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Human Development Index for Rural Andhra Pradesh

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Abstract

The method used to measure Human Development are reviewed in order to measure Human Development Index for rural AP by considering indicators such as economic attainment, longevity and education. Using UNDP method to estimate Human Development Index, which is predominantly normative approach to club different indicators by giving weights. The estimates are worked out with and without considering inequalities in economic attainment indicator. IAMR survey data for year 2001 is used for this study. However, for making comparison over time, data and analysis undertaken in other study is also used. In other methods, primarily for the analysis of data for year 2001, inequalities in all indicators were taken into consideration to measure Human Development using both UNDP and Principal Component Analysis. The comparison of results show that there has been only marginal improvement in Human development during the 1990s in rural AP considering only inequality in economic indicator using UNDP method. However, the results may differ significantly in case inequalities in all the variables are taken into account and depending upon the methodology used as is demonstrated by analysis of data for year 2001. But unfortunately comparison of analysis over time using the modified approach was not possible due to lack of detailed data for other years.

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Human Development Index for Rural AP

Jatinder S. Bedi and H. Ramachandran[1]

Human development is defined as a process of enlarging people's choice and raising the level of well-being. These choices can be infinite and vary over time and space. Several studies have shown the absence of a linear relationship between accumulation of wealth and general human welfare. Recognition of inadequacy of income-related indices in measuring 'development' led to the evolution of various other constituents of human well-being – e.g. the Level of Living Index (UNRISD 1966) and the Physical Quality of Life Index (Overseas Development Council 1979. However, the Human Development Index (HDI) is widely used by substituting income with some closely substituted indicator.

No other indicator of development has attracted as much public attention in recent years as the HDI. The approach to this index gained momentum with the release of the annual Human Development Reports (HDR) by the UNDP since 1990. The concept itself is not, however, new. From among these, the UNDP, through its global HDRs, identifies the choice to lead a long and healthy life; to acquire knowledge and be educated and to have access to resources needed for a decent level of living as the three most critical and socially valuable indicators for measuring HDI.

Thus, HDI is regarded as some kind of a measure of human welfare, which the GDP approach is unable to fully consider the aspect human development. Clearly, the adequacy of HDI would depend upon the number of dimensions of human development it is able to consider. Many people tend to use equal weights for various indicators. Most studies try to work out the human development indicator by trying to capture three indicators in this index, namely, economic attainment or command over resources, longevity and education. The aspect of basic amenities provides a crucial dimension to the issues related to human development. Thus, this is taken the fourth important indicator for estimating the HDI in several studies.

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This study makes an attempt to estimate the changes in Human Development in rural Andhra Pradesh (AP) over time by using UNDP and PCA methodologies, with and without considering inequalities. The method considering inequalities is, of course, better than the one ignoring it, as equality is one of the important considerations for improving human welfare. However, the analysis available for 1983, 1993-94, and 1999-2000 from the Planning Commission's study and for 1994 from a NCAER study, made it possible to consider inequality only for economic indicators. Thus, Method I was used using data from the IAMR survey, 2001 mainly for bringing out comparison of results over time.

In Method II, the inequalities in all the indicators were taken into account, but that was made possible only for data for 2001 based on the IAMR survey as finding inequalities from the analysis undertaken in earlier reports were not possible for other indicators save the economic ones. The results of human development attainment using Method II are definitely going to be lower than Method I, as all the indicators are going to be adjusted by level of inequalities in these indicators by multiplying it with One minus Ginni Coefficient value for the indicator.

Principal Component Analysis, used in Method III of this study, has a definite edge over the UNDP method as one of its beauties is to have as few indicators as possible and yet make it possible to capture almost all aspects of human development. In this method, the weights are supposedly treated as objective with little personal preferences. Thus, this study eventually tries to compare the results derived using all the three methods.

The methodologies used in this study are explained in details below.

I. Methodology and Data Source

The three methodologies adopted to measure human development index for rural AP are explained one by one:

Method I

Method I adopted in this study is similar to the UNDP method. The Planning Commission's method of working out HDI is similar to the UNDP method, albeit with a few

modifications. The UNDP method of estimating HDI tries to work out human well-being by assessing the three dimensions such as economic attainment or command over resources, longevity and education. The issue of weights to combine the identified indicators on each of the three dimensions of well-being can always be debated. The Planning Commission's National Human Development Report, 2002 has adopted a predominantly normative approach as against a purely empirical basis of deriving weights to club different indicators. The argument is that there are good reasons to suggest that different aspects of well-being have to be correlated. It follows that attainment on each aspect of well-being is equally important and hence should be equally weighted.

$HDI = 1/3 * (X_1+X_2+X3)$ ---------- *(i)*

Command over resources: the ability to lead a decent and socially meaningful life. Say, X_1. Economic resources such as income through employment or other sources could be better estimated by way of consumer expenditure or income. The Planning Commission's National Human Development Report (2002) corrected wide disparities among individuals by adjusting the per capita consumption with the Gini Coefficient. For the sake of comparison over time, the corrected consumption values are estimated at 2001 prices using state-specific poverty lines at 2001 prices as deflators. Thus, *X_1 is inflation and inequality adjusted per capita consumption expenditure.*

Education: the ability to read, write and acquire knowledge, say X_2. *In the Planning Commission, the composite indicator on educational attainment* is derived using following formula:

$X_2 = e_1 * 0.35 + e_2 * 0.65$

This contains e_1: i,e. literacy rate for the age group above 7 years.

and e_2: i,e. adjusted intensity of formal education such as no of years of schooling etc, which is taken care by taking average of enrolment ratio in the age group 6-11 and 11-14.

Longevity: The ability to live long and lead a healthy life. Say X_3, is taken for composite indicator on health attainment. For most individuals the choice to live a healthy life, free from illness and ailments and a reasonable life span are crucial attributes in the notion of

personal well-being. Similarly, for a society, a transition from high incidence of morbidity and mortality to a state where people generally enjoy long and disease-free lives is considered a desirable and valued social change. It is only natural, then, that indicators on health and longevity, as well as indictors that variously capture demographic concerns of a society are important constituents in the framework for evaluating the development process under the human development approach.

Being healthy and being able to live long also brings some indirect benefits to individuals or to the society as a whole. It enables release of resources that, otherwise, would be spent on treatment of ill health and ailments, at least, at the household level and perhaps also at the level of public provisioning for some health care services.

The relationship between health and poverty or health and development is complex, multifaceted and multidirectional.

Composite indicator on health attainment, say X_2 is

$X_2 = h_1 * 0.65 + h_2 * 0.35$

This contains h_1: i.e. life expectancy at the age of 1 year

and h_2: i.e. infant mortality rate.

Life expectancy is a macro-concept and cannot be estimated individually as in the case of consumption and education. Life expectancy could either be worked out for a village, district or entire sample data.

Standardisation of Indicators: All the indicators were standardised as variables chosen for analysis are usually measured in different units and are generally not additive. Hence, it is necessary to convert them in some standard comparable units such as initial scale chosen for measuring them does not bias the results.

Where xij is replaced with Xij in equation (i).

$\boldsymbol{x}ij = ((Xij - Xi\ minimum)/(Xi\ maximum - Xi\ minimum))$ ---------- *(ii)*

Here I is 1 for economic attainment variable, 2 for education and 3 for health and j are number of observations in each indicator.

The transformed indicators series is now scale free and have a mean of zero and a standard deviation of unity. NCAER working paper No 83, 2002, criticised the standardised process adopted in the methodology adopted by UNDP and suggested standardising of these indicators by way of dividing each indicators by their mean as a better option. The argument put forward in favour of latter technique is that it does not disturb relative position as well as dispersion. However this study prefers to adopt practice of standardisation of indicators as adopted in UNDP methodology. This is because this process of standardisation as suggested in the NCAER, 2002 working paper has a flaw in that it gives higher weight to an indicator with higher dispersion. Therefore, we adopted the UNDP method of standardisation, where range is restricted in between 0 and 100 depending on the level of attainment based on minimum and maximum values and one can really assess the level of attainment from the standardised value of a particular indicator.

In case of Economic attainment, it is worked out based on the maximum consumption expenditure, which is estimated at Rs 853.93 and minimum Rs 172.74 at current prices from district-wise analysis of rural AP for 2001. This has been kept constant for all the years to make the comparison over time meaningful.

In case of literacy attainment indicator, all the values including the maximum and minimum values are estimated in percentage terms.

In the case of the health indicator, the maximum and minimum achievable are applied in equation (ii) to work out the percentage of health attainment:

Health attainment indicator as percentage of maximum = (Mean Value of Health Attainment – Minimum Health Attainment) / (Maximum Health Attainment - Minimum Health Attainment)

Inequalities Adjusted Indicators: The inequalities in this study are taken into account by dividing each indicator by 1 minus Gini Coefficient (1-gc). This is because a given level of income achievement in an economy is more desirable in case it is more equally distributed. The inequalities for Method I are worked out only for economic indicator for which consumption is taken as representative. Gini Coefficient for economic attainment indicator is worked out using household consumption data from IAMR, 2001 survey for the entire state as a whole. The methodology used in this study is different compared to planning commission method on the basis of adjustments for inequalities.

e.g. in the case of the economic attainment indicator, it would be like:
Economic attainment indicator as percentage of maximum attainable is estimated using following formula = (Inequalities adjusted observations of economic attainment – Minimum economic attainment) / (Maximum economic attainment - Minimum economic attainment)

The Planning Commission's report, on the other hand, adjusted each observation on the indicator for inequalities. Thus, each value in the formula as explained below is adjusted for inequalities:

Inequality adjusted economic attainment indicator as percentage of maximum attainable is estimated using following formula = (Inequality adjusted observations of economic attainment – minimum economic attainment as derived using adjusted values) / (Maximum economic attainment as derived using adjusted values - Minimum economic attainment as derived using adjusted values)

The limitations of the method adopted by the Planning Commission for inequality adjustment is that if the inequities are high or low, but are equal, within each observation of each indicator, then the inequality adjusted indicator would be same as unadjusted one. Thus the purpose of reflecting the true extent of inequality and adjusting the indicator accordingly get defeated to that extent. This is because mean and maximum value would also be proportionately downgraded in case of equal inequalities within all observations.

Leaving maximum and minimum attainment level intact and adjusting only the observations with inequalities at state level is used as the method to estimate the inequality adjusted indicators.

Method II: One could question the wisdom of taking into account the inequalities in economic indicators only, while ignoring inequalities in health and education indicators. Thus, in Methodology II, the inequalities in all three indicators of HDI namely economic attainment, education and health attainment are taken care of. The analysis based on this method was undertaken only for year 2001, as data for various details are available from IAMR, 2001 survey. The inequalities in various indicators are estimated by working out Gini Coefficients. The method is similar as in case of adjustments for economic attainment explained above. The economic attainment is worked out using per capita consumption indicator. This is preferred to income as the data for income is generally less reliable especially from primary surveys.

Inequality Adjusted Education Indicator: The UNDP studies consider education attainment as a percentage of literates above the age of 7 years and number of years of education, etc. An attempt has been made in this study to work out the composite index for all levels of literacy and then find inequalities among individual level of education. This is the preferred indicator compared to the adult literacy rate or the percentage of graduates above the age of 15, as it tries to take all these into account in one indicator.

This indicator has been further improved in this study by working out the education attainment level for each individual aged 7 and above by giving greater weightage to higher level of education. The post graduation and above level of education, present students and children below 7 years are given 100 per cent attainment level in this indicator. The other level of education is proportionately given lower attainment level in the indicator as explained. Using these criterions, the education attainment has been estimated for various levels of age groups.

Inequality Adjusted Health Indicator: Similarly, the health indicator is adjusted for inequalities by working out expected life at zero for each village. The inequalities for health

indicators in this study are worked out on the basis of village-level indicators. This is because life expectancy is a macro concept and cannot be estimated individually as in the case of consumption and education. Life expectancy could either be worked out for a village, district or entire sample data.

This study estimated life expectancy from the IAMR survey data for 2001. The age distribution of the population could be used to estimate the number of surviving persons in each year. The expected life worked out by this method is lower because of migration taking place at each age group among the village. This study thus attempted other method for the HDI analysis. The life expectancy at age zero for each village is used for the purpose. This is preferred because it implicitly takes into account indicators like the infant mortality rate, living age, etc. and is estimated using following formula.

Thus, taking into account inequalities in all the indicators means a major improvement in methodology adopted in this study compared to generally adopted UNDP methodology.

Method II for working out HDI by taking into account the additional indicator of basic amenities also: Method II is a considerable improvement over Method I, but it could lead to further improvement by taking into account the basic amenities aspects, which is considered in several studies as an important aspect of HDI. Thus, Methodology II could work satisfactorily at assessing basic amenities, such as access to water, electricity, power, refrigerator, *pucca* houses, etc., apart from economic, education and health indicators. The biggest representative of basic amenities or rural infrastructure is household assets owned by individual villagers as it implies the potential of individuals to avail themselves of basic amenities. The depreciated value of assets owned by individual households has been arrived at by depreciating the value from the time of its purchase. Thus, the basic amenities variable is also added in Method II adopted in this study to estimate the HDI from the UNDP method. This analysis is undertaken based on IAMR, household survey data for year 2001.

Method III: Methodology III is adopted in this study to improve upon the Methodology I and II. In Methodology II, all the three dimensions of HDI were assigned equal weights for the purpose of addition. This can be taken care of by using Principal Component Analysis (PCA). The

composite index for each dimension is obtained by linearly combining the standardised value of indicators using its weights. Once the bias of measurement of variable / indicator is removed by way of standardising, then the crucial question is assigning them weight. In order to avoid subjective bias, the weights are assigned on the basis of factor analytical model. Factor Analysis or PCA is a tool used to construct a composite index in such a way that the weights given maximise the sum of square of correlations of the indicators with the composite index.

The weights given to the indicators are chosen in such a way so that PC satisfies two conditions:

1. The numbers of PCs are equal to the number of indicators and are uncorrelated or orthogonal in nature.
2. The first PC or P1 absorbs or accounts for the maximum possible proportion of variation in the set of the indicators. This is the reason why it serves as the ideal measure of Composite Index.

This is estimated by taking the simple correlation of k number of variables (indicators) and is arranged in a Correlation Table. The elements of this table in diagonal would be unity and the correlation matrix is symmetric i.e. each row are identical to the elements of the corresponding column. The total variance in the data set is simply the sum of variances of these observed variables. Because they have been standardised to have a variance one, the total variance in a PC analysis will always be equal to the number of observed variables being analysed. The factor loading for the first PC is worked out by dividing each column or row sum by the square root of the grand total.

a ij = sum rxixj/ (sum sum rxixj)^1/2

From these, the Pi or the first PC is constructed in the following way:

P1 = a11x1 + a12 x2 +_____a1kxk

The sum of squares of the loading of the PC 1 is called the latent root (or Eigen Value) of this component and are denoted by the Greek letter L1.

L1 = a^211 + a^212 + a^213 + a^214+_____a^21n

Thus, PCA is a method in which original data is transformed into a new set of data, which may capture the essential information. Often some variables are highly correlated such that the information contained in one variable is largely a duplication of the information contained

in another variable. Instead throwing away the redundant data, PCA condenses the information in interrelated variables into a few variables, called principal component. PCA is a special case of transforming the original data into a new co-ordinate system. PCA extracts direction where the cloud is more extended. For instance, if the cloud were shaped like a football, the main direction of the data would be a midline or axis along the length of the football. This is called the first component, or the principal component. PCA will then look for the next direction, orthogonal to the first one, reducing the multidimensional cloud into a two-dimensional space. The second component would be the axis along the football width (Agilent Technologies, Inc 2005, http://www.sjsu.edu/faculty/watkins/princmp.htm).

Researchers use factor analysis when they believe that certain latent factors exist, exerting casual influence on the observed variables they are studying. The number of components extracted in a PCA is equal to the number of observed variables being analysed. However, in most of the analyses, only the first few components account for meaningful amounts of variance, so only these first few components are retained, interpreted and used in subsequent analysis such as in multiple regression analysis.

In this case, we have given example of a single-stage PCA. In case of multi-stage PCA, selected variables divide into well-defined sub-groups depending upon the nature of indicators. Within a sub-group, they have a degree of inter-correlation, while the canonical correlation between pairs of sub-group is low on average. Thus, PCA could take care of large number of indicators, but these needs to be carefully selected and grouped and sub-grouped. The inappropriate selection of indicators could lead to errors. The first PCs obtained from different sub-groups have been treated as a set of new variables and combined at a second stage to obtain a Final Composite Index. The results are however almost similar in PC analysis and multi-stage PC.

The SAS/STAT system's PROC FACTOR solves for these weights by using a special type of equation called an Eigen-equation. The weights produced by these Eigen equations are optimal weights in the sense that, for a given set of data, no other set of weights could produce a set of components that are more successful in accounting for variance in the observed variables. Thus, PCA enables one to determine a vector known as the first principal

component vector, having the maximum sum of squared correlations with the indicators, linearly dependent on the constituent indicators. The Eigen vector corresponds to maximum Eigen Value of the correlation matrix and gives the required weights.

The principal component analysis is better in case the indicators are carefully selected, as it takes into account large number of indicators. However, inappropriate selection of indicators could lead to errors.

The framework used in this study is such that the final estimates take into account the adjustment required for inequalities of various variables to work out PCA. Thus, analysis in this study allows us to compare the results derived from all the three methods Method I, Method II and Method III 2001 for which IAMR, household survey data is used. Methods II & III is applied only for analysis on 2001, as this was requiring detailed information for all the variables, which was available from IAMR survey for all the districts of AP. Method I on the other hand is used to look at the dynamics in HDI over time.

Data Source: For analysis over time, the methodology adopted (Methodology-I & II) in this study tried to adopt here the methodology similar to the one followed by the United Nations Development Programme (UNDP) in its Human Development Report and the Planning Commission's National Human Development Report, 2002 with a few modifications. The period of analysis taken is 1983, 1993-94, 1994-95, 1999-2000 and 2001. For years 1983, 1993-94 and 1999-2000, the values had been taken from Planning Commission National Human Development Report, 2002 and for year 1994 from NCAER, 1999, India Human Development Report and NCAER, 2001, South India Human Development Report. The analysis for 1994 is based on the NCAER survey for 12 districts. The analysis for 2001 is based on the IAMR survey for the same 12 districts for which NCAER undertaken the study, NCAER, 1999, India Human Development Report and NCAER, 2001, South India Human Development Report.

The mean values as required for this indicator for 1983, 1993-94, 1994 and 1999-2000 for rural AP have been obtained using analysis in referred studies and occasionally using original data source used in these studies in case of non-availability of the indicators in referred

studies. The maximum and minimum values used for standardising various indicators were however taken from the IAMR household survey data for 2001 based on 22 districts from rural AP. The maximum is taken equivalent to average highest value for the district among all the districts and minimum as lowest. Apart from saving extra efforts such as digging original data sources for other years, keeping the minimum and maximum values constant for all years based on district-wise average range for 2001, make the results comparable over time.

Methodology III is used to analyse data for 2001 on all the 22 districts, which was drawn from primary survey undertaken by IAMR[2]. This method needs a detailed data on various aspects of human development. The data for other years were not available in that detail and thus the methodologies used for time period analysis were constrained by this fact.

II. Analysis of data using Method I

In this method, human well-being in rural AP is estimated over time using three dimensions –

economic attainment, education and health. The period of analysis taken is 1983, 1993-94, 1994-95, 1999-2000 and 2001. The analysis for 1983, 1993-94 and 1999-2000 is based on analysis carried out by the Planning Commission. The analysis for the year 1994 is based on the NCAER survey for 12 districts. The analysis for 2001 is based on the IAMR survey for the same 12 districts for which NCAER undertaken the survey. This analysis would be useful to draw the changes in HDI pattern for rural AP over time.

i. Inflation and inequality adjusted per capita consumption expenditure

This section basically considers the variables that give estimates of command of resources of individuals or households. Economic resources such as income through employment or other sources could be better estimated by way of consumer expenditure or income.

[2] The total number of households surveyed for the 22 districts of rural AP was 3,170. It involved 16,454 members of these families. The National Council of Applied Economic Research (NCAER) had also conducted a similar survey for the 12 districts of AP, for the year 1994. The villages taken for re -survey in the 12 districts were same as during the survey conducted by NCAER during the year 1994. The total number of districts surveyed in IAMR survey was 22 and the remaining 10 districts were selected on the basis of female literacy (NCAER had followed the same practice for the 12 districts).

Economic attainment indicator as percentage of maximum attainable is estimated using following formula = (Observations of economic attainment – minimum Economic attainment) / (maximum Economic attainment - minimum Economic attainment)

As explained in the methodology, the disparities among individuals are adjusted by adjusting per capita consumption with Gini Coefficient. For the sake of comparison over time, the corrected consumption values are estimated at 2001 prices using state-specific poverty lines at 2001 prices as deflators (Table 1).

Table 1: Inflation and inequality adjusted per capita consumption expenditure (Rs per month in rural AP)

		1983	1993-94	1999-2000	1994 NCAER Survey of 12 Districts of AP	2001* IAMR Survey of Same 12 Districts
1.	Per Capita Consumption	115.6	288.70	453.6	312.8	495.0
2.	Poverty Line	72.7	163.0	262.9	176.7	275.8
3.	Inflation Adjusted Per Capita Consumption	438.7	488.5	475.8	488.2	501
5.	Economic Attainment Indicator as percenta of maximum for AP during 2001 (%)	39.0	46.4	44.5	46.3	48.2
4.	Gini Ratio	0.298	0.282	0.258	0.293	0.276
5.	APs Inflation and Inequality Adjusted Per Capita Consumption Expenditure = (3*(1-4	27.4	33.3	33.0	32.7	34.9

Source: Derived from the Planning Commission, 2002, National Human Development Report, which used data from NSS and National Family Wealth survey for 1983, 1993-94 and 1999-2000. The data for the year 1994 is based on NCAER survey of 12 districts. The year 2001 data is based on the IAMR survey for 12 districts. These 12 districts chosen are same as of NCAER. The villages selected are also same as of NCAER in these 12 districts.

The various values in Table 1 on 2001 are derived using IAMR, 2001 survey data. For 1983, 1993-94 and 1999-2000, the values had been taken from Planning Commission National Human Development Report, 2002 and for year 1994 from NCAER, 1999, India Human Development Report and NCAER, 2001, South India Human Development Report.

Economic attainment after adjusting for inequalities has been estimated at 27.4 per cent after adjusting for inequalities for 1983. Economic attainment, without adjusting for inequalities,

has been estimated at 33.3 per cent for 1993-94 and 33 per cent during 1999-2000 as per NSS data (Table 1). Thus, there is a marginal decline from 1993-94 to 1999-2000 as the data on economic attainment reveals from secondary sources. The results show a similar pattern in case one compares results as derived from NCAER sample and IAMR sample data for the same 12 districts.

The further analysis of IAMR survey data bring out that there exist a huge gap between maximum and minimum. This is revealed by the data on percentage distribution of income among various decile population groups. The top ten per cent of the population shares 39 per cent of the total income. The next 10 per cent shares 16 per cent and another 10 per cent shares 11 per cent of the total income. The rest shares only less than 10 per cent of the total income. In this, the bottom 10 per cent shares only 2 per cent and the next to bottom 3 per cent.

Table 2: Percentage share of income distributed among various decadal of population

Bottom percentage of population	Percentage of income
10	2.04
20	4.99
30	8.74
40	13.26
50	18.69
60	25.38
70	33.91
80	44.99
90	61.09
100	100.00

Source: IAMR Survey, 2001.

ii. Composite Indicator on Education Attainment

Education is the single most important means for individuals to improve personal endowments, build capability levels, overcome constraints and in the process, enlarge their available set of opportunities and choices for a sustained improvement in well-being.

It captures the capability of acquiring knowledge, communication and participation in community life. Improvements in educational attainments have invariably been accompanied by improvement in health and longevity of the population and in their economic well-being. Educated people are likely to be more productive and hence better off. At the same time, education reinforces the socio-economic dynamics of a society towards equality in attainments and opportunities for its people.

UNDP measures the composite indicator on education attainment as derived using following formula:

$X_2 = e_1 * 0.35 + e_2 * 0.65$

This contains e_1: i.e. literacy rate for the age group of up to 7 years.
And e_2: i.e. adjusted intensity of formal education, which is taken here as average of enrolment ratio in age group 6-11 years and 11 to below 14 years[3].

For year 1981: Composition of Indicators of Education Attainment = 0.35 * 27.85 + 0.65 * 35.8 = 33 per cent. Year 1981 is taken as substitute for year 1983.

For year 1993-94: Composition of Indicators of Education Attainment = 0.35 * 35.74 + 0.65 * 47.75 = 43.55 per cent

For year 2000-2001: Composition of Indicators of Education Attainment = 0.35 * 54.68 + 0.65 * 65.5 = 61.71 per cent

For year 1994: Composition of Indicators of Education Attainment = 0.35 * 50.2 + 0.65 *58 = 55.27 per cent

For year 2001: Composition of Indicators of Education Attainment for rural AP = 0.35 * 55.33 + 0.65 * 67 = 62.92 per cent. The literacy rate is 57.21 per cent in coastal AP, 57.34 per cent in Rayalaseema and 51.55 per cent in Telengana. The overall literacy rate is 55.33 per cent in rural AP.

[3] The education data for year 1981 and 1991 are based on census data. Year 1981 and 1991 are taken as substitute for year 1983 and 1993 respectively.

This means the composition of indicators of education attainment is 33 per cent in 1983, 43.6 per cent in 1993-94 and 61.7 per cent in 2000-2001 (Table 3). Thus, considerable improvement has taken place in education attainment when one compares data from similar sets of data sources. The NACER data for 1994 show 55.27 per cent education attainment. IAMR survey results, which should be comparable to NCAER data, show 62.92 per cent education attainment. Thus data from primary sources also reveals improvement in the education attainment indicator. The achievable maximum and minimum values for education attainment could vary in the 0-100 per cent range. Thus, the above values reflect the levels attained during these periods. The composition of indicators of education attainment and deprivation are just reverse to each other. The composition of indicators of education attainment is 100 minus composition of indicators of education deprivation.

Table 3: Composite indicator of education attainment

	1983	**1993-94**	**1999-2000**	**1994**	**2001**
Composition of indicators of education attainment	33.0	43.6	61.7	55.3	62.9

Source: Planning Commission, 2002, National Human Development Report and data from IAMR survey. Indicators

iii. Composite indicator on health attainment

For most individuals the choice to live a healthy life, free from illness and ailments over a reasonable life span are crucial attributes in the notion of personal well-being. Similarly, for a society, a transition from high incidence of morbidity and mortality to a state where people generally enjoy long and disease-free lives is considered a desirable and valued social change. It is only natural, then, that indicators on health and longevity, as well as indicators that variously capture demographic concerns of a society are important constituents in the framework for evaluating the development process under the human development approach.

Being healthy and being able to live long also brings some indirect benefits to individuals or society as a whole. It enables the release of resources that would otherwise be spent on treatment of illnesses, at least the household level and perhaps, also at the level of public provisioning for some health care services.

The relationship between health and poverty or health and development is complex, multifaceted and multidirectional.

UNDP measure composite indicator on health attainment, say it $X_{2\,as}$

$X_2 = h_1 * 0.65 + h_2 * 0.35$

This contains h_1: i,e. life expectancy at the age of one year

and h2: i,e. infant mortality rate.

The estimates of h1 and h2 are available from planning commission report. For year 1994, the data is not available.

For year 1983: Composition of Indicators of Health Attainment = 0.65*(61.5) + 0.35*(90.5) = 71.65 per cent.

For year 1993-94: Composition of Indicators of Health Attainment = 0.65*64.2 + 0.35*94.2 = 74.70 per cent.

For year 2000-2001: Composition of Indicators of Health Attainment = 0.65*64.5 + 0.35*96.5 = 75.7 per cent.

For year 2001:

For 2001, the average length of life expected life at age zero is estimated at 43.20 using IAMR survey data. The expected life worked out by this method is lower because of migration taking place at each age group among the village. The data in Table 4 show the extent of migration taking place in rural AP.

Table 4: Cluster Analysis

	Total	**Adult Member (18 to 65 years)**
Percentage of household numbers with migrated individuals in total no. of Household	2.90	2.01
Percentage of Household income with migrated individuals in total Household income	9.76	7.29
Coastal Region of AP	1.14	0.52
Rayalaseema Region of AP	0.06	0.07
Telangana Region of AP	8.24	4.80

Source: IAMR Survey, 2001.

Thus for this study, the life expectancy at age zero for each village is derived using the following method from the IAMR, 2001 survey data:
Expected life at the age 0 is = R1 (101.2 - 273.5R2) - 20.1

Here R1= Ratio of no of live births to children ever born to the women in the age group of 15 to 49, R2 = Ratio of no of children born during last 1 year to no of live births to the women in the age group of 15 to 49 and 20.1 is the constant taken for women in the age group of 15 to 49.

Using IAMR survey data, the estimates of R1 is estimated at 0.9656 for the state as whole using village level estimates and R2 at 0.0466, the expected life at age zero is thus estimated at 65.31 years. This is used to estimate composite indicator on health attainment:
$X_2 = h_1*0.65+h_2*0.35$. h_1: life expectancy at the age of one year & h_2: infant mortality rate.
Thus, composition indicators of Health Attainment is estimated as = 0.65 *65.31 + 0.35 * 96.56 = 76.25 per cent.

To estimate the composite indicator on health attainment: The maximum and minimum life expectancy is used from village level analysis of survey data, which are estimated at 88.6 and 40.92 respectively. Children surviving maximum infant mortality rate are 96.56 cent and minimum 0 per cent. The maximum health attainment is thus estimated at 91.39 = (0.65 *88.6 + 0.35 * 96.56) per cent and minimum health attainment is taken as 26.60 = (0.65 *40.92 + 0.35 * 0.0) per cent.

These maximum and minimum values are applied to standardise health attainment indicator as in case of standardisation of economic attainment indicator for all the years.
For year 1983: Composition of Indicators of Health Attainment is 69.53 = (71.65-26.6)*100/ (91.39-26.60) per cent.

For year 1993-94: Composition of Indicators of Health Attainment is 74.24 = (74.70-26.6)*100/ (91.39-26.60) per cent.
For year 2000-2001: Composition of Indicators of Health Attainment is 75.78 = (75.70-26.6)*100/ (91.39-26.60) per cent.

For year 2001: Composition of Indicators of Health Attainment is 76.63 = (76.25-26.6)*100/ (91.39-26.60) per cent of the maximum possible for the year 2001.

The health attainment as a percentage of the maximum was estimated at 69.53 per cent in 1983, 74.24 per cent in 1993-94 and 75.78 per cent in 2000-2001. This further improved to 76.63 per cent during 2001 (Table 5). Thus, marginal improvement has been achieved in health over time.

Table 5: Composite indicator of health attainment

	1983	**1993-94**	**1999-2000**	**1994**	**2001**
Composite indicator on health attainment	71.65	74.70	75.70	Data not available	76.25
Health attainment as percentage of maximum	69.53	74.24	75.78	Data not available	76.63

Source: Planning Commission, 2002, National Human Development Report and data from IAMR survey.

iv. Composite indictor of human development index

The composite indictor of human development as per the UNDP method is estimated using equation (i)

Human development index HDI

$HDI = 1/3 * (X_1+X_2+X3)$ ---------- *(i)*

Table 6: Human development index

	1983	**1993-94**	**1999-2000**	**1994**	**2001**
Inequality & Inflation adjusted Economic attainment indicator as percentage of maximum for AP	27.4	33.3	33.0	32.7	34.9
Education attainment as percentage of Maximum	33.0	43.6	61.7	55.3	62.9
Health attainment as percentage of Maximum	69.53	74.24	75.78	74.24*	76.63
HDI	43.3	50.4	56.8	54.1	58.1
Index of HDI	100.0	116.3	131.2	124.9	134.2

Note: * Figure is for year 1993-94 from NSS.
Note: Planning Commission Report used data from NSS and National Family Wealth survey for 1983, 1993-94 and 1999-2000.
Source: Planning Commission, 2002, National Human Development Report and data from IAMR survey.

This means that the composite HDI improved from 43.3 per cent in 1983; 50.4 per cent in 1993-94 and 56.8 per cent in 1999-2000 (Table 6). Thus improvement in HDI has taken place over the period. Similar pattern have emerged from primary data for 1994 and 2001 as HDI improved from 54.1 to 58.1.

II. Using Method II, Estimates of HDI for year 2001 in Rural AP

As stated earlier, the limitation in Method I is that one could question the wisdom of taking into account the inequalities in economic indicators only, while ignoring inequalities in health and education indicators. Thus, under Methodology II, the inequalities in all three indicators of HDI, namely economic attainment, education and health attainment, are taken care of. Later, a fourth indicator, depreciated value of asset owned by households, is also tried to capture the aspect of basic amenities. The analysis is based on IAMR household survey data for 12 districts for 2001. The inequalities in various indicators are taken care of by multiplying the indicator with one minus Gini Coefficient value. There is no change in method discussed for economic attainment.

Education Attainment

The UNDP studies consider, among other things, education attainment as a percentage of the literate population above the age of 7 years and the number of years of education, etc. A few studies also use indicators like adult literacy rate or the percentage of graduates above the age of 15 years. These studies, however, altogether ignore inequalities in the level of education. The inequalities in education has been taken care of in this study by working out education attainment level for each individual of age 7 and above by giving higher weights to higher level of education and then estimating Gini Coefficient to adjust for it.

The post graduation and above level of education, present students and children below 7 years are given 100 per cent attainment level in this indicator. The other level of education is proportionately given lower attainment level in the indicator as explained. For developing education attainment indicator, the following criteria have been adopted for providing attainment level to each individual of age above than 7 years.

a. Illiterates have been given 0 point on the 1 point scale. One point is taken as any person with graduation or above either of technical or of general category.

b. Literates: formal education or informal education till the stage of primary level has been given 1^2 /16 = 1/16 points on 1 point scale.
c. Literates above primary education till the 12th standard have been given 2^2/16 = ¼ points on 1 point scale. Thus, higher the education, higher is the attainment level. Thus increase is not taken as a simple arithmetic as it is assumed that at higher level of education, the income-level increases along with other development indicators.
d. Literates with diploma or other technical qualifications have been given 3^2/16 = 9/16 points on 1 point scale.
e. Literates with graduation and above (general or/ and technical) have been given 4^2/16 = 16/16 = 1 points on 1 point scale. This means this is the maximum education one expects to attain, in general, from all the individuals. Above that education is subjective.

Table 7: Education Attainment

	Age 7 and above	Age 7 and 18 years	Household Head	Age >=18
AP	0.3732	0.8188	0.1373	0.3006

Source: IAMR Survey, 2001.

There seems to be wide disparities among various individuals as is clear from the Gini Coefficient values given in Table 7. In this study, inequalities in the education indicator are adjusted by multiplying the indicator with One minus Gini Coefficient value. The Gini Coefficient of 0.3732 derived for the variable based on education level attainment level explained above in detail for individuals of age group of 7 is used to adjust for inequalities in education indicators. Thus the values of Table 3 after adjusting for inequalities are reported in Table 7.

Health attainment

Similarly, the health dimension is adjusted by considering inequalities in the expected life at zero for each village. For working out health inequalities, the life expectancy at the age of zero for the village surveyed is estimated and Gini Coefficient is estimated at 0.1571. This indicator was preferred as it implicitly takes into account the various indicators such as infant mortality rate, living age etc.

Composite indictor of Human Development Index

The method adopted here takes care of inequalities for all the dimensions of human development. The estimates of HDI derived in case inequalities for only economic indicator are taken into account are 58.1 per cent of total achievable as against 46.3 per cent in case inequalities for all the indicators of HDI is taken care of (Table 8).

Table 8: Attainment of Economic, Education, Health and HDI as Percentage of Maximum Achievable for rural AP during 2001

	Economic	Education	Health	HDI
UNDP Method I	34.9	62.9	76.6	58.1
Method II	34.9	39.4	64.6	46.3

Source: Derived using IAMR Survey, 2001 data.

Estimates of HDI by Method II in which basic amenities are also taken into consideration:

The Method II though is required of considerable improvement, works satisfactorily at assessing basic amenities, such as access to water electricity power, refrigerator, pucca houses, etc. The biggest representative of basic amenities or rural infrastructure is household assets owned by individual villagers. The present value of net asset owned by individual is estimated by estimating the depreciated value of current market value of assets owned by individual from the time of its purchase using the following formula:

Depreciated value of assets = (present value of the asset owned *100) / (100+ number of years since the asset is purchased *10)

Number of years since the asset is owned is worked out by subtracting from the year when asset was purchased from the year of survey, i.e. 2001

The per capita average depreciated value of assets owned by household is estimated at Rs 29,370. The Gini Coefficient estimated at the individual level is 0.8469. But since the concept of basic amenities is more applicable for the village as whole rather than at the individual level, it would be appropriate to estimate inequalities at the village attainment level. The Gini Coefficient estimated for that is 0.6865. These assets include consumer durable goods and productive assets. The maximum value of asset is estimated at

Rs 1,42,036 and minimum at Rs 6,622. The basic amenities have high degree of inequalities. The level of attainment of basic amenities is estimated at 16.80 per cent without considering inequalities and 5.3 per cent only of the total attainable level in case inequalities are also taken into account.

The HDI thus worked out including basic amenities as one of its dimensions is estimated at: HDI = 1/4 * (economic attainment + education attainment + health attainment + basic amenities) is 47.8 per cent of the total attainable in case inequalities for only economic indicator is taken into consideration and 36.1 per cent in case inequalities for all the indicators is taken into consideration. The attainment level in case of basic amenities is of very poor quality.

Table 9: HDI: Including basic amenities for rural AP during 2001

	Economic	**Education**	**Health**	**Basic Amenities**	**HDI**
UNDP Method (Method I)	34.9	62.9	76.6	16.8	47.8
Method II Results	34.9	39.4	64.6	5.3	36.1

Source: IAMR Survey, 2001.

The HDI results, thus, show that the attainment level is highest among all indicators in case of health, followed by education, economic condition and basic amenities. The logical reason for low inequalities in case of the health indicator may be due to the fact that the health of the poor remains good as they work hard and develop natural resistance to diseases, while the rich try to maintain it by spending on health care packages. Thus, inequalities in health seem to be low and the attainment level is high compared to other indicators of HDI.

III. Estimates of HDI for year 2001 in Rural AP based on Method III

The composite index for each dimension is obtained by linearly combining the standardised value of indicators (as described above) using its weights. On the standardised indicators, principal component analysis was used to estimate weights for combining. For this method, the analysis had been undertaken for all the 22 districts.

Economic Attainment

The five economic attainment indicators chosen are average income per household, percentage of non-poor population, per capita average monthly consumption, per capita consumption of non-poor and female over male literacy rate and their district-wise values are given in Table 10.

Table 10: Economic attainment dimension during 2001

		1	2	3	4	5
District Code	**District name**	**Average Income per Household Per year**	**% Of Non-poor Population**	**Per cap Average Monthly Consumption**	**Per cap Consumption of Non-poor**	**Female/ Male Literacy Rate**
1	**Visakhapatnam**	8245	80.6	496.4	626.7	0.65
2	**Adilabad**	10128	88.8	533.4	654.0	0.64
3	**Medak**	14671	78.5	522.9	621.8	0.66
4	**Karimnagar**	9028	92.5	343.9	405.1	0.64
5	**Cuddapah**	9308	87.1	417.6	489.8	0.66
6	**Khammam**	17006	98.3	853.9	865.2	0.66
7	**Chittoor**	7134	76.2	263.8	392.9	0.68
8	**Nizamabad**	9267	87.7	489.8	794.1	0.68
9	**Anantapur**	9270	87.5	426.0	481.4	0.68
10	**Prakasam**	10194	83.9	530.8	586.2	0.67
11	**Krishna**	13306	77.1	524.5	764.4	0.65
12	**West Godavari**	9040	85.6	542.5	603.0	0.66
13	**Rangareddi**	8251	91.9	343.7	482.8	0.67
14	**Vizianagaram**	6697	83.9	375.5	427.1	0.68
15	**Srikakulam**	5476	64.4	447.1	415.7	0.66
16	**East Godavari**	5568	75.4	260.3	472.8	0.67
17	**Guntur**	7837	77.4	347.0	607.5	0.66
18	**Mahbubnagar**	7006	74.9	321.3	424.3	0.65
19	**Kurnool**	10215	90.7	308.9	418.8	0.65
20	**Nellore**	4697	74.0	172.7	416.6	0.64
21	**Warangal**	7515	93.1	395.6	435.5	0.66
22	**Nalgonda**	9516	86.4	449.1	511.8	0.65
	AP	8885	**83.7**	**410.6**	**532.6**	**0.66**

Source: IAMR Survey, 2001.

These indicators are standardised before performing PC analysis. The PC analysis is estimated by taking the simple correlation of k number of variables (indicators) and these are arranged in a correlation Table 11. The elements of this table in diagonal would be unity and the correlation matrix is symmetric i.e. each row are identical to the elements of the corresponding column. The total variance in the data set is simply the sum of variances of these observed variables. Because they have been standardised to have a variance one, the total variance in a PC analysis will always be equal to the number of observed variables being analysed.

The factor loading for the first PC is worked out by dividing each column or row sum by the square root of the grand total. This is called the weight to work out first PC.

a ij = sum rxixj/ (sum sum rxixj)^1/2

Table 11 Correlation matrix

Indictors	**1**	**2**	**3**	**4**	**5**	**Total All Rows**	**a ij**
1	1	rx1x2	rx1x3	rx1x4	rx1x5	Sum rx1xi	a11= rx1xi / ((rxixj)^(1/2)
2	rx2x1	1	rx2x3	rx2x4	rx2x5	a21	a21= rx2xi / ((rxixj)^(1/2)
3	Rx3x1	rxrx2	1	rx3x4	rx3x5	a31	a31= rx3xi / ((rxixj)^(1/2)
4	Rx4x1	rx4x2	rx4x3	1	rx4x5	a41	a41= rx4xi / ((rxixj)^(1/2)
5	rx5x1	rx5x2	rx5x3	rx5x4	1	a51	a51= rx5xi / ((rxixj)^(1/2)
Total All Colum	a11	a12	a13	a14	a14	a11+a21+a31+a41+ or a11+a12+a13+a1	

From these, the Pi or the first PC is constructed in the following way:

P1 = a11x1 + a12 x2 +_____a1kxk

The sum of squares of the loading of the PC 1 is called the latent root (or Eigen Value) of this component and is denoted by the Greek letter L1.

L1 = a11^2 + a12^2 + a13^2 + a14^2+_____a1n^2

Table 12: Component Matrix

Component Economic Attainment	**1**	**2**	**3**	**4**	**5**	**Total**	**% Of Variance Explained by PC1**
Weights (a1i) = Rows or columns Sum of rxixj Correlation matrix of Standar Variables / (Rows and Columns rxixj)	0.85	0.61	0.89	0.83	0.34		
Eigen Value LI = Variance Explained by PC1=(a1i)^2	0.72	0.37	0.79	0.68	0.12	2.68	(2.68*100/5) = 53.62

Extraction Method: Principal Component Analysis.
Source: IAMR Survey, 2001.

The correlations among indicators selected in our study are quite high. The weight or Eigen Value is high for income, consumption and consumption by poor related variables in economic indicator. Similarly, the percentage of the non-poor population and the female-over- male ratio are other important variables as estimated in Table 12.

The eight education attainment indicators chosen are per head cost of education, formal education level in different age groups, education attainment level (worked out as explained earlier), level of education and adult literacy rate are given in Table 13.

Table 13: Education Attainment Dimension during 2001

		1	2	3	4	5	6	7	8
District Code	District Name	Per head cost of Education	Literate in 6-14 age %	Literate in >7 age	% >Matric in >15	% > Middle in >15 years	Education Attainment Indicator	Graduation literacy rate	Adult literacy rate
1	**Visakhapatnam**	854	93.3	61.6	22.5	35.7	46.7	4.0	54.2
2	**Adilabad**	1196	94.5	61.5	28.5	39.6	47.1	2.5	51.7
3	**Medak**	716	98.8	65.3	33.1	43.7	47.8	3.7	56.5
4	**Karimnagar**	1240	94.1	64.0	30.8	41.8	46.1	3.9	59.4
5	**Cuddapah**	670	97.4	68.9	28.7	40.5	51.1	7.5	66.0
6	**Khammam**	2923	96.6	73.9	32.9	50.5	54.5	9.8	76.6
7	**Chittoor**	887	97.7	68.7	32.3	46.8	49.4	6.4	70.1
8	**Nizamabad**	560	97.2	57.4	27.9	37.9	41.9	3.9	49.9
9	**Anantapur**	562	94.4	62.8	24.0	39.9	46.4	3.2	58.3
10	**Prakasam**	729	97.4	70.3	29.6	42.3	48.3	3.4	70.9
11	**Krishna**	2912	99.3	77.9	34.2	48.3	56.5	9.4	77.1
12	**West Godavari**	1109	97.1	79.4	29.0	41.6	56.9	5.7	82.3
13	**Rangareddi**	964	96.6	53.3	22.2	31.0	41.3	2.0	41.9
14	**Vizianagaram**	501	98.3	63.4	22.6	34.2	46.7	4.5	54.2
15	**Srikakulam**	317	97.5	66.6	25.8	37.9	49.0	4.8	63.5
16	**East Godavari**	362	98.8	61.7	14.0	27.6	48.8	2.0	47.3
17	**Guntur**	448	89.8	58.3	16.6	28.1	44.7	3.2	54.5
18	**Mahbubnagar**	580	91.0	54.4	19.2	30.5	40.5	1.0	45.3
19	**Kurnool**	1007	91.8	67.4	23.9	36.3	51.1	3.9	62.7
20	**Nellore**	338	100.0	66.5	18.0	29.1	50.3	4.2	62.6
21	**Warangal**	732	96.7	60.8	27.5	35.6	47.5	4.6	50.2
22	**Nalgonda**	641	97.2	65.9	24.5	38.3	50.2	3.7	63.1
	AP	**891**	95.7	**64.3**	**26.2**	38.3	48.1	**4.3**	**59.8**

Source: IAMR Survey, 2001.

The Eigen Values suggest that literacy rate above age 7, graduation level, adult literacy rate, education attainment level (which is composite index of education level at various age groups) and middle-level education are five very important indicators in the education attainment level. The per head cost of education and education rate in the age group 6-14 are other important indicators (Table 14). The per head cost is slowly becoming crucial for education attainment as the quality of education of government-funded schools is deteriorating and the private sector is playing a major role in education development. Thus, the quantum of money spent on education is becoming one of the important variables of economic attainment.

Table 14: Component Matrix

Component Education Attainment	1	2	3	4	5	6	7	8	Total	% Of Variance Explained By PC1
Weights (a1i) = Rows or columns Sum of rxixj Correlation matrix of Standardised Variables / (Rows and Columns rxixj)	0.74	0.51	0.92	0.79	0.87	0.86	0.89	0.89		
Variance Explained by PC1=(a1i)^2	0.54	0.26	0.85	0.62	0.76	0.74	0.80	0.79	5.35	(5.35*100 / 8) = 66.92%

Extraction Method: Principal Component Analysis.
Source: IAMR Survey, 2001.

The five health attainment indicators chosen are infant and stillbirth mortality rate, life expectancy at 0 age, deaths rate below 5 years age, trained dai and short duration morbidity rate and are given in Table 15.

Table 15: Health attainment indicator during 2001

		1	2	3	4	5
District Code	District Name	Trained Dai others /1000	Life Expectancy at) 0 age	Infant & Still Birth Mortality Rat	Deaths Rate Below 5 years Age	Short Duration Morbidity Rate
1	**Visakhapatnam**	598.9	**70.46**	65.60	72.13	7.08
2	**Adilabad**	603.6	**70.70**	47.39	49.96	21.21
3	**Medak**	674.6	**68.79**	73.51	53.45	10.79
4	**Karimnagar**	711.5	**69.91**	65.20	17.20	29.61
5	**Cuddapah**	703.3	**69.52**	89.08	15.90	40.00
6	**Khammam**	647.9	**67.18**	54.12	23.58	19.11
7	**Chittoor**	625.0	**64.40**	169.26	57.74	19.02
8	**Nizamabad**	577.2	**65.53**	149.62	61.34	6.84
9	**Anantapur**	754.1	**63.92**	93.59	51.33	20.07
10	**Prakasam**	608.7	**67.55**	148.82	30.36	6.06
11	**Krishna**	650.6	**53.87**	79.00	9.62	16.76
12	**West Godavari**	530.5	**60.25**	222.50	86.06	14.82
13	**Rangareddi**	712.7	**59.62**	172.36	48.48	68.34
14	**Vizianagaram**	510.9	**72.85**	44.88	31.32	13.64
15	**Srikakulam**	471.0	**59.08**	163.10	79.50	26.62
16	**East Godavari**	528.5	**66.15**	117.92	61.59	33.39
17	**Guntur**	458.1	**46.84**	302.64	92.27	18.46
18	**Mahbubnagar**	466.7	**61.72**	153.42	111.46	33.90
19	**Kurnool**	426.9	**53.52**	230.33	163.32	30.38
20	**Nellore**	714.3	**70.52**	57.54	33.90	42.46
21	**Warangal**	570.6	**68.84**	78.12	24.02	23.67
22	**Nalgonda**	723.3	**62.28**	144.68	92.24	13.97
	AP	608.7	**63.92**	128.23	57.54	**24.74**

Source: IAMR Survey, 2001.

The three variables, namely infant and stillbirth mortality rate, life expectancy at 0 ages and deaths rate below 5 years age are very important for health attainment, while other two are relatively less important. PC1 explains 53.25 per cent of the varaincevariance of health attainment indicator (Table 16).

Table 16: Component Matrix

Component Health Attainment	**1**	**2**	**3**	**4**	**5**	**Total**	**% Of Variance Explained By PC1**
Weights (a1i) = Rows or columns Sum of rxixj Correlation matrix of Stanc Variables / (Rows and Columns rxixj)	0.68	0.82	0.88	0.81	0.28		
Variance Explained by PC1=(a1i)^2	0.47	0.68	0.78	0.66	0.08	2.66	(2.66 *100 / 5) = 53.25%

Extraction Method: Principal Component Analysis.
Source: IAMR Survey, 2001.

The seven variables chosen to estimate the basic amenities. The percentage of population having adequate electricity, separate kitchen, adequate drinking water and toilet facility are four important variables for the same, while having a *pucca* house is another important variable for this purpose. The household having TV and value of assets owned at depreciated rate are not those important in the basic amenity indicator. This exposes the limitation in UNDP method (Method I & II) as it gives equal weight to each of the HDI indicators irrespective of the suitability of it. The other limitation of the UNDP method is that only variable subjectively decided e.g. depreciated assets owned by household is considered, while other important variables such as water or electricity availability are ignored, while estimating that indicator.

Table 17: Basic amenities attainment dimension during 2001

		1	2	3	4	5	6	7
Distri	District Name	% Populatio Having Adequate Drinking Water	% Populatio Having Electricit	% of Populatio Having Pucca House	% Populatio Having Separate Kitchen	% Populatio Having Toilet	% Populatio Having TV	Per Capita Net Value of Assets (Depreciated)
1	**Visakhapatnam**	65.00	61.73	34.86	45.39	24.14	13.61	1297
2	**Adilabad**	80.90	80.34	36.87	50.57	25.28	11.78	3076
3	**Medak**	67.62	83.81	38.32	67.62	25.49	9.58	4958
4	**Karimnagar**	84.80	93.75	22.11	53.29	42.11	11.58	6443
5	**Cuddapah**	89.83	81.36	31.67	44.95	31.63	11.61	2895
6	**Khammam**	85.45	98.15	16.67	76.47	82.69	11.08	13332
7	**Chittoor**	93.53	97.09	34.72	77.78	54.02	12.65	7898
8	**Nizamabad**	95.41	83.02	14.91	48.45	15.22	9.43	5405
9	**Anantapur**	84.62	90.13	56.25	41.33	17.16	15.03	2039
10	**Prakasam**	97.27	88.35	47.46	52.78	32.86	15.14	2909
11	**Krishna**	96.30	94.53	28.57	65.38	71.28	15.12	7076
12	**West Godavar**	79.58	93.33	29.38	59.26	52.80	12.29	5856
13	**Rangareddi**	95.30	90.21	26.71	58.41	25.74	11.92	1842
14	**Vizianagaram**	76.92	73.91	23.66	44.57	8.14	11.55	1473
15	**Srikakulam**	97.92	90.72	41.53	83.67	6.78	10.80	6230
16	**East Godavari**	68.04	60.55	33.90	51.52	28.05	9.44	1886
17	**Guntur**	95.19	77.36	18.55	26.83	22.50	13.17	21539
18	**Mahbubnagar**	71.71	66.91	15.20	53.28	22.12	11.02	6429
19	**Kurnool**	98.55	89.39	38.57	58.33	31.19	10.40	2994
20	**Nellore**	97.75	83.12	33.00	47.76	15.22	13.45	1861
21	**Warangal**	52.26	64.15	19.38	32.91	9.87	13.47	2369
22	**Nalgonda**	81.40	69.47	37.86	53.91	25.47	12.90	27772
	AP	**83.94**	**82.16**	**31.20**	**53.11**	**42.11**	**12.12**	**5729**

Source: IAMR Survey, 2001.The weights and percentage of variance explained are given in Table 18.

Table 18: Component Matrix

Component Basic Amenities Attainment	1	2	3	4	5	6	7	Total	% Of Variance Explained By PC1
Weights (a1i) = Rows or columns Sum of rxixj Correlation matrix of Standardised Variables / (Rows and Columns rxixj)	0.68	0.87	0.38	0.73	0.61	0.12	0.06		
Variance Explained by PC1=(a1i)^2	0.46	0.75	0.15	0.54	0.37	0.01	0.00	2.28	(2.28 *100 / 7) = 32.64 %

Extraction Method: Principal Component Analysis.
Source: IAMR Survey, 2001.

PCA thus works out weight for each of the indicators such as economic, education, health and basic amenities, which in turn are used to estimate PC1 for each indicator (Table 19). The principal component analysis is further applied on these four indicators and weights thus worked out in Table 20 are used to estimate HDI.

Table 19: HDI: For rural AP during 2001 using principal component analysis

Distri	District name	Economic Attainme	Education Attainme	Health Attainme	Basic Amenities Attainm	HDI
1	**Visakhapatnam**	42.2	33.6	87.37	25.03	42.7
2	**Adilabad**	46.9	39.2	88.20	46.01	51.2
3	**Medak**	63.6	52.5	90.54	48.25	60.7
4	**Karimnagar**	27.4	47.4	94.16	57.77	52.9
5	**Cuddapah**	41.0	61.0	92.96	48.39	58.1
6	**Khammam**	82.7	92.0	88.02	77.77	85.3
7	**Chittoor**	28.3	66.4	82.47	79.72	62.9
8	**Nizamabad**	62.4	32.1	80.93	43.73	51.0
9	**Anantapur**	43.3	37.6	90.59	55.91	52.7
10	**Prakasam**	41.4	56.9	85.14	65.80	60.0
11	**Krishna**	59.2	97.5	76.08	78.40	79.3
12	**West Godavari**	45.3	78.0	72.14	62.30	64.7
13	**Rangareddi**	35.4	17.0	82.85	59.08	43.6
14	**Vizianagaram**	35.3	37.6	85.00	30.02	43.1
15	**Srikakulam**	35.2	47.9	68.05	69.08	53.5
16	**East Godavari**	23.1	22.5	78.54	25.96	33.0
17	**Guntur**	36.9	16.1	54.69	37.79	33.4
18	**Mahbubnagar**	28.4	8.0	69.70	27.35	28.6
19	**Kurnool**	29.1	44.6	58.37	63.47	47.9
20	**Nellore**	6.4	40.1	94.54	51.57	43.7
21	**Warangal**	36.5	38.7	84.60	9.12	38.3
22	**Nalgonda**	41.6	47.3	86.21	42.78	51.3
	AP	**39.3**	**45.2**	**81.4**	**52.3**	**51.6**
	AP Considering Inequalitie	**22.1**	**27.7**	**67.4**	**16.4**	**30.1**

Source: IAMR Survey, 2001.

Table 20: Component Matrix

Component Health Attainment	**1**	**2**	**3**	**4**	**Total**	**% Of Variance Explained By PC1**
Weights (a1i) = Rows or columns Sum of rxixj Correlation matrix of Stanc Variables / (Rows and Columns rxixj)	0.69	0.88	0.46	0.70		
Variance Explained by PC1=(a1i)^2	0.48	0.77	0.21	0.49	1.95	(1.95 *100 / 4) = 48.81%

Extraction Method: Principal Component Analysis. Source: IAMR Survey, 2001.

The comparison of HDI results derived from principal component analysis and UNDP methods are given in Table 20 both without and with considering inequalities.

Table 21: HDI: Comparison from different methods for rural AP during 2001

Dimensions	Economic Attainmer	Education Attainme	Health Attainmer	Basic Amenities Attainment	HDI
UNDP method	34.9	62.9	76.6	16.8	47.8
UNDP method Considering Inequalities	34.9	39.4	64.6	5.3	36.1
Principal Component Analysis	39.3	45.2	81.4	52.3	51.6
Principal Component Analysis Considering Inequalities	22.1	27.7	67.4	16.4	30.1

Source: IAMR Survey, 2001.

The HDI estimates using UNDP method are estimated at 47.8 per cent in case inequalities for only economic attainment variable are taken into consideration. In case inequalities in all the dimensions of HDI are considered, the HDI is estimated at 36.1 per cent of the total attainable level. The HDI workouts from principal component analysis are estimated at 51.6 per cent in case inequalities for only economic attainment variable are taken into consideration. In case inequalities are taken into consideration for all variables, HDI worked out from principal component analysis is estimated at 30.1 per cent only of the total attainable level. The results thus clearly brings out that the methodologies used could make lots of difference in the final outcome of the results. The results derived using PCA, which has definite edge over other method, are estimated at 30.1 per cent of the total attainable level of HDI compared to 36.1 per cent using UNDP method provided both the methods takes into account inequalities. However, in most of studies the inequalities in most of indicators is not taken into consideration and thus results could be misleading in case the methodologies used are applied properly.

This district-wise analysis reveals that Khammam, Krishna, West Godavari, Chittoor and Medak are the five districts with highest HDI in ascending order in rural AP. There is high correlation among all the indicators. Mahbubnagar, East Godavari, Warangali,

Visakhapatanam and Guntur are the districts with lowest HDI. The data show that the poor make up 16.3 per cent of the total population in rural AP and expenditure on consumption is around 13.5 per cent of the total consumption expenditure. The female literacy rate is 0.66 compared to male literacy rate in rural AP. The district-wise variations for poverty ratio are high and low for ratio of female/male literacy rate.

Summary and Conclusions

This study basically looks into the state of Human Development in rural AP. Three methods have been used for the purpose.

Under UNDP methodology, only the inequalities in economic attainment are taken care of. The comparison of results on the basis of the UNDP method, by considering only inequalities in economic attainment, show that there has been only marginal improvement in human development during the 1990s in rural AP. The composite HDI improved from 43.3 per cent in 1983, 50.4 per cent in 1993-94 and 56.8 per cent in 2000-2001. A similar pattern has emerged from primary data for 1994 and 2001 as HDI improved from 54.1 to 58.1.

An attempt is then made in this study to improve the UNDP methodology (Method I) by taking into consideration the inequalities in all the variables (Method II). The analysis for this purpose was made possible only for 2001, as detailed data for the other years were not available. The estimates of HDI derived in case inequalities for only economic indicator are taken into account are 58.1 per cent of total achievable as against 46.3 per cent in case inequalities for all the indicators of HDI are taken care of. Method II, though requiring considerable improvement, works satisfactorily at assessing basic amenities, such as access to water electricity power, refrigerator, *pucca* houses, etc. The biggest representative of basic amenities or rural infrastructure is household assets owned by individual villagers. The present value of net asset owned by individual is estimated by working out the depreciated value of current market value of assets owned by individual from the time of its purchase. The HDI thus worked out includes basic amenities as one of the dimensions of HDI. The HDI thus derived is 47.8 in case inequality for only economic indicator is taken into consideration

and 36.1 per cent in case inequality for all the indicators is taken into consideration. The basic amenities seem to be of very poor quality.

The problem with the UNDP method is that it gives equal weight to all the dimensions of HDI. This can be taken care of by using principal component analysis (PCA). The HDI works out from principal component analysis are estimated at 51.6 per cent in case inequalities for only economic attainment variable are taken into consideration. In case inequalities are taken into consideration for all variables, HDI worked out from principal component analysis is 30.1 per cent of the total attainable level.

The results derived using PCA, which has definite edge over other method, are estimated at 30.1 per cent of the total attainable level of HDI compared to 36.1 per cent using UNDP method provided both the methods takes into account inequalities. However, in most of studies the inequalities in most of indicators is not taken into consideration and thus results could be misleading in case the methodologies used are applied properly.

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