Baseline Survey of Health Status of Population in 2006 around a Uranium Mining Site in Jaduguda, India

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There is a concern about increased risk of cancer & congenital anomalies in populations staying around Jaduguda Uranium Mines, Jharkhand, India due to uranium mining activities. A cross-sectional quantitative study was done to assess the health status covering the area of 5 km around Mining site. From the household, 2,693 were called to the health camps for further screening. From 1,523 who attended the health camp, 220 cases were referred for confirmation of diagnosis. Only 91 cases could complete most of the diagnostic tests. During household survey, presence of lump (1.8%) was the most common complaint followed by bleeding from any site (1.4%), etc. Among females the most common complaint during last 6 months was leucorrhoea (3.4%). Mental retardation and physical deformity was reported in 0.3% and 0.7% individuals respectively. Out of 56 people referred to confirm cancer, only one case was confirmed. From 35 people who were referred to confirm congenital anomaly, only 6 cases were confirmed. Most of the complaints are reported from a single block which may be because people here are more aware and conscious. This data can be considered as baseline data for any future studies.

Key words: radiation, uranium, epidemiology, health status

1. Introduction

The Jaduguda area is situated in the district of East Singhbhum, Jharkhand, India. About 53% of the total area of the district is covered by residual mountains and hills consisting of granite, gneiss, schist and basalt rocks. It is a part of Chhota Nagpur plateau. Jaduguda Mines Project was set up in 1961. In 1967, Jaduguda Mines Project and Uranium Mill project was merged to form a Public Sector company, the UCIL (Uranium Corporation of India Limited) under the Department of Atomic Energy, Government of India. Jaduguda has a small township of UCIL, established in 1965. It is 35 km by road and 20 km by train from the steel city of Jamshedpur. This was the first mines where Uranium was produced in India on reasonable scales for the last five decades (Fig. 1). During the past few decades there is general awareness in the community regarding possible harmful effects of radiation on health and well being of human beings.

A report comprising of doctors and specialists from BARC (Bhabha Atomic Research Center), UCIL, Government of Bihar and Tata main Hospital in 1998 concluded that the
cases examined had congenital limb anomalies, diseases due to genetic abnormalities like Thalassemia major and Retinitis pigmentosa, moderate to gross splenomegaly due to chronic malarial infection, malnutrition etc. They said that the disease pattern could not be ascribed to radiation exposure. A health survey of Chatkidih and Dungridih, two villages nearest to the UCIL tailing ponds was conducted by a team coordinated by V.K. Singh in 2001-2002. The survey did not observe any genetic abnormalities caused by radiation. The survey says that villagers attribute all their ailments to radiation though they may not be connected with it. A health survey by G.K. Iyer in the three villages around tailing pond says that health status was found to be almost normal.

These studies and similar reports have raised the concern that there is a potential increased risk of cancer/congenital anomalies in populations due to uranium mining and milling activities. These activities could lead to elevated levels of radiation and radioactivity in the vicinity of such facilities and are associated with problems arising from potential environmental releases into the air and ground water, transport of uranium ore etc. They may also increase the natural radiation dose to members of the public residing around the complex. There are various issues at Jaduguda like Uranium irradiation damaging health of people, neglect of sludge pipes leading to spillage of waste, expansion in the wake of high demand of Uranium, etc.

Media has also been vocal about the hazards of radiation in the area. The video movie “Buddha weeps in Jaduguda”, which received the grand prize in the global environment image festival 2000, showed that health problems among the children of the Jaduguda area is being generated due to radiation. While the concerned authorities have been denying the effect of Low Level Radiation on health, the local NGOs and activists have been claiming that the radiation related health effects are quite prominent in the area. Sonowal et al stresses an urgent need of an intensive and well planned study on the issue to ease the conflicting situation in Jaduguda.

Thus, it was felt that there is a need of a baseline survey.
to determine existing health conditions around Uranium Mines. This can be helpful for future detailed investigations. In addition, local population welfare objectives will be better served when health problems of people are identified, diagnosed and treated accordingly.

2. Methodology

The overall objective of the study was to determine existing health conditions of the population living in villages within 5 km radius of Jaduguda Uranium Mining sites located in East Singhbhum district of Jharkhand.

It was a cross-sectional quantitative study to assess the prevalence of morbidity of the population in terms of carcinomas, infertility and congenital anomalies. The study was started during April 2006 and it lasted till March 2010. The long period (4 years) was mainly due to efforts made for confirmatory diagnosis of suspected cases of cancer and congenital malformations. Initially study was supposed to be carried out within 15 kilometers radius of Jaduguda Uranium Mining Site. But during a preliminary study of the area, it was found that the population within that area is over 250,000, much more than the 20,000 estimated. Subsequently, the study area was restricted to a radius of 5 kilometers around Mining Site. As shown in Figure 2, the area of 5 km around UCIL was divided into 4 blocks, i.e., Ghatshila, Jaduguda Township, Musabani and Potka. Totally 71 villages were covered in these four blocks.

The study was carried out in 3 stages. During Stage 1, household survey was carried out to identify probable cases. The study area was chalked out like a map with the help of the local people and the NGO’s. The household survey was conducted from door to door with the help of a questionnaire by the field investigators. The field investigators were trained as per the requirement of the questionnaire and knowledge was imparted to them about the details in the questionnaire and about how to fill it. They screened the villagers on the basis of symptoms of prolonged illness related to carcinoma, congenital anomaly and infertility.

The study tool used was a nine page structured questionnaire consisting of six parts. The first part enquired about the basic background of the respondent and family members. The second part sought information regarding the Standard of Living Index (SLI) (Appendix 1). In order to assess the economic status of the households, information on possession of various assets were used to construct SLI as defined by National Family Health Survey during 1998-1999. The score of this index ranges from 0-14 for a low SLI, 15-24 for a medium SLI and 25-67 for a high SLI. For the purpose of this study, while low SLI category patients are considered as poor, both medium and high SLI category patients are regarded as not poor. The households were divided into either poor or not poor categories as per SLI. The third part collected information about educational and occupational history of the family members. The
If yes to any of the following:
- Any lump or swelling in any part of your body: More than 30 days.
- Bleeding from any site: More than 30 days.
- Excessive and sudden loss of weight
- Change in colour or size in wart or mole
- Persistent cough/ change in voice/ difficulty in swallowing: More than 15 days
- Member of family suffering from mental / physical abnormality
- For females more than 13 years:
  - Recurrent white/ foul smelling discharge: More than 30 days.
  - Any child death: Only for still birth/ neonatal deaths/ infant deaths
  - History of Spontaneous abortion/ Intra uterine death
  - History of premature birth (To call child with mother)

Fig 3. Eligibility criteria for camp call

If yes to any of the following:
- Any lump or swelling in any part of your body: More than 30 days.
- Bleeding from any site: More than 30 days.
- Excessive and sudden loss of weight
- Change in colour or size in wart or mole
- Persistent cough/ change in voice/ difficulty in swallowing: More than 15 days
- Member of family suffering from mental / physical abnormality
- For females more than 13 years:
  - Recurrent white/ foul smelling discharge: More than 30 days.
  - Any child death: Only for still birth/ neonatal deaths/ infant deaths
  - History of Spontaneous abortion/ Intra uterine death
  - History of premature birth (To call child with mother)

3. Results

Table 1 shows that 6,900 households with total 34,953 population were covered during the household survey. The mean length of stay in the study area is 15.23 years with the lowest in Jaduguda Township, i.e., 9.96 years. Out of total 34,953 population, 2,015 people (i.e. 5.8%) were currently employed with the UCIL and a majority of them (1,497) were settled in Jaduguda Township along with their families.

During the Stage 2 referrals were made to tertiary health centre for confirmation of final diagnosis. Here all those patients for whom cancer or congenital anomaly cannot be ruled out at stage 2 (both stationary and mobile camps) were referred to TMH. From 1,523 who attended the health camp, 220 cases were referred to tertiary health center. Only 91 cases could complete most of the diagnostic tests. The data is presented mostly as comparison between 4 blocks and it is presented in percentage format. The statistical analysis was done using SPSS version 17. Chi square and ANOVA test were carried out with significance level taken at 0.05.
reported member of family suffering from any Mental Retardation or Physical Deformity. Mental retardation is reported in 116 (0.3%) and physical deformity is reported in 234 (0.7%). The distribution across the blocks is more or less similar.

Table 6 shows that among the females, 49 (0.3%) reported occurrence of premature birth, 103 (0.6%) infant deaths, 269 (1.6%) neonatal deaths, 96 (0.6%) intrauterine deaths, 222 (1.3%) spontaneous abortions and 145 (0.9%) stillbirths in the past. Table 7 presents block wise distribution of summary of the entire survey. After the household survey, of the total population, 7.7% i.e., 2,693 people were called to the camps for further screening. Majority (8.63%) people were invited from Musabani followed by Potka (8.09%) for the camp. Out of total 2,693 eligible patients who had been invited for further screening, we have been able to cover a total of 1,523 (56.77%). Total 220 cases were referred to TMH for confirmation of diagnosis. Out of those 220 cases, only 91 (41.36%) cases attended and completed most of the diagnostic tests at TMH. Of the 56 people, only one case of cancer was confirmed. In 38 people, cancer was ruled out and 17 people could not complete the investigation. From 35 people who had been called to rule out or confirm congenital anomaly, six cases of congenital anomaly were confirmed. One of those referred case died while the investigations were going on. In 28 people, diagnosis of congenital anomaly was either not sure or the investigations could not be completed.

<table>
<thead>
<tr>
<th>Table 1. Block wise coverage of Household and Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>No.of Households expected to cover</td>
</tr>
<tr>
<td>No.of Households covered</td>
</tr>
<tr>
<td>% coverage of the households</td>
</tr>
<tr>
<td>Population Surveyed</td>
</tr>
<tr>
<td>(% out of total)</td>
</tr>
</tbody>
</table>
4. Discussion

Indian Doctors for Peace and Development (IDPD) did a case control study between May and August 2007. The exposed (study) group was a total of 2,118 families (9,511 individuals) within the radius of 2.5 km of Jadugoda mines. The control group was a group of 1,956 families 30 km away from the area in Potka block. 49% of mothers living in the study villages reported that children with congenital anomalies were born to them. This number was 2.49% in the reference group. The report also says that Ministry of Social Justice stipulates that people with deformities constitute 3% of the population. The study says that 9.60% of women were not able to conceive even after 3 years of marriage. The number was 6.27% in the control group. Cancer deaths in cases were 2.87%. This was 1.89% in the control group. Possible shortcomings of the study by IDPD are that there was no peer review of the study, no clinical confirmations done by medical doctors, under-reporting of cases in control area, etc.

In USA, ecological study of cancer mortality in the counties with (Karnes) and without Uranium operations was carried out by Boice et al. Comparisons were also made with US and Texas general population rates. The RR for cancer mortality was seen as 1.0 (95% CI 0.9-1.1). No significant differences found for periods before, during or after Uranium mining and milling operations.

Health outcomes in persons who lived in the area surrounding a U.S. Department of Energy (DOE) uranium processing plant near Fernald, Ohio were evaluated using data of Fernald Medical Monitoring Program (FMMP) participants by Pinney et al. Findings suggest that prior living within the Fernald exposure domain is related to increased prevalence.

Table 5. Block wise distribution of specific health problems in last 6 months and other health problems

<table>
<thead>
<tr>
<th></th>
<th>Ghatshila N (%)</th>
<th>Jaduguda Township N (%)</th>
<th>Musabani N (%)</th>
<th>Potka N (%)</th>
<th>Total N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump or Swelling</td>
<td>50 (1.5%)</td>
<td>164 (1.7%)</td>
<td>150 (1.6%)</td>
<td>254 (2.0%)</td>
<td>618 (1.8%)</td>
</tr>
<tr>
<td>Bleeding from any site</td>
<td>48 (1.4%)</td>
<td>185 (1.9%)</td>
<td>180 (1.9%)</td>
<td>85 (0.7%)</td>
<td>498 (1.4%)</td>
</tr>
<tr>
<td>Excessive and Sudden loss of weight</td>
<td>0 (0.0%)</td>
<td>4 (0.0%)</td>
<td>12 (0.1%)</td>
<td>99 (0.8%)</td>
<td>115 (0.3%)</td>
</tr>
<tr>
<td>Change in color or size in wart or mole</td>
<td>14 (0.3%)</td>
<td>45 (0.5%)</td>
<td>38 (0.4%)</td>
<td>26 (0.2%)</td>
<td>123 (0.4%)</td>
</tr>
<tr>
<td>Persistent cough change in voice difficulty in swallowing</td>
<td>28 (0.8%)</td>
<td>80 (0.8%)</td>
<td>100 (1.1%)</td>
<td>166 (1.3%)</td>
<td>374 (1.1%)</td>
</tr>
<tr>
<td>Any other health problem in last 6 months</td>
<td>192 (5.8%)</td>
<td>264 (2.7%)</td>
<td>313 (3.3%)</td>
<td>783 (6.3%)</td>
<td>1,552 (4.4%)</td>
</tr>
<tr>
<td>History of hospitalization in last one year</td>
<td>39 (1.2%)</td>
<td>347 (3.6%)</td>
<td>185 (2.0%)</td>
<td>227 (1.8%)</td>
<td>798 (2.3%)</td>
</tr>
<tr>
<td>History of long standing chronic illness</td>
<td>15 (0.4%)</td>
<td>80 (0.8%)</td>
<td>119 (1.3%)</td>
<td>243 (1.9%)</td>
<td>457 (1.3%)</td>
</tr>
<tr>
<td>Mental and / or physical Abnormality</td>
<td>31 (0.9%)</td>
<td>47 (0.5%)</td>
<td>71 (0.8%)</td>
<td>189 (1.5%)</td>
<td>338 (1.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>3,336</td>
<td>9,731</td>
<td>9,419</td>
<td>12,467</td>
<td>34,953</td>
</tr>
</tbody>
</table>

Table 6. Block wise distribution of Stillbirth, Abortions, IUD and children deaths among females

<table>
<thead>
<tr>
<th></th>
<th>Ghatshila N (%)</th>
<th>Jaduguda Township N (%)</th>
<th>Musabani N (%)</th>
<th>Potka N (%)</th>
<th>Total N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature Birth</td>
<td>0 (0.0%)</td>
<td>8 (0.2%)</td>
<td>17 (0.4%)</td>
<td>24 (0.4%)</td>
<td>49 (0.3%)</td>
</tr>
<tr>
<td>Infant Death*</td>
<td>6 (0.4%)</td>
<td>20 (0.4%)</td>
<td>39 (0.9%)</td>
<td>38 (0.6%)</td>
<td>103 (0.6%)</td>
</tr>
<tr>
<td>Neonatal Death*</td>
<td>24 (1.5%)</td>
<td>51 (1.1%)</td>
<td>87 (1.9%)</td>
<td>107 (1.7%)</td>
<td>269 (1.6%)</td>
</tr>
<tr>
<td>Intra Uterine Death</td>
<td>4 (0.3%)</td>
<td>33 (0.7%)</td>
<td>35 (0.8%)</td>
<td>24 (0.4%)</td>
<td>96 (0.6%)</td>
</tr>
<tr>
<td>Spontaneous Abortion</td>
<td>7 (0.4%)</td>
<td>48 (1.0%)</td>
<td>75 (1.7%)</td>
<td>92 (1.5%)</td>
<td>222 (1.3%)</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>13 (0.8%)</td>
<td>29 (0.6%)</td>
<td>42 (0.9%)</td>
<td>61 (1.0%)</td>
<td>145 (0.9%)</td>
</tr>
<tr>
<td>Total</td>
<td>1,588</td>
<td>4,614</td>
<td>4,523</td>
<td>6,193</td>
<td>16,918</td>
</tr>
</tbody>
</table>

(* - Here, infant and neonatal deaths are exclusive of each other. For these tables, infant death does not include neonatal deaths; it includes deaths between 1 month to 12 months of life)

Table 7. Block wise distribution of Summary of Household Survey

<table>
<thead>
<tr>
<th></th>
<th>Ghatshila N (%)</th>
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<tr>
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<td>3,336</td>
<td>9,731</td>
<td>9,419</td>
<td>12,467</td>
<td>34,953</td>
</tr>
<tr>
<td>Called for Health check-up camp</td>
<td>206</td>
<td>666</td>
<td>813</td>
<td>1,008</td>
<td>2,693</td>
</tr>
<tr>
<td>% Population called for camp</td>
<td>6.18%</td>
<td>6.84%</td>
<td>8.63%</td>
<td>8.09%</td>
<td>7.70%</td>
</tr>
<tr>
<td>Total referrals</td>
<td>41</td>
<td>40</td>
<td>68</td>
<td>71</td>
<td>220</td>
</tr>
<tr>
<td>Completed most of the tests</td>
<td>15</td>
<td>5</td>
<td>17</td>
<td>54</td>
<td>91</td>
</tr>
</tbody>
</table>
of urinary system disease. Increased white blood cell count and hemoglobin levels, and decreased mean corpuscular volume were also found in those living less than 2 miles from the plant\textsuperscript{[9]}. In USA, Navajo workers experienced significant health problems, including lung cancer and nonmalignant respiratory diseases, and psychosocial problems, such as depression and anxiety. Perceptions about uranium health impacts have contributed recently to the Navajo people rejecting a resumption of uranium mining and milling on Navajo lands\textsuperscript{[10]}.

A cohort mortality study was conducted of all adult residents who ever lived in Uravan, Colorado, a company town built around a uranium mill. Vital status was determined through 2004 and standardised mortality analyses conducted for 1,905 men and women alive after 1978 who lived for at least 6 months between 1936 and 1984 in Uravan. Overall, mortality from all causes (standardised mortality ratio (SMR) 0.99) and all cancers (SMR 1.00) was less than or as expected based on US mortality rates. There was no evidence that environmental radiation exposures above natural background associated with the uranium mill operations increased the risk of cancer\textsuperscript{[11]}. Mining and milling of uranium in Montrose County on the Western Slope of Colorado began in the early 1900s and continued until the early 1980s. To evaluate the possible impact of these activities on the health of communities living on the Colorado Plateau, mortality rates between 1950 and 2000 among Montrose County residents were compared to rates among residents in five similar counties in Colorado. Relative risks (RRs) were computed as the ratio of the SMRs for Montrose County to the SMRs for the five comparison counties. Between 1950 and 2000, a total of 1,877 cancer deaths occurred in the population residing in Montrose County, compared with 1,903 expected based on general population rates for Colorado (SMR(CO) 0.99). There were 11,837 cancer deaths in the five comparison counties during the same 51-year period compared with 12,135 expected (SMR(CO) 0.98). There was no difference between the total cancer mortality rates in Montrose County and those in the comparison counties (RR = 1.01; 95% CI 0.96-1.06). The absence of elevated mortality rates of cancer in Montrose County over a period of 51 years suggests that the historical milling and mining operations did not adversely affect the health of Montrose County residents\textsuperscript{[12]}. In Grants, Cibola County, New Mexico, uranium mining took place from early in the 1950s to 1990, and the Grants Uranium Mill operated from 1958-1990. The study evaluated cancer mortality during 1950-2004 and cancer incidence during 1982-2004 among county residents. Standardized mortality (SMR) and incidence (SIR) ratios and 95% confidence intervals (CI) were computed, with observed numbers of cancer deaths and cases compared to expected values based on New Mexico cancer rates. Although etiological inferences cannot be drawn from these ecological data, the excesses of lung cancer among men seem likely to be due to previously reported risks among underground miners from exposure to radon gas and its decay products. Smoking, socioeconomic factors or ethnicity may also have contributed to the lung cancer excesses observed in our study. The stomach cancer increase was highest before the uranium mill began operation and then decreased to normal levels. With the exception of male lung cancer, this study provides no clear or consistent evidence that the operation of uranium mills and mines adversely affected cancer incidence or mortality of county residents\textsuperscript{[13]}.

A book entitled `Health Effects of Exposure to Low Levels of Ionizing Radiation: BEIR-VII` draws upon new data in both epidemiologic and experimental research. Ionizing radiation arises from both natural and man-made sources and at very high doses can produce damaging effects in human tissue that can be evident within days after exposure. However, it is the low-dose exposures that are the focus of this book. So-called late effects, such as cancer, are produced many years after the initial exposure\textsuperscript{[14]}. A review of the health effects of uranium mining, with an emphasis on newer findings (2005-2011) is presented by Brugge et al. As per them more epidemiologic research is needed to contribute to causal inference. As much damage is irreversible, and possibly cumulative, present efforts must be vigorous to limit environmental uranium contamination and exposure\textsuperscript{[15]}.

There are certain limitations associated with the present study which covers only a limited study area. There is no comparison area or group, so all the above findings should be interpreted in that light. In addition, other important limitations include validity and reliability of diagnostic tests, a potential selection bias between responders and non-responders, etc. There were also many problems associated with the study. During all the stages patients were missed due to various reasons and so it is possible that there is underestimation of prevalence rates which might lead to presumably wrong conclusion. During the household survey potential patients were missed due to locked houses, refusal to give information, misleading information, etc. During the health check-up camps they were missed due to poor attendance of invited patients in spite of repeated reminders, arrangement of vehicles, and camp over prolonged period, etc.

There were many difficulties faced in fixed camps like catchment area was too large, timing of the camp clashed with the daily work of people, acquaintances of the public with similar survey works, lack of interest of people for a health check-up and limited number of fixed camps of limited duration. Also people felt that camps are being held regularly by many other agencies without addressing the main health problem. There were also few problems in mobile camp like timing of doctor's visit not matching with patient timing, TMH doctors not willing to move on a door-to-door basis, leucorrhoea cases not expressing openly with limited duration. Also people felt that camps are being held regularly by many other agencies without addressing the main health problem. There were also few problems in mobile camp like timing of doctor's visit not matching with patient timing, TMH doctors not willing to move on a door-to-door basis, leucorrhoea cases not expressing openly with
the male doctors, etc. Some of the patients didn’t want to attend the camp despite repeated requests. In many cases, problems identified earlier had already been solved by the time of mobile camp. Mindset of patients was such that they wanted to cooperate only if there was a comprehensive diagnosis and treatment.

During confirmation of referrals and the crucial stage of final diagnosis, there was refusal of patients to come for confirmation (they felt it is useless because there is no treatment). TMH was also unable to provide committed manpower required for confirmation. In addition, diagnosis at TMH used to ask for more than one visit, so many patients dropped out, most of them after the first visit. Also there was no preference offered from TMH to the patients of this project. In addition, there were local problems like opposition from local people in some villages, effect of repeated surveys by different agencies, repeated approaches made by the media people, etc.

5. Conclusions

In this study, we tried to address the issue whether the low dose radiation exposure near the Uranium mining site affects the health among the inhabitants near the site or not. In general, most of the health problems/complaints are reported from Potka block. It may be because people living here are more aware and conscious regarding their health. However, the study design is not that strong to assess the health risk associated radiation exposures. In spite of the problems faced during the study, this data can be considered as baseline data for any future studies and detailed investigation in this area. Also findings can be used for comparison with either national or state data. There are still alternative approaches to assess the situation. Analytical studies like case control study; cohort study etc. can be carried out using hospital based data which can show some useful associations. A similar study in a control area geographically away from the mining site can be carried out to compare the prevalence rates. For this, a population similar in ethnicity, age-structure, socio-economic status, dietary patterns etc. residing 25-30 km away from the present study area should be identified.

Acknowledgements

This study was funded by the Department of Atomic Energy (DAE), Government of India. We gratefully acknowledge support given by BARC, UCIL, Tata Main Hospital and residents of study area during the period of the study.

Appendix

Appendix 1 - The Standard of Living Index (SLI) is a summary household measure, which is calculated by adding the following scores: a) House type: four for pucca, two for semi-pucca, zero for kachha; b) Toilet facility: four for own flush toilet, two for public or shared flush toilet or own pit toilet, one for shared or public pit toilet, zero for no facility; c) Source of lighting: two for electricity, one for kerosene, gas, or oil, zero for other source of lighting; d) Main fuel for cooking: two for electricity, liquid petroleum gas, or biogas, one for coal, charcoal, or kerosene, zero for other fuel; e) Source of drinking water: two for pipe, hand pump, or well in residence/yard/plot, one for public tap, hand pump, or well, zero for other water source; f) Separate room for cooking: one for yes, zero for no; g) Ownership of house: two for yes, zero for no; h) Ownership of agricultural land: four for five acres or more, three for 2.0-4.9 acres, two for less than two acres or acreage not known, zero for no agricultural land; i) Ownership of irrigated land: two if household owns at least some irrigated land, zero for no irrigated land; j) Ownership of livestock: two if owns livestock, zero if does not own livestock; k) Ownership of durable goods: four each for a car or tractor, three each for a moped/scooter/motorcycle, telephone, refrigerator, or colour television, two each for a bicycle, electric fan, radio/transistor, sewing machine, black and white television, water pump, bullock cart, or threshers, one each for a mattress, pressure cooker, chair, cot/bed, table, or clock/watch.

References


