The Road to Happiness – A Spatial Study of Accessibility and Well-Being in Hambantota, Sri Lanka

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Abstract

This study tries to visualise and explain variations and patterns in well-being throughout the Hambantota District in southern Sri Lanka. This is accomplished by using a large interview database with questions and answers on developing factors and subjective well-being and linking this to a model of accessibility. The accessibility model was developed in a Geographical Information System (GIS) as an alternative to the simple Euclidian distance model where the terrain, road network and transport availability is not accounted for. In this model all of this is included and thus the accessibility accuracy is improved. The output of this model is a raster surface with each cell containing travelling times to the defined destinations (towns and markets) and when this is combined with the coordinates for the interviews the accessibility for all the respondents to the interview is extracted. Not only the accessibility is compared with the perceived well-being but also other development factors such as economy and education to see which factors are correlated with well-being.

The visualisations of spatial variations in well-being is performed by interpolating the well-being values from all the interviews to create a smooth surface clearly showing these patterns.

A secondary objective of the study is to calculate the Human Development Index (HDI) for all the individuals interviewed and compare this to the subjective well-being to see if HDI explains this well-being to such a large extent that well-being enquires are made redundant. This is possible since data has been obtained on income, education and life expectancy.

The results show that indeed the accessibility had an effect on subjective well-being. The higher accessibility to towns when travelling by bus the higher the well-being, but when looking at accessibility to markets higher accessibility corresponds with lower well-being. The other factors also show a significant correlation with well-being, and particularly the factors concerned with improvement and relative wealth. It seems that these possibilities of improvement are more important for well-being than wealth in absolute numbers.

The calculated HDI-values did significantly correlate with the well-being but the correlation (0.116) was not so strong that you could assume that HDI-values could substitute the subjective well-being values.

Key words: Sri Lanka, GIS, Accessibility, Well-Being, Development

Sammanfattning

Denna studie har för avsikt att visualisera och förklara variationer och mönster i välmående i distriktet Hambantota i södra Sri Lanka. Detta görs genom att använda en stor intervjudatabas från distriktet med frågor och svar om subjektivt välmående och andra utvecklingsfaktorer och sammankoppla denna med en tillgänglighetsmodell. Denna modell är utvecklad i ett Geografiskt Informationssystem (GIS) som ett alternativ till den enklare Euklidiska avståndsmetoden där terräng, vägnät och privat och kollektiv fordonstillgänglighet inte är medräknat. I denna modell är alla dessa faktorer medräknade vilket innebär att noggrannheten i tillgänglighetsvärdena är högre. Utdatan av modellen är en rasteryta där varje cell har ett designerat tillgänglighetsvärde beskrivet i restid till närmaste destination (stad eller marknad). När dessa utdata kombinerats med koordinaterna i intervjuerna så får man ut tillgänglighetsvärdena för varje intervjuat hushåll. Tillgängligheten jämförs sedan med det subjektiva välmåendet liksom de andra utvecklingsfaktorerna som inkomst och utbildning för att se vilken faktor som påverkar välmåendet i högst grad.

Visualiseringen av de spatiala variationerna och mönstren hos välmåendet i distriktet åstadkoms genom interpolation av välmåendevärdena från alla intervjuer för att göra en jämn yta som tydligt visade variationerna.

Ett sekundärt mål med studien är att beräkna Human Development Index (Mänskligt Utvecklingsindex, HDI) för alla individer som intervjuats och jämföra detta med det subjektiva välmåendet för att undersöka ifall HDI förklarar detta subjektiva välmående nog för att göra enskilda välmåendefrågeställningar överflödiga. Denna beräkning är möjlig då data om inkomst, utbildning och livslängd har erhållits genom frågeformuläret och annan tillgänglig statistik.

Resultaten visar att tillgänglighet har en påverkan på det subjektiva välmåendet, desto högre tillgänglighet till städer när man reser med buss desto högre grad av välmående. Däremot så ger högre tillgänglighet till marknader en lägre grad av välmående. De andra faktorerna visade också en signifikant korrelation med välmående, i synnerhet de som hade att göra med förbättring och relativ förmögenhet. Det verkar som om dessa möjligheter för förbättring är viktigare för välmåendet än förmögenhet i absoluta tal.

De uträknade HDI-värdena korrelerade signifikant med välmående men korrelationen var inte så stark (0.116) att man kan anta att de subjektiva välmåendevärdena kan ersättas av HDI-värden.

Nyckelord: Sri Lanka, GIS, Välmående, Tillgänglighet, Utveckling

Contents

1. Introduction
1.1 Accessibility

Accessibility to various amenities has been found to have a significant influence on well-being in high income countries and the explanatory power of a certain happiness function also significantly increases when spatial variables are included (Brereton et al., 2007). Therefore this study investigates if there are similar influences on well-being in lower income countries when spatial variables associated with poverty alleviation are considered.

Accessibility does not have a single simple definition but it can be described as the ease with which a destination can be reached. This destination can be one of many things; a hospital, school, road, work space, etc. These destinations can be difficult to reach if your accessibility level is low, thus limiting your opportunities. The level of accessibility can be dependent on both geographical and social parameters. In this study however the focus when it comes to accessibility estimations lies on the geographical accessibility.

Limited spatial accessibility affects people in many ways, particularly in low-income countries where access to private or public means of transport between the home and various amenities may not be as readily available. This can be due to poorly developed infrastructure or means of transport, or it can be due to the individual not being able to take advantage of public transport because of personal hindrances such as poverty, illness or disabilities. Studies have shown that accessibility is correlated to socio-economic factors, such as poverty (Hanson, 1986; Kam et al., 2005; World Bank, 2007). Poverty is defined by different terms in the different studies. The study performed by the World Bank specifically in Sri Lanka defined poverty as earning below the national poverty line, which is 1423 Sri Lankan Rupees per capita per month (World Bank, 2007). The positive effect of rural roads on consumption patterns and poverty alleviation has also led to conclude that enhanced accessibility and mobility can lead to increased well-being (Bryceson et al., 2008; Jalan & Ravallion, 2008)

Accessibility can be divided into two parts (Hanson, 1986): proximity, which is defined by distance, road quality and topography in this study; and the mobility, which is more concerned with how you move in space, in this study represented by access to and usage of motor vehicles as well as public transport. In this case these two are not separated but will be used together to estimate travelling time, which will be used as the definition of accessibility in this study. This means that shorter travelling time to a destination will be regarded as higher accessibility.

The accessibility is sometimes modelled on simple parameters such as Euclidian distance to certain amenities, not taking road network, road quality and topography in to consideration. The accessibility values for all the individuals in this study are derived from a model of accessibility developed by Anders Ahlström (Ahlström, 2008) specifically for Hambantota District. This model was developed using a raster based approach in a Geographical Information System (referred to as GIS throughout this study), which takes incompleteness in the road network, road types and topography into account. The model is also developed by using key-informants and local knowledge to estimate travelling times and accessibility rather than using speed limits, which would not be suitable for the transport situation in Sri Lanka where the speed limits is not what limits the speed (see 1.4.2. Transport).

This model is combined with 4340 interviews conducted in the Hambantota District in the spring of 2009 and used to assess whether accessibility can be correlated to well-being.

1.2 Well-being and development indicators

The conventional way of measuring peoples well-being is Gross Domestic Product (GDP) or Gross National Income (GNI) per capita and more recently the Human Development Index (HDI), which not only takes economic development into account but also life expectancy and level of education. This

study will compare the HDI value of the individuals with the perceived well-being. Of course well-being is not only a result of economy, education and life expectancy, but if these three factors together sufficiently well describe the general well-being of an individual there is no real need to try and quantitatively measure this rather awkward subjective well-being and just focus on the more easily measurable quantitative facts.

The poverty correlation with accessibility found in the World Bank report (2007) was defined by the national poverty line in Sri Lanka. This poverty line is defined by the amount of Sri Lankan rupees (1423 Rs. In 2007) needed per capita per month to cover basic needs.

1.3 Objectives

This study aims to analyse and visualise some of the numerous factors that might affect the well-being of an individual in a low-resource country. It aims to do so mainly in a spatial dimension to see if there are any spatial variations in well-being and what these variations may be influenced by. The factors are both geographical and non-geographical. The geographical variables are mainly concerned with proximity, but also to a lesser extent with mobility. The non-geographical variables are regarding the individual economic situation and level of education.

A secondary objective of the study is to see whether the development indicators already in use give a fair picture of the well-being of an individual or if it is necessary to implement a separate indicator of well-being when studying the welfare of people.

This relationship will be studied by combining a large number of interviews from the Hambantota District, linked to specific locations with coordinates, with a model of accessibility developed by Ahlström (2008).

1.4 Study Area

Sri Lanka is an island situated in the Indian Ocean, just off the tip of the Indian peninsula. It has approximately 20 million inhabitants on an area of 65,610 km^2 (Department of Census and Statistics, 2011). It is classified by the UN as a lower-middle income country (UN, 2012). Sri Lanka is divided, from largest to smallest, into provinces, districts, divisions and Grama Niladhari (GN-divisions), see Figure 1.

Hambantota is a district in the southern province of Sri Lanka with 595,877 inhabitants on an area of 2,609 km^2 (DCS, 2011). Hambantota District consists of 13 Divisions and 593 GN Division. The 13 Divisions are about equal in size, varying between 1 234 and 2 345 ha, with a population varying from 56 000 in the most Eastern division to 123 000 in Ugabada Division in the West (Department of Census and Statistics, 2011). The GN Divisions have a population varying between approximately 500 and 3 000 (Department of Census and Statistics, 2012), but are not at all equal in size. The Eastern, more sparsely populated GN Divisions are generally larger than the more populated ones in the Western part on the District.

1.4.1 Economy and development

Hambantota has historically been one of the poorer districts in Sri Lanka but has during the last 10 years been very successful in alleviating poverty. In 20 years the head-count poverty rate has fallen from 32.4 % in 1990 to 6.9 % 2010. The district has been more successful in this aspect than the country as a whole in which the poverty has fallen from 26.1 % to 8.9 % in the same time period. Compared to the other districts in Sri Lanka one can point out that it used to be the third poorest district in the country in 1990 (with data missing from some war-torn northern provinces) and is now both the seventh richest and the seventh district with fewest poor out of the 22 districts in Sri Lanka (Department of Census and Statistics, 2011).

Large-scale infrastructure development has been substantial during the last few years with the construction of a seaport and the recent opening of the country's second international airport, both constructed with funding from China (Haviland, 2011; Gunatilleke, 2013).

Figure 1. The provinces, districts, divisions and GN-divisions of Sri Lanka. Figure by Ahlström (2008).

Compared to other countries in the South Asian region Sri Lanka is quite successful economically with a higher GDP/Capita than India, Pakistan, Bangladesh, Nepal and Afghanistan (Central Intelligence Agency, 2013). However the most staggering difference is that in health, where maternal mortality is at an almost 10-fold lower rate than in India and child mortality about 5-fold (IGME, 2012

& WHO, 2012). Hambantota also has the highest life expectancy in Sri Lanka at 79.6 years, significantly higher than the life expectancy in the country as a total which is 73 years (UNFPA, 2009).

1.4.2 Transport

The general road quality in Hambantota is poor, but the internal difference in the district is quite large. In the more populated western areas there are more and better roads than in the less populated east. There are three classes of road in this study, primary roads, secondary roads and tracks. Primary roads and secondary roads are paved and wide enough to carry lorries and buses. The difference is that the primary roads in this study all allow overtaking and are of good quality. Secondary roads can be of very varying quality with everything from tarmac as good as in the primary roads to roads covered with potholes (Ahlström, 2008).

Tracks are small dirt roads that connect farms and villages to the larger road network. The tracks are of better quality in the east, where they play a larger role than in the west. The west is also more affected by the wet season, which influences the quality of the tracks in a negative way (Ahlström, 2008).

Another problem with the road network is that there is no regulation that states which vehicles that can travel on which roads. This leads to smaller and slower vehicles travelling on the same roads as larger and faster ones, which creates a very inefficient and dangerous situation on the roads (Ahlström, 2008).

The two vehicles used for analysis are bus and landmaster (LM), a small tractor-like vehicle used mainly by farmers for transporting produce to markets for selling.

2. Data

2.1 Interviews

The interviews used in this study, a total of 4340, were not conducted by myself but were provided to me for the purposes of this study. However there are still some things that need to be explained about the interviews to be able to understand and critically question the study so a presentation about how they were performed follows.

The interviews were conducted throughout the Hambantota District in April and May of 2009 by 25 interviewers. The spatial distribution of the interviews can be seen in Figure 2. The interviews were conducted by university students from Sri Lanka, all of them were native to the Hambantota District and thus knew the language and the surroundings well. The interviewer read the questions out loud to the *head of the household*. Who this person was up to the households to decide by themselves, and the respondent answered to the best of their ability. The interviewer was there to assist if there were any difficulties in understanding or interpreting the questions.

In order to get a representative sub-set of the population a stratified random sampling design was chosen. The material was mainly stratified on GN Division level, but also on Division level. Out of the 593 GN Divisions 124 were chosen randomly. This was done by driving to a Division, following existing roads and tracks in a random direction, and performing interviews in villages, groups of houses or isolated households.

- Approximately 30 interviews were made in each selected village
- If a village was big and consisting of obviously different socio-economic societies, interviews from all societies were performed
- In selected smaller groups of houses approximately 15 to 20 interviews were made
- The visited household in a village of group of house s were selected randomly by walking in one direction and stop at houses each 200 meters

- In visited GN Divisions where no villages or groups of houses were found a small number of interviews were made with isolated households
- The maximum number of interviews in one GN Division was set to 40
- The minimum number of visited villages in one GN Division was set to 1
- The minimum number of visited groups of houses in one GN Division was set to 2

In addition to the answers coordinates was also taken to be able to use these interviews in a disaggregated manner together with other data. Without the coordinates this study would not have been possible.

The representativeness of the interviews can be debated. As can be seen in Figure 2 the interviews are spread throughout the entire district except for the in the northeast which is dominated by the Yala National park and was therefore excluded. The majority of interviews are conducted along major roads (see Figure 2) and this could be seen as a weakness. However to get a representative sub-set the interviews one should not over-represent one part of the population, and since the overwhelming majority of people live alongside the major roads (Ahlström, 2008) the majority of interviews were conducted here. Otherwise the interviewers would have to actively seek out more people on the countryside, which would conflict with the randomness of the stratification.
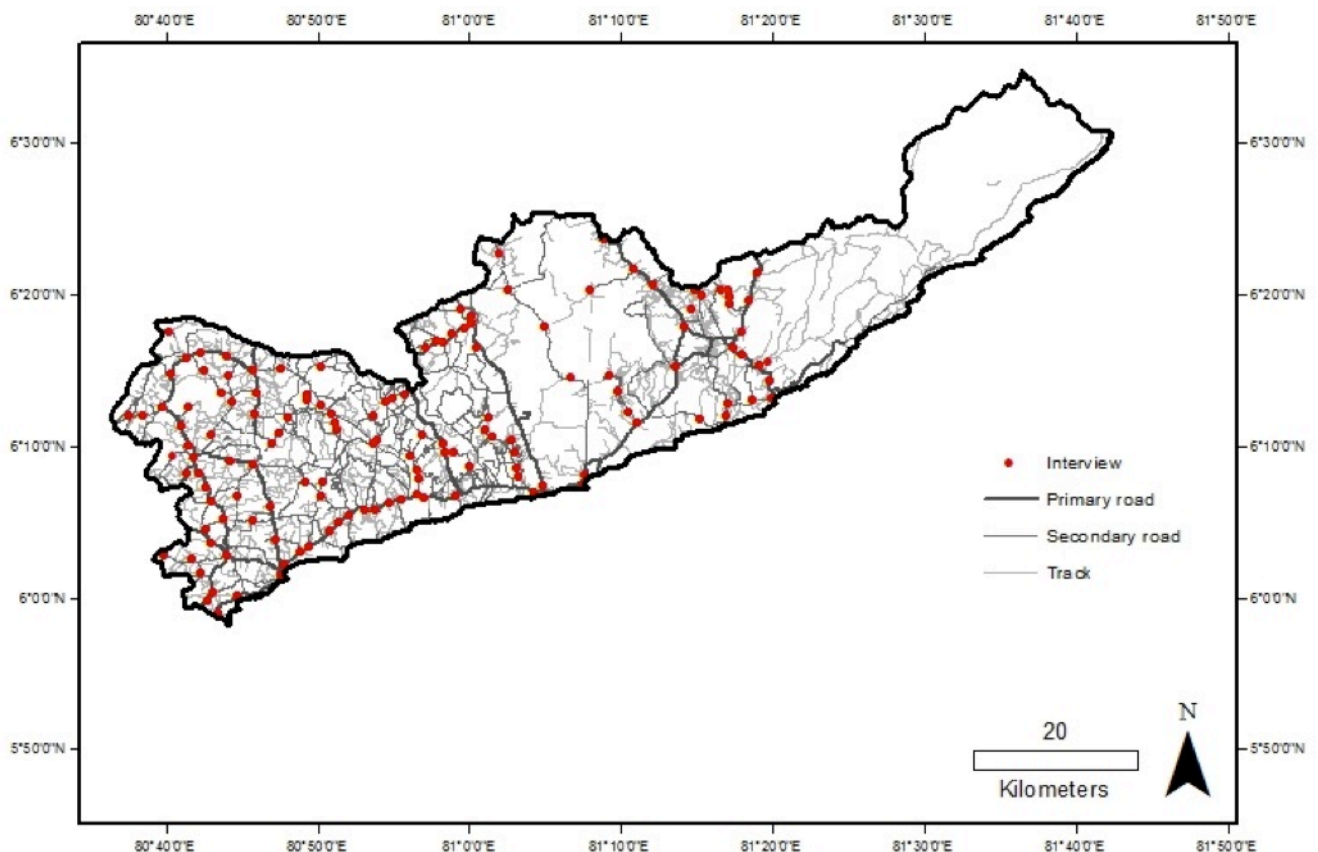

Figure 2. Distribution of interviews throughout Hambantota District.

2.2 GIS-data

All the data needed for the GIS-analysis are listed below. The original method for the analysis was developed by Ahlström (2008) and has been redone in this study. All data have been acquired from Ahlström.

- Road network data in vector format. These data were acquired from the Survey Department in Sri Lanka. The network data has been digitized from 1:50 000 maps and in the process has been undergoing generalization which might explain its original overall poor quality. This quality assessment was performed by Ahlström through field measurements. The same field measurements was used to correct the data with the result being high accuracy for primary and secondary roads. The tracks had quite good accuracy after the correction. The correction is explained and evaluated in Ahlström (2008)
- Raster data of water bodies were obtained from Sandell (2008), originally from a Landsat Thematic Mapper satellite imagery classification.
- Topography data used to estimate the slope was obtained from United States Geological Survey (USGS) as a Digital Elevation Model (DEM) with 90 m resolution from the Shuttle Radar Topography Mission (SRTM) (CIGAR-CSI, 2004).
- The data on travelling speeds and important destinations (markets and towns) were obtained through structured interviews with officials and village households. The interviews were distributed throughout the district at different distances from markets and towns.

2.3 Well-being data and other welfare indicators

The data on subjective well-being was obtained through one of the questions in the questionnaire. The respondents described their subjective well-being by placing it on a scale from 1-4 (see Appendix 1). The scale 1-4, or rather Very bad, Bad, Good, Very good, was chosen to avoid being able to select a "middle option". This forces the subject to take a stand rather than just, so to speak, taking the easy way out. Of course, as with all the questions, there was an option not to answer at all.

Other questions related to welfare and well-being were questions primarily regarding education levels and economical condition. Questions were asked about the total income, if the household had more money now than five years ago, how rich or poor they were compared to other households in the village, etc. (see Appendix 1 for full questionnaire).

The questions that were chosen from the questionnaire (question number in parenthesis) for the regression and correlation analysis together with well-being were:
1. (1) Formal education level
2. (3) What is the estimated total monetary income for the household per year?
3. (5) How would you classify the household in comparison to other households in the village?
4. (24) In general, do you think that members in this household are better off or worse off today than they were five years ago?

3. Method

Most of the background work of this study was performed by Anders Ahlström (2008), who developed the model for accessibility analysis in GIS. To perform the analysis Ahlström collected information on speeds by interviewing local people and key-informants. He also collected GIS-data which have been used to re-perform his accessibility analysis in this study. This analysis was however not the main part of the study and therefore is not described in full detail. It is merely described to explain what has been done to be able to extract accessibility values for all the respondents. For full details on the GIS-analysis see Ahlström (2008). The only part of GIS-study that was developed and performed by me was the extraction of the accessibility values and the interpolation to see the pattern of well-being in the district.

3.1 Accessibility and visualisations

All estimations and calculations were made in ArcGIS 10.1 (ESRI, 2012). GIS was used to estimate the door to door travelling time from any given cell in the raster to a destination with bus and landmaster. The reason for using these two types of vehicles was simply that these are the most used. Bus is used mainly for going to markets and towns and purchasing goods and landmaster for going to the market and selling goods. The destinations used were eight different markets and seven different towns. These most important markets and towns were picked with the help of key-informants (Ahlström, 2008).

The speed needed to be estimated on different roads and on different terrain. Where roads were not available slope was used to estimate the speed. These estimations were then used to calculate the friction surface that lies as a base for the accessibility calculations. The speed was estimated with the help of a specially designed program that assigned the average speed to each road class that gave the smallest error compared to the travelling time given by the interviews with officials and village households. The program tested all realistic combinations of paths that could be taken and all the combinations of speeds for each road class (Ahlström, 2008). It is important to know that this speed estimation program also takes into public transport availability and frequency into account. This means that the speeds given on different road classes are adjusted to include waiting time for buses (Ahlström, 2008).

When the speed is known for the different road types and for the different slopes a raster surface was created where each road type or slope was given a value that corresponded to the speed that was estimated in that road type or slope. This creates a friction surface from which the travelling time to the closest destination time wise from any raster cell can be calculated. When these values are used in the statistical analysis they will show a negative correlation if it turns out that well-being improves with accessibility. This is because the values used for representing accessibility are travelling time, and this means that the lower the travelling time, the higher the well-being. A positive correlation would mean that well-being decline with higher accessibility.

When the accessibility values had been estimated for all the cells the coordinates for the interviews were added to the GIS and overlayed with the accessibility layer, thus adding the accessibility value to all the individual interviews. These were then exported to a database file with all the respondents individual accessibility values.

The last part of the GIS-analysis was to visualise well-being in the district. By adding the coordinates of the interviews as points in the GIS and having the well-being value connected to these points, an interpolation could be made which depicts the changes in well-being throughout the district. The interpolation method used was an Inverse Distance Weighted Average (IDWA) interpolation. The reason for this was that a smooth surface was not prioritised and thus a local method was selected (Hasan et al., 2011).

3.2 Correlation analysis with well-being

The statistical analysis aimed to determine which of the chosen factors (see below) that correlate with well-being. To do this all the factors had to be standardised so that they could be compared to each other. The standardisation method that was chosen was to calculate z-scores. This is done by taking the value that needs to be standardized and subtract the mean of the total population and then dividing by the standard deviation of the population.

$$z = \frac{x - \mu}{\sigma}$$

The factors that were chosen to be analysed together with well-being were:

- Income
- If people in the household are better off now than five years ago
- Household wealth in comparison with other houses in the village
- Level of formal education
- The estimated travelling time with landmaster to markets
- The estimated travelling time with bus to towns

All these factors were standardised and run in a correlation analysis in IBM SPSS Statistics 20 (IBM, 2011).

3.3 Human Development Index calculations

To fulfil the secondary objective of the study, the Human Development Index (HDI) for each individual had to be calculated and then compared with well-being values. The HDI is calculated by the following equations:

$$Life\ expectancy\ index\ (LEI) = \frac{LE - 20}{82.3 - 20}$$

$$Education\ Index\ (EI) = \frac{\sqrt{MYSI \cdot EYSI}}{0.951}$$

$$Mean\ Years\ of\ Schooling\ Index\ (MYSI) = \frac{MYS}{13.2}$$

$$Expected\ Years\ of\ Schooling\ Index\ (EYSI) = \frac{EYS}{20.6}$$

$$Income\ Index\ (II) = \frac{\ln\left(\frac{GNI}{cap}\right) - \ln(100)}{\ln(107\ 721) - \ln(100)}$$

$$Human\ Development\ Index\ (HDI) = \sqrt[3]{LEI \cdot EI \cdot II}$$

LE: Life Expectancy at Birth
MYS: Mean Years of Schooling
EYS: Expected Years of Schooling
GNI/cap: Gross National Income at Purchasing Power Parity[1] (PPP) per capita

MYS was calculated by taking the average of all the respondents schooling and EYS was obtained from the UNESCO Institute for Statistics website (UNESCO, 2012). Life expectancy for the Hambantota District was obtained from the UNFPA website (UNFPA, 2009). Lastly the income was one of the questions in the questionnaire so this data was already available. When the HDI had been calculated a correlation with the well-being values was performed.

4. Results

4.1 Accessibility and spatial variability

The results from the accessibility modelling are presented as maps in Figure 3 and 4. Note that these maps come without a grid and reference to coordinate system, as that was deemed unnecessary for the purpose of the images. However the grid and coordinate system are identical to those in Figure 2. It is from these accessibility surfaces that the accessibility values for all the

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[1] A theory used to estimate how much money needs to be used in order to buy the same goods in different countries. When GNI/capita is adjusted with PPP it reveals more about how rich the people in the country actually are. For example, a dollar might buy you a full meal in one country but only a can of soda in another, so one dollar is worth more in the former than in the latter.

individual respondents have been derived. The maps show travelling time in hours to make the figures as comprehensive as possible.

There is clearly better accessibility in the west, especially when travelling by bus to towns, but also in the case of travelling by landmaster to markets. This is mainly due to there being more towns and markets in this area but also because the roads are more plentiful and in better condition.

The results from the well-being interpolation are shown in Figure 5. Here it is also clear that the well-being is generally higher in the west of the district where the accessibility to towns with bus is much higher. Values for the Yala National Park area were excluded because there were no interviews conducted in the area. White areas indicate impassable areas by bus, landmaster or walking, which is the travelling method where there are no roads. In this study only areas with water have been deemed impassable.
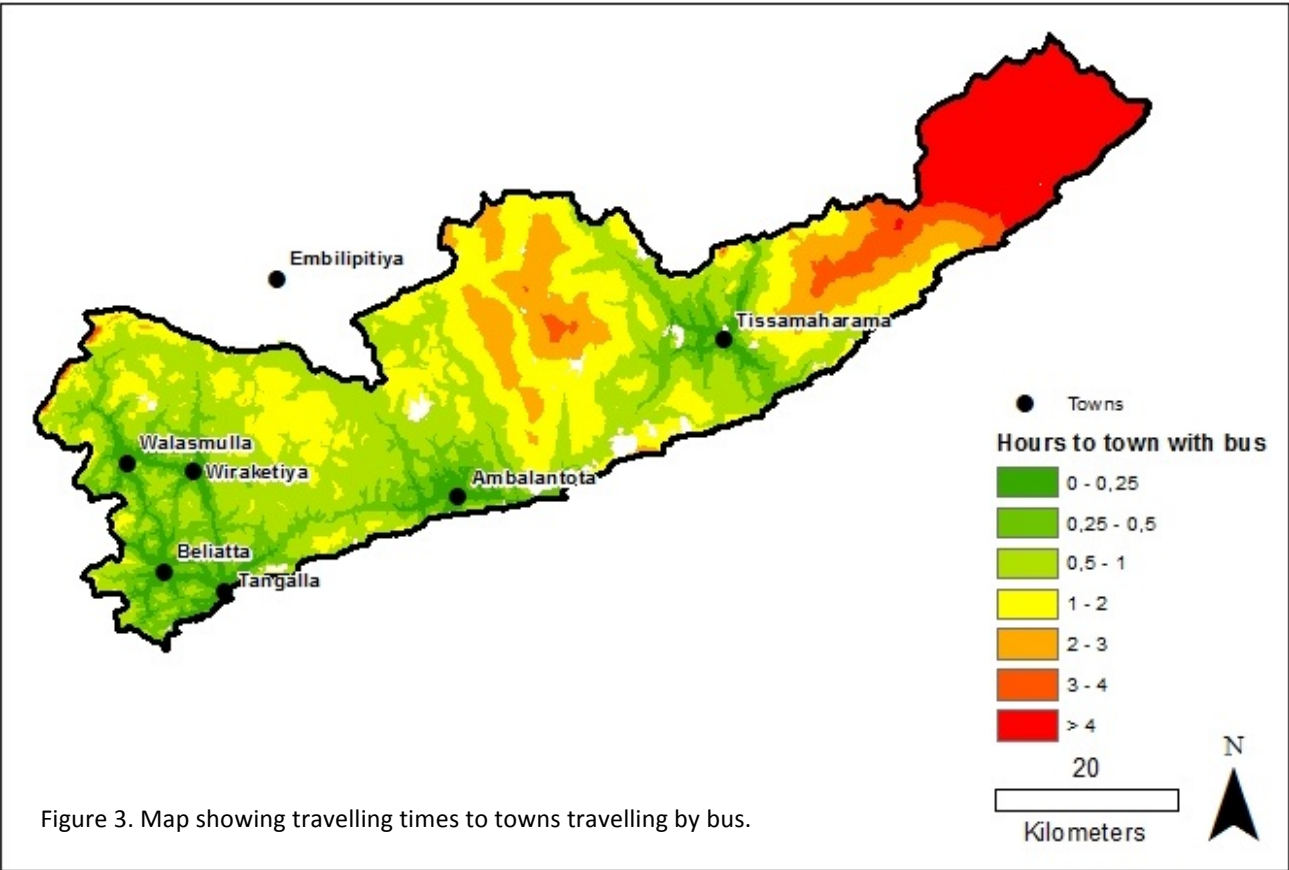

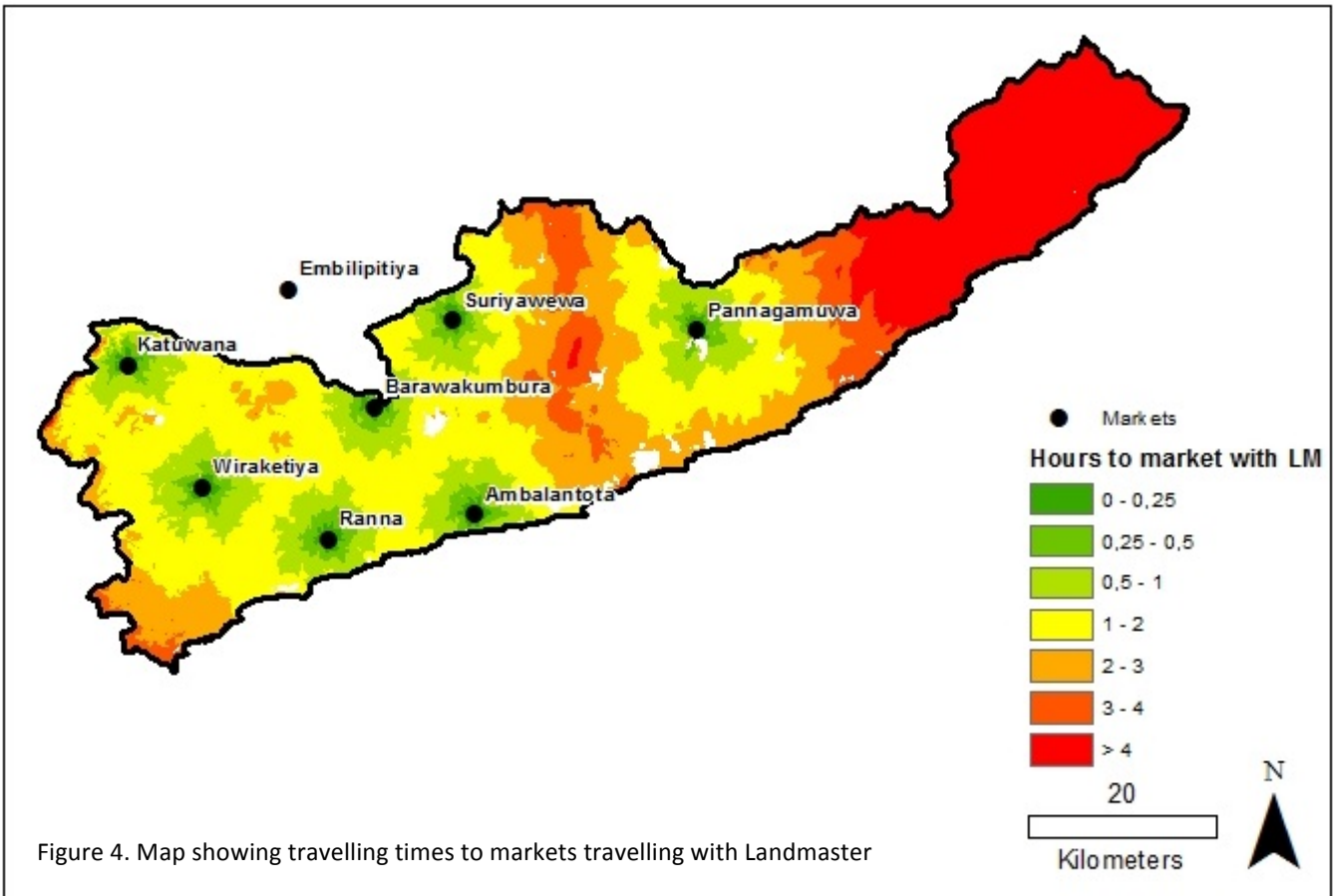Figure 3. Map showing travelling times to towns travelling by bus.

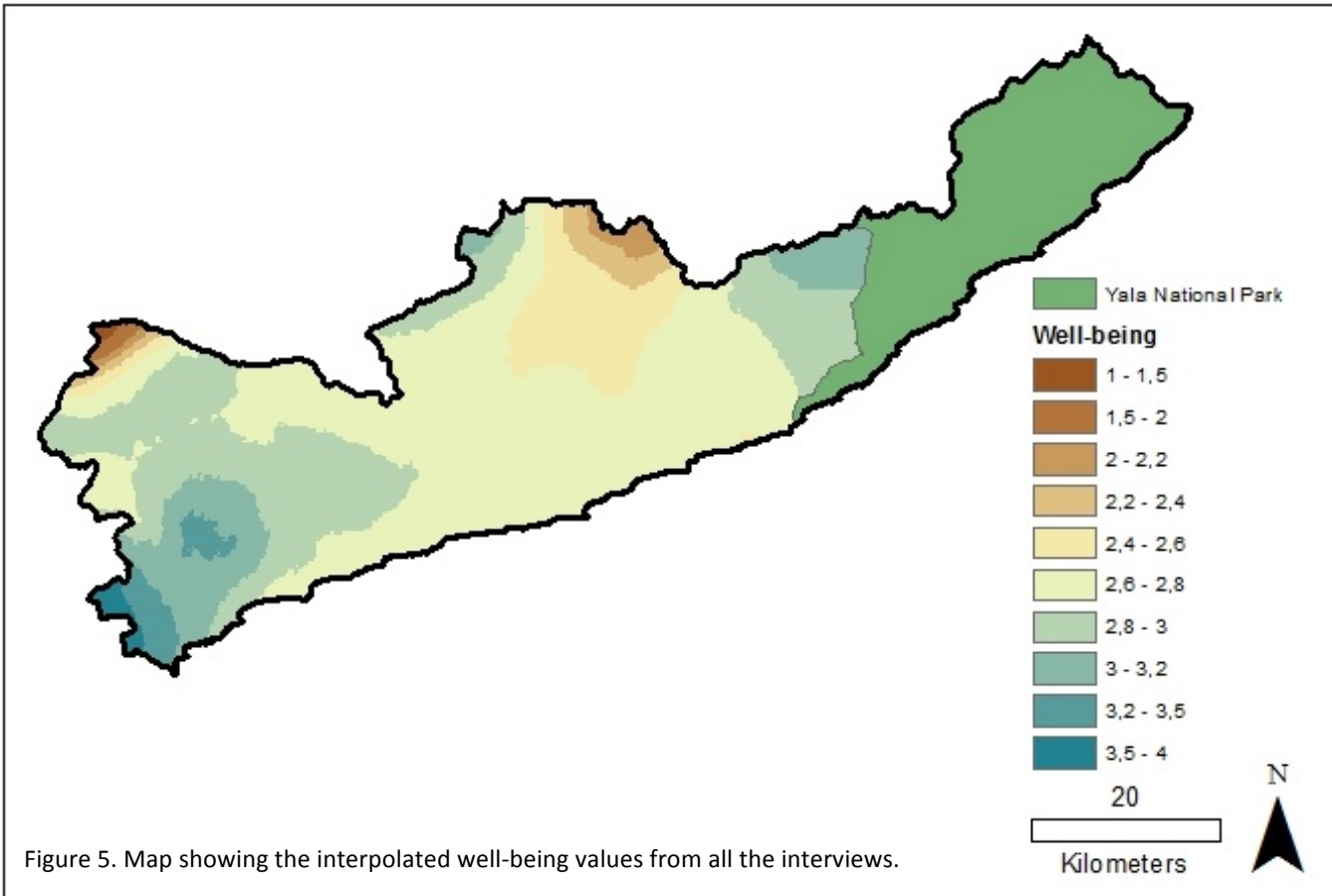Figure 4. Map showing travelling times to markets travelling with Landmaster

Figure 5. Map showing the interpolated well-being values from all the interviews.

4.2 Outcome of the statistical analysis

The results of the correlations and multiple regressions analyses can be found in Table 1 and 2 below. The correlation analyses show that all the factors have a significant correlation with well-being. Multiple regression analyses show that the most important factor was if the respondent considered the household to be better off now than five years ago, followed by how wealthy the household was in comparison to other households in the village. The third most important factor was accessibility with bus to towns. As stated before, the reason that the correlation is negative is that the shorter the travelling time the higher the well-being. As can be seen, the correlation with accessibility to markets with landmaster as positive, which means that well-being is worse if live closer to markets. Lastly both income and education had a positive correlation with well-being, but not very strong.

Table 1. The output table with a matrix of all the correlations performed in SPSS. The table shows correlations between all of the variables that were analysed but only the correlations with well-being were studied. The Pearson Correlation-value shows how strong the linear relationship is. All the correlations with well-being are significant at the 0.01 level and positive, except the accessibility with bus which is negative. This means that well-being increases when you increase the value in the other variable.

Variable		Well-being
Education	Pearson Correlation	0.185**
	Significance (2-tailed)	0.000
Comparative Wealth	Pearson Correlation	0.327**
	Significance (2-tailed)	0.000
Income	Pearson Correlation	0.275**
	Significance (2-tailed)	0.000
Better off	Pearson Correlation	0.343**
	Significance (2-tailed)	0.000
LM accessibility	Pearson Correlation	0.070**
	Significance (2-tailed)	0.000
Bus Accessibility	Pearson Correlation	-0.144**
	Significance (2-tailed)	0.000

4.3 Correlation between Human Development Index and subjective well-being

The secondary objective of the study was to see if well-being could be explained by the Human Development Index and thus making measurements of subjective well-being redundant. The results from the correlation show that even if they are significantly correlated the correlation coefficient is quite small (0.116) with 2-tailed significance at the 0.01-level.

5. Discussion

5.1 Accessibility

The accessibility analysis in GIS was re-performed in this study based on instructions from Ahlström (2008) and should in theory be identical, however no comparison has been made. For a

detailed discussion about the errors and corrections in the analysis see Ahlström (2008). A couple of things are however worthy to mention in this discussion as well. Firstly the friction values assigned to the slope did not take in to account if the slope was up- or downhill, it was deemed to have the same impact on speed. The speeds assigned to different slopes were similar to those in other studies (Verburg et al., 2004). Terrain was not used as a friction because foot-paths are very common in the district and thus terrain poses a small obstacle (Ahlström, 2008).

The markets and towns chosen as destinations were the results of interviews with key-informants and locals but of course the line had to be drawn somewhere, all villages and small market stalls could not be included in the analysis. Another way of doing the accessibility analysis would be to include more towns and then weight the towns by population for example, or by some other factor that determines which town it is *best* to have access to. One example however that might cause this method to be misleading is that Hambantota town is a middle-sized town that would certainly be included in this analysis, however this town is mainly an administrative centre and not a town with much commercial activity. It might be an advantage to have access to the administrative services too, but mainly, people go to towns with production and trading. It would be very difficult to assign these different weights in a way that no one would argue with.

5.2 What affects well-being?

The statistical analysis showed which of the factors that were correlated with well-being. It showed that all of the factors were in fact significantly correlated. This is probably due to the large sample size. The factors that had the best correlation with well-being were comparative wealth and if they felt that they were better off now than five years ago. It seems that real income does not correlate as well with well-being as the feeling of improvement over time or as feeling that the household is doing well economically compared to other households in the village. This suggests that well-being is not just connected to income but rather to improvement and relative wealth. Merton and Kitt (1950) wrote about satisfaction and how it increased in a group in general where one member was worse of than the others. Satisfaction decreased when members were equal or where one member was advantaged. This could support the fact that people's well-being increase when they feel that they are wealthier than the other households in the village. The fact that the respondents were happier if they felt that they were richer than other households could have to do with just this observation. Either they felt successful compared to other households or perhaps they appreciated what they had to a greater degree because they could see how the other households were struggling. Another theory that supports the assumption that improvement and relative wealth is more important for subjective well-being than real income is adaptation level theory, described by Brickman, Coats and Janoff-Bulman (1978) and in other studies. This theory suggests that contrast and habituation are important factors when considering subjective well-being. Contrast being that an event, like winning a large amount of money, will leave other pleasures one enjoyed in the past seeming futile. Habituation is getting used to the fact that one has won a large sum of money and the event after a while looses its thrill. This could explain why change and improvement is important for subjective-well being. One does not get habituated because things are improving and the only contrast is that things were worse before.

All of the factors had a rather weak correlation with well-being. This suggests that either well-being is correlated with other factors not considered in this study or that well-being is such a complex phenomenon that it can't be explained with just a single factor. The intention of the study was to perform a multiple regression analysis but the data did not meet the necessary requirements for a regression analysis. This was quite a big set-back since it was now hard to estimate which factors had the highest impact on subjective well-being. With the information that a multiple regression analysis could have given a more complex function could have been constructed to try and explain what factors influence a person's subjective well-being.

5.3 Spatial variance in well-being

The spatial map of well-being was produced mainly to illustrate the patterns of subjective well-being in the district. It can be seen that people have the highest degree of subjective well-being in the south-western part of the district and lowest degree in the north west and north east. One could perhaps argue that well-being is higher closer to the coast, as it has been shown to be in other studies (Brereton et al., 2007), but that would be difficult to argue in this instance since there is no clear pattern. As stated in the previous section, accessibility and proximity to tows seem to have a positive effect on well-being. Why this is the case is hard to say without further analysis. One explanation could be that there are more opportunities for education, employment and because of this more opportunities for improvement.

5.4 Is there need for data on well-being?

As has been shown, there are a number of factors that influence, or at least correlates with, well-being. However none of these factors sufficiently explains the subjective well-being to justify not individually measuring this well-being. In other words, if one is interested in the subjective well-being of people, it is not enough just to measure their HDI or their GNI/capita and assume that they are about as happy as they are educated or rich.

5.5 Weaknesses in data and analysis

The dataset of interviews is very large and that is one of the strengths with this study. One can however question how the questions was interpreted, especially the one concerning well-being. It is of course hard to formulate such a question so that it cannot be interpreted in different ways and it is also hard to formulate it in another way when the answer wanted is the subjective well-being and not anything else.

For further information on the data and the analysis in GIS there is an in depth description in Ahlström's study where small errors in the road network and accessibility model are accounted for.

There was meant to be a multiple regression analysis included in the study to show which of the tester factors had the highest impact on a persons well-being but the data did not fulfil the criteria needed for a multiple regression so this had to be left out of the study.

5.6 Further studies

There are many other things that can be analysed with this huge dataset; which factors that correlate with well-being was only one of them. Further studies could investigate more relationships with well-being or investigate what influences income. It would also be interesting to perform interviews similar to the ones performed for this study to see if the extensive infrastructure development in the district during recent years shows up in the well-being data. It would also be interesting to compare villages to each other and see if people who lived in villages with relatively equal wealth were happier than people who lived in villages where the distribution was more skewed.

It would be very interesting to analyse which factors that influence subjective well-being the most and see if it actually is more important with improvement and relative wealth than income. To do this some sort of regression needs to be performed where the output of the analysis shows to which degree a factor affects subjective well-being.

6. Conclusion

The primary objective of the study, to visualise and explain subjective well-being spatially, has been fulfilled. There was a spatial variability in the subjective well-being that could be visualised in a

map to show where people were most and least satisfied. The factors that were analysed also turned out to be significantly correlated to this perceived well-being although the correlations were not overwhelmingly strong. It was clear that the comparative wealth, both compared with earlier in your life and compared with other people, had a stronger correlation with well-being than income in absolute numbers. This suggests that improvement and relative wealth are more important for a person's well-being than just being wealthy. However further analyses need to be performed since the correlation does not say anything about how much these factors influence well-being, it merely shows which has the higher correlation. Individually, none of the factors had such a high correlation value so as to be able to use it to predict well-being.

The secondary objective was to show whether a parameter for subjective well-being was actually needed or if one could actually assume that the subjective well-being was so highly correlated with the Human Development Index that one could instead use this as an indicator of well-being. It turned out that even if the HDI was significantly correlated with the subjective well-being the correlation was not so high that well-being could be substituted for the HDI.

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8. Appendix

8.1 Questionnaire

Date: **Interview no.** **Name of respondent** **Address:**
Village:
GN: **Research assistant:**

1. **General information about members of the household**

Household member[1]	Sex	Age	Main income activity[2]	Secondary income activity	Location of main income activity[3]	Place of residence (if not in the village)[4]	Formal education level[5]

Children	Sex	Age	Type of school[6]	Location of the school	Attend private tuition[7]	Mode of transport to school	
					Yes□ No □		
					Yes □ No □		
					Yes □ No □		
					Yes □ No □		
					Yes □ No □		

2. Apart from the persons mentioned above, has anyone else contributed money to the household within the last year?
Yes (specify) □…………………….   No □
3. What is the estimated total monetary income of the household per year[8]?
………………………………………………………
4. After covering necessary expenses, does this household have more money today than it had five years ago[9]?
Yes □   No □
5. How would you classify the household in comparison to other households in the village?

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[1] Stated in terms of the relationship of the individual to the head of household (Household member 1), e.g. husband/wife, or mother/mother in law. **OBS!** It should be visible who the actual respondent is.
[2] Main income activity is defined in terms of money, rather than time devoted.
[3] State: Local (in the village), regional (outside the village but in the district), national (outside the district but in the country) or global (outside the country). If regional or national, ask if they are commuting or boarding!
[4] This is to acknowledge that although they belong to the household, certain members might be working and living in other places (e.g. Middle East). The household defines who belongs to the household.
[5] State which grade they have studied up to. If they say O-level or A-level, ask if they passed the exam. If they failed the A-level exam, state grade 13. If they failed the O-level, state grade 11.
[6] Private, national or "provincial" school. Only ask if the child goes to school at the time of the field-visit.
[7] Only ask if the child goes to school at the time of the field-visit
[8] **Total:** We have to make sure that the sum includes **all** incomes (including from remittances). This is difficult and you might need to devote some extra time here. OBS! Samurdhi should not be included.
[9] This is a difficult question. What we want is an indication of whether the household perceives itself to be rich today than five years ago. "Necessary expenses" is hence up to them to "define".

Very poor □   Poor □   Middle □   Rich □

6. Does the household receive Samurdhi?   Yes □
No □

7. Does any member in the household own a motorized vehicle? Yes □ No □

<u>If yes:</u>

7b) What kinds of motorized vehicles are owned by members of the household?

....

8. Is anyone in the household suffering from any disease or injury, which is seriously restricting him/her from working?

Yes □   No □

9. What kind of toilet facilities does the household have?

Pit □   Water sealed □ Attached □   No toilet □

10. Does the household own any animals? Yes □ No □

<u>If yes:</u>

10b) What kind of animals?

....

10c) How many animals?

....

10d) What is the main produce from the animals?

………………………………………………………………..

10e) Where is the produce from the animals generally sold?

At the market □…………………   To middle-men at farm-gate □   The produce is not sold □

11. Which of the following resources are available in the household?

	Available	Not available
11a) Electricity	□	□
11b) A TV that works	□	□
11c) Telephone	□	□
11d) Tap water	□	□
11e) Well	□	□

12. Characteristics of the land used by the household

Type of land	Size of land	Main crops today	Main crops five years ago	Does the household own this land?[2]
Home garden				Yes □ No □
High-land				Yes □ No □

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[2] **If yes:** Is there a deed for the land? Check also for other kinds of ownership!

Paddy				Yes □ No □
Chena				Yes □ No □

13. From where does the household get water for its main cultivation activity?

Major irrigation system □   Minor irrigation system □   Rain-fed □   No cultivation □

14. In a normal year, is this household selling more rice that it is buying?   Yes □
No □

15. Where does the household generally sell the produce from the cultivation[3]?

i)   Does not sell the produce □

ii)   Bring the produce to the market to sell □

iii) Sell to middle-men at the farm-gate □

iv)   Other (Specify) □…………………………………………………………………

v)   No cultivation □

<u>If the household brings the produce to a market:</u>

15b) Which market do you normally take it to?

………………………………………………………………………………………

15c) How does the household generally transport the produce to the market?

Lorry	Land-master	Motor-bike	Bicycle	Bus	Other (specify)
□	□	□	□	□	□
	□………………………				

<u>If the household is not selling the produce at all, or if it is selling to middle-men at the farm-gate:</u>

15d). What are the most important reasons for not transporting the produce to the market yourself (choose maximum two of the following)

i) Do not want to transport the produce to the market   □

ii) The distance is too long
        □

iii) Lack of roads
        □

iiii) Bad quality of roads
        □

v) Lack of vehicles
        □

vi) Transport costs are too high
        □

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[3] This is about what they produce in the fields (paddy/highland) and not if they grow a few vegetables in the garden for sale.

vii) Lack of time for travelling

□

viii) Other (specify)

□……………………….

16. How long is the distance between the household and the nearest all-weather road?
……

17. How long is the distance between the main cultivated field and the nearest all-weather road[4]?
……

18. Has the household stopped cultivating any land that was earlier cultivated, within the last five years?

Yes □   No □

If yes:

18b) Is anyone else cultivating that land today?

Yes □   No □   Does not know □

19. Is the household renting out any land?
Yes □   No □

20. Has the household sold any land within the last five years?
Yes □   No □

21. What kind of crop would you prefer to cultivate if you could cultivate any crop you wanted?
Rice   Banana   Other crop (specify)
                             Prefer to have a mix of crops

□   □   □…………………….
                             □

22. Which kind of occupation would you prefer for your children to have when they are adults[5]?
    Farm □   Non-farm □   Mix (both farm and non-farm) □   No
children/children are adults □

        If non-farm:

22b) What kind of non-farm job would you prefer for your children to have?

        Private sector job □   Government sector job □   Self-
employment □

23. What kind of an area would you prefer for your children to live in when they are adults?
Rural □   Urban □   Abroad □   Not important
□   No children/children are adults □

24. In general, do you think that members in this household are better off or worse off today than they were five years ago?
Much better off □   Little bit better off □   No change □   Little bit worse off □
          Much worse off □

---

[4] If they have more than one plot, state the distance from the biggest of them.
[5] Farm means that you cultivate your own or someone else's land, or that you engage in forestry or animal husbandry, or in fisheries. Non-farm means that you do not engage in any of the above.

25. In general, do you think that members in this village are better off or worse off today than they were five years ago?

Much better off □　　　Little bit better off □　　　No change □　　Little bit worse off □

　　　Much worse off □

26. Do you personally know of anyone who has obtained a job or been able to enter a popular school, due to political affiliations?

Yes □　　　　　　　　No □

If yes:

Job □　　　　　　　　Popular school □　　　　　　　Both job and popular school □

27. Do you personally know of anyone who has paid money in order to obtain a job or enter a popular school?

Yes □　　　　　　　　No □

If yes:

Job □　　　　　　　　Popular school □　　　　　　　Both job and popular school □

28. How would you describe your general well-being?

Very bad □　　　　　　　Bad □　　　　　　Good □　　　　　　Very good □

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