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Estimation and Comparison of Poverty Line in Different States of India by Using Quality Adjusted Life Year (QALY)

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Abstract

Objective: Poverty Line gives a snap-short about the nature of poverty. Our objective is to redefine poverty line as a cost of common utility value across a population. Based on this utility value, we estimate Quality Adjusted Life Year (QALY) for different states of India.

Methods: In this paper, we observe trend analysis on poverty ratios across different states in different time periods. We analyse the change in head count ratio from 2004-05, 2009-10, 2011-12 across different states. Our cases are more concentrated on subdividing the states into two subgroups and then apply the model stated by Martin (2006). This leads to a new revised poverty model which serve as a framework for computation of QALY.

Results: Over the different time periods, the percentage of number of states are 10%, 36.67%, 86.67% of the total states having QALY value closer to 1in the time period 2004-05, 2009-10, 2011-12 respectively.

Conclusion: There is a huge variation in the QALY values in conjunction to the poverty estimates for different states. Few states whose poverty ratios are better over different time period has better QALY values i.e.closer to 1. The other states which are in worse condition having lower poverty ratios, has indeed QALY values close to 0.

Keywords: Poverty ratio; Utilities; Stratification; Survival needs; QALY

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Introduction

India is one of the fastest growing economies in the world with a major objective to eradicate poverty from all the regions of the country. Poverty is defined as a condition of living where households (group of individuals) who don't possess enough money to meet their basic survival needs [1,2-4]. Poverty line gives a snapshot about the nature of poverty in different regions across India [6]. It not only distinguishes between the rich and poor but also reflects the same level of utility over different commodities. In terms of cost of living indices poverty line is defined by enabling inter-personal welfare comparison, when cost of acquiring basic needs varies over time or space [7-9-14]. An information theoretic approach was used to estimate poverty lines which are consistent and based on consumption pattern was also proposed [2,7]. Poverty lines are also considered as deflators for cost of living differences. These deflators categorise the individuals in such a way that their households with a defined standard of living is considered to be non-poor if they lie above the reference line while those below it are deemed to be poor [15].

Eradication of poverty is an important objective which, the government is dealing from past years. Planning Commission is the central agency which provides poverty estimates by constituting groups from time to time in order to revisit the methodological issues related to measurement of poverty. However there are different methods used for measuring poverty such as poverty line, head count ratio, poverty gap, squared poverty gap, Lorenz curve, gini coefficient, 1$ a day poverty line etc.

In the present study, we examine the trend of poverty across different states of India in different time periods. We analyse the change in head count ratio from 2004-05, 2009-10, 2011-12 across different states [16-18]. Our cases are more concentrated on subdividing the states into two subgroups and then apply the model stated by Martin [19]. Then we redefine poverty line as a cost of common utility value across a population. Further based on this utility value, we estimate Quality Adjusted Life Year (QALY) for different states.

Thus, it is for the first time QALY's have been computed for region

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specific areas across different time periods for which poverty ratios were available. Though lot of research is done in the area of computation of QALY using methodologies such as VAS (visual analog scale), standard gamble, TTO (time trade off), EQ-5D, SF-6 etc. But, for the first time new revised poverty model has been constructed which serve as a framework for computation of QALY [20-23].

QALY

Few authors defines poverty as an ill health state of a human being which is due to low income, low nutrient value leading to low standard of living [5]. One of the major reasons for occurrence of poverty is due to income inequality which directly affects the health of an individual. When we ponder about health then it directly relates to how much better is our quality of life. An individual can chose his priority of living a quality of life with or without a disease burden [24]. This quality of life is measured by means of a health outcome called QALY (Quality Adjusted Life Year).

In the present scenario, measurement of health is described in a different way [25-27]. The definition has path itself from the amount of life lived, to how far is the satisfaction level achieved for an individual. QALY is an important measurement of health outcome [28]. However their interpretation related to this health outcome is stated as, "Where should we spend whose money, to undertake what programs, to save whose lives and with what probability?".This question in turn implies on how many lives are saved alongwith the justification of the resources expanded. QALD (Quality Adjusted Life Days) for childbirth and maternity service in India have also been estimated [11].The QALD's obtained by the new proposed method are compared with the QALD's obtained by Afriat method. Both are found to be approximately same. These QALDs are estimated for different quintiles which are classified on the basis of usual monthly per capita expenditure.

Thus QALY is a summary measure which incorporates the impact on quantity as well as quality of life. In all the previous study different approaches have been used to estimate QALY but none of the studies have used polynomial fitting approach. Polynomials of different degree are formulated, tested for goodness of fit and then deriving the estimation of QALD.

Poverty lines give a true picture about prevalence of poverty across different subgroups of a population lying in different geographic areas while QALY gives the quantity and quality of life lived by a population who lie below the poverty line. When we summarise different states by using this health outcome, we are in a way giving an opportunity to those subgroups (populations) lying closer to value 1 who needs slight improvement in their health conditions. Thus a small uplift can make those subgroups rise above poverty line with good QALY values. On the other hand individuals whose values lie closer to 0 indicates that their health condition is bad and needs more improvement by means of income and better nutritional value.

Official poverty lines

Methodology for estimation of poverty has been revised from time to time in order to make poverty estimates appear more relevant in the present scenario. In India, poverty estimates are based on the recommendation of the expert group given by Professor Suresh D. Tendulkar and Dr. C Rangarajan [23]. Planning Commission is the central agency which not only estimates the incidence of poverty at national level but also at the state level [12]. However Tendulkar's approach is based on extrinsic pre-determined poverty line in terms of monthly per capita expenditure (MPCE). The poverty ratio is obtained by counting the number of person's lying below poverty line from the class of distributions of persons. CSO (Central Statistical Office) provides the estimates of expenditure of commodities at current and constant prices. The ratio between the two prices gives the consumption deflator.

The expert group disaggregated the official poverty line into state specific poverty line which helps to study the changes in inter-state price differentials. The validity of these official poverty lines were done by comparing the actual private consumption expenditure per capita with the poverty line on food, education, health against the normative expenditure on nutritional, educational and health outcomes derived. All India urban poverty line based on mixed reference period for rural as well as urban areas on the state wise basis for the time period 2004-05 [13].

Utility

The term utility has been defined as a measure of preferences which an individual attaches in a particular health state (NICE guidelines). There is a controversy in defining the measurability of utility [8]. Some authors define it as a measure of satisfaction which is subjective in nature [3]. On the other hand it is also defined as an indicator of preferences which is objective in nature. From economics perspectives, utility is defined in terms of poverty ratio as a valuation of health state of an individual which is assumed to be consistent over a period of time. Following the similar approach given by Ravallion [16], poverty lines are defined with respect to N (N=30) mutually exclusive group of states (j=1,2,…,N) such that all the individuals within a given state share the same utility function defined over various commodities with constant price over a particular year [15]. Each household has its own consumption pattern, which maximise the utility so that it uniquely belongs to a particular state.

The utility function serves two purposes in the analysis. Firstly it gives an idea about the preference of an individual in a particular health state. Secondly it reflects the inter-state differences in terms of consumption. The utility consistent poverty line is defined as minimum cost of common utility level at the prices faced by each state. The consumer expenditure function is e_j which is defined as $e_j(p_j,u)$ giving the minimum cost of utility u in j^{th} state along with vector of price p_j. Let u_z denote the minimum utility level required to escape poverty by which consistency requires to be constant for all j.

Consumption is used as an indicator for measurement of poverty when income is difficult to measure. It also indicates the differences occurring in the consumption bundles which directly affect the differences in consumption usage to reach the same utility level in different regions. The theory of revealed

preferences states that the poverty line for each subgroup in a population is expressed in terms of "welfare"[12]. Economists have further agreed on utility consistency as a functioning based approach [16]. It is also viewed as an alternative theoretic foundation for measurement of poverty [22].

In India, expert group states that a constant method of computing poverty line is done by using each comparison year as a base year. Thus yearly, NSS provides a relationship of per capita expenditure and calorie intake which is different from that of fixing the commodity bundle on the basis of price, income and preferences prevalent in a particular year for deriving the utility function. Most of the past literature relates to the economics theory which is based on the concept of welfare. This in turn supports the poverty line by means of utility function defined on the basis of consumption. Poverty line has also been stated from the point of consumption expenditure function with respect to utility [4].

The minimum income question in terms of consumer expenditure function overcomes the problem of computing utility from demand behaviour in case of alternatives which vary from one household to another. Utility in reference to poverty is defined as one welfare relevant functioning method which refers to attainment of personal satisfaction [18]. Next comes into picture is the reference problem i.e by what means is the reference level of utility (or other functionings) which governs the poverty line. Let person's functioning (consumption pattern) is determined by the consumption of goods or commodities an individual consumes over a period of time. Consider a particular state i with characteristic x_i representing the head count ratio. The utility function is defined as $u(q_i,x_i)$ where q_i is the quantity vector maximising on utility with price vector p_i. The total expenditure on consumption is defined as: $e(p_i, x_i, u)$. Next we define the estimation of QALY.

Thus quality of life can be quantified by using the concept of utility [25]. The utilitarian philosophers describe utility as a measure for increasing or decreasing the value for happiness. People desire for things or goods which in turn leads to maximization of positive utility (pleasure) or negative utility (pain). QALY's are defined as the summation of utility adjusted values over various time intervals. There lies an underlying assumption for QALY to be of additive separability. It also states that the utility of a given health state is unaffected by the other health state which precedes or follow it.

Methodology

Data has been collected from NSS 61st round (2004-05), NSS 66th round (2009-10), NSS 68th round (2011-12) along with the report of Planning Commission of India [26]. This is a secondary data which enlists the poverty estimates, head count ratio (%), number of people below poverty line (lakhs), share in consumption expenditure of food and non-food items (%), constant prices for health and education for the time period 2004-2012. There is a huge literature related to measurement of poverty along with the study of trend pattern but for the first time it has been done by means of QALY for different states across different time periods.

The major objective of building a model and hereby compute QALY is to uplift those sections of the populations which are lying below poverty line by indexing them on a scale of 0-1. In a way we refer to those particular regions which need more or less improvement through standard of living. Although poverty ratio gives crude idea about the actual condition of different states but QALY gives an exact picture of particular state will lie with respect to a quality of life. To formalise this approach for model building, we assume that there are N mutually exclusive group of states indexed from j =1 to N (N=30). All the individuals within a given state enjoy the same utility function defined over commodities with respect to constant price over a period of time.

Martin model is given by: $e(p_i, x_i, u)$.

Where e represents the expenditure function, p_i refers to per capita per month public expenditure at constant prices (education & health), x_i refers to the head count ratio (% of people below poverty line), u represents % share in consumer expenditure for food as well as non-food items.

Test for Heteroscedasticity

Breusch Pagan test is used to test for heteroscedasticity. It tests for error variances in the regression model.

Hypothesis: H_0: *Error variances are equal*

H_1: *Error variances are not equal*

The test statistic follows a chi square distribution wherein we accept H_0 if p value is greater than 0.05 and reject H_0 otherwise at 5% level of significance.

Stratification

We consider all the different states together and try to establish a causal relationship between poverty estimates (dependent variable) and other explanatory variables like head count ratio, below poverty line, utility(food and non-food items). On taking data as a whole, it did not give good results may be due to huge variation in the values across different states.Thus, the above model did not work well. So we further resort to stratify the data. Stratified random sampling is a method of sampling in which we subdivide the population into smaller groups known as strata. This sampling technique gives better precision. The strata so obtained give a better representation of the entire population under study. Since poverty ratios and value of variances differ across the strata so we consider disproportionate stratification.

From **Table 1a**-**3a** gives the poverty estimates for different strata with PRU representing the poverty ratio for urban areas, HCRU gives the head count ratio in percentage which is defined as the proportion of population that lives below the poverty line. BPLU represents the number of people below poverty line in lakhs, IHCRU is the inverse of HCRU which is taken on the basis of negative correlation with the poverty ratio. The expected value is given by estimated PRU which lies within the lower confidence interval limit (LCL) and upper confidence interval limit (UCL).

In stratum A1 we have those states for which number of persons below poverty line value is greater than λ (λ=10). We have a sample of 17 states with fitted polynomial equation as:

Table 1a Poverty estimates for stratum A1 (2004-05).

States	PRU	HCRU	BPLU	IHCRU	Est PRU	LCL	UCL
Andhra Pradesh	563	23.4	51.3	0.042735	587.3869	561.45	613.32
Bihar	526	43.7	40.9	0.022883	521.5728	444.05	599.09
Chattisgarh	514	28.4	13.4	0.035211	555.9324	528.07	583.80
Gujarat	659	20.1	41.9	0.049751	607.451	578.99	635.91
Haryana	626	22.4	15.8	0.044643	593.6568	567.03	620.28
Jharkhand	531	23.8	15.6	0.042017	584.8525	559.15	610.55
Karnataka	588	25.9	50.8	0.03861	571.4733	546.16	596.79
Kerela	585	18.4	15.7	0.054348	616.7619	585.91	647.62
Madhya Pradesh	532	35.1	61.7	0.02849	522.9859	482.57	563.40
Maharashtra	632	25.6	116.1	0.039063	573.3809	548.13	598.63
Odisha	497	37.6	22.7	0.026596	516.5019	474.55	558.46
Punjab	643	18.7	17.2	0.053476	615.1883	584.92	645.46
Rajasthan	568	29.7	42.8	0.03367	548.2946	517.91	578.68
Tamil Nadu	560	19.7	61.3	0.050761	609.7229	580.86	638.59
Uttar Pradesh	532	34.1	130.3	0.029326	526.6535	487.42	565.88
West Bengal	573	24.4	57.9	0.040984	581.0339	555.62	606.45
Delhi	642	12.9	18.9	0.077519	638.1506	563.44	712.87

Table 1b Poverty estimates for stratum B1 (2004-05).

States	PRU	HCRU	BPLU	IHCRU	Est PRU	LCL	UCL
Arunachal Pradesh	618	23.5	0.7	0.042553	645.9204	579.96	711.88
Assam	600	21.8	8.4	0.045872	633.122	557.33	708.91
Goa	671	22.2	1.7	0.045045	636.4975	563.37	709.62
Himachal Pradesh	606	4.6	0.3	0.217391	605.7511	436.36	775.15
Jammu & Kashmir	603	10.4	2.9	0.096154	543.4069	418.43	668.39
Manipur	641	34.5	2.1	0.028986	659.6344	500.45	818.82
Meghalaya	746	24.7	1.2	0.040486	652.6573	590.22	715.10
Mizoram	700	7.9	0.4	0.126582	697.2719	529.09	865.45
Nagaland	783	4.3	0.2	0.232558	783.1645	613.75	952.58
Sikkim	742	25.9	0.2	0.03861	657.7006	594.57	720.83
Tripura	556	22.5	1.3	0.044444	638.879	567.63	710.12
Uttarakhand	602	26.2	6.4	0.038168	658.7191	594.68	722.76
Puducherry	506	9.9	0.7	0.10101	561.2754	446.92	675.63

$$\widehat{PR} = 574.76 - 145.82x_i + 26.70x_i^2 + 25.96x_i^3 + u_z \quad (1.1)$$

For all the states lying in stratum A1 the poverty estimates obtained from equation (1.1) are given in table 1a and they lie within the confidence interval for the year (2004-05). The value of R^2 is 55.86% of the total variation in poverty estimates for stratum A1is explained by the head count ratio for the people who lie below the poverty line based on monthly per capita expenditure (MPCE).

Breusch Pagan test for heteroskedasticity shows that the p value for stratum A1 is 0.1345 (>0.05). Thus we accept H_0 i.e. the variances of the error terms are homoscedastic.

In stratum B1 we have those states for which number of persons below poverty line value is less than λ (λ=10). We have a sample of 13 states with fitted polynomial equation as:

$$\widehat{PR} = 644.15 + 56.35x_i + 112.04x_i^2 + 2.05x_i^3 + 91.09x_i^4 + 132.39x_i^5 + u_z \quad (1.2)$$

For all the states lying in stratum B1 the poverty estimates obtained from equation (1.2) are given in **Table 1b** and they lie within the confidence interval for the year (2004-05). The value of R^2 is 53.63% of the total variation in poverty estimates for stratum B1is explained by the head count ratio for the people who lie below the poverty line based on monthly per capita expenditure (MPCE).

Breusch Pagan test for heteroskedasticity shows that the p value for stratum B1 is 0.573 (>0.05). Thus we accept H_0 i.e. the variances of the error terms are homoscedastic.

In stratum A2 we have those states for which number of persons below poverty line value is greater than λ (λ=10). We have a sample of 17 states with fitted polynomial equation as:

$$\widehat{PR} = 889.53 - 80.05x_i - 127.89x_i^2 + 73.16x_i^3 - 131.97x_i^4 + 163.62x_i^5 + u_z \quad (2.1)$$

For all the states lying in stratum A2 the poverty estimates obtained from equation (2.1) are given in **Table 2a** and they lie within the confidence interval for the year (2009-10). The value of R^2 is 60.36% of the total variation in poverty estimates for stratum A2 is explained by the head count ratio for the people who lie below the poverty line based on monthly per capita expenditure (MPCE).

Table 2a Poverty estimates for stratum A2 (2009-10).

State	PRU	HCRU	BPLU	ICHRU	Est PRU	LCL	UCL
Andhra Pradesh	926	17.7	48.7	0.056497	959.5788	898.09	1021.06
Assam	871	26.1	11.2	0.038314	921.5818	835.33	1007.84
Bihar	775	39.4	44.8	0.025381	774.7845	630.19	919.38
Chattisgarh	807	23.8	13.6	0.042017	874.9892	811.49	938.49
Goa	1025	14.4	22.9	0.069444	1009.883	901.79	1117.98
Haryana	975	17.9	44.6	0.055866	951.7137	892.01	1011.42
Himachal Pradesh	888	23	19.6	0.043478	863.5944	800.81	926.38
Karnataka	908	31.1	24	0.032154	882.341	786.86	977.83
Kerela	831	19.6	44.9	0.05102	891.7105	829.67	953.75
Madhya Pradesh	772	12.1	18	0.082645	730.6335	605.78	855.49
Maharashtra	961	22.9	44.9	0.043668	862.5407	799.60	925.48
Manipur	955	18.3	90.9	0.054645	936.1338	878.31	993.96
Punjab	961	25.9	17.7	0.03861	917.6304	833.81	1001.45
Sikkim	1035	18.1	18.4	0.055249	943.8771	885.38	1002.37
Tamil Nadu	801	19.9	33.2	0.050251	883.6404	820.00	947.28
Uttar Pradesh	800	12.8	43.5	0.078125	865.0555	777.75	952.36
West Bengal	831	31.7	137.3	0.031546	852.3112	742.19	962.43

Table 2b Poverty estimates for stratum B2 (2009-10).

State	PRU	HCRU	BPLU	IHCRU	Est PRU	LCL	UCL
Arunachal Pradesh	925	24.9	0.8	0.040161	830.674	621.71	1039.64
Gujarat	951	6.9	0.6	0.144928	950.9793	694.62	1207.33
Jammu & Kashmir	845	12.6	0.9	0.079365	906.8062	719.20	1094.42
Jharkhand	831	12.8	4.2	0.078125	902.2798	708.43	1096.13
Meghalaya	990	46.4	3.7	0.021552	990.0005	672.00	1308.00
Mizoram	939	24.1	1.4	0.041494	959.739	645.60	1273.88
Nagaland	1148	11.5	0.6	0.086957	940.1899	772.74	1107.64
Orissa	736	25	1.4	0.04	812.4393	570.85	1054.03
Rajasthan	846	1.6	0.1	0.625	828.1596	592.33	1063.99
Tripura	783	5	0.1	0.2	775.4119	473.45	1077.37
Uttarakhand	899	10	0.9	0.1	990.1192	775.06	1205.17
Delhi	1040	17.7	0.3	0.056497	1026.342	711.77	1340.92
Puducherry	778	1.7	0.01	0.588235	797.8593	577.41	1018.31

Breusch Pagan test for heteroskedasticity shows that the p value for stratum A2 is 0.3989 (>0.05). Thus we accept H_0 i.e. the variances of the error terms are homoscedastic.

In stratum B2 we have those states for which number of persons below poverty line value is less than λ (λ=10). We have a sample of 13 states with fitted polynomial equation as:

$$\widehat{PR} = 900.85 + 109.18x_i - 41.19x_i^2 + 172.62x_i^3 + 83.41x_i^4 + 57.20x_i^5 + 157.39x_i^6 - 71.98x_i^7 + u_z \quad (2.2)$$

For all the states lying in stratum B2 the poverty estimates obtained from equation (2.2) are given in **Table 2b** and they lie within the confidence interval for the year (2009-10). The value of R^2 is 52.21% of the total variation in poverty estimates for stratum B2 is explained by the head count ratio for the people who lie below the poverty line based on monthly per capita expenditure (MPCE).

Breusch Pagan test for heteroskedasticity shows that the p value for stratum B2 is 0.6903 (>0.05). Thus we accept H_0 i.e. the variances of the error terms are homoscedastic.

In stratum A3 and using table 3a we have those states for which number of persons below poverty line value is greater than λ (λ=10). We have a sample of 13 states with fitted polynomial equation as:

$$\widehat{PR} = 1141.31 - 167.46x_i - 515.27x_i^2 + 349.93x_i^3 - 217.58x_i^4 - 425.24x_i^5 + u_z \quad (3.1)$$

For all the states lying in stratum A3 the poverty estimates obtained from equation (3.1) are given in **Table 3b** and they lie within the confidence interval for the year (2010-11). The value of R^2 is 69.25% of the total variation in poverty estimates for stratum A3 is explained by the head count ratio for the people who lie below the poverty line based on monthly per capita expenditure (MPCE).

Breusch Pagan test for heteroskedasticity shows that the p value for stratum A3 is 0.0508 (>0.05). Thus we accept H_0 i.e. the variances of the error terms are homoscedastic.

In stratum B3 we have those states for which number of persons below poverty line value is less than λ (λ=10). We have a sample of 17 states with fitted polynomial equation as:

Table 3a Poverty estimates for stratum A3 (2011-12).

State	PRU	HCRU	BPLU	IHCRU	Est PRU	LCL	UCL
Andhra Pradesh	1009	5.8	17	0.172414	1033.974	629.18	1438.77
Bihar	923	31.2	37.8	0.032051	921.1146	443.42	1398.81
Chattisgarh	849	24.8	15.2	0.040323	972.2925	712.32	1232.27
Goa	1134	9.8	16.5	0.102041	1170.66	930.45	1410.87
Haryana	1167	10.1	26.9	0.09901	1225.502	989.82	1461.18
Karnataka	1089	24.8	20.2	0.040323	972.2925	712.32	1232.27
Kerela	1987	15.3	37	0.065359	1666.238	1308.27	2024.20
Maharashtra	1126	21	43.1	0.047619	1019.119	622.47	1415.76
Manipur	1170	9.1	47.4	0.10989	1046.944	781.34	1312.55
Punjab	1155	17.3	12.4	0.057803	1486.47	1175.54	1797.40
Sikkim	1226	10.7	18.7	0.093458	1333.365	1090.82	1575.91
Tripura	920	6.5	23.4	0.153846	893.0706	594.79	1191.36
Uttarakhand	1082	26.1	118.8	0.038314	1095.958	735.84	1456.08

Table 3b Poverty estimates for stratum B3 (2011-12).

State	PRU	HCRU	BPLU	IHCRU	Est PRU	LCL	UCL
Arunachal Pradesh	1060	20.3	0.7	0.049261	1022.41	842.12	1202.70
Assam	1008	20.5	9.2	0.04878	1027.62	840.58	1214.66
Gujarat	1152	4.1	0.4	0.243902	1193.254	960.39	1426.12
Himachal Pradesh	1064	10.3	9.4	0.097087	1077.966	929.98	1225.95
Jammu & Kashmir	988	4.3	0.3	0.232558	932.855	720.85	1144.86
Jharkhand	974	7.2	2.5	0.138889	1031.92	869.01	1194.82
Madhya Pradesh	897	5	8.5	0.2	933.8742	685.46	1182.29
Meghalaya	1154	32.6	2.8	0.030675	1154.663	891.64	1417.68
Mizoram	1155	9.3	0.6	0.107527	1008.061	871.68	1144.44
Nagaland	1302	6.4	0.4	0.15625	1219.263	994.58	1443.95
Orissa	861	16.5	1	0.060606	984.3127	812.65	1155.97
Rajasthan	1002	9.2	9.8	0.108696	1000.271	862.00	1138.55
Tamil Nadu	937	3.7	0.1	0.27027	931.602	669.10	1194.11
Uttar Pradesh	941	7.4	0.8	0.135135	998.8557	829.13	1168.59
West Bengal	981	10.5	3.4	0.095238	1087.928	933.80	1242.06
Delhi	1134	15.4	0.3	0.064935	1004.587	810.08	1199.09
Puducherry	1309	3.4	0.02	0.294118	1309.557	1046.47	1572.64

$$\widehat{PR} = 900.85 + 109.18x_i - 41.19x_i^2 + 172.62x_i^3 + 83.41x_i^4 + 57.20x_i^5 + 157.39x_i^6 - 71.98x_i^7 + u_z \quad (3.2)$$

For all the states lying in stratum B3 the poverty estimates obtained from equation (3.2) are given in **Table 3b** and they lie within the confidence interval for the year (2010-11). The value of R^2 is 68.16 % of the total variation in poverty estimates for stratum B3 is explained by the head count ratio for the people who lie below the poverty line based on monthly per capita expenditure (MPCE).

Breusch Pagan test for heteroskedasticity shows that the p value for stratum B3 is 0.4739 (>0.05). Thus we accept H_0 i.e. the variances of the error terms are homoscedastic.

On fitting the polynomial for six strata for three different years we get the estimated poverty ratio and then using the utility function we computed QALY. From table 4.1, PRU gives the poverty ratio for urban areas, Food and Non-food total column

The utility function is defined as

$$u_z = 12.11638 - 0.13413c_z \quad (4.1)$$

Using the **Table 4a** we have defined the utility function based on yearly data. The utility values are assumed to be constant for a particular year for all the states. Due to unavailability of data we could not fit the varying utility function over different states. After forming the utility function as given by equation (4.1) we next compute the quality adjusted life values for different strata of states. The QALY values are computed using equation (4.2)

Table 4a Share in consumer expenditure for all India level.

Year	PRU	$Food_T$	$Non\text{-}Food_T$
2004-05	579	42.5	57.5
2009-10	860	40.7	59.3
2010-11	1000	38.5	61.5

$$QALY = Length\ of\ Life * Quality\ of\ Life\ for\ people\ living\ below\ poverty\ line \quad (4.2)$$

The length of life for population of individuals residing in different states is assumed to be 1 year. Since the poverty estimates are defined for a yearly basis so we follow the methodology for computation of QALY in the similar manner **(Table 4b).**

For strata A the sample size varies from 17 to 21 from 2004-12, though for 2004-05 & 2009-10 it remains the same. There are

Table 4b QALY values for strata A.

States	QALY (2004-05)	State	QALY (2009-10)	State	QALY (2009-10)
Andhra Pradesh	0.28	Andhra Pradesh	0.61	Andhra Pradesh	0.84
Bihar	0.13	Assam	0.39	Bihar	0.75
Chattisgarh	0.22	Bihar	0.22	Chattisgarh	0.79
Gujarat	0.34	Chattisgarh	0.41	Goa	0.96
Haryana	0.30	Goa	0.78	Haryana	1
Jharkhand	0.27	Haryana	0.59	Karnataka	0.79
Karnataka	0.25	Himachal Pradesh	0.42	Kerela	1
Kerela	0.37	Karnataka	0.32	Maharashtra	0.83
Madhya Pradesh	0.17	Kerela	0.51	Manipur	0.85
Maharashtra	0.25	Madhya Pradesh	0.67	Punjab	1
Odisha	0.15	Maharashtra	0.42	Sikkim	1
Punjab	0.37	Manipur	0.57	Tripura	0.73
Rajasthan	0.21	Punjab	0.40	Uttarakhand	0.89
Tamil Nadu	0.35	Sikkim	0.58		
Uttar Pradesh	0.17	Tamil Nadu	0.50		
West Bengal	0.27	Uttar Pradesh	0.76		
Delhi	0.55	West Bengal	0.30		

Table 4c QALY values for strata B.

States	QALY (2004-05)	States	QALY (2009-10)	State	QALY (2011-12)
Arunachal Pradesh	0.31	Arunachal Pradesh	0.37	Arunachal Pradesh	0.56
Assam	0.32	Gujarat	0.51	Assam	0.56
Goa	0.32	Jammu & Kashmir	0.80	Gujarat	0.97
Himachal Pradesh	0.10	Jharkhand	0.79	Himachal Pradesh	0.88
Jammu & Kashmir	0.58	Meghalaya	0.24	Jammu & Kashmir	0.76
Manipur	0.21	Mizoram	0.45	Jharkhand	0.84
Meghalaya	0.30	Nagaland	0.91	Madhya Pradesh	0.76
Mizoram	0.30	Odisha	0.36	Meghalaya	0.4
Nagaland	0.21	Rajasthan	0.44	Mizoram	0.82
Sikkim	0.28	Tripura	0.41	Nagaland	0.99
Tripura	0.32	Uttarakhand	0.53	Odisha	0.67
Uttarakhand	0.28	Delhi	0.65	Rajasthan	0.82
Puducherry	0.63	Puducherry	0.43	Tamil Nadu	0.76
				Uttar Pradesh	0.81
				West Bengal	0.89
				Delhi	0.73
				Puducherry	1

number of 8 states such as Andhra Pradesh, Bihar, Chattisgarh, Haryana, Karnataka, Kerela, Maharashtra, Punjab whose position remains constant in strata A with improved QALY values over a period of three different years. For the time period 2004-05 the QALY values remain less than 0.5 for almost all the states except for Delhi. Since their values lie closer to 0 which indicates a bad possible state of health for people of different states who lie below the poverty line. Thus, in that time period it indicates greater improvement is needed for the states in order to rise above the poverty line. For strata A(2009-10), more than half of the number of states have QALY values greater than 0.5. The time period 2009-10 shows better improvement in comparison to 2004-05. Thus a moderate improvement is needed for those states with QALY value greater than 0.5. On the other hand few states with value closer to 0 (or less than 0.5) need greater improvement in terms of QALY which in turn help them to rise above the poverty line. For strata A (2010-11), there are 4 states such as Haryana, Kerela, Punjab, Sikkim whose QALY values is 1. It implies that these states have a stage of perfect health of individuals and are majorly ready to rise above the poverty line. Almost all the other states of this time period have QALY values closer to 1 which also implies that a slight improvement in terms of QALY values can make a larger section of the population lie above the poverty line **(Table 4c).**

For strata B the sample size varies from 13 to 17 from 2004-12, though for 2004-05 & 2009-10 it remains the same. There are number of 6 states such as Arunachal Pradesh, Jammu & Kashmir, Meghalaya, Mizoram, Nagaland, Puducherry whose position

remains constant in strata B with improved QALY values over a period of three different years. For the time period 2004-05 the QALY values remain less than 0.5 for almost all the states except for Jammu & Kashmir, Puducherry. Since their values lie closer to 0 which indicates a bad possible state of health for people of different states who lie below the poverty line. Thus, in that time period it indicates greater improvement is needed for the states in order to rise above the poverty line. For strata B(2009-10), half of the number of states have QALY values greater than 0.5. The time period 2009-10 shows better improvement in comparison to 2004-05. Thus a moderate improvement is needed for those states with QALY value greater than 0.5. On the other hand few states with value closer to 0 (or less than 0.5) needs greater improvement in terms of QALY which in turn help them to rise above the poverty line. For strata B (2010-11), there are 3 states such as Gujarat, Nagaland, Puducherry whose QALY values is 1or very close to 1 (approximately). It implies that these states have a stage of perfect health of individuals and are majorly ready to rise above the poverty line. Almost all the other states of this time period have QALY values closer to 1 (except Meghalaya) which also implies that a slight improvement in terms of QALY values can make a larger section of the population lie above the poverty line. Over a period of three time periods, the number of states are 10%, 36.67% , 86.67% of the total states having QALY value closer to 1in the time period 2004-05, 2009-10, 2011-12 respectively.

Conclusion

Poverty line gives the level of income needed to meet the basic survival needs. Earlier poverty was measured on consumption basis while all other dimensions such as calorie requirements, share of consumption expenditure on food & non-food items etc. which were of not much significance. Economists feel that a minimum standard of living is chosen as a reference cut-off for households in order to meet their basic survival needs [10].

Eradication of poverty is an important objective. Human being needs a certain minimum consumption of food and non-food items to survive [17]. Measurement of poverty help us to evaluate the performance of quality of life lived by an individual in order to meet his survival needs. A group of household in a particular area will have different consumption needs, different prices and geographical areas which lead to formation of different poverty estimates. In India there is a variation of climate from north to south or east to west along with variation in lifestyle, standard of living, prices and consumption needs [27,28]. All these criteria indicate that the same consumption bundle cannot be used throughout for all the states which yield the same level of utility.

Poverty lines represent the same level of utility through time and space [20,21]. This concept helps us to make an assumption about utility being constant in a particular year. This paper demarcates the different states on the basis of number of people below poverty line as well as quality of life lived by those sections of the population. The concept behind QALY serves as a great importance for policy makers to identify the quality of life of different states lived by the group of individuals who are deemed to lie below the poverty line. They help in uplifting those sections of the populations whose QALY value is close to 1. Thus by means of providing adequate facilities we can help them rise above the poverty line based on QALY measurement. There is a huge variation in QALY values across different states of India. It indicates that few states are on the verge of better quality of life with QALY value closer to 1 than other states are in worse condition with value close to 0. This will help the policy makers to initiate new frameworks for people lying below the poverty line so that they meet their survival needs at the earliest.

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