



Determinants of Life Satisfaction for Rural North Indians: Estimation Using Generalised Ordinal Logistic Regression

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ABSTRACT

The study presents the results of a survey experiment aimed at assessing the level of life satisfaction for rural north Indians and captures the determinants in deciding one's satisfaction level. The study hypothesised human, material and social capital plays a significant role in determining one's level of life satisfaction. The study uses individual data from the Sanitation Quality, Use, Access and Trends (SQUAT) survey collected in rural Bihar, Haryana, Madhya Pradesh, Rajasthan, and Uttar Pradesh in 2013–14 from India. The study estimates first, proportional odds logistic regression, followed by Generalised Ordinal Logistic regression techniques. It is evident from the analysis that the overall PO assumption, as well as separate PO assumptions for most of the variables, is violated and, in that case, generalised ordinal logistic regression may provide a better model. From the analysis, it is very clear that for rural north Indians the level of life satisfaction is most affected by health status, possession of agricultural land, and administrative environment of villages (e.g., functioning of Panchayats).

Keywords: Generalised ordinal logistic model; human capital; life satisfaction; rural India; social capital

The study of social welfare has gained interest among scholars from different disciplines over the last few years which raised the importance of satisfaction. From the *classical utilitarianism* to neoclassical *marginal utility approach* and from *egalitarian utilitarianism* to implicit *value judgments and ethics*, the concept of welfare economics has seen a drastic change over the centuries. Classical utilitarianism focused on national welfare as a whole to increase the total utility of the community and gave lesser importance to the individual utility. Even the utility functions are assumed to be linear which means utility increases at a constant rate for every individual whether he/she is most or least wealthy and where it does not matter if the welfare of the most or least wealthy is increased. Neoclassicals helped in this regard and gave the concept of diminishing marginal

utility of welfare which ultimately influenced towards 'egalitarian' approach as to maximise the social welfare by increasing the welfare of the least wealthy.

Egalitarian utilitarianism emphasised not only production but also on redistribution of income but it was assumed that this redistribution would not affect society's total income. This formed the basis of new welfare economics which gave importance to '*allocative efficiency*' and '*optimisation problem*' but economic calculation problem related to the measurement of welfare and varying optima leads to the introduction of economic efficiency with distributive justice which

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introduced distributive justice to the agenda and explicit value judgments about the distribution of income. This approach gave more importance to individual choice and preference. Now the focus has been changed from total national income to individual welfare and satisfaction as Sen (1990) rightly pointed out that utility means happiness and desire fulfillment which is associated with consumption of goods & services and amount of leisure enjoyed. It is closely related to political, economic, social, cultural, and environmental factors that provide real freedom that people enjoy.

The consumption of goods and services depends on its utility to the individual which leads to satisfaction or well-being; the aggregate of total utility for an individual, from consumption of goods and services. The economics of welfare gives importance to value decisions for maximum welfare of society; that is an aggregate of utilities or satisfaction obtained by individuals from the same society, because of the ordinal nature of utility. Scholars have earlier used terms like; 'subjective well-being' or 'happiness' for analysing the overall life satisfaction and its determinants (Alexandrova 2005; Li *et al.* 2012) but most empirical researches are now using the term 'life satisfaction' because it only focuses on the overall evaluation of life leaving aside the current feelings, emotions and psychological thoughts (Borg *et al.* 2006; Myers & Diener 1995; Zaidi *et al.* 2009). The term 'life satisfaction' can also be linked to the economics of utility or the utility from one's life as a whole (Veenhoven 2015) over a period which cannot be measured exactly but one can relatively put oneself in a scale measuring overall life satisfaction.

In practice to measure life satisfaction common methods like Life Satisfaction Index (LSI) and the Satisfaction with Life Scale (SWLS) were used (Diener *et al.* 1985; Neugarten *et al.* 1961) which were mostly based on symmetric scaling of opinions or attitudes (Likert scale methods) and getting ordinal responses. This makes the measurement of life satisfaction quite difficult which gives rise to an approach of the single direct question within the context of survey schedule which includes possible outcomes on a ladder-like situation and makes it cardinal with a specific order (Dolan *et al.* 2008) and assumes that an individual can differentiate among

every ladder and can put herself/himself on a particular ladder at a particular point of time.

Estimation of life satisfaction depends on many social, economic, cultural, political, etc. factors that have varying spatial and temporal effects. Earlier cross-country studies (Diener and Seligman 2004; Frey and Stutzer 2002; Hayo 2004) have shown that human capital indicators like age, education, and health are strongly associated with the level of life satisfaction. Better occupational status, higher relative socio-economic status also increases well-being and level of life satisfaction. Here particularly for rural setups, the possession of agricultural land and asset count can also be taken as proxies for socioeconomic status.

The literature on life satisfaction and its determinants are fairly available in the context of western countries and studies (Maass *et al.* 2016; Takahashi *et al.* 2011) found social capital; particularly group membership or participation in multiple groups is significantly associated with increased life satisfaction as social capital; measured by social trust, civic engagement and relations, also influence the health status of an individual (Helliwell & Putnam 2004; Kawachi *et al.* 2008; World Health Organisation [WHO] 2003) thereby influencing life satisfaction. Many other studies (Anheier *et al.* 2004; Bjornscov 2005; Elgar *et al.* 2011) have also found a strong positive correlation between social capital and self-reported well-being. Angelini *et al.* (2017) using six specific life domains e.g. income, family, job, friends, sentiment relationships, and health found raising awareness of these life domains strongly correlated with self-reported levels of life satisfaction and effects were not homogenous across subgroups which can be also be seen in caste and class system of contemporary India. Ebrahim *et al.* (2013) found similar results for South Africa where race and gender differences were prevalent in deciding one's level of life satisfaction with blacks and females being the least satisfied taking other socio-economic factors as constant.

The nature and characteristics of an economy from the west are different from Asian countries but the determinants of life satisfaction are near to similar. A study (Ngoo *et al.* 2015) found that income is not only

one big influencer of SWB and factors like married status, relative living standard, and role of government have a greater influence on life satisfaction in Asian countries rather than only talking about age, education, and gender. So, family values, culture, and good governance are more important factors for Asian countries. Similarly comparing Europe and Asia, Jagodzinski (2010) found economic factors influencing both the regions in the same way but social and cultural factors strongly influence the level of life satisfaction when it comes to Asian countries.

Particularly in India, a study (Spears 2016) explores caste norms and differences in the level of life satisfaction which solely cannot be explained by mere economic differences measured by income, asset count, or wealth. Antaramian *et al.* (2015) found a significant association between coping behaviour of problem-solving/externalizing behaviour and level of life satisfaction. Similarly, for elderly individuals, cognitive health was the most influential factor in deciding life satisfaction level and social support was also among the main factors other than socio-economic and demographic variables (Banjare *et al.* 2015).

Objective and hypothesis

Earlier reviews showed that there is a dearth of literature on life satisfaction when it comes to Asian countries, particularly the developing and less developed countries from Asia. I found very few studies from India and even that were only related to limited factors influencing life satisfaction. The present study tries to measure the level of life satisfaction for rural north Indians and capture the determinants in deciding one's satisfaction level. The study hypothesised that whether human, material and social capital play a significant role in determining one's level of life satisfaction and for testing the same on econometric tools the study presents the methodology and conceptual framework in subsequent sections.

Data and Methodology

The present study uses individual data from the Sanitation Quality, Use, Access and Trends (SQUAT) survey collected in rural Bihar, Haryana, Madhya Pradesh, Rajasthan, and Uttar Pradesh in 2013–14 by a

team of researchers. These data and their representative sampling strategy have previously been described in detail in Coffey *et al.* (2014). The cleaned SQUAT dataset and questionnaires are publicly available online¹. The SQUAT survey was a multipurpose survey with hour-long interviews on a range of topics. Therefore, neither the occupational nor caste-related questions could directly influence the asset count measure (Deaton and Stone 2013). The sample size of the SQUAT survey is 24,070 and all respondents pertain to rural areas. The study filtered out the individuals who rely on “pension” and “others” category of the main source of livelihood and social category classified as “others” category. Non-response and filtering used in the study narrowed down the sample to 17,091 in the present case.

Variables

The study uses various variables which are described by variable type, description, and corresponding range (see table 1).

Table 1: Description of variables used in the study

Variable	Type	Description	Range
Life satisfaction	Categorical (Ordinal)	Life satisfaction ladder score (1 - 11)	1 – 4 = Low 5 – 8 = Medium 9 – 11 = High
Age	Continuous	Age of the respondents in years	0 – 99
Education	Continuous	Years of education attained by the respondents	0 – 16
Health	Scale (Ordinal)	Health ladder score	1 – 11
Main occupation	Categorical	Main source of livelihood of the respondent	1 = Agriculture and allied 2 = Labourer activities 3 = Self-employed 4 = Salaried

¹The data set and questionnaires are available at www.riceinstitute.org

Agricultural land	Dummy	Possession of agricultural land	1 = Yes 0 = No
Asset count	Continuous	Summation of assets	0 – 26
Social category	Categorical	Social category of the respondent	1 = General 2 = OBC 3 = SC/ST
Heterogeneity of castes	Categorical	People in village mostly of similar castes or different types of castes.	1 = Similar 2 = Different
Peaceful environment	Categorical	Do people of different castes live together peacefully, or is there a conflict?	1 = Conflicts 2 = Peaceful
Functioning of Panchayat	Categorical	How is the functioning of Panchayat?	0 = Do not exist 1 = Not good 2 = Good
Male	Dummy	Gender of the respondent	1 = Male 0 = Female
State dummies	Categorical	State of the respondent	1 = Haryana 2 = Bihar 3 = Uttar Pradesh 4 = Madhya Pradesh 5 = Rajasthan

Source: Calculations based on SQUAT 2013.

Theoretical modeling framework

The outcome variable is the life satisfaction level of rural north Indian individuals, which is an ordinal variable with three levels (1 = low life satisfaction; 2 = medium life satisfaction and 3 = high life satisfaction level). These three levels of satisfaction were upward ordinal structured and table 2 provides the categories and frequencies of life satisfaction ladder score.

As our dependent variable is ordinal of categories then conventional ordinary least square (OLS) regression techniques are inappropriate because OLS regression is

only useful when the dependent variable is continuous. In such cases where the dependent variable is ordinal of categories of more than two, the proportional odds model or ordered logit regression is a better alternative. However, in cases, the assumption of proportional odds or parallel lines is violated; the generalised ordinal logit regression is a superior alternative because it is less restrictive than earlier methods and more parsimonious than methods like multinomial logit regression which does not consider the ordinal nature of regressand.

The proportional odds (PO) model

The PO model estimates the cumulative probability of being at or below a particular level of the dependent variable or being beyond that level. The interpretation of predictors in this model is according to the assumption of proportional odds or parallel line which assumes the effect of each predictor is to be the same across the categories of the ordinal regressand, meaning thereby, for each regressor, the effect on the likelihood of being at or below any level/category does not change within the model.

The binary logistic regression analysis, as we know, should have a dichotomous dependent variable. As far as the regressand is categorical, we cannot predict ordinary least square (OLS) estimates because the best-fit approach is based on minimizing error term and this is inappropriate in the case of categorical regressand. For that purpose, binomial probability theory is applied in logistic regression which predicts only two values: that probability (p) is 1 or 0, i.e. the event/person belongs to one group or the other.

The logistic regression model can be defined as:

$$\ln(Y') = \log it [p(x)]$$

$$\ln(Y') = \ln \left(\frac{p(x)}{1-p(x)} \right)$$

$$\ln(Y') = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n \quad \dots(1)$$

But as the study encounters regressand that is of more than two categories as well as ordinal, the ordinal logistic regression estimated the odds of being at or below a specific outcome level given some regressors.

The aforementioned model can be expressed in the following form as follows:

$$\ln(Y'_j) = \text{logit}[p_j(\underline{x})]$$

$$\ln(Y'_j) = \ln\left(\frac{p_j(\underline{x})}{1-p_j(\underline{x})}\right)$$

$$\ln(Y'_j) = \alpha_j + (-\beta_1 X_1 - \beta_2 X_2 - \beta_3 X_3 - \dots - \beta_n X_n) \quad \dots(2)$$

Where $p_j(\underline{x}) = p(Y \leq j / x_1, x_2, x_3, \dots, x_n)$ is the odds of being at or below level/category $j, j = 1, 2, 3, \dots, J - 1, \alpha_j$ are cut points which usually indicates where the regressand is cut to make three categories that I observe in data. In general, the cut-points are closely related to thresholds and $\beta_1, \beta_2, \beta_3, \dots, \beta_n$ are logit coefficients. This PO model estimates $J - 1$ cut points and according to PO or parallel line assumption, it assumes the coefficients for the underlying binary models are the same across all cut points.

To estimate the likelihoods of being at or below the j^{th} category, the PO model can be extended as follows:

$$\text{logit}[p(Y \leq j / x_1, x_2, x_3, \dots, x_n)] = \ln\left(\frac{p(Y \leq j / x_1, x_2, x_3, \dots, x_n)}{p(Y > j / x_1, x_2, x_3, \dots, x_n)}\right)$$

$$\text{logit}[p(Y \leq j / x_1, x_2, x_3, \dots, x_n)] = \alpha_j + (-\beta_1 X_1 - \beta_2 X_2 - \beta_3 X_3 - \dots - \beta_n X_n) \quad \dots(3)$$

Most of the time the PO assumption is violated for some or the other regressors and I have to go for post-estimation tests like the Brant test to testify whether the PO assumption is met for some or the other regressors or not. The Brant test estimates logistic coefficients for underlying binary logistic regression and produces the chi-square test statistics for each regressor and the overall model.

The generalised ordinal logistic regression (GOLOGIT) model

The GOLOGIT model is an extension or improvement over the PO model. Whenever the PO assumption is violated for some or the other predictor variables, the PO estimations are not correct or more appropriately say not correctly specified. The Brant test, which is used to testify the PO assumption, specifies which regressors

are violating the PO assumption, and if the assumption is violated by certain regressors, then the GOLOGIT model estimates the odds freely across different levels/categories of the regressand. The model can be expressed as follows:

$$\ln(Y'_j) = \ln\left(\frac{p_j(\underline{x})}{1-p_j(\underline{x})}\right)$$

$$\ln(Y'_j) = \alpha_j + (\beta_{1j} X_1 + \beta_{2j} X_2 + \beta_{3j} X_3 + \dots + \beta_{nj} X_n) \quad \dots(4)$$

The above form can also be rewritten as follows:

$$\text{logit}[(Y > j / x_1, x_2, x_3, \dots, x_n)] = \ln\left(\frac{p(Y > j / x_1, x_2, x_3, \dots, x_n)}{p(Y \leq j / x_1, x_2, x_3, \dots, x_n)}\right)$$

$$\text{logit}[p(Y > j / x_1, x_2, x_3, \dots, x_n)] = \alpha_j + (\beta_{1j} X_1 + \beta_{2j} X_2 + \beta_{3j} X_3 + \dots + \beta_{nj} X_n) \quad \dots(5)$$

Where α_j are the cut points or intercepts, and $\beta_{1j}, \beta_{2j}, \beta_{3j}, \dots, \beta_{nj}$ are logistic coefficients. This model estimates the likelihood of being beyond a certain level/category relative to being at or below that level/category. A positive logit coefficient indicates that the likelihood of being in a higher level/category is more for an individual/event than to a lower level/category of the regressand and vice versa. To estimate the likelihoods of being at or below a particular level/category, however, the signs must be reversed before both the intercepts and logit coefficients in equation (5).

A special case of the GOLOGIT model is the Partial Proportional Odds (PPO) model, which allows for interactions between a regressor that violates the PO assumption and different levels/categories of the ordinal regressand. On the other hand, the GOLOGIT model relaxes the PO assumption for each regressor to vary across different cut-points of the ordinal regressand i.e. this model estimates parameters that are different from the PPO model.

First, the Proportional Odds (PO) model uses the life satisfaction level as our regressand and human capital, material capital, and social capital as our regressors to estimate the level of life satisfaction among rural north Indians. The study controls for gender and state variables to capture the regional differences in life satisfaction

levels of individuals. The human capital variables include age, years of education and health perspective of individuals, material capital includes the main source of livelihood (main occupation), possession of agricultural land and asset count and lastly; social capital includes the social category, heterogeneity of castes in villages, peaceful environment and functioning of the panchayat. The equation for PO logistic regression can be given as follows:

$$\text{Level of life satisfaction}_i = \beta_0 + \beta_1 \text{ human capital}_i + \beta_2 \text{ material capital}_i + \beta_3 \text{ social capital}_i + \varepsilon_i \quad \dots(6)$$

Where there are N individuals, indexed $i = 1 \dots N$ such that;

- (a) The variable on the left-hand side (L.H.S) level of life satisfaction is ordinal of three categories and taken as regressand.
- (b) The variables on the right-hand side (R.H.S.) are the regressors of the model and are the error term and residuals.

The PO model for these three different capitals has been fitted as Model 1 including only human capital, Model 2 including both human and material capital, and Model 3 including all three types of capital e.g. human, material and social.

The Brant test was then used as the analysis of the post-estimation test to examine the PO assumption (parallel line assumption) and identify regressors that violated the assumption. After that, based on Brant test diagnostic the study uses the generalised ordinal logit model or PPO model to correctly specify our model of estimation of life satisfaction level on the same equation one (equation 6). Although the PPO model allows the effects of all regressors to vary even when some violate the PO assumption, it can put equal-slope constraints on those regressors whose effects are constant across cut points (Liu & Koirala 2012).

RESULTS AND ANALYSIS

For the year 2013-14 outcome variable; life satisfaction level, which is an ordinal variable with three levels (low, medium, and high) showed the hierarchical structure as category high indicates higher levels of all previous levels.

Table 2 provides the categories and frequencies of all satisfaction levels. The sample frequency distribution shows all three categories are having approximately equal weight and more than two-thirds of the sample fall in the low or medium life satisfaction category.

Table 2: Life satisfaction categories and proportions for sample SQUAT 2013-14

Life satisfaction categories	Description	Frequencies
Low	Life satisfaction ladder scores from 1 to 4	7133 (29.82)
Medium	Life satisfaction ladder scores from 5 to 8	8388 (35.07)
High	Life satisfaction ladder scores from 9 and above	8399 (35.11)

Source: SQUAT 2013-14 and figures in parentheses are proportions in the column.

A PO model for human capital was fitted first (Model 1) and subsequently, the models for material (Model 2) and social capital (Model 3) were estimated. The overall model fit for Model 1, = 3739.97, $p < 0.01$, indicates that the coefficient of the regressors was statistically significantly different from 0 (see table 3). The estimated logit regression coefficient for human capital indicated that all three variables e.g. age, level of education, and health status is taken as human capital indicators, had a positive and significant effect on life satisfaction level for rural north India. Particularly, the health of an individual is directly related to life satisfaction and better health leads to a more satisfying life, whereas age (experience) and education are less important than health in deciding life satisfaction but still significantly affecting one's perception about life satisfaction.

The odds (>1) for human capital indicated that the likelihood of being at or below a particular level of satisfaction relative to beyond that level increases as a unit increase in human capital indicators. In other words, a higher level of human capital, particularly the health of an individual, was related to the likelihood of being in a higher level of life satisfaction.

Model 2 which was fitted with human and material capital showed the model gets better with material capital and the log-likelihood ratio or Pseudo R^2 increases from 0.0970 to 0.1184 with the better overall model fit, $\chi^2 = 4563.55$, $p < 0.01$ (see table 3).

Table 3: Results of the proportional odds model (ordinal logistic regression)

Variables	Model 1 (N=17606)		Model 2 (N=17606)		Model 3 (N=17091)	
	B	Odds Ratio	B	Odds Ratio	B	Odds Ratio
	0.888		2.062		2.651	
	2.708		3.947		4.551	
Age	0.002** (0.0008)	1.002	-0.001 (0.0008)	0.999	-0.001 (0.0008)	0.999
Education	0.028*** (0.0030)	1.028	-0.001 (0.0032)	0.999	-0.002 (0.0033)	0.998
Health	0.27*** (0.0051)	1.312	0.26*** (0.0052)	1.292	0.26*** (0.0053)	1.289
Laborer			0.007 (0.0433)	1.007	0.006 (0.0444)	1.006
Self-employed			0.41*** (0.0472)	1.499	0.41*** (0.0482)	1.504
Salariat			0.31*** (0.0503)	1.364	0.29*** (0.0510)	1.334
Agricultural land			0.35*** (0.0410)	1.412	0.33*** (0.0421)	1.384
Asset count			0.09*** (0.0040)	1.088	0.08*** (0.0042)	1.087
OBC					-0.19*** (0.0365)	0.830
SC/ST					-0.11** (0.0464)	0.899
Heterogeneity of castes					0.12*** (0.0438)	1.129
Peaceful environment					0.00005** (0.0000)	1.00005
Functioning of Panchayat					0.31*** (0.0266)	1.358
Male	-0.09*** (0.0298)	0.911	-0.02 (0.0302)	0.981	-0.02 (0.0308)	0.984

Bihar	-0.62*** (0.0457)	0.534	-0.17*** (0.0511)	0.840	-0.07 (0.0529)	0.935
U.P.	-0.53*** (0.0459)	0.583	-0.10* (0.0514)	0.907	0.03 (0.0529)	1.028
M.P.	-0.10** (0.0455)	0.909	0.33*** (0.0504)	1.395	0.41*** (0.0514)	1.507
Rajasthan	0.11** (0.0551)	1.120	0.35*** (0.0584)	1.420	0.40*** (0.0611)	1.493

LR R^2	0.0970		0.1184		0.1234	
Brant test	$\chi^2_8 = 131.4***$		$\chi^2_{13} = 347.0***$		$\chi^2_{18} = 426.0***$	
Model fit	$\chi^2_1 = 3739.97***$		$\chi^2_2 = 4563.55***$		$\chi^2_3 = 4619.05***$	

Source: Computed from SQUAT data.

Note: Standard errors are in parentheses, N stands for sample size and * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

After including the variables for material capital e.g. labour market status, possession of agricultural land, and asset count, human capital variables like; age and education became insignificant but still, the variable of health status was significantly affecting life satisfaction level which again proves the importance of better health in deciding life satisfaction for rural north Indians. The logit regression coefficients for material capital showed that better employment or labour market status, possession of agricultural land, and increased asset count was related to the likelihood of being at a higher level of life satisfaction. It is evident from the regression coefficients and odds of material capital that it is positively significantly related to life satisfaction level, particularly being in self-employment and possession of agricultural land in rural north India was highly significant and positively related to an increased likelihood of being in the higher level of life satisfaction.

Our full PO Model (model 3) that is for human, material, and social capital has a better fit and the log-likelihood ratio or Pseudo R^2 increases from 0.1184 to 0.1234 (see table 3). Logit coefficients and odds for social capital variables e.g. heterogeneity of castes, peaceful environment, and functioning of panchayats in villages were significantly positively associated with the level of life satisfaction and social identity or being associated with a particular caste or social category was significantly associated with life satisfaction level in rural north India. Being an individual from the OBC and SC/ST community was associated with lower levels

of satisfaction when compared to the general caste. This showed caste norms are still prevalent at least in rural north India setup and life satisfaction is merely not associated with socio-economic and demographic variables. Individual life satisfaction also depends on good governance, social harmony, and the caste identity of an individual.

The full model also estimated five cut points, which were used to differentiate among adjoining categories of level of life satisfaction. Here and were the cut points for a logistic model for $Y > 1$ and $Y > 2$ respectively.

Table 4: Brant tests of the proportional odds (PO) assumption for each predictor and the overall model

Variable	Chi-squared test statistic	p-value
Age	0.03	0.860
Education	2.91	0.088*
Health	6.63	0.010***
Main occupation	0.37	0.546
Agricultural land	18.75	0.000***
Asset count	183.25	0.000***
Social category	0.54	0.462
Heterogeneity of castes	0.37	0.542
Peaceful environment	33.20	0.000***
Functioning of Panchayat	15.14	0.000***
Male	2.61	0.106
State dummies	9.11	0.003***
All (overall model)	370.47 (12)	0.000***

Source: Computed from SQUAT data.

Note: Degree of freedoms are in parentheses and * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The Brant test is used to identify whether the overall model/separate variables (each predictor) follow the PO assumption or not. Table 4 presents the respective chi-square test statistics and corresponding p values for each predictor variable. The Brant test for the overall model, $\chi_{12}^2 = 370.47$, $p = 0.000$, points out that the PO assumption for the overall model gets violated (see table 4). A separate Brant test for each predictor shows that the Brant test was violated for predictors like; the level of education, health, possession of the agricultural land, asset count, peaceful environment,

and proper functioning of Panchayats in villages. Violation of the PO assumption leads to the use of the Partial Proportional Odds (PPO) model because of the limitation related to the earlier model (e.g. PO model). The PPO or generalised ordinal logit model relaxes the proportionality assumption by allowing the logit effects of predictor variables to vary across cut points which dichotomise the underlying outcome variable e.g. life satisfaction (e.g. $Y > 1$ vs. $Y \leq 1$ and $Y > 2$ vs. $Y \leq 2$).

The generalised ordinal model estimates the logistic coefficients and corresponding odds ratios for all regressors at different levels/categories e.g. beyond one level versus at or below that level. The outcome variable (e.g. life satisfaction level) has three categories so in the PPO model, I have two categories to be compared. After relaxing the PO assumption, the model fit gets better and LR R^2 increased up to 0.1328 from 0.1234 for the full PPO model (see table 5).

Table 5: Results of Partial Proportional Odds Model (Generalised Ordinal Logit)

Variables	$Y > 1$ vs. $Y \leq 1$		$Y > 2$ vs. $Y \leq 2$	
	B	Odds Ratio	B	Odds Ratio
Age	-0.001 (0.0008411)	0.999	-0.001 (0.0008411)	0.999
Education	-0.007 (0.0042625)	0.993	0.0002 (0.0038356)	1.0002
Health	0.245*** (0.0063679)	1.276	0.266*** (0.0069679)	1.305
Laborer	0.045 (0.0443707)	1.046	0.045 (0.0443707)	1.046
Self-employed	0.408*** (0.0484851)	1.504	0.408*** (0.0484851)	1.504
Salariat	0.302*** (0.0515509)	1.352	0.302*** (0.0515509)	1.352
Agricultural land	0.426*** (0.047257)	1.530	0.202*** (0.0486168)	1.224
Asset count	0.133*** (0.0054738)	1.142	0.057*** (0.0046065)	1.059
OBC	-0.190*** (0.0368582)	0.827	-0.190*** (0.0368582)	0.827
SC/ST	-0.103** (0.046473)	0.902	-0.103** (0.046473)	0.902

Heterogeneity of castes	0.131*** (0.0441156)	1.140	0.131*** (0.0441156)	1.140
Peaceful environment	-0.00002 (0.0000215)	0.999	0.00009*** (0.0000194)	1.00009
Functioning of Panchayat	0.374*** (0.033005)	1.453	0.239*** (0.03136)	1.271
Male	-0.015 (0.0309292)	0.985	-0.015 (0.0309292)	0.985
Bihar	-0.047 (0.0534339)	0.954	-0.047 (0.0534339)	0.954
U.P.	0.033 (0.0535006)	1.033	0.033 (0.0535006)	1.033
M.P.	0.407*** (0.0519682)	1.503	0.407*** (0.0519682)	1.503
Rajasthan	0.415*** (0.0617508)	1.514	0.415*** (0.0617508)	1.514
	$\alpha_1 = -3.168^{***}$ (0.1400404)		$\alpha_2 = -4.215^{***}$ (0.1455771)	
LR R ²	0.1328 (N =17091)			
Model fit	$\chi^2_4 = 4971.24^{***}$			

Source: Computed from SQUAT data.

Note: Standard errors are in parentheses, N stands for sample size and * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5 indicates that for predictors like; the level of education, health, possession of the agricultural land, asset count, peaceful environment, and proper functioning of Panchayats in villages the odds ratios are different for different comparable categories because for these predictors the PO assumption was violated and for rest of the predictors the odds are same in different categories. Better human capital like the increased level of education and better health except for the age of an individual was associated with the likelihood of being in a higher life satisfaction level. The effect of increased education was first negative and further became positive with lower to a higher level of life satisfaction although better health was positively affecting in an increased level of life satisfaction and the effect became stronger when satisfaction level moved from low/middle to high.

The effects of material capital like possession of agricultural land and asset count were also positively associated with the likelihood of being above a particular level of life satisfaction as opposed to being at or below that level. It is clear from the odds that the effects of material capital became weaker when life satisfaction

level moved from low to high. Among social capital the effect of a peaceful environment of the village was first negative and further became positive with lower to a higher level of life satisfaction, moreover; better functioning of Panchayats in villages was associated with the likelihood of being in a higher level of life satisfaction and the effect became much stronger when satisfaction level moved from low to high.

CONCLUSION, POLICY IMPLICATIONS, AND LIMITATIONS

To analyse the determinants of life satisfaction level for rural north Indians, the study estimated first, proportional odds logistic regression, followed by generalised ordinal logistic regression techniques. It is evident from the analysis that the overall PO assumption, as well as separate PO assumptions for most of the variables, is violated and, in that case, generalised ordinal logistic regression may provide a better model. From the analysis, it is very clear that for rural north Indians the level of life satisfaction is most affected by health status, possession of agricultural land, and administrative environment of villages (e.g. functioning of Panchayats). Better health, possession of agricultural land, and better functioning of Panchayats significantly affect the life satisfaction level of rural north Indians after controlling for gender and regional differences. The effects of other capitals like better occupation, increased assets, heterogeneity of castes, and peaceful environment are also significant except age and education of an individual in rural north India. Our results got support from previous studies like Banjare *et al.* (2015), Jagodzinski (2010), Ngoo *et al.* (2015), and Spears (2016) who explored the same social, cultural, and caste norms prevalent in deciding one's well-being or satisfaction from life.

The results indicate policy implications in advancing health facilities in rural India. This is only a part of good governance and the overall functioning of local governance can be made more transparent which was most significant in deciding life satisfaction because individuals or society expect so much from an elected government in a democracy. Besides, agricultural land being a resource in rural India affects life satisfaction

very significantly. Particularly for those who do not possess agricultural land and mainly for the socially deprived sections of society, the policy of land reforms is most important. Why education is not significant in deciding life satisfaction for rural north Indians can be interpreted as very low educational outcome and occupational opportunities in rural India. The implications may be limiting as the sample consists of only five states from rural India and I may get more precise estimations using a larger sample size consisting of all the rural settlements of India. This also helps to get some potential directions for future studies to have a larger sample size and include some other psychological aspects relating to life satisfaction which may be done with an interdisciplinary approach.

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