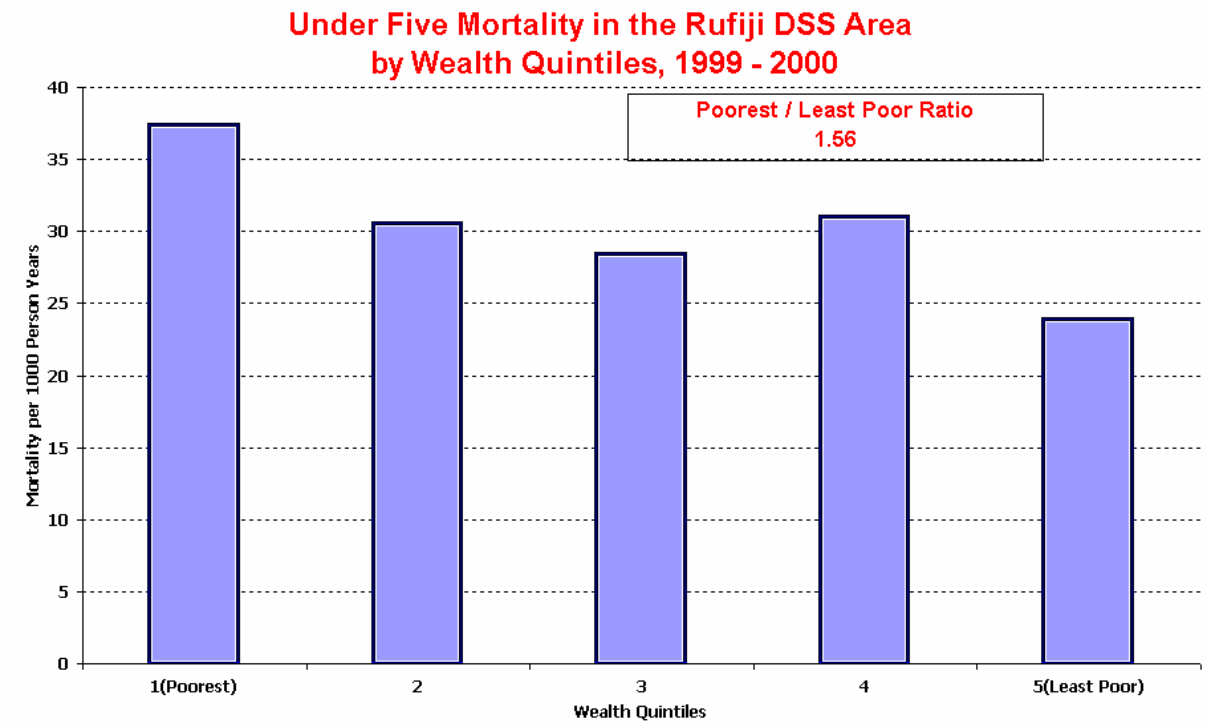

Figure 3. Under five mortality in the Rufiji DSS Area by wealth quintiles, 2000.

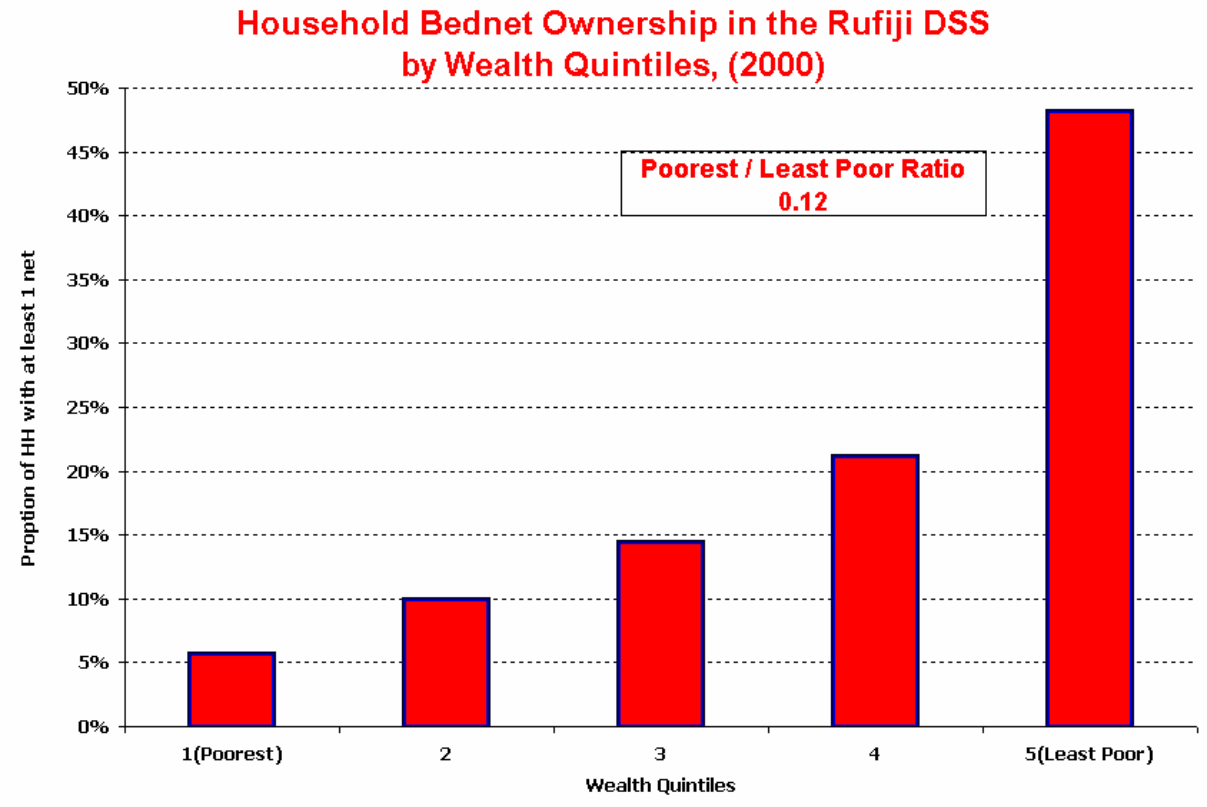

Figure 4. Bed net ownership (coverage) in the Rufiji DSS Area by wealth quintiles, 2000.

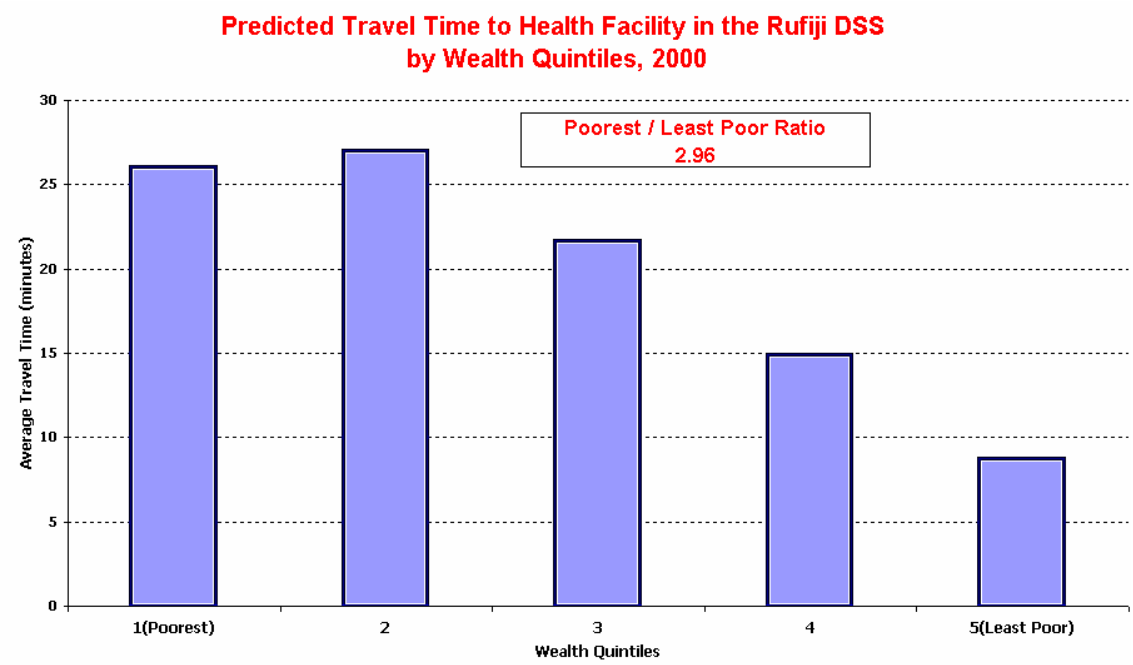

Figure 5. Average travel time (minutes) in the Rufiji DSS Area by wealth quintiles, 2000.

Appendix: 1

English Translation of Asset Survey Questionnaire Nested into a DSS Survey.

Rufiji DSS Asset Survey, September 2000 – January 2001

Does anyone in this household own any of the following items?

1. Bicycle ..... Y N
2. Car ..... Y N
3. Motorbike ..... Y N
4. Radio ..... Y N
5. Refrigerator or freezer ..... Y N
6. Television ..... Y N
7. Clock/watch ..... Y N
8. Own Land ..... Y N
9. Sofa set ..... Y N
10. Wooden bed ..... Y N
11. Electric Iron ..... Y N
12. Mattress (foam/cotton) ..... Y N
13. Own House ..... Y N
14. Radio cassette ..... Y N
15. Wardrobe ..... Y N
16. Water pump ..... Y N
17. Livestock ..... Y N
18. Sewing machine ..... Y N
19. Poultry ..... Y N
20. Bed net ..... Y N
21. Satellite dish ..... Y N
22. Fan ..... Y N

What are the floors of this house made of? ..... ☐
1=Earth, 2=Wood, 3=Tiles, 4=Cement, 5=Other

What are the walls of this house made of? ..... ☐
1=Stone, Coral Block, Cement block, Burnt bricks
2=Mud bricks (plastered or unplastered), wood
3=Galvanised, mud & stick, mud
4=Grass, Cardboard
5=Other

What is the roof of this house made of? ..... ☐
1=Tiles, concrete, cement
2=Glanvanised iron and asbestos
3=Bamboo, wood, mud, grass, thatch
4=Other

How many rooms are used for sleeping in this household? ..... ☐

What is the main source of drinking water for this household? ..... ☐
1=piped into residence, 2=rain water harvesting, 3=public tap, 4=vendor, 5=river, canal, spring, 6=other

What is the main toilet facility for this household? ..... ☐
1=Private Flush, 2=Shared flush, 3=VIP or pit, 4=Neighbour or bush, 5=other

What is the main source of energy for cooking in this household? ..... ☐
1=Electricity, propane, or solar; 2=biogas, kerosene or charcoal; 3=firewood; 4=crop residue, coconut husks, sawdust, animal dung, chaff, grass; 5=other