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Poverty, Undernutrition and Vulnerability in Rural India: Role of Rural Public Works and Food for Work Programmes[1]

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Abstract

This paper analyses the effects of access to Rural Public Works (RPW) or Food for Work programme (FFW) on consumption poverty, vulnerability and undernutrition in India using the large household data sets constructed by National Sample Survey for 1993 and 2004. Treatment-effects model is used to take account of sample selection bias in evaluating the effects of RPW in 1993 or FFW in 2004 on poverty. We have found significant and negative effects of participation in RPW and Food for Work Programme on poverty, undernutrition (e.g. protein) and vulnerability in 1993 and 2004. However, state-wise results show considerable geographical diversity in poverty and vulnerability estimates as well as policy effects of RPW.

Key Words: Poverty, Undernutrition, Vulnerability, Rural Public Works (RPW), Poverty Reduction Policy, Treatment Effects Model, India

JEL Codes: C21, C23, C31, I32, I38, O15, O22

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Poverty, Undernutrition and Vulnerability in Rural India: Role of Rural Public Works and Food for Work Programmes

1. Introduction

Despite the recent spurt in economic growth at the national level in India, concern has been raised over the regional disparity of poverty levels as well as the slow rate of poverty reduction in recent years (e.g., Jha and Gaiha, 2003; Kijima 2006; Himanshu 2007). The disparity could be associated with geographical locations (e.g., among different states or between urban and rural areas) or among social groups or castes (Kijima, 2006, Gang et al., 2008). However, there has been no consensus as to what is the best option for a set of policies to alleviate poverty efficiently at national scale. While policies to promote the macro economic growth is likely to reduce poverty, targeted interventions directly to support the poor have been in operation and considered the crucial component in public policies in India at both government and state levels because economic growth alone would not be sufficient to reduce poverty of those in backward areas or in disadvantaged social groups, since they lack access to the market or education.

Due to the advantages arising from their salient features, such as self-targeting[1]and building infrastructure, Rural Public Works (RPWs) have been considered one of the best options for rapid poverty alleviation. However, previous assessments of RPWs have pointed out that they did not reach the poor (e.g., Gaiha et al., 2001, Jha, Bhattacharyya, and Gaiha, 2009). The past literature also suggests that the workers who are poor do not have enough incentives to participate in the scheme. In particular, this applies to workers caught in the poverty trap. Workers caught in this trap will either be left out of the labour market (or unemployed) (e.g., Dasgupta, 1997; Jha, Gaiha and Sharma, 2009) or receive only marginal wages as they cannot carry out physically demanding tasks due to undernutrition or poor health. This implies that it is difficult to evaluate the effect of participation in RPW on poverty because poverty or undernutrition would not necessarily be the outcome of participation in the scheme, but would also affect the participation decision. Rigorous empirical work to examine the relationship between RPWs and poverty is thus of enormous help in driving policy implications. The purpose of this paper is to statistically assess whether participation in RPWs affects poverty or vulnerability defined in terms of consumption expenditure. Our analysis is based on the two most recent comparable large household sample surveys for rural India: the National Sample Survey data in the 50th round in 1993–1994 and the 61st round in 2004–2005. We use the data of participations in RPWs for the 50th round and those on FFW (Food for Work) programme, a version of RPWs, for the 61st round.[2] In 1997 RPW accounted for 2.3 per cent of the central plan budgetary expenditure of the Government of India. By way of comparison, the Public Distribution Scheme (PDS) accounted for 3.22 per cent.[3]

It should be noted that there is some difference in its salient features between RPW and FFW. As noted by Jha, Bhattacharyya, and Gaiha (2009), whilst FFW, which was introduced in the poorest 150 districts in 2004-05, has all the features of a typical RPW program, such as Sampoorna Grameen Rojgar Yojana (SGRY) , it has a stronger emphasis on wage payment in kind (e.g. mandatory supply of 5 kg of foodgrains per person day). As FFW was only at the initial stage of implementation in 2004 and allocation of resources to the latter is on a residual basis, it is likely to perform less well than its potential (Jha, Bhattacharyya, and Gaiha, 2009). Analytically, however, we will treat them in the same framework given that FFW is a variant of RPW.

It is not straightforward to evaluate the effects of RPW on poverty because of endogeneity or sample selection problems associated with access to the scheme. Participation in RPW is likely to be endogenous either because of endogenous program placement where policy makers purposefully allocate funds according to the objectives of the program (e.g., poverty alleviation in remote areas or among disadvantaged groups) or self-selection, i.e., the poor may have more incentives to participate in the scheme. For this purpose, we will employ treatment effects model, a version of Heckman sample Selection Model (Heckman, 1979) where the participation equation is estimated in the first stage and, in the second stage, poverty or consumption is estimated by the predicted participation among other determinants.[4]

The present study goes beyond the standard definition of poverty (defined by the national poverty line based on income or consumption data) in two important ways. First, for the 50th round, we compute undernutrition in terms of calories and proteins, which were constructed by converting the detailed food expenditure data available in NSS 50–1.0 into their nutritional equivalents (Jha and Gaiha, 2003). Hence, whether a household is poor is defined not only by its consumption level but also by nutritional deficiencies. This is important in light of the link of the labour market participation and nutrition, which leads to the nutrition-based poverty trap. Second, we have estimated vulnerability measures as the probability of a household falling into poverty using the cross-sectional estimation drawing upon Chaudhuri (2003) and Chaudhuri et al. (2002). While poverty and vulnerability are correlated, they are conceptually different as some households above the poverty threshold may be vulnerable, or those who are just below the poverty line, but have secure income sources, may not be vulnerable (e.g., Gaiha and Imai, 2009). Hence, the effects of RPW on poverty and those on vulnerability are likely to be different. In particular, given the high vulnerability in the backward areas, the role of reducing vulnerability or protecting households from shocks that could lead to vulnerability is likely to be very important.

The rest of the paper is organised as follows. Section 2 briefly explains the data. Section 3 describes the econometric methodologies which we have used to estimate the treatment-effects model. Section 4 provides the econometric results and main findings. The final section offers some concluding remarks.

2. Data

(1) NSS data

The NSS, set up by the Government of India in 1950, is a multi-subject integrated sample survey conducted all over the India level in the form of successive rounds relating to various aspects of social, economic, demographic, industrial and agricultural statistics.[5] We mainly use the data in the 'Household Consumer Expenditure' schedule, called 'the scheduled 01', quinquennial surveys in the 50th round, 1993–94 and in the 61st round, 2004-05.[6] These form repeated cross-sectional data sets, each of which contains a large number of households across India.[7] The consumption schedule contains a variety of information related to mean per capita expenditure (MPCE), disaggregated expenditure over many items together with basic socio economic characteristics of the household (e.g., sex, age, religion, caste, and land-holding). To derive wages at the level of NSS region, we supplement the consumption schedule by 'Employment and Unemployment' schedule called 'the scheduled 10' which has data on employment and unemployment.

NSS covers the whole of the Indian Union except (i) Leh (Ladakh) and Kargil districts of Jammu & Kashimir, (ii) some interior villages of Nagaland, and (iii) villages in Andaman and Nicobar Islands which remain inaccessible throughout the year. In this study, we will use the data in 'Household Consumer Expenditure' schedule in 50th round and 61st round because the data on Rural Pubic Works in the 'Employment and Unemployment' have numerous missing observations. Appendix 1 reports on the definitions of the variables used.

While the 50th round collected data on which household participated in RPWs, only the data on household participation in Food for Works (FFW) are available in the 61st round. Hence, these participation data are not strictly comparable, but we use these data as proxies for the household-level access to RPW, i.e., whether any member of the household participated in RPW.

(2) **Computation of Nutritional Deficiency**[8]

For NSS 50th round, we have derived the nutrition-based poverty cut-off points by taking into account calorie and protein intakes as well as minimum cut-off points (for both) on the assumption of moderate work (Gopalan, 1992, Gopalan et al., 1971). The official poverty line takes into account the cost of a nutritionally adequate diet in terms of per capita consumption expenditure. The poverty line is taken as monthly per capita consumption worth Rs. 49 at 1973–74 prices for the rural sector. Expenditure is used as a proxy for income, since the NSS does not collect income data. Many authors have reported poverty computations using this poverty line. We derived nutritional deficiency calculated using nutritional equivalents of actual consumption baskets for households compared against recommended daily allowance as elaborated in Gopalan et al. (1971). The daily nutritional requirements as reported by Gopalan et al. are reproduced in Appendix 2. We use energy per capita and protein per capita from the NSS 50th round data files converted into nutritional equivalents. These data are computed as total consumption (of calories, protein and other nutrients) of the households divided by variable 'members' where the number of members in a household is calculated by giving unit weights to the adults and 0.5 weight to the children. Age specific weights for children are not possible since ages of children are not recorded.

3. Econometric Modelling

(1) Deriving Vulnerability Measures using Large Cross-sectional data

It would be ideal to use panel data to derive household's vulnerability measures, but, in its absence, we can derive a measure of 'Vulnerability as Expected Poverty' (VEP), an *ex ante* measure based on Chaudhuri (2003) and Chaudhuri, Jalan and Suryahadi (2002), who applied it to a large cross-section of households in Indonesia[9] and defined vulnerability as the probability that a household will fall into poverty in the future.

$$VEP_{it} \equiv V_{it} = \Pr\left(c_{i,t+1} \leq z\right) \quad (1)$$

where vulnerability of household i at time t, V_{it}, is the probability that the *i-th* household's level of consumption at time t+1, $c_{i,t+1}$, will be below the poverty line, z.

Three limitations, amongst others, should be noted in our measure of vulnerability. First, the present analysis is confined to a consumption (used synonymously with income) threshold of poverty. Second, our measure of vulnerability in terms of the probability of a household's consumption falling below the poverty threshold in the future is subject to the choice of a threshold.[10] Third, while income/consumption volatility underlies vulnerability, the resilience in mitigating welfare losses depends on assets defined broadly-including human, physical and social capital. A household with inadequate physical or financial asset or savings, for example, may find it hard to overcome loss of income. This may translate into lower nutritional intake and rationing out of its members from the labour market (Dasgupta, 1997; Foster, 1995). Lack of physical assets may also impede accumulation of profitable portfolios under risk and generate poverty traps (Fred and Carter, 2003).

The consumption function is estimated by the equation (2).[11]

$$\ln c_i = X_i \beta + e_i \tag{2}$$

where c_i is mean per capita consumption (MPCE) (i.e. food and non-food consumption expenditure) for the *i-th* household and X_i is a vector of observable household characteristics and other determinants of consumption.[12] These include;

A_i: A set of variables indicating household composition, such as whether a household is headed by a female member, number of adult male or female members, dependency burden: the share of household members under 15 years old or over 60 years old)[13]

E_i: A set of variables on the highest level of educational attainment of household members (e.g. whether completed primary school, secondary school, or higher education).

L_i: Owned land as a measure of household wealth.

O_i: Occupation of parents in terms of (i) whether the household is classified as non-agricultural self-employment and (ii) whether as agricultural self-employment.

B_i: Social backwardness of the household in terms of (i) whether a household belongs to scheduled caste and (ii) whether it belongs to scheduled tribe.

D: A vector of state dummy variables.

β is a vector of coefficients of household characteristics, and e_i is a mean-zero disturbance term that captures idiosyncratic shocks to per capita consumption. It is assumed that the structure of the economy is relatively stable over time and, hence, future consumption stems solely from the uncertainty about the idiosyncratic shocks, e_i. It is also assumed that the variance of the disturbance term depends on:

$$\sigma^2_{e,i} = X_i\theta \quad (3)$$

The estimates of β and θ are obtained using a three-step feasible generalized least squares (FGLS)[14]. Using the estimates $\hat{\beta}$ and $\hat{\theta}$, we can compute the expected log consumption and the variance of log consumption for each household as follows.

$$E[\ln C_i | X_i] = X_i\hat{\beta} \quad (4)$$

$$V[\ln C_i | X_i] = X_i\hat{\theta} \quad (5)$$

By assuming $ln\,c_i$ as normally distributed and letting $\Phi(\cdot)$ denote the cumulative density function of the standard normal distribution, the estimated probability that a household will be poor in the future (say, at time t+1) is given by:

$$V\hat{E}P_i \equiv \hat{v}_i = \hat{P}r(\ln c_i < \ln z | X_i) = \Phi\left(\frac{\ln z - X_i\hat{\beta}}{\sqrt{X_i\hat{\theta}}}\right) \quad (6)$$

This is an *ex ante* vulnerability measure that can be estimated with cross-sectional data. Note that this expression also yields the probability of a household at time *t* becoming poor at *t+1* given the distribution of consumption at *t.*

A merit of this vulnerability measure is that it can be estimated with cross-sectional data. However, it correctly reflects a household's vulnerability only if the distribution of consumption across households, given the household characteristics at time t, represents time-series variation of household consumption. Hence this measure requires a large sample in which some households experience positive shocks while others suffer from negative shocks. Also, the measure is unlikely to reflect unexpected large negative shocks (e.g., Asian financial crisis), if we use the cross-section data for a normal year.

(2) Estimation of Wage Equations

As the employment schedule of NSS provides us with individual data of earnings during the previous week of the survey date, these could be used as proxies for wages. We estimate the male and female wage equations by the Tobit model.

$$w_j^{Male} = w_j^{Male}(E_j, A_j, B_i, O_i, M_i, L_i, D) \quad (7)$$

$$w_j^{Female} = w_j^{Female}(E_j, A_j, B_i, O_i, M_i, L_i, S_i, D) \quad (7)'$$

Here wage for workers is estimated by a set of variables at individual levels for the individual *j*, such as a set of education dummies, E_j, age or its square, denoted as a vector, A_j. Other variables include B_i: Social backwardness of the household; O_i: Occupation; M_i: Religion of the household, L_i: Owned land as defined before. This will give us predicted wages for male and female workers, $\hat{w}_j^{Male}$ and $\hat{w}_j^{Female}$ which will be aggregated at the level of NSS regions and used as one of the determinants of participation in RPWs. Aggregation is necessary because the consumption schedule and the employment schedule survey different samples of households. These are used as instruments for the access to RPW.

(3) Treatment Effects Model

We employ the treatment effects model, a version of the Heckman sample selection model (Heckman, 1979), which estimates the effect of an endogenous binary treatment. This would enable us to take account of the sample selection bias associated with access to RPW. In the first stage, access to RPW is estimated by the probit model. In the second, we estimate poverty (or a binary variable on whether the household is below the poverty threshold), undernutrition (or a binary variable on whether the household is below the threshold of calorie or protein intakes), only for

NSS 50th, and the vulnerability measure after controlling for the inverse Mill's ratio which reflects the degree of sample selection bias. The instruments are the predicted individual wages aggregated at the level of NSS regions for RPW. They are admittedly not ideal instruments in terms of the exclusion restrictions, but the data set does not contain any better variables for instruments, which are correlated with RPW, but not with poverty.

The merit of treatment effects model is that sample selection bias is explicitly estimated by using the results of probit model. However, the weak aspects include (i) strong assumptions are imposed on distributions of the error terms in the first and the second stages, (ii) the results are sensitive to choice of the explanatory variables and instruments, and (iii) valid instruments are rarely found in the non-experimental data.

The selection mechanism by the probit model above can be more explicitly specified as (e.g., Greene, 2003):

$$D_i^* = \gamma X_i + u_i \quad (8)$$

and $D_i^* = 1$ if $D_i^* = \gamma X_i + u_i > 0$

$D_i^* = 0$ otherwise

where $\Pr\{D_i = 1 | X_i\} = \Phi(\gamma' X_i)$

$\Pr\{D_i = 0 | X_i\} = 1 - \Phi(\gamma' X_i)$

D_i^* is a latent variable. In our case, D_i takes 1 if a household has access to and 0 otherwise and X_i is a vector of household characteristics and other determinants. Φ denotes the standard normal cumulative distribution function.

The linear outcome regression model in the second stage is specified below to examine the determinants of poverty, undernutrition or vulnerability denoted as W_i. That is,

$$W_i = \beta' Z_i + \theta D_i + \varepsilon_i \tag{9}$$
$$(u_i \ \varepsilon_i) \sim \text{bivariate normal}[0,0,1,\sigma_\varepsilon,\rho].$$

where θ is the average net wealth benefit of accessing RPW.

Using a formula for the joint density of bivariate normally distributed variables, the expected poverty (or undernutrition or vulnerability) for those with access to RPW is written as:

$$\begin{aligned} E[W_i | D_i = 1] &= \beta' Z_i + \theta + E[\varepsilon_i | D_i = 1] \\ &= \beta' Z_i + \theta + \rho\sigma_\varepsilon \frac{\phi(\gamma' X_i)}{\Phi(\gamma' X_i)} \end{aligned} \tag{10}$$

where ϕ is the standard normal density function. The ratio of ϕ and Φ is called the inverse Mill's ratio.

Expected poverty (or undernutrition or vulnerability) for non-clients is:

$$\begin{aligned} E[W_i | D_i = 0] &= \beta' Z_i + E[\varepsilon_i | D_i = 0] \\ &= \beta' Z_i - \rho\sigma_\varepsilon \frac{\phi(\gamma' X_i)}{1 - \Phi(\gamma' X_i)} \end{aligned} \tag{11}$$

The expected effect of poverty reduction associated with RPW is computed as (Greene, 2003, 787-789):

$$E[W_i | D_i = 1] - E[W_i | D_i = 0] = \theta + \rho\sigma_\varepsilon \frac{\phi(\gamma' X_i)}{\Phi(\gamma' X_i)[1 - \Phi(\gamma' X_i)]} \tag{12}$$

If ρ is positive (negative), the coefficient estimate of θ using OLS is biased upward (downward) and the sample selection term will correct this. Since σ_ε is positive, the sign and significance of the estimate of $\rho\sigma_\varepsilon$ (usually denoted as β_λ) will show whether there exists any selection bias. To estimate the parameters of this model, the likelihood function given by Maddala (1983, 122) is used where the bivariate normal function is reduced to the univariate function and the correlation coefficient ρ. The predicted values of (10) and (11) are derived and compared by the standard t test to examine whether the average treatment effect or poverty reducing effect is significant.

The results of treatment effects model will have to be interpreted with caution because the results are sensitive to the specification of the model or the selection of explanatory variables and/or the instrument. Also important are the distributional assumptions of the model. However, applying the treatment effects model would overcome the potential limitation in propensity score matching to evaluate the impacts of RPW.

4. Results

In this section we will summarise key findings obtained from the econometric estimations of the models we described in the last section.

(1) Vulnerability Estimates

Table 1 presents the regression results for vulnerability estimations for NSS 50 (1993–04) and NSS 61 (2004–05). The results for consumption (equation (2)) or log mean per capita expenditure (MPCE) (equation (3)) are reported. Most of the results are generally expected. For example, the coefficient estimate of the number of adult female members and that of being headed by a female member are negative and significant in 2004. The former is negative and significant in 1993. Dependency burden is negative and highly significant in 1993 and 2004, reflecting the negative effects of dependency burden on children and the elderly on per capita consumption. While the age of the household head is negative and significant to explain per capita household expenditure in 1993 with significant non-linear effect suggested by positive and significant coefficient estimate of its square, the signs are opposite in 2004. Higher levels of educational attainment are positively and significantly associated with higher per capita consumption in both 1993 and 2004. Dummy variables associated with larger areas of land owned are also positively associated with per capita expenditure in 1993 and 2004. Dummy variables on household head's occupation show a similar pattern of results for the two rounds. Belonging to Schedule Castes (SC) or Schedule Tribe (ST) is negative and highly significant in 1993 and 2004. While the results of state dummies are omitted from the table, they indicate a high degree of geographical differences in household consumption in 1993 and 2004.

(Table 1 to be inserted)

Table 1 also shows the results of variance of log mean per capita expenditure. Female member's headedness of the household is positively and significantly associated with higher variance in consumption in 2004, implying the wider range of (conditional) distribution of consumption for female headed household than for male headed household. Higher level of educational attainment of household members and larger land holding (more than 2.5 hectares) seems to be associated with higher consumption variance in both years. Not being agricultural labourers or not belonging to SC or ST is associated with higher variance of consumption. These estimation results are used to derive vulnerability measures.

Appendix 3 presents the results for the wage equations for male and female workers based on the employment schedule of NSS 50th and 61st rounds. While most of the results are expected, a few unexpected results are also found. Thus, land ownership of the household to which the worker belongs is negatively associated with female wages both in 1993 and in 2004 and land area is positively associated with male wages with a significant coefficient estimate for 2004 and insignificant for 1993. The underlying reasons are not clear, but it could be due to the fact that men's ownership of land may imply higher opportunity cost of wage employment and thus higher wages may be needed to induce them to work. Further, it may be the case that, in the main, land as an asset is controlled by men so the above logic does not carry over to female ownership of land. The coefficients for ST or SC are negative and significant in determining wages. Workers in households classified as non-agricultural or agricultural self employed tend to have higher wages. Age is positive significant, while its square is negative and significant in both years. Because there are not many observations for female wages and they are not significant in the equation of RPW, we use predicted male wage as an instrument for the participation equation in RPW.

(2) Treatment-effects Model

Table 2 and Table 3 present results of the treatment effects model. Table 2 reports the regression results in the first stage whereby the access to RPW is estimated by probit model and those in the second stage for the equation of poverty (or vulnerability or undernourishment) taking account of sample selection bias. Table 3 summarises the treatment effects for various cases. Two cases are highlighted in Tables 2, 3 and 4: the case where the treatment effect of RPW is estimated by NSS 50th round in 1993 and the case where this is done by NSS 61st round in 2004.

(Table 2 and Table 3 to be inserted)

We now briefly explain the determinants of participation in RPW in 1993 and 2004. The fact of a household being headed by a female is a negative and significant determinant of RPW participation in 2004. In both 1993 and 2004 RPW participation increased with larger number of male members in the household. Education dummies are mostly negative and significant, which implies the household with lower levels of educational attainment or without literate members tends to access RPW. This is indirect evidence of good targeting performances of these schemes at least in this area. Households who own land between 0.1 to 2.5 hectares are more likely to participate in RPW than the landless or those who own more than 2.5 hectares in both 1993 and 2004. Agricultural and non-agricultural labourers tend to join RPW. The schemes are more likely to be utilised by those belonging to SCs or STc. While predicted male wage is positive and significant in 1993, it is negative and highly significant in 2004 in the RPW participation equation.

Table 2 reports the results of the second-stage regressions where the dependent variable is Case (a) consumption-based poverty (in the first panel of the second stage results), Case (b) vulnerability estimate (in the second panel), and Case (c) undernutrition (or nutrition-based poverty based on calorie estimates) for NSS 50th and 61st rounds. We summarise the key results here. First, the coefficient of β_{λ}, the degree of sample selection, is significant in all the cases except Case (b) for NSS50. The actual poverty-reducing effects are affected by the sample selection effects and direct effects of the schemes, θ. The treatment effects are calculated and summarised in Table 3.

The comparison of determinants of (a) consumption-based poverty, (b) vulnerability estimate, and (c) undernutrition based on calorie and protein for the cases of RPW would be of empirical significance in itself. Household composition is significantly associated with poverty, vulnerability and undernutrition. For example, all three rise with higher dependency burden of children and with the number of adult male or female members in the household. Higher levels of educational attainment and larger land area tend to decrease the probabilities of being poor, vulnerable and undernourished. Belonging to SCs or STs is highly correlated not only with poverty, but also with vulnerability and undernutrition.

Table 3 summarises the treatment effects associated with RPW. RPW decreases consumption-based poverty and protein-based significantly in 1993, but not calorie-based poverty in 1993. This might reflect the fact that RPW are sometimes physically demanding and require higher calorie intake to perform tasks. In 1993, significant *vulnerability*-reducing effects are observed only for the vulnerability calculated as 80% of the national poverty line (and the effects are positive for 100% and 120% of the poverty line). In 2004, RPW is confirmed to have significant impact on reducing poverty and vulnerability. However, the caution is needed to interpret the results as the absolute values of average treatment effects (ATT) are low. For example, after controlling sample selection bias, poverty based on consumption (or protein based poverty) on average only -0.5% (or -0.4%) lower for participating households than for non-participating households in 1993. In 2004, ATT is -1.6% for consumption based poverty, that is, participating household's poverty is on average 1.6% lower than non-participating households after controlling for sample selection. ATT for vulnerability based on the 80% threshold is only -0.6% in 1993 and -0.2% to -9.6% in 2004. If we applied propensity score matching, ATT is generally higher, but we obtained the similar pattern of the results (see Jha, Imai, and Gaiha, 2009 for details).

(3) State-wise results

In view of the large spatial variations across India in the incidence of poverty, vulnerability and undernutrition we applied the treatment-effects model for 16 Indian states with reasonably large number of observations for NSS-50 and NSS-61. The results are shown in Table 4.

(Table 4 to be inserted)

The states with negative average treatment effect are shown in bold in Table 4, which shows a significant degree of diversity among different states. For example, while RPW has a negative and significant effect on poverty reduction in 1993, the significant and negative effects of RPW are observed in only some states, such as Rajasthan, Orissa, Madhya Pradesh and Tamil Nadu.

The pattern of diversity differs considerably once we focus on vulnerability. While RPW increases vulnerability for all India, negative and significant average treatment effects of RPW are observed for Punjab, Orissa, and Tamil Nadu in 1993. For NSS 61 in 2004, we found a negative and significant average treatment effect of RPW on poverty for all India. However, the state-wise results show that the treatment effects are significant and negative only in Punjab, Haryana, West Bengal, Maharashtra and Andhra Pradesh. Many of other states show positive and significant treatment effects.

It is found that although RPW reduced vulnerability significantly for India as a whole in 2004, many states had positive and significant treatment effects. The negative and significant effects are found only for Bihar, West Bengal and Kerala.

5. Conclusions

This paper analyses the effects of access to Rural Public Works (RPW) on consumption poverty, vulnerability and undernutrition in India drawing upon large household data sets constructed by National Sample Survey (NSS) data, 50th round in 1993-1994 and 61st round in 2004-2005. Vulnerability is defined as the probability of a household falling into poverty and is estimated using the methodology of Chaudhuri (2003) and Chaudhuri et al. (2002). Undernutrition measures are derived by converting the detailed expenditure data into the nutritional equivalent of calorie intakes and protein.

The need has arisen to take account of sample selection in evaluating policy effects because access to RPW is not randomly distributed across the sample due to self selection such that a household opts to take up the programme in light of its specific characteristics or circumstances (e.g., hunger, lack of human resources) and/ or the endogenous programme placement. In other words, policymakers target specific geographical areas according to their stated objectives (e.g., poverty reduction). Treatment-effects model, a version of Heckman sample selection model, is used at least partly, to take account of sample selection bias in evaluating the effects of RPW on poverty. The results, however, will have to be interpreted with caution because of the presence of unobservable factors which are important in the decision to participate in RPW. Such factors cannot be fully controlled by the survey data.

We have found significant and negative effects of the household participation in Rural Public Works and Food for Work Programmes on poverty, undernutrition (e.g., protein) and vulnerability in 1993 and 2004. This study provides some support for the recent Indian government's decision to expand the National Rural Employment Guarantee Scheme, an extended version of RPW, to all 604 districts with an employment guarantee of 100 days per household. Although this is likely to be a huge fiscal burden, we have discovered that a related national poverty alleviation policy, RPW, has in the past been found to be effective in reducing not only poverty, but also vulnerability and undernutrition. However, once we apply the treatment effects model separately for each state, a great degree of diversity is observed. This implies that great caution is needed to implement NREGS to maximise its poverty-alleviating effects. The evaluation of the effect of NREGS on household poverty based on the new national household data would be an important topic for future research.

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Table 1 Estimation of Vulnerability Equations

	NSS 50 (1993-1994)						NSS 61 (2004-2005)					
Dep. Variable	Consumption log(MPCE)			Variance			Consumption log(MPCE)			Variance		
	Coef.	T		Coef.	T		Coef.	T		Coef.	t	
Whether a household is headed by a female member	-	-		-	-		-0.021	(-3.67)	**	0.230	(8.09)	**
Number of adult female members	-0.314	(-83.30)	**	-0.010	(-0.90)	*	-0.123	(-51.36)	**	-0.049	(-4.08)	**
Number of adult male members	- 0.284	(79.19)	**	0.007	(0.71)	**	0.101	(43.24)	**	0.025	(2.10)	*
Dependency Burden (share of household members under 15 or above 60)	-2.201	(-238.64)	**	-0.351	(-8.86)	**	-0.627	(-81.53)	**	0.063	(1.62)	
Age of household head	-1.046	(-11.92)	**	-3.057	(-9.02)	**	0.560	(7.52)	**	-0.814	(-2.10)	*
Age squared	1.056	(11.76)	**	3.245	(9.23)	**	-0.250	(-3.33)	**	1.184	(3.05)	**
The max. education of adult (Primary)	0.103	(17.29)	**	0.036	(1.20)	**	0.081	(18.09)	**	-0.058	(-2.23)	*
The max. education of adult (Middle)	0.180	(25.97)	**	0.109	(3.41)	**	0.197	(45.30)	**	0.069	(2.85)	**
The max. education of adult (>=Matriculates)	0.326	(45.04)	**	0.192	(6.08)	**	0.416	(74.64)	**	0.328	(11.49)	**
Land (0.1<=2.5 ha) (default: the landless)	0.141	(24.05)	**	0.096	(3.72)	*	0.051	(13.37)	**	-0.048	(-2.37)	*
Land (>2.5 ha) (default: the landless)	0.195	(8.21)	**	0.828	(12.45)		0.273	(39.42)	**	0.158	(4.49)	**
Whether self-employed in non-agriculture	-0.115	(-14.93)	**	-0.221	(-6.36)	*	-0.118	(-21.33)	**	-0.032	(-1.15)	
Whether agricultural labour	-0.326	(-47.40)	**	-0.448	(-14.38)	**	-0.318	(-52.90)	**	-0.329	(-10.33)	**
Whether non-agricultural labour	-0.258	(-30.42)	**	-0.387	(-9.63)	**	-0.241	(-37.52)	**	-0.201	(-5.99)	**
Whether self-employed in agriculture	-0.143	(-21.79)	**	-0.316	(-10.96)	**	-0.129	(-24.63)	**	-0.132	(-4.91)	**
Whether a household belongs to SC (Scheduled Caste)	-0.165	(-28.40)	**	-0.030	(-1.02)		-0.156	(-32.62)	**	-0.088	(-3.17)	**
Whether a household belongs to ST (Scheduled Tribe)	-0.105	(-23.13)	**	-0.064	(-2.72)		-0.102	(-25.19)	**	-0.092	(-4.04)	**
Constant	8.341	(232.99)		-3.339	(-24.90)		9.741	(489.22)		-2.992	(-27.98)	
Number of obs		69206			69206			78873			78873	
F(51, 58632)		2250			45		F(51, 78821)	1065			45	
Prob > F		0			0			0			0	
Root MSE		0			2			0			2	

** =significant at 1% level. *=significant at 5% level. +=significant at 10% level.
State dummy variables are included, but the results are not shown to save the space.

Table 2 Treatment Effects Model (Regression Result)

Case (a) Poverty

1st Stage Probit

Dep Variable- Whether one of the members participate in RPW	NSS50 RPW Coef.	z		NSS61 RPW Coef.	z	
Whether a household is headed by a female member	-	-		-0.107	(-2.46)	*
Number of adult female members	-0.010	(-0.87)		0.022	(1.29)	
Number of adult male members	0.064	(6.02)	**	0.080	(4.89)	**
Dependency Burden (share of household members under 15 or above 60)	0.068	(1.54)		0.091	(1.68)	+
Age of household head	0.330	(0.85)		-0.663	(-1.24)	
Age squared	-0.465	(-1.14)		0.614	(1.12)	
The max. education of adult (Primary)	-0.082	(-2.60)	**	-0.065	(-2.13)	*
The max. education of adult (Middle)	-0.081	(-2.38)	*	-0.211	(-6.77)	**
The max. education of adult (>=Matriculates)	-0.038	(-1.14)		-0.466	(-10.45)	**
Land (0.1<=2.5 ha) (default: the landless)	0.058	(2.15)	*	0.100	(3.71)	**
Land (>2.5 ha) (default: the landless)	-0.059	(-0.23)		-0.066	(-1.33)	
Whether self-employed in non-agriculture	-0.078	(-1.89)	*	0.496	(8.43)	**
Whether agricultural labour	0.108	(3.11)	**	1.023	(17.32)	**
Whether non-agricultural labour	0.262	(6.08)	**	1.112	(18.79)	**
Whether self-employed in agriculture	-0.070	(-2.04)	*	0.691	(12.41)	**
Whether a household belongs to SC (Scheduled Caste)	0.163	(5.39)	**	0.285	(9.50)	**
Whether a household belongs to ST (Scheduled Tribe)	0.081	(3.26)	**	0.105	(3.53)	**
Predicted male wages (at NSS region)	0.001	(1.69)	+	-0.086	(-34.92)	**
Constant"	-2.112	(-16.25)		0.643	(3.70)	
Number of obs		58664			76686	
LR chi2(42)		420			5477	
Prob > chi2		0			0	
Log likelihood		0			-7537	

*State dummies are included, but not shown.

2nd Stage (a)

Dep Variable- Whether a household is under the poverty line defined by consumption	NSS50 Coef.	z		NSS61 Coef.	z	
Whether a household is headed by a female member	-	-		0.010	(2.39)	*
Number of adult female members	0.009	(4.76)	**	0.055	(29.57)	**
Number of adult male members	0.023	(12.05)	**	0.037	(20.81)	**
Dependency Burden (share of household members under 15 or above 60)	0.027	(3.67)	**	0.306	(52.01)	**
Age of household head	-0.513	(-7.94)	**	-0.164	(-2.79)	**
Age squared	0.491	(7.33)	**	-0.024	(-0.40)	
The max. education of adult (Primary)	-0.039	(-7.66)	**	-0.067	(-16.96)	**
The max. education of adult (Middle)	-0.059	(-10.70)	**	-0.129	(-34.52)	**
The max. education of adult (>=Matriculates)	-0.109	(-19.91)	**	-0.173	(-39.05)	**
Land (0.1<=2.5 ha) (default: the landless)	-0.031	(-6.92)	**	-0.031	(-9.90)	**
Land (>2.5 ha) (default: the landless)	-0.057	(-1.44)		-0.106	(-19.80)	**
Whether self-employed in non-agriculture	-0.003	(-0.47)		0.041	(9.78)	**
Whether agricultural labour	0.074	(12.51)	**	0.158	(31.53)	**
Whether non-agricultural labour	0.040	(4.81)	**	0.081	(14.93)	**
Whether self-employed in agriculture	-0.010	(-1.68)	+	0.017	(4.04)	**
Whether a household belongs to SC (Scheduled Caste)	0.107	(18.20)	**	0.106	(24.16)	**
Whether a household belongs to ST (Scheduled Tribe)	0.036	(8.25)	**	0.046	(13.35)	**
Θ	0.495	(4.47)	**	0.275	(9.00)	**
β_λ	-0.215	(-4.31)	**	-0.097	(-6.52)	**
Constant"	0.123	(6.22)		0.229	(14.04)	
Number of obs		58664			76686	
Wald chi2(103)		8862			26299	
Prob > chi2		0			0	

*State dummies are included, but not shown.

(cont'd over)

(Table 2 continued)

Case (b) Vulnerability

2nd Stage (b) Dep Variable- Vulnerability estimate (based on Table 1)	NSS50 Coef.	z		NSS61 Coef.	z	
Whether a household is headed by a female member	-	-		-0.002	(-0.86)	
Number of adult female members	0.135	(108.35)	**	0.050	(49.97)	**
Number of adult male members	0.128	(106.79)	**	0.040	(41.87)	**
Dependency Burden (share of household members under 15 or above 60)	1.397	(294.99)	**	0.221	(69.10)	**
Age of household head	1.025	(25.97)	**	-0.100	(-3.10)	**
Age squared	-0.891	(-21.67)	**	-0.041	(-1.28)	
The max. education of adult (Primary)	-0.058	(-16.13)	**	-0.084	(-38.86)	**
The max. education of adult (Middle)	-0.125	(-32.30)	**	-0.130	(-63.92)	**
The max. education of adult (>=Matriculates)	-0.235	(-62.00)	**	-0.134	(-55.45)	**
Land (0.1<=2.5 ha) (default: the landless)	-0.080	(-25.87)	**	-0.030	(-17.76)	**
Land (>2.5 ha) (default: the landless)	-0.097	(-12.07)	**	-0.066	(-22.55)	**
Whether self-employed in non-agriculture	0.060	(14.42)	**	0.007	(3.17)	**
Whether agricultural labour	0.180	(47.01)	**	0.191	(69.90)	**
Whether non-agricultural labour	0.155	(30.11)	**	0.072	(24.26)	**
Whether self-employed in agriculture	0.080	(22.48)	**	0.011	(4.78)	**
Whether a household belongs to SC (Scheduled Caste)	0.098	(27.75)	**	0.121	(50.76)	**
Whether a household belongs to ST (Scheduled Tribe)	0.063	(22.00)	**	0.052	(27.33)	**
Θ	-0.039	(-0.71)		0.223	(14.19)	**
β_λ	0.020	(0.80)		-0.107	(-14.02)	**
Constant	0.880	(55.90)		0.139	(15.68)	
Number of obs		69206			76687	
Wald chi2 (103)		148448			65896.43	
Prob > chi2		0			0	

*State dummies are included, but not shown.

Case (c) Undernutrition

2nd Stage (c) Dep Variable- Undernutrition Whether a household is under the poverty line based on calorie	NSS50 Coef.	Z		NSS50 Coef.	z	
Whether a household is headed by a female member	-	-		-0.007	(-1.13)	
Number of adult female members	0.003	(1.39)		0.004	(2.35)	*
Number of adult male members	0.018	(9.44)	**	0.014	(7.68)	**
Dependency Burden (share of household members under 15 or above 60)	0.011	(1.52)		0.017	(2.48)	*
Age of household head	-0.453	(-7.14)	**	-0.424	(-7.16)	**
Age squared	0.428	(6.51)	**	0.415	(6.76)	**
The max. education of adult (primary)	-0.045	(-8.88)	**		(-7.54)	**
The max. education of adult (Middle)	-0.071	(-12.98)	**	-0.053	(-10.42)	**
The max. education of adult (>=Matriculates)	-0.120	(-22.32)	**	-0.095	(-18.81)	**
Land (0.1<=2.5 ha) (default: the landless)	-0.027	(-6.11)	**	-0.021	(-5.02)	**
Land (>2.5 ha) (default: the landless)	-0.126	(-3.22)	**	-0.079	(-2.17)	*
Whether self-employed in non-agriculture	0.003	(0.49)		0.000	(0.03)	
Whether agricultural labour	0.092	(15.86)	**	0.072	(13.19)	**
Whether non-agricultural labour	0.050	(5.99)	**	0.032	(4.22)	**
Whether self-employed in agriculture	-0.004	(-0.69)		-0.004	(-0.74)	
Whether a household belongs to SC (Scheduled Caste)	0.089	(15.20)	**	0.081	(15.17)	**
Whether a household belongs to ST (Scheduled Tribe)	0.049	(11.31)	**	0.033	(8.28)	**
Θ	0.323	(2.77)	**	0.492	(5.16)	**
β_λ	-0.140	(-2.65)	**	-0.216	(-5.02)	**
Constant	0.165	(8.52)		0.601	(6.30)	
Number of obs		58664			58664	
Wald chi2 (103)		10007.5			8390.33	
Prob > chi2		0			0	

*State dummies are included, but not shown.

Table 3 Treatment Effects Model (Summary of the Final Results)

Policy Effects on Poverty and Undernutrition

NSS50	Effects on Poverty (Consumption Based)						
RPW	Effects on Poverty						
RPW	Effects on Poverty (Consumption Based)						
n.	treat.	n.	contr.	ATT	Std. Err.	T	
	3232		65947	-0.00483	0.000964	-5.01	**
RPW	Effects on Poverty (Calorie Based)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	3232		65947	0.000821	0.001014	0.81	
RPW	Effects on Poverty (Protein Based)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	3232		65947	-0.00376	0.000864	-4.35	**
NSS61	Effects on Poverty (Consumption Based)						
RPW							
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	2,290		76,709	-0.01565	0.001071	-14.61	**

Policy Effects on Vulnerability

NSS50	Effects on Vulnerability						
RPW	Effects on Vulnerability						
RPW	Effects on Vulnerability (based on 100% of poverty line)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	3232		65947	0.004171	0.002312	1.804	+
RPW	Effects on Vulnerability (based on 80% of poverty line)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	3232		65947	-0.00641	0.002228	-2.879	**
RPW	Effects on Vulnerability (based on 120% of poverty line)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	3232		65947	-0.00641	0.002228	1.048	
NSS61	Effects on Vulnerability						
RPW							
RPW	Effects on Vulnerability (based on 100% of poverty line)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	2,290		76,709	-0.09649	0.001013	-95.29	**
RPW	Effects on Vulnerability (based on 80% of poverty line)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	2,290		76,709	-0.06807	0.000419	-162.32	**
RPW	Effects on Vulnerability (based on 120% of poverty line)						
n.	treat.	n.	contr.	ATT	Std. Err.	t	
	2,290		-0.17155	0.001817	0.001013	-94.425	**

Table 4 Summary of state-wise results of Treatment Effects Models

	NSS 50	RPW					NSS 50	RPW				
	Estimated Poverty						Vulnerability Estimate (based on 100 % poverty line)					
	A	B	A-B			number of	A	B	A-B			number of
	With RPW	Without RPW	ATT	t value		Observations	With RPW	Without RPW	ATT	t value		observations
State												
Punjab	0.096	0.054	0.042	12.34	**	2046	0.214	0.296	-0.082	-8.006	**	2046
Haryana	0.071	0.038	0.033	30.86	**	1040	0.489	0.467	0.022	1.298		1040
Rajasthan	0.247	0.268	-0.021	-11.29	**	3097	0.879	0.511	0.368	35.5	**	3097
Uttar Pradesh	0.112	0.077	0.035	34.03	**	9010	0.654	0.638	0.016	2.967	**	9010
Bihar	0.498	0.115	0.383	115.9	**	6976	0.705	0.704	0.001	0.199		6979
Assam	0.162	0.146	0.016	6.479	**	3199	0.659	0.639	0.02	0.2096		3199
West Bengal	0.206	0.139	0.067	38.11	**	5581	0.5365	0.536	0.0005	0.056		5581
Orissa	0.18	0.213	-0.033	-9.779	**	3330	0.661	0.682	-0.021	-2.281	**	3330
Madhya Pradesh	0.139	0.182	-0.043	-19.074	**	5331	0.678	0.669	0.009	1.15		5331
Gujrat	0.408	0.299	0.109	26.02	**	2219	0.531	0.508	0.023	1.969	*	2219
Maharastra	0.45	0.448	0.002	0.594		4440	0.578	0.574	0.004	0.503		4440
Andhra Pardesh	0.167	0.162	0.005	2.445	*	4908	0.481	0.45	0.031	3.832	**	4908
Karnataka	0.502	0.502	0.0003	0.053		2617	0.608	0.582	0.026	2.4	**	2617
Kerala	0.35	0.277	0.073	16.54	**	2553	0.247	0.258	-0.011	-1.21		2555
Tamil Nadu	0.172	0.231	-0.059	-21.12	**	3901	0.364	0.424	-0.06	-6.211	**	3901
All India	0.157	0.162	-0.005	-5.01	**	69206	0.479	0.475	0.004	1.804	+	69206

	NSS 61	RPW					NSS 61	RPW				
	Estimated Poverty						Vulnerability Estimate (based on 100 % poverty line)					
	A	B	A-B			number of	A	B	A-B			number of
	With FFW	Without FFW	ATT	t value		observations	With FFW	Without FFW	ATT	t value		observations
State												
Punjab	-3.73	0.03	-3.76	-5.25	**	2444	9.05	0.003	9.047	5.455	**	2444
Haryana	-0.293	0.052	-0.345	-50.84	**	1680	0.0008	0.001	-0.0002	18.98	**	1680
Rajasthan	0.101	0.104	-0.003	-1.169		3536	0.127	0.001	0.126	97.18	**	3536
Uttar Pradesh	0.99	0.234	0.756	99.12	**	7787	2.708	0.053	2.655	406.66	**	7787
Bihar	0.826	0.321	0.505	63.82	**	4283	0.142	0.225	-0.083	-7.436	**	4283
Assam	0.766	0.111	0.655	96.23	**	3317	0.027	0.016	0.011	8.39	**	3317
West Bengal	0.132	0.16	-0.028	-9.97	**	4962	0.023	0.035	-0.012	-6.78	**	4962
Orissa	0.703	0.453	0.25	49.37	**	3800	0.432	0.41	0.022	2.433	*	3800
Madhya Pradesh	0.337	0.332	0.005	1.11		3832	1.591	0.209	1.382	174.96	**	3832
Gujrat	0.768	0.09	0.678	47.87	**	2302	0.25	0.0009	0.2491	47.22	**	2302
Maharastra	0.093	0.202	-0.109	-32.75	**	5000	0.0945	0.0675	0.027	9.547	**	5000
Andhra Pardesh	0.118	0.174	-0.056	-16.09	**	5500	0.312	0.009	0.303	226.28	**	5500
Karnataka	0.639	0.199	0.44	23.11	**	2880	2.033	0.098	1.935	136.05	**	2880
Kerala	0.679	0.044	0.635	10.82	**	3292	-0.0003	0.0004	-0.0007	-9.803	**	3292
Tamil Nadu	0.719	0.169	0.55	44.43	**	4137	0.076	0.025	0.051	13.7	**	4137
All India	0.164	0.179	-0.015	-14.61	**	76687	-0.015	0.082	-0.097	-95.29	**	76687

** =significant at 1% level. *=significant at 5% level. +=significant at 10% level.

Appendix 1:

Definitions and Descriptive Statistics of the Variables

Variable	Definition
Whether a household is headed by a female member	Whether a household is headed by a female member, (=1 if yes, =0 if no).
Number of adult female members	Number of adult female members (15 years old or above) in a household
Number of adult male members	Number of adult male members (15 years old or above) in a household
Dependency Burden	The share of children under 15 years old or adults over 60 years old in the total number of household members.
Age of household head	Age of household head (years)
Age squared	Square of age of household head
The max. education of adult (Primary)	The maximum level of educational attainment of adult member in the household is the completion of primary school.
The max. education of adult (Middle)	The maximum level of educational attainment of adult member in the household is the completion of middle school.
The max. education of adult (>=Matriculates)	The maximum level of educational attainment of adult member in the household is matriculates or higher.
Land (0.1<=2.5 ha) (default: the landless)	The area of owned land of the household is from 0,1 hectare to 2.5 hectare.
Land (>2.5 ha) (default: the landless)	The area of owned land of the household is larger than 2.5 hectare.
Land pc	The area of owned land per capita
Whether self-employed in non-agriculture	Whether the occupation type of the household head is self-employed in non-agriculture (=1 if yes, =0 if no).- default of the four choices is 'others'.
Whether agricultural labour	Whether the occupation type of the household head is agricultural labour (=1 if yes, =0 if no).
Whether non-agricultural labour	Whether the occupation type of the household head is labour in non-agriculture (=1 if yes, =0 if no).
Whether self-employed in agriculture	Whether the occupation type of the household head is self-employed in agriculture (=1 if yes, =0 if no).
Whether a household belongs to SC (Scheduled Caste)	Whether a household belongs to SC (Scheduled Caste) (=1 if yes, =0 if no).
Whether a household belongs to ST (Scheduled Tribe)	Whether a household belongs to ST (Scheduled Tribe) (=1 if yes, =0 if no).
RPW	Whether a household has access to Rural Public Works.
FFW	Whether a household has access to Food for Work Programme.
Predicted agricultural wage rate for males	Agricultural Wage Rate for male workers averaged at NSS region.
Poor	Whether the household per capita expenditure is under the national poverty line for rural areas.
poor (calorie based)	Whether the household is undernourished in terms of calorie intakes.
poor (protein based)	Whether the household is undernourished in terms of protein intakes.
Vulnerability Measure (based on 100% income poverty line)	Whether the household is vulnerable (based on 100% of the national poverty line).
Vulnerability Measure (based on 80% income poverty line)	Whether the household is vulnerable (based on 80% of the national poverty line).
Vulnerability Measure (based on 120% income poverty line)	Whether the household is vulnerable (based on 120% of the national poverty line).

Appendix 2:

Daily Allowances of Nutrients for Indians ***(Recommended by the Nutrition Expert Group in 1968)***

Group	Particulars	Calories	Proteins (gm.)	Calcium (gm.)	Iron (mg.)	Vitamin A		Thiamine (mg.)	RibofLavin (mg.)	Nictonicacid (mg.)	AscoRbic acid (mg.)	FolicAcid (μg)	Vitamin B12 (μg)	Vitamin D
						Retinol (μg)	β-carotene (μg)							200
Man	Sedentary work	2400	55	0.4 to0.5	20	750	3000	1.2	1.3	16	50	100	1	200
	Moderate work	2800	55	0.4 to0.5	20	750	3000	1.4	1.5	19	50	100	1	200
	Heavywork	3900	55	0.4 to0.5	20	750	3000	2.0	2.2	26	50	100	1	200
Woman	Sedentary work	1900	45	0.4 to0.5	30	750	3000	1.0	1.0	13	50	100	1	200
	Moderate work	2200	45	0.4 to0.5	30	750	3000	1.1	1.2	15	50	100	1	200
	Heavywork	3000	45	0.4 to0.5	30	750	3000	1.5	1.7	20	50	100	1	200
	SecondHalf ofpregnancy	+300	+10	1.0	40	750	3000	+0.2	+0.2	+2	50	150-300	1.5	200
	LactationUp to one year	+700	+20	1.0	30	1150	4600	+0.4	+0.4	+5	80	150	1.5	200
Infants	0-6months	120/kg	2.3-1.8/kg		1 mg/kg	400				30				200
	7-12months	100/kg	1.8-1.5/kg	0.5-0.6		300	1200			30	25	0.2		200
Children	1 year	1200	17	0.4-0.5	15-20	250	1000	0.6	0.7	8	30-50	50--100	0.5-1	200
	2 years	1200	18	0.4-0.5	15-20	250	1000	0.6	0.7	8	30-50	50—100	0.5-1	200
	3 years	1200	20	0.4-0.5	15-20	250	1000	0.6	0.7	8	30-50	50—100	0.5-1	200
	4-6 years	1500	22	04-0.5		300	1200	0.8	0.8	10	30-50	50—100	0.5-1	200
	7-9 years	1800	33	04-0.5		400	1600	0.9	1.0	12	30-50	50—100	0.5-1	200
	10-12years	2100	41	04-0.5		600	2400	1.0	1.2	14	30-50	50—100	0.5-1	200
Adolescents	13-15 years boys	2500	55	0.6-0.7	25	750	3000	1.3	1.4	17	30-50	50--100	0.5-1	200
	13-15 yearsgirls	2200	50	0.6-0.7	35	750	3000	1.1	1.2	14	30-50	50—100	0.5-1	200
	16-18 yearsboys	3000	60	0.5-0.6	25	750	3000	1.5	1.7	21	30-50	50--100	0.5-1	200
	16-18 yearsgirls	2200	50	0.5-0.6	35	750	3000	1.1	1.2	14	30-50	50--100	0.5-1	200

Source Gopalan et. al. (1971), p. 27

Appendix 3:

Wage Equations for male and female workers in rural areas based on NSS data in 1993 and 2004

	1993		2004	
	Male wage	Female Wage	Male Wage	Female Wage
	Coef.	Coef.	Coef.	Coef.
	(t value)	(t value)	(t value)	(t value)
Land Owned	0.349	-0.324	0.00	-0.082
	(0.98)	(4.86)**	(2.39)*	(8.35)**
Scheduled Tribe (ST) dummy (ST=1, otherwise=0)	-322.569	-1,018.14	-121.41	-108.96
	(0.87)	(4.08)**	(9.13)**	(7.53)**
Scheduled Caste (SC) dummy (SC=1, otherwise=0)	-2,177.57	-381.166	-	-
	(7.95)**	(1.89)		
non-agricultural self employment dummy (non-agricultural self employment=1 otherwise)	7,216.57	2,324.92	1,859.26	566.23
	(10.27)**	(5.49)**	(68.44)**	(21.97)**
agricultural self employment dummy (agricultural self employment=1 otherwise=0)	7,899.48	5,204.41	2,196.08	880.79
	(15.13)**	(14.37)**	(69.07)**	(22.83)**
Muslim dummy(Muslim=1, otherwise=0)	746.744	185.894	113.494	-330.9
	(1.61)	(0.46)	(5.59)**	(10.79)**
Age	662.822	204.695	139.625	49.933
	(8.65)**	(3.65)**	(37.08)**	(10.15)**
Age^2	-4.072	-1.257	-1.638	-0.637
	(4.17)**	(1.69)	(39.07)**	(10.24)**
Whether is literate, but has not completed primary school	3,542.99	2,126.39	92.081	-205.98
	(12.71)**	(7.36)**	(5.10)**	(8.72)**
Whether mother completed primary school	7,518.66	3,208.70	175.043	-227.04
	(23.01)**	(7.49)**	(9.45)**	(9.53)**
Whether mother completed middle school	14,163.75	10,200.92	360.514	-192.21
	(29.57)**	(8.09)**	(19.49)**	(7.37)**
Whether completed secondary or higher secondary school	35,055.00	38,201.86	810.913	201.04
	(56.87)**	(26.88)**	(33.86)**	(5.63)**
Whether completed higher education	57,151.06	53,253.26	1,473.09	1,004.51
	(47.65)**	**(17.32)****	**(64.15)****	**(20.43)****
Constant	-2,171.00	4,216.78	-2,940.20	-1,749.97
	(1.50)	(4.18)**	(34.97)**	(16.65)**
Observations	33720	15849	67168	59221

Robust z-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Notes

[1] In self targeting, the participants themselves decide to participate in the scheme explicitly or implicitly by comparing the potential benefits (e.g., wage incomes, reduction of seasonality or risk) and costs (e.g., physical labour, transportation costs, opportunity costs). Better targeting performance through work requirements would lead to the better cost effectiveness of poverty interventions as put forward as 'screening arguments' by Besley and Coates (1992).

[2] The data on RPWs in the 50th round and those on FFW in the 61st round are the most reliable with relatively few missing observations,

[3] Jha, Imai and Gaiha (2009) evaluated the effects of RPWs and Public Distribution System (PDS), the public scheme of food subsidy, on poverty and vulnerability.

[4] Jha, Imai and Gaiha (2009) used the propensity score matching (PSM) and obtained broadly similar results to those based on the treatment effects model.

[5] See the website of National Sample Survey Organisation http://mospi.nic.in/nsso_test1.htm for more details of NSS data.

[6] We are not using 55th round in 1999-2000 as the consumption data in 55th round are not comparable with those in 50th or 61st round because of the change in recalling periods. The consumption data are comparable between 50th round and 61st round.

[7] After dropping the households with missing observations in one of the explanatory variables, the number of households used for the estimation is 69206 and 78999 respectively for 50th and 61st rounds.

[8] See Jha and Gaiha (2003) for more details. The computation of nutritional deficiency for NSS 61st round would be an important extension for the future study.

[9] See a summary by Hoddinott and Quisumbing (2003a, b) of methodological issues in measuring vulnerability.

[10] One of the limitations of this definition of vulnerability is that it is sensitive to the choice of z. We have defined the poverty line based on the national poverty line and checked the sensitivity of the results by applying different levels of poverty line (i.e., 120% and 80%).

[11] We have used White-Huber sandwich estimator to overcome heteroscedasticity in the sample.

[12] See Appendix 1 for definitions of the variables. These variables are used to estimate the poverty and undernutrition equations.

[13] Female headedness was dropped in all the regressions based on NSS50, because it consistently shows a counter-intuitive sign.

[14] See Chaudhuri (2003), Chaudhuri et al. (2002), and Hoddinott and Quisumbing (2003b) for technical details.